Journal for Labour Market Research

ORIGINAL ARTICLE

Open Access

Labor market regulation and the cyclicality of involuntary part-time work

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Abstract

In times of economic crisis, many employers in liberal labor markets reduce their employees' working hours, which leads to an increase in the incidence of involuntary part-time work. We analyze the effectiveness of working time regulation in preventing such an increase during downswings. For this we look at the case of Germany, where hours adjustments are highly restricted by law. Using a state-level panel regression approach, we find that the incidence of involuntary part-time work is positively associated with the unemployment rate but that the association is much weaker than in the US and in the UK. Transition probabilities between employment states over the cycle suggest two particular underlying mechanisms: First, already employed workers are more likely to want a full-time position in economic downturns ("added hours effect"). Second, job seekers make concessions with regards to their desired hours when labor market conditions are bad ("reservation hours effect"). We are the first to document these margins of cyclical hours adjustments which are fundamentally different from those in less regulated labor markets, where the cyclicality of involuntary part-time work is predominantly driven by hours changes at the same employer.

Keywords Involuntary part-time work, Business cycle, Labor market institutions, Hours adjustment

JEL Classification E24, J21, J22, J23

1 Introduction

In many developed economies, a sizable share of the labor force works fewer hours than they would like to. This means that there is an underutilization of labor beyond unemployment, and the rate of involuntary part-time workers has become a useful additional measure of labor market slack.[1] Since workers who work part-time despite preferring a full-time job are already participating in the labor market, they offer a potential to easily increase aggregate working hours. From a welfare perspective, IPT deserves attention too: employees who work part-time involuntarily suffer from not realizing full-time earnings and working below one's desired hours is detrimental to workers' happiness, as argued by Friedland and Price (2003) and Bell and Blanchflower (2018).

It is well known that involuntary part-time behaves strongly countercyclically in rather liberal labor markets, such as the US and UK. Thus underemployment rises during recessions along two margins, unemployment and under-utilization of employed workers. The costs of recessions are higher than the unemployment rate alone would suggest, because many workers get an hours' cut in downswings (Borowczyk-Martins and Lalé 2019; Valletta et al. 2020). In fact, recent evidence by Borowczyk-Martins and Lalé (2019) shows that movements in the share of part-time work in the US and the UK are predominantly driven by transitions between full-time and part-time work at the same employer rather than by mobility between jobs. This is possible because employers in those

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[1] In 2014, for example, Janet Yellen, at the time chair of the Board of Governors of the Federal Reserve System emphasized at the Federal Reserve Bank of Kansas City Economic Symposium that IPT was one of the main reasons *"why the current level of the unemployment rate may understate the amount of remaining slack in the labor market".*

countries are allowed to reduce their workers' hours at will. While this gives employers the flexibility to respond to changes in demand, it means that workers face sudden unwanted changes in hours worked.

In continental European countries, labor markets are often more regulated than Anglo-Saxon labor markets. This raises the question of how the cyclical response of part-time and involuntary part-time work differs when both the intensive and extensive margin of hours adjustment are restricted by legislation. For example, in Germany, workers are more strongly protected both from dismissal and from reductions in paid working hours. Unlike in less regulated labor markets, employers thus *cannot* unilaterally reduce working hours. We evaluate the effectiveness of these regulations in preventing a rise in involuntary part-time work during downswings. We apply the approach of Valletta et al. (2020) in order to assess the influence of cyclical and structural factors on the variation in the share of involuntary part-time, by exploiting regional variation in these factors. Furthermore, we analyze the transitions of workers between non-participation, unemployment, full-time and voluntary as well as involuntary part-time work.

We find that, as in the US and the UK, changes in the incidence of involuntary part-time are mainly associated with variations in the unemployment rate, i.e., that involuntary part-time work fluctuates countercyclically in Germany, as in those countries. However, the cyclicality is attenuated: In our preferred specification, a one percentage point increase in the regional unemployment rate leads to a change in the IPT share of about 0.17 percentage points, which is less than one third of the US effect.

By looking at German data, we are able to provide some novel insights on working hours dynamics over the cycle. Despite the fact that there is a positive relationship between involuntary part-time work and unemployment at the regional level, the mechanisms underlying this correlation are fundamentally different than in the US and the UK. Transitions from full-time to IPT that take place at the same employer play a minor role in Germany. While their share in all IPT inflows accounts for about one third in the US, it is 11% in Germany. This raises the question of which alternative mechanisms contribute to the countercyclical patterns of IPT. To shed light on the matter, we analyze how workers' transitions between employment states vary with the regional unemployment rate. Two interesting patterns emerge.

