ECONSTOR
Make Your Publications Visible.

A Service of

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Krebs, Tom; Scheffel, Martin

Conference Paper

Labor Market Reform and the Cost of Business Cycles

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2014: Evidenzbasierte Wirtschaftspolitik - Session: Labor Market Reform in Germany, No. A02-V3

Provided in Cooperation with:
Verein für Socialpolitik / German Economic Association

Suggested Citation: Krebs, Tom; Scheffel, Martin (2014) : Labor Market Reform and the Cost of Business Cycles, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2014: Evidenzbasierte Wirtschaftspolitik - Session: Labor Market Reform in Germany, No. A02-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:
https://hdl.handle.net/10419/100427

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

Labor Market Reform and the Cost of Business Cycles

Tom Krebs
University of Mannheim*

Martin Scheffel
University of Cologne†

Februar 2014

Abstract

This paper studies the effect of labor market reform on the welfare cost of business cycles. Motivated by the German labor market reforms of 2003-2005, the so-called Hartz reforms, the paper focuses on two labor market institutions: the unemployment insurance system determining search incentives and the system of job placement services affecting matching efficiency. The paper develops a tractable search model with idiosyncratic labor market risk and risk-averse workers, and derives a closed-form solution for the welfare cost of business cycles as a function of the various parameters of interest. An improvement in job placement services leads to a reduction in the welfare cost of business cycles, but a change in unemployment benefit generosity has in general an ambiguous effect. A quantitative analysis based on a calibrated version of the model suggests that the German labor market reforms of 2003-2005 reduced the non-cyclical unemployment rate by 3 percentage points *and* reduced the welfare cost of business cycles by 30 percent.

Keywords: Labor Market Reform, Cost of Business Cycles

JEL Codes: E21, E24, D52, J24

---

*Department of Economics, L7,3-5, 68131 Mannheim, Germany.

†Department of Economics, Albertus-Magnus-Platz, 50923 Cologne, Germany

1. Introduction

The Great Recession has ended an era of macroeconomic stability and has provided new impetus to research on the nature and economic consequences of business cycles. One central question of this research agenda is to what extent government policy can reduce the cost of adverse macroeconomic shocks to workers. The standard answer in the literature is that macroeconomic stabilization policy is the most effective instrument, and perhaps the only instrument, for reducing the cost of recessions.[1] In this paper, we take a different approach and study to what extent good labor market institutions can reduce the negative labor market consequences of adverse macroeconomic shocks. Specifically, in this paper we argue that labor market reform raising job finding rates of unemployed individuals can reduce the welfare cost of business cycles and hence the gains from stabilization policy.

Our analysis is motivated by the German labor market experience that turned "the sick man of Europe" into a "labor market miracle". Starting from very low levels in the 1970s, the non-cyclical unemployment in Germany had been rising steadily until reaching a level of $9-10$ percent at the beginning of the last decade. In response to this alarming trend, the German government implemented in 2003-2005 a package of far-reaching labor market reforms, the so-called Hartz reforms. Two essential ingredients of these reforms were i) a complete overhaul of the Public Employment Agency (Hartz III) in conjunction with the introduction of a voucher system for job placement services and ii) a substantial reduction in the unemployment benefits for the long-term unemployed (Hartz IV) to increase search incentives. There is strong empirical evidence that, in line with the theoretical prediction, these two parts of the reform package led to a substantial increase in the non-cyclical compo-

[1] The recent academic literature on the business cycle effects of macroeconomic stabilization policy is vast and we make no attempt to survey this literature. Akerlof and Yellen (2006) provide a summary of the standard arguments in support of counter-cyclical monetary policy, and Yellen (2013) provides an account of US monetary policy since the Great Recession and how it has been shaped by concerns for the labor market. The IMF World Economic Outlook October 2012 provides one of many examples how recent policy making has been strongly influenced by the view that counter-cyclical fiscal policy is an effective tool to reduce the cost of adverse macroeconomic shocks. Our paper is also related to the recent work on cyclical labor market policy, which we discuss below.

nent of the job finding rate of unemployed workers. This empirical evidence in conjunction with the scale of the German labor market reforms of 2003-2005 make them an ideal candidate for studying the interaction between labor market institutions and the welfare cost of business cycles.[2]

Our analysis is based on a tractable macro model with job search, idiosyncratic labor market risk and incomplete insurance markets. In a first step, we provide a theoretical analysis of the two labor market institutions that have played the most important role in the German experience with labor market reform: the unemployment insurance system determining search incentives and the system of job placement services affecting matching efficiency. Our theoretical analysis shows that an improvement in job placement services generally reduces the welfare cost of business cycles, but that a reduction in unemployment benefits has an ambiguous effect. The intuition for this result is simple. Clearly, both types of labor market reform increase the non-cyclical component of the job finding rate and therefore reduce the response of the unemployment rate to macroeconomic shocks, which tends to reduce the cost of recessions. In the case of an increase in matching efficiency, individual losses of the unemployed are also reduced so that the overall effect on the welfare cost of recessions is unambiguously negative. In contrast, a cut in unemployment benefits increases the individual loss associated with unemployment so that the overall effect on the welfare cost of recessions is ambiguous.

In a second step we provide a quantitative analysis. Specifically, we calibrate the model economy to German pre-reform data and then simulate the effects of the Hartz III reform and the Hartz IV reform using the available empirical evidence on the effect of these reforms on matching efficiency and search incentives of unemployed workers. We find that the resulting

[2]In the US, labor market policy has often been adjusted in response to business cycle conditions, the recent extension of unemployment benefit eligibility from 26 weeks to up to 99 weeks being a case in point. However, after WWII the US has not witnessed any permanent changes in labor market policy comparable to the Hartz reforms. Of course, most European countries introduced some type of labor market reform in the last 20 years, but they were either much more limited in scope than the Hartz reforms or the implementation was much more gradual.

increase in labor market flexibility led to a significant reduction in non-cyclical (steady state) unemployment. Specifically, Hartz III reduced the steady state unemployment rate by 1.7 percentage points and Hartz IV by 1.2 percentage points. Further, both reforms reduced the welfare costs of business cycles, but Hartz III had a much larger effect than Hartz IV. Overall, the two reforms taken together reduced non-cyclical unemployment by about 3 percentage points *and* reduced the welfare cost of business cycles by about 30 percent. In other words, these reforms were highly effective in reducing the welfare cost of business cycles and, in contrast to macroeconomic stabilization policy, they also improved the long-run performance of the German labor market substantially.

In sum, this paper shows that certain types of labor market reform reduce the adverse welfare consequences of recessions and therefore reduce the gains from macroeconomic stabilization policy. Once we take into account that macroeconomic stabilization policy also has economic costs, our results imply that labor market reform changes the design of optimal stabilization policy dramatically. In other words, there is an important interaction between these two policy tools and discarding this interaction can lead to very mis-leading policy recommendation. In particular, a stabilization policy that is optimal before the labor market reform may become suboptimal after the reform.

We conclude this introduction with a comment regarding methodology. Following Lucas (1987, 2003), we discuss the welfare effects of macroeconomic stabilization policy without explicitly modeling stabilization policy. Specifically, we take the job destruction process as exogenously given and then model the effect of stabilization policy as a change in the volatility and mean of the job destruction process. This approach has two advantages. First, we do not have to commit to a particular model of stabilization policy and can therefore derive more general results. In particular, we show that the German labor market reforms have reduced the gains from macroeconomic stabilization policy by $30-40$ percent independently of the type of stabilization policy under consideration. Clearly, a more detailed analysis of the effect of macroeconomic stabilization policy on the job destruction process yields additional insights and is an important topic for future research.

The second advantage of our approach is that it allows us to focus on one basic channel for which independent empirical evidence exists. More precisely, in this paper we emphasize that labor market reforms that increase the steady state job finding rate have the potential to reduce the welfare cost of business cycles. As we argue in section 2, there is ample evidence that the German labor markets reforms of 2003-2005 increased the non-cyclical job finding rate by about 50 percent for both the short-term unemployed and the long-term unemployed. In standard search and matching models along the lines of Mortenson and Pissaridies (1994) and Den Haan, Ramey, and Watson (2000) the labor market reforms considered here would increase the steady state job finding rate *and* reduce the volatility of the job destruction rate (see Costain and Reiter, 2008, and Kuhn and Jung, 2012) thereby providing an additional channel by which the welfare costs of business cycles are reduced. Clearly, extending our approach to models with endogenous job destruction rate is an important topic for future research.

Literature Our paper is related to three strands of the literature. First, it is closely related to the large literature on the welfare cost of business cycles that is based on the seminal contribution of Lucas (1987, 2003). This literature has extensively studied to what extent the introduction of uninsurable idiosyncratic risk increases the welfare cost of business cycles. For example, Atkeson and Phelan (1994), Imrohoroglu (1989), and Krusell and Smith (1999) analyze cyclical fluctuations in unemployment rates and unemployment duration and Gomes, Greenwood, Rebelo (2001) introduce endogenous search effort. Krebs (2003) and Storesletten, Telmer, and Yaron (2001) study cyclical variations in labor income risk more generally and Beaudry and Pages (2001) and Krebs (2007) focus on the long-term earnings losses associated with job displacement. Our paper contributes to this literature by taking a next step and analyzing how labor market institutions affect the welfare cost of business cycles and hence the gains from stabilization policy.

