Which Factors are behind Germany's Labour Market Upswing?

Christian Hutter, Sabine Klinger, Carsten Trenkler and Enzo Weber

Abstract: The strong and sustained labour market upswing in Germany is widely recognized. The relevant literature covers a variety of single reasons. The contribution of our study is to offer a broad set of factors in a unified methodological framework and systematically weigh the candidate reasons against each other on an empirical basis. The candidates are: shocks on the (de)regulation of employment, the efficiency of the matching process, wages, the separations margin, the size of the labour force, technology, cycle and working time per employee. To meet the requirements of our purpose, we specify an SVECM that leaves as many of the systematic interlinkages as possible for empirical determination while operating with a minimal set of restrictions in order to identify the economically meaningful shocks. Identification is achieved by a combination of short- and long-run restrictions based on search-and-matching theory and well-established assumptions on labour force development and technological change.

JEL classification: C32, E24

Keywords: employment, unemployment, deregulation, efficiency, SVECM, identification

1 Introduction

While labour markets in Europe and around the world have struggled from the repercussions of the great recession and the European debt crisis for nearly a decade, Germany embarked on a strong and sustained labour market upswing. By 2018, unemployment more than halved as compared to the peak in 2005, and employment follows a steep and stable upward trend even in times of weak economy. Consequently, debates in academics and politics revolve around the question of the decisive reasons for this extraordinary development. These discussions are of high relevance far beyond the national context, since, e.g., in Europe in particular it is considered in how far the German labour market reforms of the last decade should be replicated or whether the German success was based on wage dumping policies fuelling disequilibria in the EU.

In this study, we explore the empirical relevance of a comprehensive set of potential factors and weigh them against each other on the basis of a large and well-identified structural macroeconometric model. In particular, we address eight shocks, namely, labour force shock, working time shock, technology shock, cycle shock, wage shock, matching efficiency shock, separations shock, and deregulation shock. This collection represents both a synopsis and an extension of the previous literature. For example, increased matching efficiency after severe labour market reforms has been documented (e.g., Launov and Wälde, 2016; Klinger and Weber, 2016; Hertweck and Sigrist, 2015), as well as lower separation rates (Hartung et al., 2018; Klinger and Weber, 2016). Some argue that worsened outside options increased the willingness of the unemployed to make concessions (Krebs and Scheffel, 2013). Others point to a positive effect of moderate wages and flexible wage setting (Dustmann et al., 2014). Moreover, an increase in labour supply could have boosted employment (Burda and Seele, 2016) as well as generally lower and more flexible working hours (especially during the Great Recession, see Burda and Hunt, 2011; Balleer et al., 2016; Weber, 2015).

This brief review demonstrates that the literature as a whole provides an extensive debate on the subject. Notwithstanding, the single papers usually focus on specific points. While in the course of that many crucial points are illuminated, an investigation comprising a broad set of

factors in a unified methodological framework makes a crucial contribution: By systematically weighing the candidate reasons for the labour market upswing against each other on an empirical basis, we learn about the relevance and timing of the different effects. This is the purpose of our study.

To meet the requirements of this purpose, it is crucial to choose an open approach that minimises the need of setting assumptions a priori. I.e., the less restrictive the econometric procedure is designed the more will the data speak in the results. In this regard, a Structural Vector Error Correction Model (SVECM) provides the preferable framework: we leave as many of the systematic interlinkages as possible for empirical determination – including the existence of cointegration – while operating with a minimal set of restrictions to identify the economically meaningful shocks.

We construct such an SVECM for the German labour market development between 1992 and 2013 (We update to 2017 as soon as the microdata are available.) The model comprises the stocks of unemployment, vacancies and employment, labour market flows (job finding rate, separation rate) as well as hourly wages, productivity, and working time. This set of variables reasonably models the labour market and allows for various relevant mechanisms. We identify the eight structural shocks mentioned above via a combination of short- and long-run restrictions. These are based on cointegration properties, on well-established assumptions about labour force development, technological change, and cyclical fluctuations as well as on the search and matching theory of the labour market. In doing so, we demonstrate how to reconcile the theoretical search and matching framework with an empirical structural time series model with parsimonious restrictions. This adds to the growing literature that implements labour market dynamics into macro-econometric applications (compare Hairaulta and Zhutova, 2018; Rahn and Weber, 2017; Nordmeier et al., 2016; Fujita, 2011; Ravn and Simonelli, 2007). Having identified the shocks, we demonstrate their labour market impacts in an impulse response analysis. Then, in order to assess the relevance of the shocks for the German labour market upswing, we conduct a historical decomposition of employment and unemployment. This instrument allows tracing the labour market impact of the major driving forces through

time. For this exercise, we consider particularly the period since the middle of the last decade.

We find (examples; to be stated more precisely) that the efficiency shock as well as the wage shock are of high potential explaining the strong upswing. Both trigger large and highly significant effects on employment as well as unemployment. Moreover, deregulation has positive effects on the labour market. And so does an increase in the labour force shock; at least, the increasing effect on unemployment becomes insignificant.

The paper proceeds as follows. The subsequent section introduces the background of German labour market development and the data used in this paper. Section 3 discusses potential driving forces. Section 4 explains our macroeconomic model, the identification strategy and the estimation procedure. Section 5 presents the results and the final section concludes.

2 Data

2.1 Data description

We document the development of the German economy and labour market using eight variables: vacancies and unemployment, employment, working hours per employee and hourly wages, job finding rate and separation rate, as well as productivity per hour.

The worker flow rates are calculated from the IAB employment panel, which comprises a 2% representative sample taken from the German social security and unemployment records. The sample contains employees covered by the compulsory German social security system and excludes self-employed and civil servants. It covers about 80% of the German labour force. To calculate the worker flows, we choose a cutoff-date each month and check for two subsequent months whether the employment status has changed. Employment-to-unemployment flows are divided by the number of employees in the previous month while unemployment-to-employment flows are divided by the number of unemployed workers in the previous month. This is consistent with the counting mechanism of the Federal Employment Agency: unemployment is counted in the mid of a month while flows from unemployment are counted between that date and the mid of the following month. A previous version of that data has been used by Klinger and

Weber (2016).