Transition probabilities suggest that there is an "added hours effect" and a "reservation hours effect". Analogously to the added worker effect, the added hours effect means that some individuals would like to work more in economic downturns. Already employed workers are more likely to want a full-time position compared to times with good economic conditions. Thus, while the added worker effect refers to the extensive margin, the added hours effect refers to the intensive margin. We are the first to document this dimension of cyclicality in labor supply. The reservation hours effect refers to the observation that job seekers make concessions with regards to their desired hours when labor market conditions are bad. Unemployed individuals are more likely to accept a part-time position even though they prefer a full-time position. It seems that unemployed workers choose a reservation level of hours, which varies over the cycle, just like reservation wages. Our findings contribute to a better understanding of the labor market adjustment in a setting with strict regulation. While the German regulation indeed hampers hours reductions, there are other market mechanisms that lead to an anticyclical pattern of involuntary part-time.

There are some institutional peculiarities in the German labor market that we make sure to sufficiently consider in our analysis as they could affect hours adjustment: marginal employment, working time accounts and short-time work. Our main finding regarding the link between unemployment and involuntary part-time work is not qualitatively affected when we include them in our regression. Interestingly, only the incidence of working time accounts is significantly associated with the development of involuntary part-time work. The association is positive, suggesting that employers hire more part-time instead of full-time employees when the firm uses working time accounts and that this comes with a higher incidence of involuntary part-time. An explanation is that employers can ask part-time employees to work full-time hours when needed without paying overtime premia as long as working time accounts are balanced over time. This suggests that employers also use working time accounts as a strategy to adjust workers' hours to varying needs.

In Sect. 2, we give a short overview of our data and key measurement concepts. Section 3 provides the theoretical (Sect. 3.1) and institutional (Sect. 3.2) background for our analysis. It also contains descriptive evidence regarding the cyclicality of IPT in Germany and structural factors associated with it (Sect. 3.3). We turn to our empirical analysis in Sect. 4. After investigating the relationship between cyclical and structural factors and IPT at the macroeconomic level (Sect. 4.1), we turn to the underlying mechanisms (Sect. 4.2). In Sect. 5, we confirm that our key findings do not depend on specific forms of employment. Section 6 concludes.

2 Data and key concepts

In this section, we describe our data and present some key measurement concepts. We primarily use yearly cross-sectional micro data from the European Labour Force Survey (LFS), which collects demographic and employment information on households in European countries. For Germany, it includes about 830,000 respondents per year. Our analysis covers the time period 2002 through 2017, as information on federal states ("Bundesländer") is only available as of 2002. Since we exploit variation of cyclical, structural and institutional factors at the federal state level, this information is crucial.

The LFS provides information on relevant socio-demographic characteristics of employees and on their occupation as well as industry. Most importantly, it allows for the identification of (involuntary) part-time workers. The definition of part-time work varies in the literature. The part-time measure in the LFS is based on self-assessment, but 95% of self-identified part-time workers work 31 h or less, which is in line with rather restrictive part-time definitions in the literature. To ensure we only rely on plausible self-assessments, we further restrict our definition of part-time work to those working no more than 35 h in total.[2] Respondents are also asked why they work part-time. Those who are in part-time employment because they "could not find a full-time job" are considered IPT. If instead respondents state to work part-time for family or school related reasons for example, they are working part-time voluntarily.

Our main indicators of interest are the yearly unemployment rate and the share of IPT workers in all workers.[3] Similarly, structural factors are also measured as the share of a certain demographic group or industry in the whole population or all employed persons. To have an internationally harmonized measure of unemployment, we use the ILO definition. Respective data on unemployment and GDP growth is drawn from Eurostat.

Some steps of our analysis require further information. Additional data is necessary to calculate transition probabilities in Sect. 4.2.3. Here we use the Mikrozensus, which can be combined into a panel in certain time periods. Since it forms the basis of the LFS, the measurement of IPT is identical in both data sets. We are interested in aggregate-level transition rates between employment states which we relate to federal state level variation in labor market conditions. This information is available on a yearly frequency. To consider the incidence of particular German employment forms in Sect. 5, we need data on the prevalence of these types of employment at the federal state level. Analogous to our main analysis, we calculate the share of marginally employed workers, the share of workers on short-time work compensation and the share of workers using working time accounts relative to all workers to account for them in our empirical analysis. For this, we draw on data from the Federal Employment Agency as well as the Socio-Economic Panel. Additional file 5 provides an overview of our data sources.

3 Involuntary part-time work: theory and evidence for Germany

In this section, we first provide some theory on the demand for part-time work. We then discuss the institutional setting and present descriptive evidence for Germany. It thereby becomes clear why Germany is a useful example case of a country with rather strict regulation of working hours on the extensive and intensive margins and why it is suitable for evaluating the effectiveness of working time regulation in preventing IPT.

3.1 Demand for part-time

In this Section, we briefly discuss why employers might prefer part-time employees over full-time employees although using part-time labor will usually be associated with higher overall fixed costs. While fixed costs of employment have decreased over time, they are still relevant for most jobs (see for example Neubäumer and Tretter 2008). The most important reasons for certain employers wanting to hire part-time employees despite higher overall fixed costs are the following.