Our paper is also related to the large literature on labor market institutions and unemployment. This literature has studied extensively the effect of various labor market institutions on non-cyclical unemployment, but much less work has been done on the interaction

between labor market institutions and macro shocks. Blanchard and Wolgers (2002) provide a comprehensive empirical study of the issue and Ljungqvist and Sargent (1998) use a search model to argue that the the rise of unemployment rate in many European countries observed in the 1980s and 1990s can be explained by the interaction of a generous social insurance (welfare) system with a rise in market turbulence. More recently, Bentolila et al. (2012) and Jung and Kuhn (2012) use search and matching models to study to what extend labor market institutions can explain the differences in worker flow volatilities between France and Spain, respectively Germany and the US. However, the focus of this literature has not been on welfare analysis, and to the best of our knowledge there is no work that has analyzed the link to the welfare cost of business cycles.

Finally, our paper is related to the economic literature on the German labor market reforms. There is a large empirical literature on this issue, which is surveyed in sections 2 and 5. Structural studies of the Hartz reforms based on macroeconomic models are surprisingly rare. Three notable exceptions are Launov and Waelde (2013), Krause and Uhlig (2012), and Krebs and Scheffel (2013), which are discussed in more detail in sections 5 and 6. Of these three contributions the paper by Krebs and Scheffel (2013) is most closely related to the current paper in the sense that they provide a welfare analysis of the Hartz reforms. However, Krebs and Scheffel (2013) do not consider cyclical variations in labor market variables and therefore cannot analyze the welfare cost of business cycles.

2. The German Labor Market 1970 - 2012

In section 2.1 we briefly review the German labor market experience since the 1970s and in section 2.2 we discuss the main elements of the labor market reforms implemented in 2003-2005, the so-called Hartz reforms. Jacobi and Kluve (2007) provide a detailed account of the Hartz reforms and Wunsch (2005) provides a comprehensive survey of German labor market policy before the reform. In section 2.3 we discuss the empirical evidence on the effect of the Hartz reforms on matching efficiency and job finding rates.

2.1. Macroeconomic Performance

Figure 1 shows the unemployment rate in Germany in the period 1970-2012. The graph suggests that the German unemployment rate has a trend-component and a cyclical component, and that both have been affected by the Hartz reforms implemented in 2003-2005. Specifically, the trend component has been rising since the 1970s until the mid 2000s, and then started a secular decline that continued until the end of 2012. Further, the response of the German unemployment rate to the Great Recession was relatively mild compared to the cyclical increases of the German unemployment rate in previous recessions that occured before the Hartz reforms.

FIGURE 1 HERE

Figure 2 shows the evolution of per capita output and real wages in the post-unification period 1992-2011. We see that per capita output grew modestly at an average annual rate of 1 percent. In this period, Germany went through three recessions, 1993, 2003-2004, and 2008-2009, and had two periods of strong economic expansion, 2004-2007 and starting in 2010, and one prolonged period of weak but positive GDP growth in 1994-2001. Real wages stagnated between 1992 and 2003, and then fell about 4 percent in the period 2004-2009.

FIGURE 2 HERE

2.2. Labor Market Reforms in 2003-2005: Hartz I-IV

The dismal labor market performance and a tightening of the social security budget convinced the German government that a drastic policy reversal had to take place. As a consequence, the German government enacted in 2002 the so-called JOB-AQTIV amendment and then implemented in 2003-2005 a number of far-reaching labor market reforms, the so-called Hartz reforms.[3] The Hartz reforms consisted of four laws that were implemented in three

[3]Until 1997 the legal basis of German labour market policy was the Employment Promotion Act (Arbeitsfoerderungsgesetz). In addition to passive income support for the unemployed it strongly emphasized the need for public training and job creation programs for both the employed and unemployed. In 1998 the

steps in January 2003 (Hartz I+II), January 2004 (Hartz III), and January 2005 (Hartz IV). Their core elements were based on recommendations made by an expert commission (Hartz et al. 2002) that was headed by Peter Hartz, the Chief Human Resources Officer of Volkswagen at that time. Overall, the Hartz reforms constitute one of the most ambitious attempts in recent history of restructuring the labor market of an advanced economy.

The main objective of the Hartz reforms was simple yet ambitious: improve the process of moving workers from unemployment to employment.[4] In other words, these reforms mainly aimed at increasing the non-cyclical component of the job finding rate of unemployed workers. To achieve their objective, the reforms used a multi-layered strategy that had three core elements: i) increase the matching efficiency by improving job placement services, ii) increase labor supply by activating the unemployed, and iii) increase labor demand by deregulating the market for temporary work and providing employment subsidies. It seems fair to say that Hartz III was mainly about the first point, Hartz IV was concerned with the second point, and Hartz I and II were mainly dealing with the last point. Given that this paper is concerned with job placement and unemployment insurance, which affect matching efficiency and search incentives, the focus of the subsequent discussion is on Hartz III and Hartz IV.

The reforms improved the quality of job placement services for the unemployed in two ways. First, Hartz III restructered the Public Employment Agency transforming it from a strongly centralized and bureaucratic institution with little quality control into a decentralized, customer-oriented organization with a high degree of responsibility and accountability of local employment offices (called job centers after the reform). Further, in the wake of the

---

Employment Protection Act was replaced by the Social Code III (Sozialgesetzbuch III), which shifted the attention away from public sector training and job creation programs towards helping the unemployed job seeker to find private-sector employment as quickly as possible. In this sense the enactment of the Social Code III in 1998 foreshadowed the pardigm shift in German labor market policy that took place in the period 2003-2005.

[4]In the preamble of the commission's report (Hartz et al 2002) this objective in combination with the idea of "challenge and promote" ("Fordern und Foerdern") are singled out as the most important principles guiding any reform effort (Hartz et al. 2002).

reform many services were streamlined and heavy emphasis was placed on helping the unemployed (costumers) to find jobs. Second, heavy regulation made the Public Employment Agency almost the only provider of job placement services in Germany until 2002, and on the labor market reforms broke this de facto monopoly by allowing for a more market-based approach. In particular, a voucher system was introduced in 2002 as part of the Job-AQTIV amendment and the Hartz reforms (in particular Hartz IV) subsequently allowed for a widespread application of vouchers by making the rules for using vouchers less restrictive. The voucher system provides individual job seekers whom the public employment agency is unable to place within a period of six weeks the opportunity to choose an alternative private placement agency.[5]

The Hartz IV legislation was the part of the reform package that focussed on activating the unemployed and constituted a radical change in unemployment insurance and welfare policy. Before the reform, the system was characterized by a very long period of Unemployment Benefit entitlement followed by a relatively generous and essentially unlimited, means-tested Social Welfare Program (consisting of a combination of Unemployment Assistance and/or Social Assistance). Further, very little effort was made to re-integrate the long-term unemployed and/or welfare recipients into the formal labor market. The Hartz IV reform reduced the benefits payments for many of the long-term unemployed/welfare recipients and introduced new measures to activate the long-term unemployed/welfare recipients.[6] The Hartz IV reform resulted in a simple two-tier unemployment insurance system

[5]The Job-AQTIV amendment in 2002 and Hartz I in 2003 also introduced the possibility of outsourcing placement services through assignment of unemployed individuals to private placement companies, respectively temporary work agencies.

[6]The first step made in the direction of improved monitoring of job search was taken with the Job-AQTIV amendment in 2002. This amendment introduced qualitative profiling of job-seekers upon unemployment registration with the Local Employment Agency (LEA) and a compulsory written agreement between the LEA and the job-seeker (Eingliederungsvereinbarung) in order to determine the duties and efforts of both contracting parties during the job-search process. Hartz I then tightened in 2003 the conditions for the acceptability of jobs and introduced benefit sanctions in the case of non-compliance. The eligibility period for short-term unemployment benefits (Unemployment Benefit I) was reduced in February 2006, but this change was not officially a part of the Hartz-laws and had only a small effect on the average net replacement rate.

in which most unemployed workers with unemployment spells less than one year (short-term unemployed) receive unemployment benefits that are proportional to earnings at the last job (called Unemployment Benefit I) and most unemployed workers with an unemployment spell of more than one year (long-term unemployed) receive means-tested payments that heavily depend on household composition (called Unemployment Benefit II).