Beyond the register data necessary for the calculation of the flows, we follow the labour force concept to select the other labour market variables. Therein, employment is total employment and contains employees covered by social security, civil servants, marginally employed, and self-employed. Unemployment is defined according to the ILO standard and is taken from the (European) labour force survey.

Vacancies are registered at the Federal Employment Agency. Though this number comprises about half of the total number of vacancies, the register data outperfom the German Job Vacancy Survey regarding length and frequency of the available time series data.

The system of national accounts provides information on wages and productivity. Wages contain gross wages including employers' social security contributions. They are converted into real terms using the GDP deflator. Both wages and productivity are provided on an hourly basis by the German Federal Statistical Office, in which the number of working hours stems from the IAB Working Time calculations. This data set summarizes several source statistics – survey as well as register-based – to calculate average working time per employee. Our series on working time is drawn directly from the IAB source.

Most of the data are available at a monthly frequency. Working hours, wages and productivity, however, have to be interpolated from quarterly data. All data are adjusted for seasonality. The sample (of the finale paper) ranges from January 1992 to December 2017. So the total number of observations amounts to 300. An extended model using longer series (of West Germany in the first sample part) will be provided in the robustness section.

The empirical methodology would be able to cope with stationary as well as non-stationary data. According to the ADF test, however, the null-hypothesis of non-stationarity cannot be rejected for any of the series (Table is to follow).

2.2 The German labour market upswing

Figures 1 to 3 (to be updated with the final data) document the enormous labour market upswing in Germany that lasts for at least 12 years now.

Figure 1 shows employment, wages and productivity. It becomes obvious that the steep and sustained increase in employment starting in 2006 has been accompanied by a rather moderate increase in wages. In fact, the development of wages relative to productivity implies a decrease in the labour share making labour more profitable for firms than before. The behaviour of employment during the great recession in 2008 and 2009 has given food for debate in many developed economies. Despite the strongest decline in GDP and productivity, Germany experienced an outstanding period of labour hoarding such that the labour market started from basically the level of 2007 while many other economies had to offset the employment losses from the great recession first. However, the crisis had left its footprint on the development of productivity which has been sluggish since then. I.e., the German labour market upswing is not accompanied by a productivity upswing. On the contrary, a partial GDP-employment decoupling has been found by Klinger and Weber (2015). Nonetheless, GDP has been on a stable growth path during the past few years.

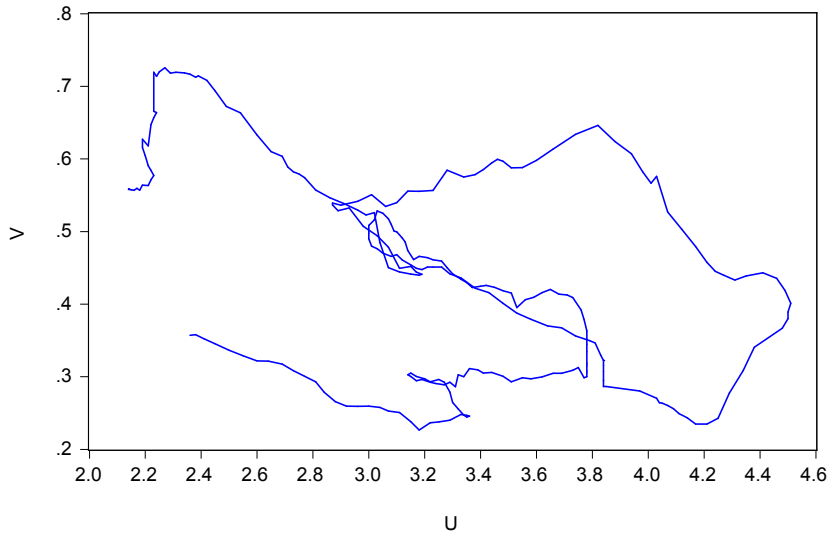
Figure 1: Employment, wages and productivity, 1992-2013

Notes: Normalized data. Source: Destatis. Own interpolation of productivity.

Figure 2 presents the Beveridge curve, the generally downward-sloping relation between vacancies and unemployment. The ratio of the two is interpreted as labour market tight-

ness. The figure presents several important impressions regarding the upswing: following the Hartz reforms 2003-2005, the curve shifted inwards which indicates a better functioning of the labour market (compare Blanchard and Diamond, 1989). This has been connected to improved matching efficiency (Klinger and Weber, 2016). Second, starting in 2010, the curve did not shift inwards remarkably anymore but instead of a curve we observe an strongly upward moving limb indicating that the number of vacancies relative to the unemployed has been rising extraordinarily. The labour market has become unusually tight. With an exception during the Eurozone recession, unemployment is no longer reduced in the same way as the stock of vacancies increases.

Figure 2: The Beveridge curve: unemployment and vacancies, 1992-2013

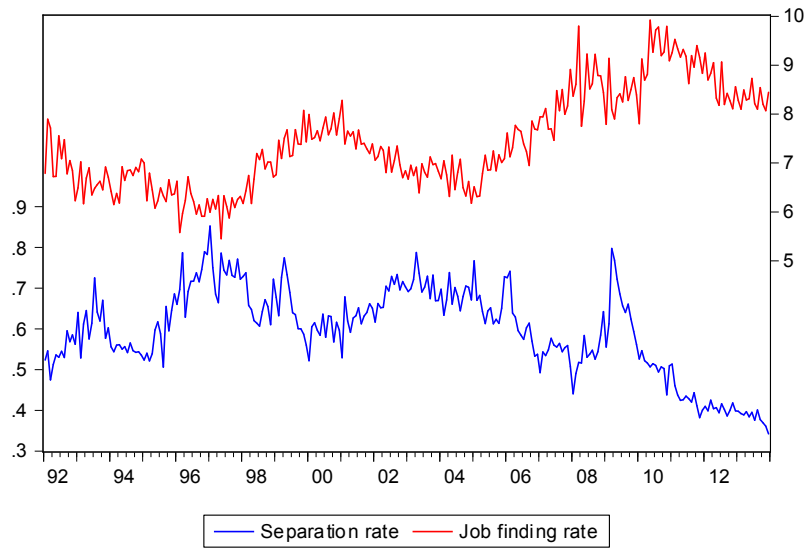


Notes: The graph shows the Beveridge curve starting in January 1992 (lower left) and ending in December 2013 (upper left). Unit: 1 million. Source: Federal Employment Agency (vacancies V), Eurostat (unemployment U).