Employers hire part-time employees for production requirements. Some firms face regular and predictable demand peaks. Hiring part-time workers allows them to use their work force more flexibly. The need for part-time labor can also stem from opening hours that cannot be adequately covered by full-time staff. Studies on the determinants of part-time demand find that part-time work can increase firm productivity for these reasons (see for example Euwals and Hogerbrugge 2006; Devicienti et al. 2015). If those industries which require a high degree of flexibility become relatively more relevant compared to those which rely more on full-time work, this will result in a higher share of IPT, all else being equal. Production might depend on part-time not only for organizational reasons. There is a large literature investigating the effect of working hours on individual productivity, with many studies finding decreasing returns to hours. See Collewet and Sauermann (2017) for recent evidence and an overview of previous studies.

[2] This means that respondents who work more than 35 h by combining two jobs are not considered as involuntary part-timers.

[3] We use non-self-employed, non-agricultural employment for our analysis and further exclude workers producing for own use and employees of extra-territorial organizations and bodies.

Other reasons for using part-time labor stem from business cycle developments, for example if employers prefer decreasing working hours over laying off part of their work force during economic downturns. This is mainly due to employers' incentives to hold on to human capital and to avoid redundancy payments. This reasoning implies a negative relationship between economic activity and the incidence of IPT. In fact, IPT is observed to behave countercyclically in many countries (see for example Bredemeier and Winkler 2017; Bell and Blanchflower 2018; Borowczyk-Martins and Lalé 2019; Valletta et al. 2020). Moreover, some employers hire part-time employees to screen them for full-time positions. If they are risk-averse, they will be even more likely to do so in periods of economic downturns to reduce uncertainty (Buddelmeyer et al. 2004).

Employers may also expand their workforce and reduce the number of hours per employee for strategic purposes with regard to wages. Dossche et al. (2019) analyze overhiring strategies in an intra-firm bargaining framework with extensive and intensive margins. Under the assumption that the marginal disutility of working is increasing in the number of hours, firms overhire and reduce hours as they can thereby enforce a reduction in wages.

Depending on the institutional framework, legal requirements might impose additional incentives for using part-time labor or prevent employers from doing so.[4] Therefore, country-specific regulations have to be taken into account as well.

3.2 Institutions and the choice of working hours

When negotiating a new employment contract, employers and employees are fairly free in choosing the number of working hours. The framework within which the negotiations can take place in Germany is mainly restricted by laws that limit the maximum permissible working time. Further restrictions may result from collective or works council agreements. Within that scope, negotiation outcomes can be assumed to depend on employers' and employees' preferences as well as their respective bargaining positions.

If employers hire part-time employees, they are bound to treat them in the same way as full-time employees[5] by the European Council Directive 97/81/EC and respective German law, with exceptions for marginal employment ("minijobs"). Marginal employment is a particular German form of employment which is defined by income limits.[6] Especially with binding minimum wages, these limits imply a maximum number of working hours. Minijobs are partly exempt from social security contributions, which induces incentives for restricting working hours. In 2003, the Hartz I and II reforms, among other things expanded the possibilities to hire marginal employees. In Sect. 5, we examine whether marginal employment plays an important role for the extent of IPT, specifically differentiating between marginal employment as only employment or secondary employment. In many respects, the Hartz reforms can be considered the most important set of reforms of the German labor market in recent decades as they brought about fundamental changes in the regulation of different forms of employment and in unemployment benefits. We therefore come back to these reforms at various points in the analysis, but they are not the main focus of this analysis (for an overview of the reforms and their performance see for instance, Jacobi and Kluve (2006); Giannelli et al. 2016; Jung and Kuhn 2019).

Once an employment contract is in force, there may be various reasons to change the working hours that employers and employees initially agreed on. From employers' perspective, organizational requirements might change over time. Even more importantly, the economic situation might change. Borowczyk-Martins and Lalé (2019) show that employers in the US and the UK adjust employment via the intensive margin. They observe that the share of part-time workers strongly increases during recessions. This rise is due to changes in the transitions between full-time and part-time rather than transitions between unemployment/non-employment and part-time. Moreover, these transitions between full-time and part-time work mostly occur at the same employer. In Germany, however, reductions of working hours are usually only possible if employees agree to them unless flexible hours have been stipulated.[7] Unilateral reductions are only admissible in particular circumstances, which we explain in the next paragraph. In addition, there is a comparatively high level of protection against dismissal. These major differences to the far more liberal labor markets in the UK and especially in the US motivate our analysis.

In Germany, there are a number of exceptions that allow employers to unilaterally reduce working hours under very restrictive circumstances for a certain time span. The most important ones are the following two: First, short-time work ("Kurzarbeit") is a government subsidy which firms can apply for when they face

[4] In the US, the Affordable Care Act (ACA) imposes institutional incentives for using part-time work (see for example Jolevski and Sherk 2014; Garrett 2014; Even and Macpherson 2015).