The Hartz IV reform reduced unemployment payments for many households, but the extent of the reduction varies substantially across household groups and length of unemployment spell. One way to aggregate this heterogeneity is to follow the OECD and to report the median net replacement rate for short-term unemployed households, defined as unemployment spell less than one year, and long-term unemployed households. Figure 5 shows the net replacement rate for single households with median labor income before the unemployment spell based on the OECD data (see the Appendix for more details on the construction of this variable). Clearly, Hartz IV, which was enacted in January 2005, had almost no effect on the net replacement rate of the short-term unemployed, but a very large effect on the net replacement rate of the long-term unemployed. For this measure, we find that the Hartz IV reform reduced the net replacement rate from 0.57 in the period 2000-2004 to 0.46 after the reform in 2005. Based on this evidence, we simulate the effect of Hartz IV in section 6 assuming that it reduced the net replacement rate for the long-term unemployed from 0.57 to 0.46 and that it left the net replacement rate for the short-term unemployed unchanged.

FIGURE 3 HERE

Finally, the main objectives of Hartz I and Hartz II, implemented in January 2003, were to reduce labor costs through wage subsidies, to create new employment opportunities, and to redesign and streamline existing training programs and (public) job creation schemes. For example, these laws eliminated the social security tax for jobs paying up to 400 Euro per month (Mini-job) and reduced social security contributions for jobs paying up to 800 Euro per month (Midi-jobs) and for firms hiring older workers. Further, various forms of subsidies are paid to employers when hiring certain types of hard-to-place workers and to unemployed

workers who decide to become self-employed. They also deregulated the labor market by weakening restrictions on temporary work agencies and fixed-term contracts.[7]

2.3. Empirical Evidence

There is strong evidence that the restructuring of the Federal Employment Agency in the wake of the Hartz III reform in 2004 had a substantial impact on aggregate matching efficiency. The best known empirical studies about this topic are Fahr and Sunde (2009) and Klinger and Rothe (2012), who use labor market flow data to estimate matching functions for the German labor market before and after the Hartz III reform. Fahr and Sunde (2009) find that Hartz III increased the efficiency parameter of the estimated matching function by 11.6 percent for manufacturing occupations and around 5 percent for non-manufacturing occupations according to their most preferred specification (column 4 of table 5). Klinger and Rothe (2012), who do not distinguish between manufacturing and non-manufacturing, find an increase in matching efficiency around 5 percent (see their table 2). Hertwick and Sigrist (2012) provide evidence that the German Beverage curve shifted inwards around the mid 2000s and estimate that the Hertz reforms taken together (Hartz I-IV) increased matching efficiency by 20 percent.

Empirical work using micro data support the view that the introduction of vouchers for job placement services had positive effects on matching efficiency. Winterhager, Heinze, and Spermann (2006) use a very rich administrative data set provided by the Federal Employment Agency to analyze the efficiency improvements generated by the market-based approach to job placement introduced with the Hartz reforms. Specifically, they apply propensity score matching to estimate the effect of the job placement voucher scheme comparing voucher recipients to a matched control group of non-recipients. They define treatment in the evaluation design as receipt of a first voucher during the unemployment spell in May and June

[7]The law abolished restrictions on re-employment, synchronisation, fixed-term contracts, and the maximum duration of temporary work. However, the law also requires temporary work agencies to either guarantee equal pay and equal treatment of temporary workers and regular workers or to join a collective bargaining agreement.

2003, and outcome as employment within 12 months after voucher issue. The main finding of Winterhager, Heinze, and Spermann (2006) is that 12 months after the receipt of a voucher, 27.09 percent of the recipients are in regular employment, whereas only 20.60 percent of the matched control group are employed. Thus, the average treatment effect on the treated amounts to an increase in the job finding rate by around 30 percent - a very large effect indeed. Their results are in line with the finding of Pfeiffer and Winterhager (2006), who find strong evidence for positive effects of vouchers for job placement services on re-employment probabilities.

There is no micro-econometric work evaluating the effect of the benefit reductions associated with Hartz IV on job-finding rates of the unemployed, mainly because the Hartz IV reform entailed a significant change in the official measurement of unemployment.[8] However, the available evidence based on structural models of the German labor market (Krause and Uhlig, 2012, Krebs and Scheffel, 2013) suggests substantial effects of Hartz IV on job finding rates and equilibrium unemployment. Further, empirical work estimating the effect of changes in unemployment generosity on re-employment probabilities for Germany using data before the Hartz IV reform suggests substantial effects (Hunt, 1995), in line with the findings for the US (Krueger and Meyer, 2002). We review the literature in more detail in section 5 on calibration.

The time-series evidence supports the view that Hartz III and Hartz IV had substantial effects on the non-cyclical component of the job-finding rate of unemployed individuals in Germany. In figure 4 we show the quarterly job finding rate for the short-term unemployed and long-term unemployed over the period 2000-2013. The job finding rates for both groups have been relatively stable before implementation of these two reform packages and then began to rise steadily until the years 2007, at which stage they remained relatively stable at a significantly higher level.footnoteThe analysis of Jung and Kuhn (2013) confirms that

[8]This added more than half a million workers to the pool of unemployed between January 2005 and March 2005 (see Bundesagentur fuer Arbeit, 2005) and explains the spike in the unemployment rate in 2005. more than 80 percent of these added unemployed workers lacked the equivalent of a high school degree.

the German job finding rate is relatively stable over the business cycle, in contrast to the findings for the US economy (Shimer, 2005). For the long-term unemployed the average job finding rate in the period 2000-2003 is 6.3 percent and the average unemployemnt rate in the period 2007-2012 is 9.3 percent. For the short-term unemployed the corresponding numbers are 24 and 37 percent, respectively. Thus, for both groups of unemployed individuals the job finding rate increased by about 50 percent. Our quantitative analysis in section 6 suggests that most, but not all of this increase in job finding rates can be attributed to the Hartz III and Hartz IV reforms.

3. Model

This section develops the model and provides a convenient characterization of equilibrium. To ease the exposition, we focus on the baseline model with log-utility, no wage risk and no heterogeneity in the quality of new matches. The Appendix shows how to extend the equilibrium analysis to these cases.

3.1 Workers

Time is discrete and open ended. There is a unit mass of infinitely-lived workers. The employment status of a worker in period t is denotes by s_t and can take on three values, $s_t \in \{e, su, lu\}$, where e stands for employed, su for short-term unemployed, and lu for long-term unemployed. Unemployed workers search for jobs and the job finding rate depends on search effort l and possibly the aggregate state S_t. We denote the job finding rate of the short-term unemployed by $\pi(e|su, S, l)$ and the job finding rate of the long-term unemployed by $\pi(e|lu, S, l)$. At the beginning of any unemployment spell, the household is short-term unemployed, and then becomes long-term unemployed with probability $\pi(lu|su)$. Employed households become unemployed with probability $\pi(su|e, S)$ (job destruction rate), which is independent of effort but depends on the aggregate state S. We assume that the aggregate state follows a Markov process with transition probabilities denoted by $\pi(S'|S)$. We denote the transition probabilities of the joint Markov process over individual and aggregate states by $\pi(s', S'|s, S, l)$.

We consider two types of labor market policy/institution and corresponding labor market reforms. The first type of policy/institution is defined by the structure of the Public Employment Agency affecting job matching efficiency. This policy affects the job finding rates $\pi(e|su, S, l)$ and $\pi(e|lu, S, l)$ directly and its effect is summarized by an efficiency parameter z. We suppress the dependence of these transition probabilities on the parameter z until we return to the discussion of labor market reform in section 4.3. The second type of policy/institution analyzed in this paper is the unemployment insurance system. The level and duration of unemployment benefit payments do not affect job finding rates directly, but have an indirect impact through their effect on search effort l. We next turn to a discussion of the unemployment insurance system.

Employed workers receive labor income $(1-\tau)wh_t$, where w is the wage per unit of human capital and τ is a linear tax on labor income (social security tax). Unemployed workers receive unemployment benefits $b(s_t)h_t$ with $s_t = su, lu$. For tractability reasons, we also assume that unemployment benefit payments depend on the current human level of human capital. At the beginning of life, worker have no financial wealth but they can save at the risk free rate r_t and borrow at the rate $r_t + \theta$, where θ is an exogenous cost of financial intermediation. Thus, workers' budget constraint reads

$$a_{t+1} = \begin{cases} (1+r_t)a_t + (1-\tau)wh_t - c_t & if\ a_{t+1} \geq 0\ and\ s_t = e \\ (1+r_t)a_t + b(s_t)h_t - c_t & if\ a_{t+1} \geq 0\ and\ s_t = su, lu \\ (1+r_t+\theta)a_t + (1-\tau)wh_t - c_t & if\ a_{t+1} < 0\ and\ s_t = e \\ (1+r_t+\theta)a_t + b(s_t)h_t - c_t & if\ a_{t+1} < 0\ and\ s_t = su, lu \end{cases}$$

$$h_{t+1} = (1+\epsilon(s_t, s_{t+1}))h_t \tag{1}$$

Note that the exogenous process of human capital (skills) defined in (1) defines in conjunction with the wage rate the labor income process.