The worker flow rates in Figure 3 give some intuition of why the labour market stocks improved so much. Remarkably, the job finding rate has increased stepwise after the Hartz reforms. This increase was shown to be a permanent improvement by Klinger and Weber (2016). Even more striking, the separation rate has declined for years. By the end of our sample, it had reached the lowest value since reunification. As for Germany, the separation rate has been found to be more influential for the dynamics of unemployment than job findings

(e.g. Jung and Kuhn, 2013), this outstanding development also points to a potential source of the remarkable increase in employment and decrease in unemployment.

Figure 3: Separation rate and job finding rate, 1992-2013



Notes: Unit: percent. Source: IAB employment panel. Own calculations.

Undoubtedly, the figures mirror an extraordinary labour market development. Regarding OECD harmonized unemployment rates alone, Germany ranked 6 among 35 OECD countries in 2017 – while it ranked 33 in 2005. It was not for nothing that Germany had used to be called "sick man of Europe" (Economist, 2004). As for the long-lasting aggravation the interaction of aggregate shocks and institutions has been found to be a plausible reason (Blanchard and Wolfers, 2000), a similar approach seems to be rational when explaining the reverse direction, too. Previous studies that investigated why the upswing occurred and, by the same token, whether it is replicable, typically focus on single or a very small set of shocks or institutions. Our approach, however, is to comprise a reasonable number of driving forces in a unified empirical framework and let the data speak which had when an influential effect. Not only does this approach choose from a broader set of potential explanations, it also allows them to interact.

3 Driving forces

In part, the shocks that we explore as potential upswing drivers deviate from the (neutral or investment-specific) technology or (fiscal or monetary) policy shocks that can usually be found in the literature (e.g., Ravn and Simonelli, 2007; Rahn and Weber, 2017). These studies primarily focus on the dynamic labour market outcomes following tech or policy shocks. Beyond their scope, however, shocks to labour market institutions themselves are highly informative for an explanation of the labour market upswing. This is even more true as the German labour market underwent a lot and deep institutional reforms. Thus, applying our econometric methodology on these kinds of labour market shocks has the main advantage that we extend the usual selection of shocks and comprise the essential issues discussed so far on our topic.

Labour force shock. A simple comparison of the changes in employment and unemployment during the past decade uncovers that the observed increase in employment would not have been possible within the frame of the existing labour force. Burda and Seele (2016) and Klinger and Weber (2018) argue in favour of a supply side effect. Indeed, while the demographic component of the German labour force is clearly negative, the labour force itself increased strongly due to record levels of net migration as well as higher participation. Thereby, legislative changes might have played a role. Regarding immigration, this involves the enlargement of the European Union towards the east including free movement if workers. Regarding participation, we refer to reforms of the pension system raising the legal retirement age as well as abolishing early retirement subsidies. Thus, older workers' incentives to stay with the their firm increased. Beyond legal changes, the labour force rose because of refugee immigration and because more and more mostly female workers decided to participate, albeit often in part-time jobs. All in all, net migration between 2006 and 2017 amounts to 3.8 million while the participation rate of those aged 15 to under 65 increased from 73.7% in 2005 to 77.6% in 2016.

Working time shock. Hours worked is a variable as important as controversial. Given the debate in the literature on whether hours worked and employment are a substitutes or complements, the question whether working time shocks contributed to the labour market upswing is an empirical one. In the data, two observations are specifically well documented:

First, the part-time ratio – the share of part-timers in total dependent employment – rose from 34.9% in 2006 to 39.2% in 2017. Provided that this rise generated job-sharing in a significant manner, the reduction in working time can be interpreted as an influential factor for employment growth. Second, during the Great Recession in 2008/09, companies adjusted labour input along the intensive margin: in 2009, GDP shrank by 5.6%, per capita working hours by 3.2%, and productivity per hour by 2.6%. The extensive margin was kept untouched on aggregate. The labour hoarding effect of slimming working-time accounts or short-time work schemes subsidized by the Federal Employment Agency were demonstrated by a large body of literature (Balleer et al., 2017, 2016; Weber, 2015; Herzog-Stein and Zapf, 2014; Burda and Hunt, 2011; Möller, 2010). Certainly, a negative working time shock strengthened employment.

Technology shock. The technology shock is commonly meant as a supply-side shock that improves total factor productivity (compare, e.g. Gali, 1999; Uhlig, 2004; Ravn and Simonelli, 2007; Rahn and Weber, 2017). In line with the real business cycle theory (Kydland and Prescott (1982), Plosser (1989)), the technology shock can create economic fluctuations at business cycle frequencies. During the time of the labour market upswing, the German economy experienced a rather stable and vivid economic performance, but also the Great Recession in 2008/09 as well as the Eurozone recession in 2011/12. On average, GDP rose by an annual rate of 1.6% between 2006 and 2017.

Cycle shock. In view of the criticism on the idea that the technology shock is the only source of cyclical fluctuations (e.g., Summers, 1986), we offer a further source of economic fluctuations and establish an explicit cycle shock. As such, we refer to rather demand-sided drivers of economic activity, for example government expenditure during the downturns. With regard to the German labour market upswing, arguments have been put forward that stress the enormous economic performance of China in the mid-2000s combined with the strong export-orientation of the German economy. Moreover, the recent economic upswing witnesses an unforeseen weakness in business investment. The investment-to-GDP ratio has come down to an average of 6.7% since 2009 while it was 7.7% before. This also points to a rather transitory impact than long-term changes in productivity or potential growth.