[5] Legally, part-time and full-time work are not clearly defined by a specific working time. Instead, the respective employment relationship is taken into account. The benchmark is a comparable full-time employee of the same company. If employees regularly works less, they are legally considered as part-time workers.

[6] The income may not regularly exceed 450 euros.

[7] Contracts that stipulate on-call working hours, especially those that do not specify a minimum number of working hours, are rare in Germany (see for example Tobsch et al. 2012).

short-term demand slumps (firm-specific component) and which is also frequently facilitated during recessions (discretionary component) (Balleer et al. 2016). In short-time work, working hours are reduced and associated losses in income are compensated at a rate of about 60% by the social security system or the state. Whether short-time work results in IPT is not easy to predict as it depends on employees' preferences regarding hours/wage combinations. Second, working time accounts ("Arbeitszeitkonten") allow for adjusting working hours dynamically. The basic idea behind working time accounts is that over a certain period of time employers can have their employees work longer or shorter hours than collectively agreed. Employees thereby collect working time credits or debits in an individual working time account, which are later compensated for by additional free time or work. Theoretically, the use of working time accounts can have opposing effects on the incidence of IPT.[8] In Sect. 5, we also look at the relevance of short-time work and working time accounts for the incidence of IPT.

Not only employers, but also employees might want to change their working hours. Employers are usually obligated by the "Teilzeit- und Befristungsgesetz" (TzBfG) to allow for a reduction of working hours unless they qualify for an exception because of certain firm characteristics. Since the amendment of the "Bundeselterngeld- und Elternzeitgesetz" (BEEG) in 2015, it has been even easier for parents to reduce hours. This should not lead to IPT. However, while part-time employment might be voluntary at first, it can result in IPT if preferences for working hours change again. Until last year, employees had only been allowed to reduce hours, but had not been entitled to increase them again against their employer's will. This is especially relevant for women, who often reduce their working hours after giving birth and want to increase their working time again when the child has reached a certain age.[9]

Summarizing, unlike in the US, employers' choices of working hours in Germany are restricted in many ways. Reductions of working hours are thus relatively more costly for employers. This raises the question of whether employers adjust differently to economic shocks.

3.3 Descriptive evidence on involuntary part-time employment in Germany

In this Section, we present some key facts on the incidence of involuntary part-time employment in Germany as well as its cyclicality and variation across demographic groups, occupations, industries, and federal states.

For a first impression, Fig. 1 illustrates the aggregate time-series patterns of IPT as a share of total employment and the unemployment rate between 1997 and 2017, and puts them in the context of recession periods. IPT ranges between 2.2% and 5.5%, which is a magnitude quite comparable to other developed countries (see for example Glauber 2017). In absolute numbers, this means that between 800 thousand and two million people were working involuntarily in part-time during the sample period. IPT and unemployment develop in a somewhat parallel manner but the cyclical patterns of IPT are not entirely evident from an aggregate perspective. There also seems to be no clear response to recessions.[10]

Our analysis does not rely on the aggregate business cycle because we assume that the decisions of labor market agents are determined by local rather than aggregate conditions. We define labor markets by federal states and exploit federal state level variation in demand and supply factors to assess the determinants of IPT. This assumption is supported by the fact that mobility between federal states in Germany is rather low. Additional file 6 shows descriptive statistics on the commuting and moving behavior of people between states. Ideally, we would want to define labor markets by commuting zones. However, crucial information, especially the incidence of IPT, is only available for federal states.

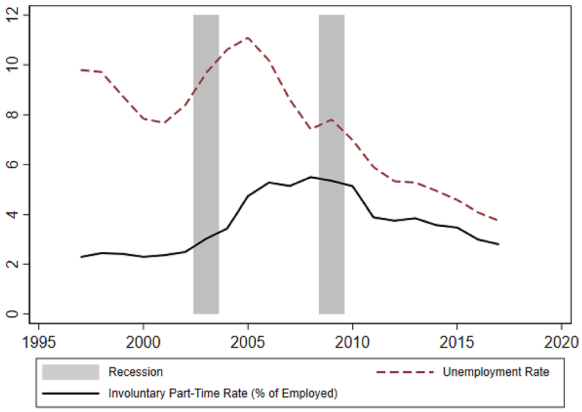
To explore the relationship between cyclical indicators and IPT at the federal state level, Fig. 2 plots the state specific IPT share and unemployment rate (left panel) as well as GDP growth (right panel) for the years between 2002 and 2017. There is a positive correlation between unemployment and IPT, despite substantial deviation from the fitted line. As there seems to be no relationship of IPT with GDP growth at the federal state level, we focus on unemployment as the key cyclical indicator in our empirical analysis. We do, however, control for GDP growth.

Based on Fig. 2 we do not know whether the stronger relationship between unemployment and IPT stems from level differences between federal states or movements over

[8] In addition to these two important exceptions, there are working time corridors as a further instrument, which is, however, not widely used (see for example Burda and Hunt 2011).