Workers are risk-averse and have identical preferences that allow for a time-additive expected utility representation. The one-period utility function depends on consumption, search effort, and the employment status:. We confine attention to utility functions that are logarithmic over consumption: $u(c, l, s) = \ln c - d(l, s)$, where d is an increasing and strictly

convex function in l. Expected life-time utility associated with a consumption-effort plan, $\{c_t, l_t\}$ for a worker with initial employment status s_0 is given by

$$U(\{c_t, l_t\}) \;=\; E\left[\sum_{t=0}^{\infty} \beta^t \left(\ln c_t - d(l_t, s_t)\right) | s_0\right] \tag{2}$$

where β is the pure discount factor of workers. Note that the expectations in (2) is taken with respect to joint distribution over idiosyncratic and aggregate shocks that depends through the transition probabilities π on the effort choice $\{l_t\}$. For notational ease we suppress this dependence.

Workers choose a plan $\{c_t, l_t, a_t\}$ so as to maximize (2) subject to (1).

3.2 Firms

The consumption good is produced using the production function $Y_t = AL_t$, where Y_t is aggregate output in period t, L_t is the aggregate stock of effective labor employed in production (the human capital stock of employed households), and A is a productivity parameter. Firms hire labor in competitive labor markets and the real wage adjusts so that equilibrium profit is zero: $A = w$.

3.3 Equilibrium Definition

Define the aggregate stock of human capital of worker of type s as $H_{t,s} = E[h_t | s_t = s]$ with $s = e, su, lu$. Note that we have $H_t = H_{t,e} + H_{t,su} + H_{t,lu} = E[h_t]$. Labor market clearing requires that labor hired by firms, L_t, is equal to the aggregate labor supply, $H_{t,e}$. We assume that the risk-free asset is in zero net supply. Thus, market clearing in the labor market and the asset market reads:

$$\begin{aligned} L_t &= H_{t,e} \\ E_t[a_t] &= 0 \end{aligned} \tag{3}$$

where the expectation in (3) is taken over all individual histories s^t conditional on the history of aggregate shocks S^t. We further assume that the government runs a balanced budget in

expected value terms (on average). To define this budget constraint, let $\Omega_{t,s} = H_{t,s}/H_t$ the human capital share of workers of type s in period t with $s = e, su, lu$. Below we show that in equilibrium Ω is the solution to a recursive equation. Let Ω^* be the stationary point of this recursive equation – the vector of human capital shares in steady state. We impose the following government budget constraint:

$$\tau w \Omega^*(e) \;=\; b(su)\Omega^*(su) + b(lu)\Omega^*(lu) \tag{4}$$

A (sequential) competitive equilibrium is defined in the standard manner:

Definition For given government policy (b, τ), a competitive equilibrium is a wage rate $w = A$, a sequence of interst rates, $\{r_t\}$, and a worker plan, $\{c_t, a_t, l_t\}$, so that

i) for given wage rate w and sequence of interest rates $\{r_t\}$, the individual plan $\{c_t, a_t, l_t\}$ maximizes expected lifetime utility (2) subject to (1).

ii) market clearing condition (3) holds in each period t

A budget feasible government policy is a (b, τ) satisfying the government budget constraint (4).

3.5 Equilibrium Characterization

The recursive formulation of workers' maximization problem reads

$$\begin{aligned} V(a,h,s,S) \quad &= \quad \max_{c,l,a'} \left\{ \ln c - d(l,s) + \beta \sum_{s',S'} V(a',h',s',S')\pi(s',S'|s,l,S) \right\} \\ &\quad s.t. \quad (a',c) \;\in\; \Gamma(a,h,s,S) \\ &\quad s.\,t. \quad h' \;=\; (1+\epsilon(s,s'))h \end{aligned} \tag{5}$$

where Γ is the correspondence defined by the individual budget set (1). Note that the effort choice l is only relevant if $s = su, lu$. In the Appendix we show that under certain conditions there is an equilibrium in which workers choose asset holdings $a_t = 0$ and consumption $c_t = \phi(s_t, S_t)h_t$ for all histories (for all states), that is, no trade in financial assets and

consumption equals income (after-tax earnings or unemployment benefits). The equilibrium interest rate is determined by the intertemporal marginal rate of substitution of employed workers

$$1 + r(S) \;=\; \frac{1}{\beta}\left(\sum_{s',S'} \frac{\nu(s)}{\nu(s')(1+\epsilon(e,s'))}\pi(s',S'|e,S)\right)^{-1} \tag{6}$$

Equation (6) ensures that $a_t =$ is an optimal choice for employed workers. To ensure that unemployed workers have no incentive to save or borrow, the transaction cost θ has to be at least as large as

$$\begin{aligned}\theta_{min} \;&=\; \max_S \left\{\frac{1}{\beta}\left(\sum_{s',S'} \frac{\nu(s)}{\nu(s')(1+\epsilon(su,s'))}\pi(s',S'|su,l(su,S),S)\right)^{-1}\right. \\ &-\; \left.\frac{1}{\beta}\left(\sum_{s',S'} \frac{\nu(s)}{\nu(s')(1+\epsilon(e,s'))}\pi(s',S'|e,S)\right)^{-1}\right\}\end{aligned} \tag{7}$$

where $l(su,S)$ is the equilibrium effort choice of short-term unemployed workers specified below. In this characterization we assume that employed workers have the strongest incentive to save and short-term unemployed workers have the strongest incentive to dissave. The equilibrium characterization for the other cases is accordingly.

The value function of workers in equilibrium at $a_t = 0$ can easily be computed and is given by

$$V(0,h,s,S) \;=\; v(s,S) + \frac{1}{1-\beta} ln\, h \tag{8}$$

where v together with the optimal effort choice are the solution to the intensive-form Bellman equation

$$\begin{aligned}v(s,S) \;&=\; \max_l \left\{\ln\phi(s,S) - d(l,s) + \frac{\beta}{1-\beta}\sum_{s'} \ln(1+\epsilon(s,s'))\pi(s'|s,S,l)\right. \\ &\left. +\beta\sum_{s',S'} v(s',S')\pi(s',S'|s,S,l)\right\}\end{aligned} \tag{9}$$

The solution to equation (9) defines the equilibrium effort choice of workers. We further have $a_t = 0$ and $c_t = \phi(s_t)h_t$ with $h_{t+1} = (1+\epsilon(s_t,s_{t+1}))h_t$ in equilibrium, which implies that

the solution to (9) also defines the equlibrium plan $\{c_t, a_t, l_t\}$ of workers. The law of motion for the aggregate human captal stock and for the aggregate human capital shares becomes:

$$H'_{s'} = \sum_s (1+\epsilon(s,s'))\pi(s'|s,S,l(s,S))H_s \tag{10}$$

$$\Omega'_{s'} = \frac{\sum_s (1+\epsilon(s,s'))\pi(s'|s,S,l(s,S))\Omega_s}{\sum_{s,s'}(1+\epsilon(s,s'))\pi(s'|s,S,l(s,S))\Omega_s}$$

Proposition 1. Suppose that the cost of financial intermediation θ is greater or equal to θ_{min} given in (7). Then the solution to (9) and (10) defines a recursive equilibrium.

Proof: Appendix.

4. Cost of Business Cycles

We now turn to the analysis of the interaction between labor market reform and the cost of business cycles. In section 4.1 we discuss how to eliminate business cycles in our framework and in section 4.2 we derive a useful formula for the cost of business cycles. Section 4.3 considers the effect of labor market reform, in particular permanent changes in unemployment benefits and permanent changes in job matching (search) efficiency.

4.1 Eliminating Business Cycles

We follow Lucas (1987, 2003) and analyze the welfare consequences of macroeconomic stabilization policy without having an explicit model of the interaction between stabilization policy and the business cycle. As in Lucas (1987, 2003) we consider a thought experiment in which stabilization policy completely eliminates business cycles, that is, we consider moving from an economy with S-dependent labor market risk π and ϵ to an economy with labor market risk $\hat{\pi}$ and $\hat{\epsilon}$, that is, independent of business cycle conditions S. The question that arises is how to find $\hat{\pi}$ and $\hat{\epsilon}$ given π and ϵ.

For economies without idiosyncratic risk Lucas (1987, 2003) postulates that the elimination of business cycles amounts to replacing all S-dependent random variables by their expected value. In this paper, we follow Krebs (2003) and Krusell and Smith (2002) and

extend this principle to economies with idiosyncratic risk by taking the expected value conditional on each possible individual state s:

$$\begin{aligned} \hat{\pi}(s'|s,l) &= \sum_{S} \pi(s'|s,S,l)\tilde{\pi}(S|s) \\ \hat{\epsilon}(s,s') &= \epsilon(s,s') \end{aligned} \tag{11}$$

Note that in our baseline model on job destruction rates depend on the business cycle and (10) is therefore only relevant for $s = e$.