Wage shock. The potential influence of wages on labour market outcomes is straightforward. The sources of a wage shock and the mechanisms how it spreads, however, may be manifold. First, Dustmann et al. (2014) highlight the positive effect of wage moderation after reunification when large parts of the Eastern German economy turned out to be unproductive and had to face new competitors form the Eastern European transition economies. Second, wage setting institutions have become more flexible. Collective bargaining coverage in Western Germany has decreased from 57% in 2006 to 49% in 2017. Opening clauses in collective bargaining contracts ease the adjustment process over the business cycle (also Dustmann et al., 2014). Wage concessions by workers were observed during the Great Recession (Heckmann et al., 2009). Third, wage concessions by firms have become slightly more important since 2005 (German Job Vacancy Survey data) as the labour market tightness has increased tremendously. Fourth, the introduction of a general minimum wage in 2015 increased reservation wages and made wage setting less flexible again. It affected about 10% of all employees (Bossler, 2017). A diff-in-diff analysis revealed only limited short-run effects on employment (Caliendo et al., 2018). Fifth, workers' outside options worsened remarkably. The Hartz Reform reduced the entitlement period to unemployment benefit. It introduced sanctions when unemployed did not meet the targeted search effort. It established a means-tested social assistance system that led to an immediate reduction of the net replacement rate by 11 percentage points between 2004 and 2005 (OECD data). Between 2003 and 2011, the replacement rate even dropped by 20 percentage points. Worse outside options reduce reservation wages and bargaining power of workers. Krebs and Scheffel (2013) as well as Rebien and Kettner (2011) show that workers' willingness to make (wage) concessions had increased after the Hartz reforms.

Matching efficiency shock. Regarding the efficiency of the matching process we disentangle efficiency connected to job or worker search intensity and efficiency connected to the quality of the public employment service. Much of the former is captured by the wage shock (see above). Regarding the latter, the Federal Employment Agency and its local branches underwent a severe restructuring of its organisation and tasks in the course of the Hartz reforms. Since 2004, the Federal Employment Agency has been providing measures of active labour mar-

ket policy according to the principles of effectiveness and efficiency. It introduced a customer segmentation to tailor treatment properly, established specific service departments for firms, and increased market transparency by online job platforms. All this targeted at reducing mismatch and imperfect information. Indeed, an increase of matching efficiency after the reforms has been documented by, e.g., Launov and Wälde (2016); Klinger and Weber (2016); Stops (2016); Hertweck and Sigrist (2015); Klinger and Rothe (2012); Fahr and Sunde (2009).

Separations shock. A separations shock changes firing costs. One source of this shock may be changes in the employment protection legislation. The OECD indicator on the strictness of employment protection in temporary contracts indeed shrank from 3.25 at the beginning of the 1990s to 1.13 since 2013. Negotiation of fixed-term contracts has been made easier by the Hartz reforms, too. Moreover, the firm size for which the standard employment protection law applies was lowered. However, the literature typically finds that relaxing EPL (or allowing fixed-term contracts) increases job creation and labour market flows but has hardly any effect on employment and unemployment (Kahn, 2010; Cahuc and Postel-Vinay, 2002). Another source of a separations shock may be changes in opportunity costs of firing and rehiring. As the labour market has become tighter and tighter, companies rethink their usual firing strategies. The role of separations in explaining the labour market upswing in Germany has been addressed by Hartung et al. (2018) and Klinger and Weber (2016).

Deregulation shock. Deregulation of market segments has not been mentioned in the literature so far. However, against the background of the observed development – temporary agency work as well as marginal employment accounted for a substantial part of the labour market dynamics – we implement the notion of making labour contracts more flexible and define a as we call it deregulation shock. The legal framework for temporary agency work was changed by the Hartz reforms. In 2003, the government abolished limits of assignment duration, made it easier to rehire, and allowed for own collective bargaining instead of equal pay. The share of temporary agency workers in total employment covered by social security has more than doubled from 1.2% in 2004 to 2.7% in 2017. The share in total incoming vacancies increased from 21.3% in 2005 to 34.4% in 2017 (earlier comparable data is not available). Another

deregulation example is marginal employment. Also in 2003, the tax and social contribution burden was lowered for jobs with a maximum monthly income of then 400 EUR (raised from 325, now 450 EUR). Although by the same time the threshold regarding working hours was abolished, this kind of employment usually contains very low working hours (not even 30% of a full-time contract). Within the first four years after the reform, the number of marginally employed rose by more than 10%. Since then, it has been declining.

In the next section, we present the econometric model to explore when and how much the diverse shocks affected the German labour market.

4 Methodology

4.1 Model

The precondition of reliable impulse-responses and a meaningful historical decomposition is an empirical model that captures very general dynamics and interaction of the variables without imposing strong structural assumptions a priori. In fact, the task of the model structure is to provide a suitable econometric frame to let the data speak. Thus, we start with a VAR of lag length $q+1$:

$$y_t = c_0 + c_1 t + \sum_{i=1}^{q+1} A_i^* y_{t-i} + u_t \ , \tag{1}$$

where y_t contains the $k = 8$ endogenous variables vacancies (V), unemployment (U), employment (E), job finding rate (F), wages (W), productivity (P), separation rate (S) and working time per employee (H). A_i^* are $k \times k$ coefficient matrices and u_t is a k-dimensional vector of white noise errors. As deterministic terms, we allow for a $k \times 1$ vector of constants c_0 and a linear trend. In choosing the model size, we seek to limit the complexity and empirical requirements while upholding economic interpretability.

Augmented Dickey-Fuller (ADF) tests confirm that our variables should be treated as non-stationary. This implies, first, the existence of long-run effects and, second, the need to model the variables in first differences. However, a simple first difference VAR would restrict the

stochastic trends to be unique for each variable. In order to restrict as sparsely as possible, we turn down this restriction and generalize the VAR towards a VECM. Thus, we allow for cointegration and as many level relationships as preferred by the data. The VECM reads as

$$\Delta y_t = \Pi y_{t-1} + c_1(t-1) + c_0 + \sum_{i=1}^{q} A_i \Delta y_{t-i} + u_t \ , \tag{2}$$

with $A_i = -\sum_{j=i+1}^{q+1} A_j^*$, $i = 1, \ldots, q$. Having reduced rank in the presence of cointegration, Π is decomposed into a $(k \times r)$ matrix of adjustment coefficients α and a $(r \times k)$ matrix of cointegrating coefficients β' with the first elements normalised to I_k. The linear trend with coefficient c_1 is restricted to the cointegration space (compare Johansen, 1995).