[9] However, since 2019, employees can opt for a temporary reduction of hours under certain circumstances ("Brückenteilzeit"). Whether the new law applies, depends mainly on the size of the company and operational and organizational particularities. As our sample period does not include 2019, this does not affect our analysis.

[10] The unemployment rate and GDP growth are not as closely related in the German economy as they are in other countries. While the fall in GDP growth experienced during the crisis of 2009 was the largest since the Second World War, there was no equivalent rise in unemployment. The causes of this particularly German phenomenon have been extensively studied by other authors (see for example Burda and Hunt 2011).



Notes: Evolution of the unemployment rate (dashed red) and involuntary part-time rate (solid black) for the years 1997-2017. Recessionary periods are indicated in gray. Source: European Labour Force Survey and Eurostat, own calculations using sampling weights of the Labour Force Survey.

Fig. 1 Involuntary part-time employment and unemployment in Germany. *Notes*: Evolution of the unemployment rate (dashed red) and involuntary part-time rate (solid black) for the years 1997–2017. Recessionary periods are indicated in gray. *Source*: European Labour Force Survey and Eurostat, own calculations using sampling weights of the Labour Force Survey

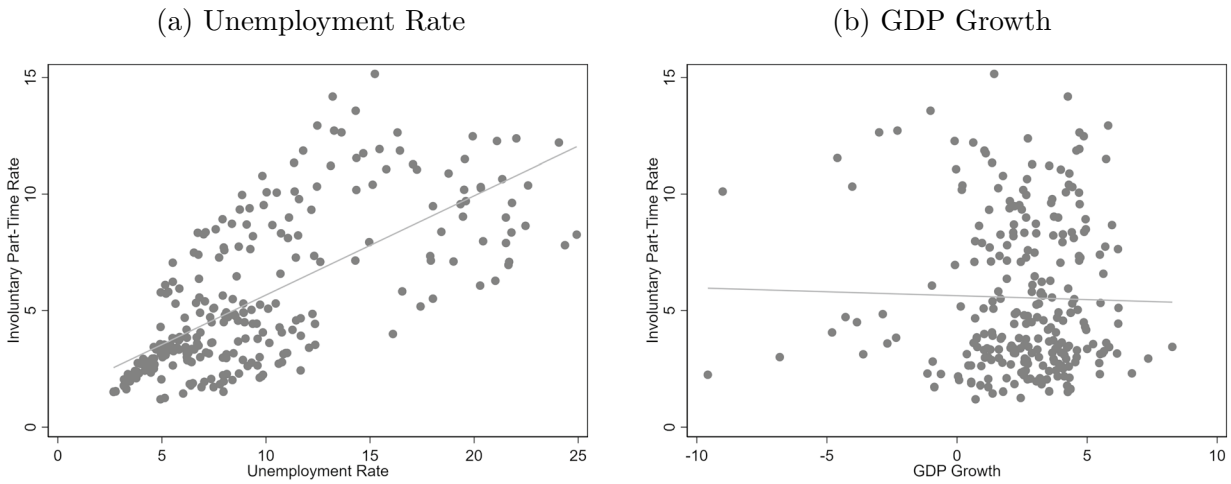
time within states.[11] Table 1 provides detailed information on the incidence of (involuntary) part-time by demographic groups and industries as well as federal states. It reads as follows: for any given row, the table lists the share of the respective group that works part-time (involuntarily) for the years 2002, 2010 and 2017 in order to span our sample period. Additionally, the last three columns show the overall employment share of each group. There are substantial level differences in the shares of IPT employment between states, with IPT being particularly high in Eastern Germany. However, there is also considerable variation within states over time. Our regression analysis only exploits within-state variation. We now turn to structural factors that are potentially related to IPT. Structural factors pertain to long-term changes in the demographic composition of the population and in the structure of the economy, i.e. changes in the relevance of different industries. There is considerable variation in the incidence of IPT across demographic groups. Both part-time in general and IPT are more prevalent among women. Depending on gender, the share of IPT also differs strongly between age groups. While men are more prone to becoming IPT when they are young, the opposite is true for women. Overall, shifts in the demographic composition of the workforce as well as developments over time within groups can influence the level of IPT, which is why we account for demographics in our regression analysis.

The incidence of IPT also differs greatly between industries (which in turn is related to the gender differences, see for example Acosta-Ballesteros et al. 2021). It is particularly prevalent in industries that comprise services, like for example *Hotels and Restaurants* or *Other Services*. The high relevance of part-time labor for service industries is frequently highlighted in the literature (see for example Buddelmeyer et al. 2004; Euwals and Hogerbrugge 2006). Organizational flexibility is often particularly important for service providers, whose businesses rely on certain opening hours and are subject to short-term demand peaks. Variations in industry shares between federal states and over time can be relevant for the prevalence of IPT in a state as both the intensity of part-time work within an industry as well as the relevance of that industry in the whole economy can vary.