We use different assumptions for the weighting distribution $\tilde{\pi}$ corresponding to different assumptions regarding the effect of macroeconomic stabilization policy. One assumption is

$$\tilde{\pi}(S|s) = \pi(S|s) \tag{12}$$

An alternative assumption is that stabilization policy has an asymmetric effect on the business cycle in the sense that it removes recessions without affecting negatively the economy in all other states.:

$$\tilde{\pi}(S|s) = \begin{cases} \frac{\pi(S|s)}{\sum_{S \neq L} \pi(S|s)} & if\ S \neq L \\ 0 & if\ S = L \end{cases} \tag{13}$$

where L stands for the aggregate state with the lowest output growth rate (recession states). This asymmetry can arise, for example, if the fiscal multiplier is larger in recessions than in booms ( ). Further, Hairault, Lagot, and Osotimehim (2010) and Jung and Kuester (2011) have shown that in the search and matching model of Mortensen and Pissarides (1994) a mean-preserving reduction in the volatility of aggregate productivity shocks reduces the mean unemployment rate. Clearly, for our baseline model with two aggregate states the two methods define a lower bound and upper bound on the welfare cost of business cycles.

When we eliminate business cycles we not only change the economy according to (10), but we also adjust the tax rate τ and/or benefit rate b to ensure that the government budget constraint (4) remains satisfied. There are, of course, different ways of changing τ and b that all ensure (4), and in the following we compute the welfare cost of business cycles under various assumptions.

4.2 Cost of Business Cycles

Let Δ stand for the welfare cost of business cycles for workers. We define this welfare cost as the ex-ante welfare difference, expressed in lifetime consumption units, between living in an economy with business cycles (recessions) and an economy without business cycles (recessions). Here we use ex-ante in the sense of not knowing the initial values of (s_0, S_0), but conditional on h_0. Thus, if we denote variables in the economy without business cycles by a hat, then this welfare cost Δ is the solution to the equation

$$E\left[\sum_{t=0}^{\infty}\beta^t\left(\ln\left((1+\Delta)c_t\right)-d(l_t,s_t)\right)|h_0\right] \;=\; E\left[\sum_{t=0}^{\infty}\beta^t\left(\ln\left(\hat{c}_t\right)-d(\hat{l}_t,s_t)\right)|h_0\right] \tag{14}$$

where c_t is worker consumption in the economy with business cycles and $\hat{c}_t$ is worker consumption in the economy without business cycles. Our equilibrium characterization result (proposition 1) allows us to compute equilibrium consumption for given fundamentals and our method of eliminating business cycles (10) specifies the fundamentals for the economy without business cycles.

Using the value function defined by (7) and (8) the welfare cost of business cycles can be written as

$$\ln(1+\Delta) \;=\; \sum_{s}\hat{v}(s)\hat{\pi}(s)-\sum_{s,S}v(s,S)\pi(s,S) \tag{15}$$

where $\hat{v}$ is the intensive-form value function in the economy without business cycles. Further, π and $\hat{\pi}$ are the stationary distributions of the economy with business cycles, respectively without business cycles. Of course, the equilibrium value function as well as the equilibrium distributions depend on equilibrium effort choices l, respectively $\hat{l}$, through their dependence on the transition probabilities $\pi(s',S'|s,S,l)$, respectively $\hat{\pi}(s'|s,l)$. Using formula (8) for the intensive-form value function we find that the cost of business cycles can be written as:

$$\begin{aligned}\ln(1+\Delta) \;&=\; \sum_{s}\ln\hat{\phi}(s)\hat{\pi}(s)-\sum_{s}\ln\phi(s)\pi(s) \\ &\quad-\left[\sum_{s}d(\hat{l}(s),s)\hat{\pi}(s)\;-\;\sum_{s,S}d(l(s,S),s)\pi(s,S)\right]\end{aligned} \tag{16}$$

$$+\frac{\beta}{1-\beta}\left[\sum_{s,s'}\ln(1+\hat{\epsilon}(s,s'))\hat{\pi}(s,s')\ -\ \sum_{s,s'}\ln(1+\epsilon(s,s'))\pi(s,s')\right]$$

Of course, we can also define a welfare cost of business cycles for each worker type s. This welfare cost is defined in analogy to (12) and can be computed as:

$$\begin{aligned}\ln(1+\Delta(s)) \ &= \ \ln\hat{\phi}(s)-\ln\phi(s) \\ &\quad -\left[d(\hat{l}(s),s)\ -\ \sum_{S} d(l(s,S),s)\pi(S|s)\right] \\ &\quad +\frac{\beta}{1-\beta}\left[\sum_{s'}\ln(1+\hat{\epsilon}(s,s'))\hat{\pi}(s'|s)\ -\ \sum_{s'}\ln(1+\epsilon(s,s'))\pi(s'|s)\right]\end{aligned} \tag{17}$$

5. Model Specification and Calibration

In this section, we specify a baseline model and calibrate the model economy in order to match a number of facts of the German labor market before the Hartz reforms. In particular, the model economy matches some of the key features of the German unemployment insurance system before the reform. In addition, we require the model economy to be consistent with the empirical evidence on labor market risk and the unemployment benefit elasticity of individual job finding rates (search intensity). We also require the model economy to match the cyclical properties of the German job destruction and job finding rate (the flow into and out off unemployment). Finally, we impose the restriction that the values of a number of macro variables (unemployment rate, flows in and out of unemployment) in the stationary equilibrium of the calibrated model economy should match the corresponding long-run values for the German economy before the reform.

Our calibration strategy requires us to find the long-run values of a number of macro variables before the reform. We use two methods to find these long-run values. The first method computes from the data the average value in the period 2000-2004. The second method is to apply the HP-filter to the data in the period until 2005, and then to take the value of the long-run trend in year 2002. Both methods yield almost identical results and we therefore report only the results using the first method. However, it is conceivable that

alternative methods could produce very different target values. We therefore return to the issue of finding long-run values from the data in our robustness analysis in section 7, where we report how our main results change if we choose target values that differ substantially from the ones chosen here.

5.1 Model Specification

The basic model period is one quarter. We use a Cobb-Douglas production function, $Y = AK^{\alpha}L^{1-\alpha}$, where A is a constant parameter (no aggregate productivity shocks). We assume a two-state aggregate shock process $S \in \{L, H\}$, where L stands for low growth and H for high growth. We further assume $\epsilon = \epsilon(s)$ and denote skill depreciation of the short-term unemployed and long-term unemployed by $\epsilon(su) = \delta_{h,su}$ and $\epsilon(lu) = \delta_{h,lu}$, respectively. For the baseline calibration, we assume $\delta_{h,su} = \delta_{h,lu}$. We use the standard convention and define long-term unemployment as any unemployment spell that lasts longer than 12 months. Thus, we choose the probability $\pi(lu|su)$ of transiting from su to lu equal to 0.25.

5.2 Search

For the job search technology, we follow Hopenhayn and Nicolini (1997), Lentz (2009), and Shimer and Werning (2008) and assume an exponential specification:

$$\begin{aligned} \pi(e|su,l) &= 1 - e^{-\lambda(su)l} \\ \pi(e|lu,l) &= 1 - e^{-\lambda(lu)l} \,. \end{aligned} \tag{18}$$

We choose the values of $\lambda(su)$ and $\lambda(lu)$ so that the corresponding job finding probabilities match the observed average transition rates in the period 2000-2004 for the short-term unemployed and long-term unemployed, respectively. The values for the quarterly transition probabilities are $\pi(e|lu) = .06$ and $\pi(e|su) = .24$ according to the data provided by the Federal Employment Agency (Bundesagentur fuer Arbeit), which yields $\lambda(su) = 0.724$ and $\lambda(lu) = 0.229$.

We assume that dis-utility of search is

$$d(l,s) \;=\; d_0\, l^{\gamma} - d_1(s) \tag{19}$$

For the employed workers, we set the disutility of work, $d_1(e)$, equal to the value assumed in the standard real business cycle model with log utility (Prescott and Hansen, 1995). It is well-known that with the above specification the parameters $\lambda(su)$, $\lambda(lu)$ and d_0 are not separately identified. We therefore choose a numerically convenient normalization of $d_0 = 1$. We choose $d_1(su)$ and $d_1(lu)$ so that the value of the disultility term d in equilibrium is the same for employed workers, short-term unemployed workers, and long-term unemployed workers. We choose the curvature parameter γ to match a given value of the elasticity of the job finding rate with respect to benefits payments for the short-term unemployed. This target elasticity is chosen as follows.

For the US, there are a number of empirical micro studies estimating the search elasticity directly. The best known studies are Moffitt (1985) and Meyer (1990) who estimate elasticity of around -0.9. Krueger and Meyer (2002) survey the literature and suggest an elasticity of around -1. Landais, Michaillat, and Saez (2010) calibrate theor model economy using an elasticity of -0.9. There is much less work on this issue for Germany, but Hunt (1995) finds estimates for Germany that are similar to the US results. Consistent with this finding are the results reported in Hofmann (2012) and Mueller and Steiner (2008), who find that imposing benefit sanctions on long-term unemployed for non-compliance has significant effects on the unemployment-to-employment transition in Germany. Addison, Centeno and Portugal (2008) use a structural search model and the European Community Household Panel (ECHP) to estimate the elasticity for several European countries, and they find values ranging from -1.14 to -1.66 for Germany. Almost all empirical studies deal with unemployed workers who are short-term unemployed according to our definition (less than one year of unemployment). We therefore use the empirical results to match a given elasticity for the short-term unemployed. In our baseline calibration, we choose -0.6 as a target, which is a conservative value given the available empirical evidence.