4.2 Identification

The VECM in Equation (2) represents the reduced form of an underlying structural system. In particular, the correlated residuals in u_t do not represent economically interpretable innovations. Instead, they are usually specified as linear combinations of some structural shocks. Formally, this can be written as

$$u_t = B\epsilon_t \ . \tag{3}$$

B is a $k \times k$ parameter matrix and contains the initial impacts of the shocks on the respective variables. ϵ_t represents the vector of structural disturbances.

In general, identification of the system with $k = 8$ structural shocks requires $k^2 = 64$ restrictions. Assuming $E[\epsilon_t \epsilon_t'] = I_k$ by convention delivers $k + k(k-1)/2 = 36$ restrictions. Thus, the necessary conditions require 28 further restrictions on the short-run impact matrix B or the long-run impact matrix $\Xi B = [\beta_\perp(\alpha_\perp'(I_k - \sum_{i=1}^{q} A_i)\beta_\perp)^{-1}\alpha_\perp']B$. Regarding the latter, restrictions from the cointegration properties apply, too: Each column of the long-run impact matrix must reflect the cointegrating proportions. In fact, we will overidentify the system using 29 restrictions. Leaving out another restriction would distort the economic plausibility when the theoretical background points to a set of restrictions. This strategy is confirmed by an overidentification test. Moreover, it enables us to test subsets of restrictions in the robustness

section. The rank criterion insures that the columns in the stacked matrix $\binom{B}{\Xi B}$ as well as their linear combinations are independent from one another.

In order to identify the above mentioned economically meaningful shocks, we distinguish them by when, how, and how long they hit the model economy. This is done by a combination of short- and long-run restrictions based on well-established assumptions about labour force development, technological change, and cyclical fluctuations as well as on the search and matching theory of the labour market.

The underlying search-and-matching approach (Diamond, 1982; Mortensen and Pissarides, 1994) contains the following main features: We explicitly consider two labour market states, employed and unemployed. In addition, a third state, out of the (domestic) labour force, is taken into account due to the fact the labour force (employment plus unemployment) is allowed to be time-varying. Free entry of firms is ensured. Search for a job or a worker, respectively, is costly and time-consuming. Search frictions arise from asymmetric information, mismatch, and the lack of a central market place. Matches are formed out of vacancies and unemployed according to a matching function, i.e. the production function of matches. Matching efficiency represents the productivity measure of that function. It depends on determinants such as the institutional quality of employment services, search intensity, willingness to take up work, or mismatch (compare Launov and Wälde, 2016; Klinger and Weber, 2016; Davis et al., 2013). It creates a surplus when a vacancy and an unemployed person match. For workers, the resulting wage exceeds the value of outside options like unemployment benefit or home production while for firms, the profit from the productive match exceeds the value of a vacant job. The surplus is shared in wage negotiations according to a Nash bargaining rule where bargaining power of either party and reservation wages become relevant. Separations are endogenous. They occur when a match has become unproductive for whatever reason.

Relying on that model has several implications for our identification strategy. The theory postulates relations between variables where we cannot restrict the empirical outcome. The details which effects we may restrict are given below. In general, the matching function states that the job finding rate varies if either matching efficiency or the stocks of unemployment

and vacancies change. The stock variables enter the matching function with one lag, which for monthly data seems resasonable for at least two reasons: It accounts for the expenditure of time that the whole search and recruiting process takes. And it is consistent with the counting mechanism of the Federal Employment Agency (see section 2.1 above). An unemployed person counted at point of time t cannot have exited unemployment between t-1 and t. Regarding monthly data, the time aggregation bias is negligibly small (Nordmeier, 2014). As a consequence of this timing, the job finding rate will react on impact only to shocks that directly affect matching efficiency but not to shocks that change only unemployment and vacancies in the first round. Furthermore, we refrain from composition effects.

Labour force shock. Once workers have entered the labour force, they are either employed or unemployed. Then, changes to employment are equivalent to changes in unemployment with opposite sign, at least on impact. The labour force shock can be understood as a blow-up of the work force e.g. due to immigration or higher participation. It is the only one that can immediately affect the labour force and may thus move both employment and unemployment into the same direction (for exceptions see below). Without composition effects, the labour force shock does not affect matching efficiency, such that the job finding rate does not react on impact. In the long run, labour market theory suggests that the blow-up of the labour force corresponds to a blow-up in vacancies leaving labour market tightness and the job finding *rate* as well as the separation *rate* unaffected. By the same token, one may restrict the long-run responses of wages and productivity as well. However, since these restrictions are not necessary for full identification and would considerably decrease the likelihood, we leave these effects unconstrained. This also has the advantage of not a priori excluding specific results from the migration literature (e.g., Ottaviano and Peri, 2012).

Working time shock. We identify this shock as being the only one to change working hours per employee immediately (for exceptions see below). An example of a working time shock is the facilitation of short-time work during the great recession.

Technology shock. The technology shock is the only one to affect labour productivity in the long run, following the standard assumption as in Gali (1999) and many others. In fact,

it is the only shock that is not restricted at all. In particular, we allow free estimates of the responses of employment and working hours on impact as well as in the long run (these are exceptions to the identifying rules of the labour force and the working time shocks). Given the discordant literature on how technology shocks affect total hours worked (e.g. Uhlig (2004), Canova et al. (2010)), an unrestricted empirical strategy seems reasonable.

Cycle shock. The cycle shock is allowed to produce economic fluctuations at business cycle frequencies but does not affect the economy in the long run. A complete zero column in the matrix of long-run effects implies six restrictions. The other two zeroes are an implicit consequence of the cointegration properties that force the long-run effects to hold the proportions of the cointegrating coefficients. On impact, the cycle shock is excempted from the identifying rule of the working time shock. Instead, an immediate reaction of working time is allowed in order to accommodate results that demand shocks are mitigated by the intensive margin (e.g. Panovska (2017), Herzog-Stein and Zapf (2014)).