4 Empirical analysis

As a first step, we investigate whether the apparent positive relationship between IPT and unemployment on the regional level upholds when we account for the influence of structural factors. To do this, we apply the state panel regression framework by Valletta et al. (2020), which has been proven useful in assessing the importance of both, market and cyclical factors for IPT (see for example MacDonald 2019). Afterwards, we disentangle the mechanisms underlying the association of IPT and unemployment. Among other things, we calculate transition probabilities between employment states at the individual level.

[11] Fig. 2a looks very similar when we plot only the deviations of the regional unemployment rate from the national trend, suggesting that there is meaningful variation within states over time.



Notes: Correlation within German federal states between the involuntary part-time rate and the unemployment rate (a) and GDP growth (b) for the sample period 2002-2017. Source: European Labour Force Survey and Eurostat, own calculations using sampling weights of the Labour Force Survey.

Fig. 2 Correlation between involuntary part-time employment and unemployment/GDP growth in German federal states. *Notes*: Correlation within German federal states between the involuntary part-time rate and the unemployment rate (**a**) and GDP growth (**b**) for the sample period 2002–2017. *Source*: European Labour Force Survey and Eurostat, own calculations using sampling weights of the Labour Force Survey

4.1 Aggregate analysis

The state panel regression framework exploits variation in cyclical and structural factors within German federal states over time. This approach allows to jointly account for changes in demand and supply factors. As argued by Valletta et al. (2020), considering those factors together is crucial to properly evaluate their respective roles as different structural changes may be offsetting one another.

We apply state fixed effects to control for unobserved differences between states. We also include year fixed effects which capture unobserved common developments over time. These could be developments due to nationwide regulatory changes such as the Hartz reforms. It also makes sure that the regression results do not simply reflect an overall similarity in the trends of the time series of IPT and explanatory factors. As our dependent variable is a share, we also use the fractional regression method proposed by Papke and Wooldridge (1996, 2008). Observations are weighted by employment of the respective state. Standard errors are clustered by state. All tables report marginal effects at the mean, that is, the impact of a one percentage point change in the respective independent variable on the dependent variable, with all other explanatory variables held at their mean values.

The regression model is specified as follows

$$IPT_{st} = \alpha + \beta u_{st} + \gamma u_{st}^2 + \zeta' X_{st} + \varphi_s + \varpi_t + \epsilon_{st} \quad (1)$$

with s indexing states and t indexing years and IPT_{st} being the fraction of the employed population that is involuntarily part-time employed. Variable u_{st} represents the unemployment rate, and u_{st}^2 is the square of the unemployment rate. Including the quadratic term controls for a potential non-linearity of the relationship between IPT and unemployment and improves our model fit as shown in Additional file 2. X_{st} represents a vector of structural variables that includes time and state dependent industry and demographic group shares.[12] It furthermore includes GDP growth as an additional cyclical control variable. State fixed effects are φ_s and year fixed effects are ϖ_t. In Sect. 4.2.2, we present additional specifications to consider the role of labor force participation and voluntary part-time employment for the assumed relationship between IPT and the explanatory variables.

Table 2 shows the results. In the baseline specification (column 1), we only include the cyclical indicators u_{st} and u_{st}^2 as well as state and time effects. The coefficient of the unemployment rate is positive and precisely estimated. It shows a significant correlation between unemployment and the share of IPT in a region. Interpreting the effect of unemployment requires accounting jointly for the effect of unemployment and the quadratic term,

[12] Note that we use population shares of demographic groups as opposed to employment shares as they cover the exogenous differences in labor supply between federal states more accurately. We obtain, however, qualitatively similar results when including employment shares instead.

Table 1 Incidence of (involuntary) part-time work by labor market group, sector, and federal state