Our calibration implies an elasticity of unemployment duration with respect to unemployment benefits for the long-term unemployed of -1.13, which is almost twice as large as the corresponding elasticity for the short-term unemployed. We are not aware of any study that estimates this elasticity separately for the short-term and long-term unemployed. However, work by Chetty (2008) shows that the effect of unemployment benefits on unemployment duration is much stronger for low-wealth individuals, an effect he calls the liquidity effect based on the assumption that low-wealth individuals are liquidity constrained. In the data and in our model the long-term unemployed are the low-wealth individuals. Indeed, in Germany unemployment insurance for the long-term unemployed (Unemployment Benefits II) is means-tested with very low levels of permissable asset holdings. In line with our results, the estimates reported in Chetty (2008) suggest that the elasticity of the long-term unemployed (low-wealth unemployed) is at least twice as large as the search elasticity of the short-term unemployed.

We choose the job separation rate, $\pi(e|su)$, so that the implied unemployment rate is equal the average unemployment rate in the period 2000-2004, namely 9 percent. This yields a job separation rate of $\pi(e|su) = 0.0148$, which is in line with Jung and Kuhn (2013). Finally, we choose $\pi(su|lu)$ to match a given fraction of long-term unemployed in the unemployment pool. According to the OECD statistics, the share of long-term unemployment was 50 percent for the period 2000-2004, a value we match if $\pi(su|lu) = 0.190$.

5.3 Skill Loss During Unemployment

There is substantial empirical evidence that job loss leads to subsequent lower wages and earnings, and that these wage losses increase with the duration of unemployment. For the US, Addisson and Portugal (1989) use data drawn from the Displaced Worker Survey and find that an increase in the unemployment duration by 10% reduces wages between 0.8% and 1.4%. Using the same data, Neal (1995) finds that an additional week of unemployment reduces the wages by 0.37%, implying a monthly rate of wage loss of 1.5%. Further, using a structural approach Keane and Wolpin (1997) estimate high rates of skill depreciation

during unemployment. For Germany, Schmieder, Wachter, and Bender (2012) use a large administrative data set to implement a regression discontinuity (RD) design and find that each month out of work reduces reemployment wages by 0.9 percent, pointing to very high costs of long-term unemployment. In this paper, we interpret the duration dependence of wage losses as arising from skill depreciation during unemployment. Guided by the findings of the empirical literature, we set the skill depreciation parameter to a quarterly depreciation rate of 2.5%.

5.4 Unemployment Benefits

We choose the unemployment benefit parameters $b(su) = w$ so that consumption of the short-term unemployed only changes because of the loss of human capital (perfect consumption smoothing of transitory income shocks). We choose the unemployment benefit parameter $b(lu)$ to match the difference in the net replacement rate of the short-term unemployed and long-term unemployed (the change that occurs when moving from short-term unemployment to long-term unemployment).[9] The OECD reports the net replacement rate for short-term and long-term unemployed, where long-term unemployment is defined as unemployment duration longer than one year. The Hartz IV reform clearly had different effects on different sub-groups of the short-term and long-term unemployed. However, neither the model nor the OECD data are detailed enough to capture all aspects of this heterogeneity. We therefore focus on net replacement rates of single households with median earnings before the job loss. The OECD reports the net replacement rate for two subgroups of this group of households, namely single households without children and single households with two children. We calibrate the parameter $b(lu)$ so that the model matches the weighted average net replacement rate for these two groups, where the weight for the first group is set equal to the population weight of all households without children and the weight of the second group is set equal to the population weight of all households with children. For the period 2000-2004, this yields a net replacement rate of 0.63 for the short-term unemployed and 0.57 for the long-term

[9] In the model, the net replacement rate is not b, but $b/((1-\tau)r_h)$, and we choose b so that the implied value of $b/((1-\tau)r_h)$ matches the corresponding net replacement rate.

unemployed.[10]

5.5 Production

We normalize the wage rate per unit of human capital to one: $w = 1$. We assume a Cobb-Douglas production function, $F(K, H^e) = AK^{\alpha}(H^e)^{1-\alpha}$, and set the capital share of output to $\alpha = 0.36$. We choose the technology parameter A, the capital depreciation rate δ_k, and the discount factor of the capitalist β_c so that the model matches and interest rate of 3 percent and the output growth rate and saving rate in Germany before the reform, namely one percent economic growth and a saving rate of 20 percent.

5.6 Cyclical Variation

We estimate job separation rates and job finding rates from OECD data according to Elsby et al (2008) for the period 1992-2005 and detrend the time series using a HP filter. See figures 3 and 4 for the resulting flow rates into and out off unemployment expressed as percentage deviation from the HP-trend. We identify the times the job separation rate is above trend with the low-growth scenario $S = L$. We then count the relative number of periods the state $S = L$ has occured and find that this event happened 43 percent of the times. We also find that the average duration of the low growth scenario $S = L$ is about 8 periods. We set the two free parameters of the 2×2 transition matrix $\pi(S'|S)$ to match these two targets, which yields $p(H|H) = 0.1250$ and $p(L|L) = 0.8750$. We set the value of the job separation rates $\pi(su|e, L)$ and $\pi(su|e, H)$ to match the mean and volatility (standard deviation) of the cyclical component of the empirical job separation rate. Correspondingly, we set the two values of the job finding rate, averaged over short-term and long-term unemployed, to match the mean and volatility of the corresponding empirical time series.

[10]The results are similar, at least in terms of the effect of Hartz IV on net replacement rates, if we take couples instead of singles as long as we weigh the group without children and the group with two children the same way. The OECD does not report net replacement rates for households with one child. Hartz IV had a larger effect on the net replacement rate of households with one child than it had on the net replacement rate of households with two children, and our weighing scheme therefore understates the effect of Hartz IV on net replacement rates.

5.7 Hartz III

The evidence reviewed in section 2 suggests that the restructering of the Public Employment Agency (Hartz III) increased the efficiency parameter of the aggregate matching function by at least 5 percent and perhaps up to 10 percent. The evidence also suggests that the introduction of vouchers for placement services improved the job finding rate of affected workers by about 30 percent. On average, 20 percent of unemployed workers receive a voucher (Pfeiffer and Winterhager, 2006), which translates into into an increase in the unconditional job finding rate by 6 percent for all unemployed workers. Based on this evidence, we assume that restructering of the Public Employment Agency in conjunction with the adoption of the voucher system for placement services led to an increase of matching efficiency by 10 percent, a choice also made by Krause and Uhlig (2012) to mimic the gain in aggregate matching efficiency from the Hartz reforms.

There are two reasons why the choice of a 10-percent increase in matching efficiency is conservative. First, Fahr and Sunde (2009) and Klinger and Rothe (2012) are likely to underestimate the true effect of Hartz III on matching efficiency since they only consider data until January 2006, and any effect of the Hartz reforms that materialized after this date is not captured by their estimation. Second, the introduction of vouchers in (2002) injected an element of competition in the market for placement services thereby improving the efficiency of the Public Employment Agency, an effect that is not captured by the empirical work on vouchers or the empirical work on Hartz III.

The available empirical evidence points towards substantial gains in matching efficiency brought about by Hartz III in conjunction withe the voucher system. Such gains are plausible given that i) job search assistance before the reform was basically non-existent[11] and ii) well-executed job search assistance has been shown to have large effects on re-employment rates of unemployed job seekers (see Card, Kluve, and Weber, 2010, for a survey). Of course, most

[11]Private providers could not compete because of heavy regulation and the public provider had no incentive to compete. More here

of the empirical work on job search assistance is microeconomic in nature and does not take into account the possibility of negative externalities through equilibrium effects (Cahuc and Le Barbanchon, 2010), and a recent study by Crepon et al. (2012) has shown that these effects can be substantial using data for young, educated job seekers in France. However, our calibration is mainly based on the empirical results of Fahr and Sunde (2009) and Klinger and Rothe (2012), who take a semi-aggregate approach that accounts for possible equilibrium effects within an occupation or region. This leaves open the possibility of equilibrium effects across regions or occupations, but these effects are likely to be small in our case given the low levels of regional and occupational mobility in Germany (see Fahr and Sunde, 2009, and Klinger and Rothe, 2012).

5.8 Hartz IV

As discussed in section 2, the Hartz IV reform consisted of a complete overhaul of the German unemployment insurance system and resulted in a number of far-reaching changes. However, its impact on the net replacement rate of the short-term unemployed, regardless of household type, was limited. It is therefore not surprising that the average net replacement rate for the short-term unemployed was not affected by the reform (figure XXX). In contrast, the net replacement rate for the long-term unemployed dropped sharply after the reform for all households without children. For our average measure, we find that the Hartz IV reform reduced the net replacement rate from 0.57 in the period 2000-2004 to 0.46 after the reform in 2005 (see figure XXX). Based on this evidence, we simulate the effects of Hartz IV assuming that it reduced the net replacement rate for the long-term unemployed from 0.57 to 0.46 and that it left the net replacement rate for the short-term unemployed unchanged.