Wage shock. The wage shock is the only one that immediately affects all variables but working time (see the working time rule above). This generous identification scheme is rationalized as the shock summarizes several sources why wages initially change (see section 3), among them wage bargaining, wage concessions, minimum wage reform, outside options and reservation wages. This collection is justified by the Nash bargaining rule of the search-and-matching model: Wages are negotiated to optimally share the surplus from the match between workers and firms. They depend on the bargaining power and the outside options of workers (as well as productivity and tightness which refer to other shocks of our model). However, the collection demands a strict scheme where to impose a zero restriction. Wage concessions may influence firms' separation decisions. Outside options and reservation wages impact job findings immediately via matching efficiency, when a (low-paid) job is more quickly accepted. Moreover, wage shocks following changes to labour market institutions do not solely enforce adjustments within the labour force but may even prompt agents to enter or leave the labour force (Rothe and Wälde, 2017; Fuchs, 2014). Certainly, one could think of alternative assignments of the ingredients to the shocks. E.g., outside options and search intensity could be seen as parts of

the efficiency shock, too. We analyse this specification in the robustness section.

Matching efficiency shock. The efficiency shock captures parameters that influence the functioning of the labour market beyond job search intensity. Examples are the institutional quality of employment services, the level of mismatch, or the degree of imperfect information in the search process. Theoretically, the efficiency shock affects the matching technology – immediately moving the job finding rate, employment and vacancies. We refrain from immediate impacts of the efficiency shock on wages and the separation rate. While both could potentially work through changes in hiring costs, empirical studies such as Carbonero and Gartner (2017) find hiring costs to be low, so their changes would be of a size of secondary importance. Moreover, the share passed to workers through wage renegotiations is likely to be limited, and the effect on the average wage level of all employees is negligible. By the same token, the option value of labour hoarding in the reservation productivity (the cut-off point for separations) would not be changed considerably.

Separations shock. In the search-and-matching model, a separations shock affects firing costs that change the option value of a job in case of split-up. Via job creation, tightness reacts. But matching efficiency is unaffected, so we restrict the effect on the job finding rate to be zero on impact. Furthermore, the rules identifying the labour force and the working time shocks are binding. As the bargaining power of workers is affected by the readiness for dismissals (depending on employment protection, fixed-term contracts, rehiring costs etc.) wages may well be renegotiated, and this effect is left unrestricted.

Deregulation shock. A deregulation shock allows for more flexible employment contracts on the brink of the labour market, as for temporary agency work or marginal employment. In terms of the search-and-matching model, these features are captured by lower hiring costs and lower wages. This affects the value of (such) jobs for firms which increases vacancies and tightness and raises the job finding rate, but – according to the matching function – only with delay. There might be an increase in matching efficiency, because for given tightness, the share of vacancies for temps with comparatively low duration rises. This increases the average job filling rate and, consequently, the job finding rate – but also with delay as this

kind of vacancies has to be created, and filled, first. By the same token, the separation rate cannot react immediately: vacancies have to be created and filled before the new match can be separated. With job finding rate and separation rate being constant on impact, the law of motion implies a zero effect for unemployment, too. However, as an exception from the rule determining the working time shock, we allow the deregulation shock to have short-run effects on working time. Therefore, legislative changes such as regarding marginal employment with typically low working hours can be captured.

4.3 Estimation

Proper estimation of Equation (2) requires a few tests in advance. First, it is essential to avoid serial correlation in the reduced form residuals. We try to keep the model as parsimonious as possible by sequentially excluding the elements in A_i of lagged endogenous variables that lead to worse information criteria values and do not satisfy a t-value of at least 1. Even though the information criteria (Akaike, Schwarz) would have preferred fewer lags, we add lags up to $q = 7$, until the Portmanteau test cannot reject the null hypothesis of no serial correlation in the first 36 lags anymore.

Having the dynamics of the model fixed, second, we run the Johansen trace test and find two cointegration relations. In the first place, we specify these two CI relations to bring the model as close to the data as possible. Beyond that, the search-and-matching theory gives rise to believe that such long-run relations economically exist (think of the Beveridge curve or the job creation curve). Consequently, the adjustment coefficients matrix α is of dimension (8×2) and the cointegrating coefficients matrix β' of dimension (2×8).

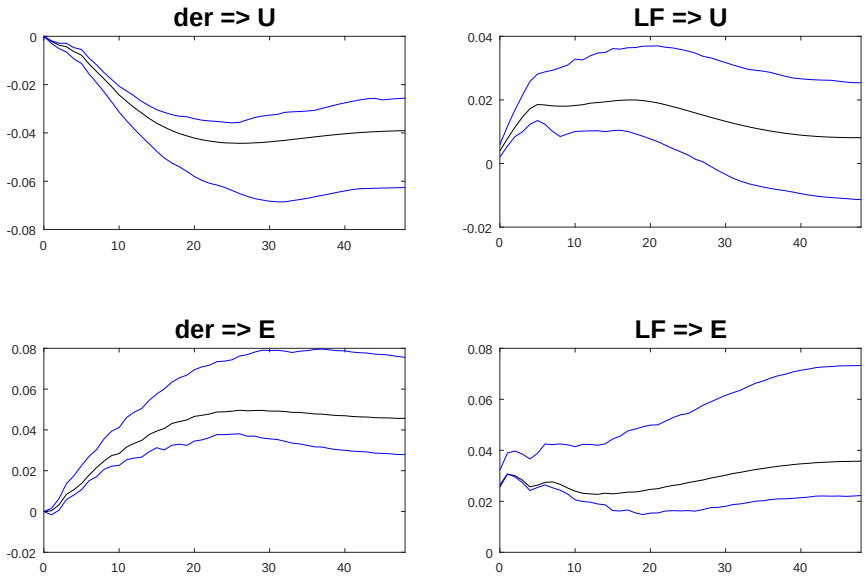
After having obtained a proper reduced form, the structural form is estimated by Johansen maximum likelihood given the restrictions described in section 4.2.

5 Results

Having identified the shocks, we demonstrate their labour market impacts in an impulse response analysis. (A historical decomposition and a robustness analysis will follow.) The prelim-

inary results in Figures 4 and 5 focus on a subset of the shocks and their effects on employment and unemployment.[1]

Figure 4: Impulse responses of unemployment and employment to deregulation and labour force shocks



Notes: The solid lines show the responses of unemployment (U) and employment (E) to 1 unit deregulation (der) and labour force (LF) shocks up to 48 months. The blue lines denote Hall (1992)'s 2/3 bootstrapped confidence intervals.