	Involuntary						Employment		
	Part-time			Part-time			Share		
	2002	2010	2017	2002	2010	2017	2002	2010	2017
All	0.025	0.051	0.028	0.207	0.263	0.279	1	1	1
Demographic groups									
All 17–26	0.020	0.041	0.019	0.140	0.221	0.258	0.116	0.109	0.096
Men 27–36	0.013	0.040	0.018	0.066	0.111	0.108	0.123	0.106	0.112
Women 27–36	0.033	0.057	0.032	0.318	0.349	0.337	0.100	0.091	0.094
Men 37–56	0.008	0.021	0.015	0.032	0.059	0.064	0.295	0.283	0.252
Women 37–56	0.051	0.088	0.045	0.449	0.519	0.521	0.243	0.248	0.226
All 57–66	0.026	0.061	0.037	0.233	0.267	0.297	0.113	0.147	0.193
All 67+	0.012	0.011	0.007	0.599	0.668	0.711	0.010	0.016	0.027
Occupations									
Clerks	0.021	0.052	0.019	0.292	0.344	0.336	0.130	0.122	0.132
Craft	0.008	0.021	0.012	0.046	0.069	0.082	0.168	0.147	0.125
Elementary occupations	0.078	0.168	0.099	0.442	0.525	0.562	0.075	0.076	0.074
Managers	0.004	0.008	0.003	0.049	0.085	0.074	0.066	0.064	0.048
Plant and machine operators	0.013	0.027	0.017	0.077	0.113	0.134	0.073	0.070	0.061
Professionals	0.019	0.020	0.013	0.162	0.199	0.241	0.139	0.163	0.185
Services and sales	0.057	0.112	0.065	0.393	0.485	0.454	0.120	0.126	0.142
Technicians	0.020	0.037	0.016	0.209	0.262	0.268	0.214	0.219	0.231
Industries									
Business activities & real estate	0.034	0.074	0.034	0.259	0.322	0.330	0.089	0.107	0.112
Construction	0.012	0.022	0.013	0.078	0.104	0.118	0.078	0.069	0.070
Education	0.053	0.074	0.038	0.349	0.410	0.438	0.058	0.067	0.069
Electricity, gas and water	0.003	0.028	0.008	0.063	0.104	0.110	0.008	0.013	0.014
Financial intermediation	0.007	0.016	0.009	0.170	0.197	0.241	0.038	0.035	0.032
Health and social work	0.034	0.064	0.041	0.316	0.395	0.429	0.109	0.125	0.132
Hotels and restaurants	0.057	0.099	0.069	0.295	0.443	0.456	0.035	0.040	0.038
Manufacturing	0.008	0.017	0.008	0.103	0.118	0.120	0.242	0.210	0.195
Other services	0.038	0.075	0.043	0.296	0.401	0.428	0.058	0.042	0.043
Public administration and defence	0.014	0.023	0.012	0.158	0.181	0.209	0.082	0.076	0.070
Logistics and communication	0.021	0.045	0.024	0.141	0.206	0.206	0.058	0.084	0.083
Wholesale and retail trade	0.040	0.085	0.042	0.296	0.351	0.332	0.143	0.131	0.142
Federal states									
West									
Schleswig–Holstein	0.021	0.044	0.025	0.232	0.270	0.301	0.034	0.035	0.034
Hamburg	0.025	0.034	0.024	0.222	0.247	0.250	0.022	0.023	0.024
Lower Saxony	0.021	0.049	0.027	0.229	0.279	0.284	0.092	0.091	0.094
Bremen	0.031	0.069	0.039	0.235	0.353	0.319	0.007	0.007	0.008
North Rhine-Westphalia	0.014	0.042	0.025	0.217	0.275	0.285	0.208	0.208	0.207
Hesse	0.018	0.040	0.023	0.216	0.275	0.293	0.078	0.076	0.077
Rhineland-Palatinate	0.017	0.048	0.021	0.220	0.300	0.303	0.049	0.049	0.049
Baden-Württemberg	0.011	0.032	0.019	0.224	0.270	0.290	0.139	0.138	0.142
Bavaria	0.012	0.030	0.014	0.213	0.265	0.269	0.163	0.163	0.167
Saarland	0.019	0.029	0.019	0.224	0.282	0.293	0.012	0.012	0.011
East									
Berlin	0.049	0.073	0.051	0.205	0.263	0.273	0.041	0.041	0.044
Brandenburg	0.066	0.076	0.053	0.143	0.186	0.235	0.030	0.032	0.029
Mecklenburg western pomerania	0.074	0.095	0.055	0.146	0.215	0.299	0.019	0.019	0.018
Saxony	0.084	0.130	0.056	0.157	0.223	0.259	0.050	0.049	0.047

Table 1 (continued)

	Involuntary Part-time			Part-time			Employment Share		
	2002	2010	2017	2002	2010	2017	2002	2010	2017
Saxony-Anhalt	0.060	0.124	0.069	0.122	0.205	0.225	0.028	0.028	0.024
Thuringia	0.054	0.085	0.054	0.125	0.207	0.247	0.029	0.028	0.025

Share of workers in part-time and involuntary part-time for the years 2002, 2010 and 2017 for labor market groups, sectors, and federal states as well as the overall employment share of the respective group

Source: European Labour Force Survey, own calculations using sampling weights of the Labour Force Survey

which is negative and significant. Calculated at the weighted sample mean of 7,9%, a one percentage point increase in the regional unemployment rate leads to a change of about 0.17 percentage points in the IPT share in this specification. The maximum difference between the lowest and highest regional unemployment rate in our sample period is 19 percentage points in Mecklenburg Western Pomerania. A change of this magnitude indicates a change in the share of IPT of approximately 3.3 percentage points, an effect that is of economic significance but is less than a third of the effect in the US. The mean of within-state differences is about 10 percentage points in our sample. An increase in the unemployment rate of this magnitude would translate into an increase in the number of involuntary part-time workers of about 600 thousand people. The negative effect of the quadratic term indicates that the marginal effect of unemployment becomes smaller as unemployment increases. Our data are almost entirely within the range where the marginal effect remains positive.