6. Quantitative Results

To be written

Appendix

To ease the notation, we confine attention to the case of a constant interest rate $r_{f,t} = r_f$. Consider an extended household maximization problem with endogenous choice of human capital. Specifically, suppose that the household can transform one untit of the good into $\nu(s)$ units of human capital and denote the (resource) cost of human capital investment by x. Thus, the extended household maximization problem is the problem of choosing $\{c_t, a_t, h_t, x_t, l_t\}$ so as to maximize (2) subject to the sequential budget constraint

$$a_{t+1} = \begin{cases} (1+r_f)a_t + \phi(s_t) - c_t - x_t & if\ a_{t+1} \geq 0 \\ (1+r_f+\varphi)a_t + \phi(s_t) - c_t - x_t & if\ a_{t+1} < 0 \end{cases}$$

$$h_{t+1} = (1+\epsilon(s_t, s_{t+1}))\,(h_t + \nu_t x_t) \qquad (A1)$$

where ϵ and ϕ are the same functions as in the basic household decision problem of maximizing (2) subject to (1).

Clearly, if $\{c_t^*, a_t^*, h_t^*, x_t^*, l_t^*\}$ solves the extended household maximization problem with $x_t^* = 0$, then $\{c_t^*, a_t^*, l_t^*\}$ solves the basic household decision problem for given $\bar{h}_t = h_t^*$. In particular, if $\{c_t^*, a_t^*, h_t^*, x_t^*, l_t^*\}$ solves the extended household maximization problem with $x_t^* = 0$ and $a_t^* = 0$, then $\{c_t^*, a_t^*, l_t^*\}$ with $a_t^* = 0$ solves the basic household decision problem for given $\bar{h}_t = h_t^*$. Thus, proposition 1 is proved if we can construct a solution $\{c_t^*, a_t^*, h_t^*, x_t^*, l_t^*\}$ to the extended household maximization problem with $x_t^* = 0$ and $a_t^* = 0$. We now show how to construct such a plan if the interest rate, r_f, is given by (6) and the financial intermediation cost is not less than φ_{min} defined in (7).

Define the following new variables:

$$\begin{aligned} \tilde{c}_t &= \nu_t\, c_t \\ w_{t+1} &= (1+r_{t+1})\,(h_{t+1}/(1+\epsilon_{t+1}) + \nu_t a_{t+1}) \\ \theta_{a,t+1} &= \frac{\nu_t\,(1+r_{t+1})a_{t+1}}{w_{t+1}} \\ \theta_{h,t+1} &= \frac{(1+r_{t+1})h_{t+1}}{(1+\epsilon_{t+1})w_{t+1}} \end{aligned}$$

$$1 + r_{t+1} \quad = \quad \begin{cases} \theta_{a,t+1}\left(\frac{\nu_{t+1}}{\nu_t}(1+r_f)\right) + \theta_{h,t+1}(1+\epsilon_{t+1})(1+\phi_{t+1}\nu_{t+1}) & if\ \theta_{at} \geq 0 \\ \left(\frac{\nu_{t+1}}{\nu_t}(1+r_f+\varphi)\right) + \theta_{h,t+1}(1+\epsilon_{t+1})(1+\phi_{t+1}\nu_{t+1}) & if\ \theta_{at} < 0 \end{cases}$$

Here w is the value of total wealth, financial and human, including asset payoffs in period $t+1$, θ is the share of total wealth invested in financial assets, and r is the total return on investment (in human and physical capital). Note that $h_{t+1}/(1+\epsilon_{t+1}) + \nu_t a_{t+1}$ is total wealth excluding asset payoffs in period $t+1$. Using the new definitions, the household budget constraint (A1) can be written as

$$\begin{aligned} w_{t+1} \quad &= \quad (1 + r(\theta_{a,t+1}, \theta_{h,t+1}s_t, s_{t+1}))\,(w_t - c_t) \\ & \qquad \theta_{a,t+1} + \theta_{h,t+1} \;=\; 1 \qquad\qquad (A2) \\ & \qquad w_{t+1} \geq 0 \;\;,\;\; \theta_{h,t+1} \geq 0 \end{aligned}$$

The extended household maximization problem is to choose a plan $\{c_t, w_t, \theta_{at}, \theta_{ht}, l_t\}$ that maximizes (1) subject to (A2).

The Bellman equation associated with the extended household maximization problem reads

$$\begin{aligned} V(w,s) \quad &= \quad \max_{c,\theta'_a,\theta'_h,w',l} \left\{ ln\,\tilde{c} - \ln \nu(s) - d(l,s) + \beta \sum_{s'} V(w',s')\pi(s'|s,l) \right\} \\ & s.\,t. \quad w' \;=\; (1 + r(\theta'_a, \theta'_h, s, s'))(w - c) \\ & \qquad \theta'_a + \theta'_h \;=\; 1 \qquad\qquad (A3) \\ & \qquad w' \geq 0 \;\;,\;\; \theta'_h \geq 0 \end{aligned}$$

where the effort choice, l, is only relevant if $s = su, lu$. The extended household maximization problem has the feature that probabilities depend on choices, in contrast to the class of problems analyzed in Stokey and Lucas (1989). However, the standard argument for the principle of optimality still applies, and without loss of generality we can confine attention to solving (A3) subject to a corresponding transversality condition.[12]

---

[12]There is a technical issue regarding the construction of the appropriate function space since the economic problem is naturally an unbounded problem. To deal with this issue, one can, for example, follow Streufert

The Bellman equation (A3) has a simple solution. More precisely, the optimal portfolio choice, (θ'_a, θ'_h), is independent of wealth, w, and consumption and next-period wealth are linear functions of current wealth:

$$\begin{aligned} c &= (1-\beta)w \qquad (A4) \\ w' &= \beta(1+r(\theta', s, s'))w \ . \end{aligned}$$

Moreover, the value function has the functional form

$$V(w,s) \ = \ \tilde{V}(s) + \frac{1}{1-\beta}\ln w \qquad (A5)$$

and the optimal portfolio choice and optimal search effort are the solution to the intensive-form Bellman equation

$$\tilde{V}(s) \ = \ \max_{\theta'_a, \theta'_h, l} \left\{ B - \nu(s) - d(l,s) + \frac{\beta}{1-\beta} \sum_{s'} ln\,(1 + r(\theta'_a, \theta'_h, s, s'))\pi(s'|s,l) \ + \ \beta \sum_{s'} \tilde{V}(s')\pi(s'|s,l) \right\} \ ,$$

$$\theta'_a + \theta'_h \ = \ 1 \ , \ \ \theta'_h \ \geq \ 0 \qquad (A6)$$

where B is a constant. It is straightforward to show that this solution satisfies the relevant transversality condition.

Clearly, the maximization problem (A6) is a convex problem (concave objective function and convex choice set), and first-order conditions are therefore necessary and sufficient. These first-order condition read

$$\begin{aligned} 0 \ &\leq \ \sum_{s'} \frac{(1+\epsilon(s,s'))(1+\phi(s')\nu(s')) \ - \ \frac{\nu(s')}{\nu(s)}(1+r_f)}{1+r(\theta'_a, \theta'_h, s, s')} \pi(s'|s,l) \quad if\ \theta'_a \geq 0 \qquad (A7) \\ 0 \ &\geq \ \sum_{s'} \frac{(1+\epsilon(s,s'))(1+\phi(s')\nu(s')) \ - \ \frac{\nu(s')}{\nu(s)}(1+r_f+\varphi)}{1+r(\theta'_a, \theta'_h, s, s')} \pi(s'|s,l) \quad if\ \theta'_a \leq 0 \end{aligned}$$

(1990) and consider the set of continuous functions B_W that are bounded in the weighted sup-norm $||V|| \doteq sup_x |V(x)|/W(x)$, where $x = (w, \theta, s)$ and the weighting function W is given by $W(x) = |L(x)| + |U(x)|$ with U an upper bound and L a lower bound, and endow this function space with the corresponding metric.[13] A straightforward but tedious argument shows that confining attention to this function space is without loss of generality. More precisely, one can show that there exist functions L and H so that for all candidate solutions, V, we have $L(x) \leq V(x) \leq H(x)$ for all $x \in \mathbf{X}$.

where the first inequality has to hold with equality if $\theta'_a > 0$ and the second inequality has to hold with equality if $\theta'_a < 0$. Note that the numerator is the excess return of human capital investment over the return to financial investment and that $(1+r)^{-1}$ is the marginal utility of consumption. Thus, equation (A7) says that expected marginal utility weighted returns are equalized across assets, a well-known optimality condition in portfolio choice theory.