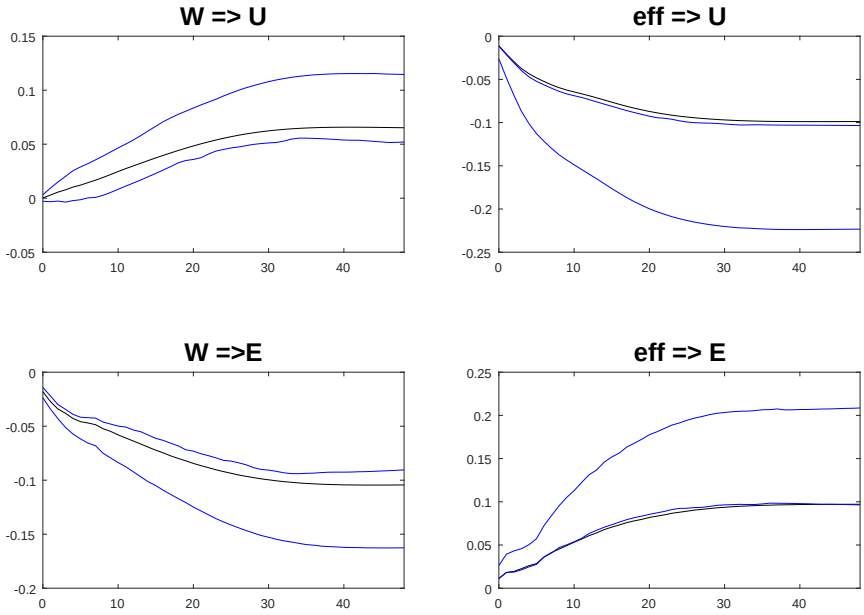
The two panels on the left side of Figure 4 show that deregulation has positive effects on the labour market. While employment increases following a positive deregulation shock, unemployment decreases.

Both unemployment and employment increase significantly following a labour force shock (Figure 4, right panels). The effect on unemployment becomes insignificant after two years. While employment reaches the total (i.e. long-run) effect rather quickly, the unemployment reaction needs approximately 6 months to fully develop before decreasing again after 20 months. The quick reaction of employment to labour force shocks is in line with Blanchard (2006). We argue that when the labour force increases due to later retirement age, for instance, unemployment is not affected at all.

The two panels on the left side of Figure 5 show harmful effects following wage increases. The effects are highly significant and economically relevant: A unit shock to the wage level in-

[1]The effects on the other variables and of the other shocks are available upon request.

Figure 5: Impulse responses of unemployment and employment to wage and efficiency shocks



Notes: The solid lines show the responses of unemployment (U) and employment (E) to 1 unit wage (W) and efficiency (eff) shocks up to 48 months. The blue lines denote Hall (1992)'s 2/3 bootstrapped confidence intervals.

creases unemployment by 65.000 people and reduces employment by more than 100.000 people. Furthermore, higher wages reduce the number of vacancies and the job finding rate, whereas they increase the separation rate. Vice versa, *negative* wage shocks as described above may have contributed to the labour market upswing in a considerable manner.

Highly significant and economically relevant effects are also visible following a unit efficiency shock (Figure 5, right panels): In the long run, unemployment is reduced by 100.000 people while employment increases by approximately the same amount. Higher matching efficiency also raises the number of vacancies and the job finding rate while it decreases the separation rate.

6 Conclusion

The German labour market has been experiencing a widely recognized, strong, and sustained labour market upswing. The underlying study analyses which factors were the most relevant for this extraordinary development and whether it is so long-lasting because some factors - by

the time they faded out - had been replaced by others. To answer these empirical questions, we employ a structural VECM that operates with a minimum of a priori restrictions. On the basis of well-established facts as well as economic theory we identify 8 economically meaningful driving forces.

A structural impulse response analysis revealed that the matching efficiency shock as well as the wage shock are of high potential explaining the strong upswing. Both trigger large and highly significant effects on employment as well as unemployment. Moreover, deregulation has positive effects on the labour market. And so does an increase in the labour force.

The results imply that one should be cautious about uncritically resuming the German labour market reforms. As regards features that target matching efficiency as well as labour market flexibility, however, our results point to a positive outcome. Still, aspects of wage inequality are not taken into account.

To be continued.

References

Balleer, A., B. Gehrke, W. Lechthaler, and C. Merkl (2016). Does short-time work save jobs? A business cycle analysis. *European Economic Review 84*, 99–122.

Balleer, A., B. Gehrke, and C. Merkl (2017). Some surprising facts about working time accounts and the business cycle in Germany. *International Journal of Manpower 98*(7), 940–953.

Blanchard, O. (2006). European unemployment: the evolution of facts and ideas. *Economic Policy 21*(45), 5–59.

Blanchard, O. and P. Diamond (1989). The Beveridge Curve. *Brookings Papers on Economic Activity 1*.

Blanchard, O. and J. Wolfers (2000). The role of shocks and institutions in the rise of European unemployment: the aggregate evidence. *The Economic Journal 110*(462), 1–33.

Bossler, M. (2017). Employment expectations and uncertainties ahead of the new German minimum wage. *Scottish Journal of Political Economy 64*(4), 327–348.

Burda, M. and J. Hunt (2011). What Explains the German Labor Market Miracle in the Great Recession. *Brookings Papers on Economic Activity 42*, 273–335.

Burda, M. and S. Seele (2016). No Role for the Hartz Reforms? Demand and Supply Factors in the German Labor Market, 1993-2014. SFB 649 Discussion Paper 2016-010, Humboldt-Universität zu Berlin, Germany.

Cahuc, P. and F. Postel-Vinay (2002). Temporary jobs, employment protection and labor market performance. *Labour Economics 9*, 63–91.

Caliendo, M., A. Fedorets, M. Preuss, C. Schröder, and L. Wittbrodt (2018). The short-run employment effects of the German minimum wage reform. *Labour Economics 53*, 46–63.