Suppose the human capital productivity parameter ν is chosen as

$$\nu(s) \;=\; \frac{1-\beta}{\beta}\frac{1}{\phi(s)} \qquad (A8)$$

Using this condition and substituting $\theta'_a = 0$ and $\theta'_h = 1$ into (A???) yields:

$$\begin{aligned} 1 \;&\geq\; \beta \sum_{s'} \frac{\phi(s)}{\phi(s')} \frac{1+r_f}{1+\epsilon(s,s')}\, \pi(s'|s,l) \qquad (A9) \\ 1 \;&\leq\; \beta \sum_{s'} \frac{\phi(s)}{\phi(s')} \frac{1+r_f+\varphi}{1+\epsilon(s,s')}\, \pi(s'|s,l) \end{aligned}$$

Clearly, if the interest rate, r_f, is set according to (6) and the financial intermediation cost is at least as large as φ_{min} given in (7), then (A9) is satisfied (and holds with equality if the cost is equal to φ_{min}). Straightforward algebra shows that in this case the value function (A5) reduces to (8) and equation (A6) becomes (9). Further, in this case the optimal plan given by (A4) is simply $c_t = \phi(s_t)h_t$ and $h_{t+1} = (1+\epsilon(s_t, s_{t+1}))h_t$. This completes the proof of proposition 1.

References

Acemoglu, D., and R. Shimer (2000) "Productivity Gains from Unemployment Insurance," *European Economic Review* 44: 1145-1224.

Alvarez, F., and U. Jermann (2004) "Using Asset Prices to Measure the Cost of Business Cycles," *Journal of Political Economy* 112: 1223-1256.

Addison, J., and Portugal, P (1989), "Job Displacement, Relative Wage Changes, and Duration of Unemployment," *Journal of Labor Economics* 7: 281-302.

Addison, J., Centeno, M., Portugal, P. (2008) "Unemployment Benefits and Reservation Wages: Key Elasticities from a Stripped-Down Job-Search Model," IZA Discussion Paper.

Atkeson, A., and C. Phelan (1994) "Reconsidering the Cost of Business Cycles with Incomplete Markets," *NBER Macroeconomcis Annual*

Barlevy, G. (2004) "The Cost of Business Cycles under Endogenous Growth," *American Economic Review* 94: 964-960.

Beaudry, P., and C. Pages (2001) "The Cost of Business Cycles and the Stabilization value of Unemployment Insurance," *European Economic Review* 45: 1545-72

Blanchard, O., and J. Wolfers (2000) "The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence," *Economic Journal* 100: 1-33.

Bundesagentur fuer Arbeit (2005) "Der Uebergang von der Arbeitslosen- und Sozialhilfe zur Grundsicherung fr Arbeitssuchende," Sonderbericht.

Bundesagentur fuer Arbeit (2011) "Der Arbeitsmarkt in Deutschland: Sockel- und Langzeitarbeitslosigkeit," Arbeitsmarktberichterstattung.

Burda, M. and J. Hunt (2011) "What Explains the German Labor Market Miracle in the Great Recession?" NBER Working Paper.

Cahuc, P., and T. Le Barbanchon (2010) "Labor Market Policy Evaluation in Equilibrium: Some Lessons of the Job Search and Matching Model," *Labor Economics* 17: 196-205.

Card, D., Kluve, J. and A. Weber (2010) "Active Labour Market Policy Evaluation: A Meta-Analysis," *Economic Journal* 120: 452-477.

Chetty, R. (2008) "Moral Hazard vs Liquidity and Optimal Unemployment Insurance," *Journal of Political Economy* 116: 173-234.

Crepon, B., Duflo, E., Gurgand, M., Rathelot, R. and P. Zamora (2012) "Do labor Market Policies Have Displacement Effects: Evidence from a Clustered Randomized Experiment," *NBER Working Paper*

Fahr, R., and U. Sunde (2009) "Did the Hartz Reforms Speed Up the Matching Process? A Macro-Evaluation Using Empirical Matching Functions," *German Economic Review* 10, 284-316.

Hairault, J., Lagot, F., and S. Osotimehim (2010) "Matching Frictions, Unemployment Dynamics, and the Cost of Business Cycles," *Review of Economic Dynamics* 13; 759-779.

Hartz, P., N. Bensel, J. Fiedler, H. Fischer, P. Gasse, W. Jann, P. Kraljic, I. Kunkel-Weber, K. Luft, H. Schartau, W. Schickler, H.-E. Schleyer, G. Schmid, W. Tiefensee, and E. Voscherau (2002) "Moderne Dienstleistungen am Arbeitsmarkt, *Bericht der Kommission*.

Hofmann, B. (2012) "Short- and Long-Term ex Post Effects of Unemployment Insurance Sanctions," *Journal of Economics and Statistics* 232: 31-60.

Hertweck, M., and O. Sigrist (2012) "The Aggregate Effects of the Hartz Reforms in Germany," Working Paper

Hunt, J. (1995) "The Effect of Unemployment Compensation on Unemployment Duration in Germany," *Journal of Labor Economics* 13: 88-120.

Jacobi, L., and J. Kluve (2006) "Before and After the Hartz Reforms: The Performance of Active Labor Market Policy in Germany," IZA Discussion Paper.

Jung, P., and K. Kuester (2011) "The (Un)Importance of Unemployment Fluctuations for Welfare," *Journal of Economic Dynamics and Control* 35: 1744-1768.

Jung, P., and M. Kuhn (2013) "Labor Market Institutions and Worker Flows: Comparing Germany and the US?", *Economic Journal* forthcoming

Keane, M., and K. Wolpin "The Career Decision of Young Men," *Journal of Political Economy* 105: 473-522.

Krause, M., and H. Uhlig (2012) "Transitions in the German Labor Market: Structure

and Crisis," *Journal of Monetary Economics* 59: 64-79.

Krebs, T. (2003) "Growth and Welfare Effects of Business Cycles with Economies with Idiosyncratic Human Capital Risk," *Review of Economic Dynamics* 6: 846-68.

Krebs, T. (2007) "Job Displacement Risk and the Cost of Business Cycles," *American Economic Review* 97: 664-686.

Krebs, T., and M. Scheffel (2013) "Macroeconomic Evaluation of Labor Market Reform in Germany," *IMF Economic Review* forthcoming.

Krusell, P., and A. Smith (1999) "On the Welfare Effects of Eliminating Business Cycles," *Review of Economic Dynamics* 2: 245-272.

Krusell, P., Mukoyama, T., Sahin, A., and A. Smith (2009) "Revisiting the Welfare Effects of Eliminating Business Cycles," *Review of Economic Dynamics*

Landais, C., Michaillat, P., and E. Saez (2010) "Optimal Unemployment Insurance over the Business Cycle," NBER Working Paper

Launov, A., and K. Waelde (2013) "Estimating Incentive and Welfare Effects of Non-Stationary Unemployment Benefits," *International Economic Review* forthcoming.

Lucas, R. (1987) *Models of Business Cycles*. London: Blackwell Publishing.

Lucas, R. (2003) "Macroeconomic Priorities," *American Economic Review* 93: 1-14.

Ljungqvist, L., and T. Sargent (1998) "The European Unemployment Dilemma," *Journal of Political Economy* 514-550.

Ljungqvist, L., and T. Sargent (2008) "Two Questions about European Unemployment, *Econometrica* 76:1-29.

Meyer, B. (1990) "Unemployment Insurance and Unemployment Spells," *Econometrica* 58: 757-782.

Meyer, B., and A. Kreuger (2002) "Labor Supply Effects of Social Insurance," *Handbook of Public Economcis*

Mortensen, D., and C. Pissarides (1994) "Job Creation and Job Destruction in the Theory of Unemployment," *Review of Economic Studies* 61: 397-415.

Mueller, K., and V. Steiner (2008) "Imposed Benefit Sanctions and the Unemployment-to-Employment Transition: The German Experience," *DIW Discussion Paper 792*.

Neal, D. (1995) "Industry-Specific Human Capital: Evidence from Displaced Workers," *Journal of Labor Economics*

Pissarides, C. (1992) "Loss of Skill During Unemployment," *Quarterly Journal of Economics* 107: 1371-1391.

Pfeiffer, F., and H. Winterhager "Vermittlungsgutscheine und Beauftragung Dritter im Vergleich," *Zeitschrift fuer Arbeitsmarktforschung* 39: 425-445.

Storesletten, K., Telmer, C., and A. Yaron (2001) "The Welfare Cost of Business Cycles Revisited: Finite Lifes and Cyclical Variations in Idiosyncratic Risk," *European Economic Review* 45: 1311-39.

Winterhager, H., Heinze, A., and A. Spermann (2006) "Deregulating Job Placement in Europe: A Microeconometric Evaluation of an Innovative Voucher System in Germany," *Labour Economics* 13: 505-517.

Yellen, J. (2013) "Monetary Policy: Many Targets, Many Instruments. Where Do We Stand?" Speech given at the IMF Confererence "Rethinking Macro Policy II" on April 16, 2013.

Yellen, J., and G. Akerlof (2006) "Stabilization Policy: A Reconsideration," *Economic Inquiry* 44: 1-22.