Canova, F., D. Lopez-Salido, and C. Michelacci (2010). The effects of technology shocks on hours and output: a robustness analysis. *Journal of Applied Econometrics 25*, 755–773.

Carbonero, F. and H. Gartner (2017). Inspecting the relation of search cost and search duration for new hires. Discussion papers in economics 21, Friedrich Alexander University (FAU).

Davis, S., R. J. Faberman, and J. C. Haltiwanger (2013). The Establishment-Level Behavior of Vacancies and Hiring. *The Quarterly Journal of Economics 128*(2), 581–622.

Diamond, P. A. (1982). Aggregate demand management in search equilibrium. *Journal of Political Economy 90*(5), 881–894.

Dustmann, C., B. Fitzenberger, U. Schönberg, and A. Spitz-Oener (2014). From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy. *Journal of Economic Perspectives 28*, 167–188.

Economist, T. (2004). Germany on the mend.

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.

Fuchs, J. (2014). Der Einfluss von Hartz IV auf die westdeutsche Stille Reserve – Ergebnisse auf Basis unterschiedlicher methodischer Ansätze. *AStA Wirtschafts- und Sozialstatistisches Archiv 8*(1), 33–48.

Fujita, S. (2011). Dynamics of worker flows and vacancies: Evidence from the sign restriction approach. *Journal of Applied Econometrics 26*(1), 89–121.

Gali, J. (1999). Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations? *The American Economic Review 89*(1), 249–271.

Hairaulta, J.-O. and A. Zhutova (2018). The cyclicality of labor-market flows: A multiple-shock approach. *European Economic Review 103*, 150–172.

Hall, P. (1992). *The Bootstrap and Edgeworth Expansion*. Springer, New York.

Hartung, B., P. Jung, and M. Kuhn (2018). What hides behind the German labor market miracle? A macroeconomic analysis. Technical report.

Heckmann, M., A. Kettner, S. Pausch, J. Szameitat, and K. Vogler-Ludwig (2009). Wie Betriebe in der Krise Beschäftigung stützen. Short Report 18, Institute for Employment Research (IAB).

Hertweck, M. and O. Sigrist (2015). The ins and outs of German unemployment: a transatlantic perspective. *Oxford Economic Papers 67*, 1078–1095.

Herzog-Stein, A. and I. Zapf (2014). Navigating the great recession: the impact of working-time accounts in Germany. *ILR Review 67*(3), 891–925.

Johansen, S. (1995). *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*. Oxford: Oxford University Press.

Jung, P. and M. Kuhn (2013). Labour market institutions and worker flows: comparing Germany and the US. *The Economic Journal 124*(12), 1317–1342.

Kahn, L. M. (2010). Employment protection reforms, employment and the incidence of temporary jobs in Europe: 1996-2001. *Labour Economics 17*, 1–15.

Klinger, S. and T. Rothe (2012). The impact of labour market reforms and economic performance on the matching of the short-term and the long-term unemployed. *Scottish Journal of Political Economy 59*, 90–114.

Klinger, S. and E. Weber (2015). GDP-Employment decoupling and the productivity puzzle in Germany. University of Regensburg working papers in business, economics and management information systems, 485.

Klinger, S. and E. Weber (2016). Decomposing Beveridge Curve Dynamics by Correlated Unobserved Components. *Oxford Bulletin of Economics and Statistics 78*(6), 877–894.

Klinger, S. and E. Weber (2018). GDP-Employment decoupling and the productivity puzzle in Germany. *Empirical Economics ??*, ???–???

Krebs, T. and M. Scheffel (2013). Macroeconomic Evaluation of Labor Market Reform in Germany. *IMF Economic Review 61*, 664–701.

Kydland, F. E. and E. C. Prescott (1982). Time to build and aggregate fluctuations. *Econometrica 50*(6), 1345–1370.

Launov, A. and K. Wälde (2016). The employment effect of reforming a public employment agency. *European Economic Review 84*, 140–164.

Möller, J. (2010). Germany's job miracle in the world recession. Shock-absorbing institutions in the manufacturing sector. In *The Economy, Crises, and the Labor Market. Can Institutions Serve as a Protective Shield for Employment? (Applied Economics Quarterly Supplement)*, Volume 56, pp. 9–28. Klaus F. Zimmermann and Christian Wey (Publisher).

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

Nordmeier, D. (2014). Worker flows in Germany: Inspecting the time aggregation bias. *Labour Economics 28*, 70–83.

Nordmeier, D., H.-J. Schmerer, and E. Weber (2016). Trade and labor market dynamics: What do we learn from the data? *Economics Letters 145*, 206–209.

Ottaviano, G. and G. Peri (2012). Rethinking the effects of immigration on wages. *Journal of the European Economic Association 10*(1), 152–197.

Panovska, I. B. (2017). What explains the recent jobless recoveries? *Macroeconomic Dynamics 21*(3), 708–732.

Plosser, C. I. (1989). Understanding real business cycles. *Journal of Economic Perspectives 3*(3), 51–77.

Rahn, D. and E. Weber (2017). Patterns of unemployment dynamics in Germany. *Macroeconomic Dynamics online first*.

Ravn, M. O. and S. Simonelli (2007). Labor market dynamics and the business cycle: Structural evidence for the United States. *Scandinavian Journal of Economics 109*(4), 743–777.

Rebien, M. and A. Kettner (2011). Die Konzessionsbereitschaft von arbeitslosen Bewerbern und Beschäftigten nach den Hartz-Reformen. *WSI-Mitteilungen 64*(5), 218–225.

Rothe, T. and K. Wälde (2017). Where did all the unemployed go? Discussion Paper 18, Institute for Employment Research (IAB).

Stops, M. (2016). Revisiting German labour market reform effects - a panel data analysis for occupational labour markets. *IZA Journal of European Labor Studies 5*, 43 pages.

Summers, L. H. (1986). Some skeptical observations on real business cycle theory. *Federal Reserve Bank of Minneapolis Quarterly Review 10*(4), 23–27.

Uhlig, H. (2004). Do technology shocks lead to a fall in total hours worked? *Journal of the European Economic Association 2*(2-3), 361–371.

Weber, E. (2015). The labour market in Germany: reforms, recession and robustness. *De Economist 163*(4), 461–472.