In column (2), we present a specification that also includes the structural variables, only a few of which have a significant impact on the regional IPT rate.[13] Higher shares of employment in *Wholesale and Retail Trade* and in *Electricity, Gas and Water Supply* are associated with a higher share of IPT. Most of the structural factors are not individually significant, but the overall model fit does improve with their inclusion as indicated by a lower Akaike information criterion and the within R^2.[14] This is probably due to the fact that the demographic group and industry shares have been rather stable within states over the sample period compared to the cyclical indicators. Further, the respective group shares are correlated with each other and the sample size is rather small. However, a Wald test of joint significance indicates that the structural factors as a whole do affect the incidence of IPT, but the effect cannot be attributed to single regressors. More importantly, the marginal effect of unemployment is almost unaffected by the inclusion of structural variables and most importantly in terms of effect size.

In column (3), we further add regional GDP growth to account for the cyclical dynamics in terms of output. The coefficient of the unemployment rate is almost unaffected. The other effects also remain qualitatively unchanged, except for a higher population share of men aged between 27 and 36 now significantly corresponding to a lower share of IPT. The effect of GDP growth itself is positive. A one percentage point increase in output is associated with an increase in IPT of 0.043 percentage points. Bearing in mind that a change of that magnitude in GDP growth would be quite substantial, the effect it has on IPT seems rather negligible. Moreover, as we show in Additional file 1, it is only prevalent in a few sectors. In most sectors, IPT is rather connected to unemployment. In the same additional file, we present the results of an additional specification in which we include interaction terms of the structural variables (vector X_{st}) with the national unemployment rate. Our results regarding the association between involuntary part-time employment and unemployment remain largely unchanged. Thereby we show that the association cannot be explained by the fact that structural factors react differently to nationwide business cycle developments within federal states.[15] In Additional file 2, we explore different specifications of the indicators presented here and of alternative indicators. Basically, it seems that the rather strict regulation of the German labor market does not prevent that high unemployment reduces the chances of employees realizing their desired full-time positions.

To understand the connection between unemployment and IPT better, we also conduct heterogeneity analyses, which reveal that the connection differs in important dimensions. In Additional file 3, we focus on macro level heterogeneity and show that the correlation is larger in Western Germany than in Eastern Germany and it has been larger after the Great Recession than before. This

[13] This finding is in line with the results of Dietz et al. (2013) who conduct shift-share analyses that show that changes in atypical employment, including part-time employment, can hardly be explained by structural change.

[14] The within R^2 is directly calculated from the sum of squares as demonstrated by Valletta et al. (2020).

[15] Analyses of the relationship between labor market developments and the economic cycle in other countries show that such links could exist, e.g. Bredemeier et al. (2023).

Table 2 Cyclical and structural determinants of involuntary part-time work, regression results

Share IPT	(1)		(2)		(3)	
Unemployment rate	0.273***	(0.0659)	0.251***	(0.0668)	0.253***	(0.0695)
Unemployment rate squared	− 0.592***	(0.201)	− 0.549***	(0.160)	− 0.550***	(0.167)
GDP Growth					0.0432**	(0.0200)
Women 17–26			0.0267	(0.122)	0.0228	(0.120)
Women 27–36			0.00334	(0.134)	0.0337	(0.139)
Women 37–56			− 0.0391	(0.131)	− 0.0329	(0.130)
Women 57–66			0.0250	(0.148)	0.0365	(0.151)
Women 67+			0.0787	(0.514)	0.123	(0.524)
Men 27–36			− 0.180	(0.118)	− 0.202*	(0.114)
Men 37–56			0.00757	(0.122)	0.0173	(0.122)
Men 57–66			− 0.0561	(0.149)	− 0.0444	(0.151)
Men 67+			− 0.283	(0.415)	− 0.214	(0.436)
Manufacturing			− 0.0136	(0.0547)	− 0.0101	(0.0541)
Electricity, gas and water			0.152*	(0.0840)	0.156*	(0.0875)
Construction			0.0405	(0.0474)	0.0458	(0.0509)
Wholesale and retail trade			0.136**	(0.0562)	0.142**	(0.0567)
Hotels and restaurants			− 0.0132	(0.105)	− 0.0187	(0.102)
Financial intermediation			− 0.0924	(0.0828)	− 0.100	(0.0810)
Business activities and real estate			0.0805	(0.0579)	0.0797	(0.0552)
Public administration and defence			− 0.0188	(0.0511)	− 0.0160	(0.0468)
Education			0.00455	(0.0787)	0.00397	(0.0759)
Health and social work			0.00573	(0.0602)	0.0174	(0.0581)
Other services			0.0571	(0.0613)	0.0557	(0.0592)
State fixed effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
AIC	0.2577781		0.2576841		0.2576776	
R^2 within	0.82		0.94		0.94	
N = 256						

Dependent variable is the share of IPT at federal state level in the years 2002–2017. Marginal effects at the mean reported. Mean of state employment used for regression weights

Men 17–26 is omitted demographic group, *Transportation, Storage and Communication* is omitted industry category. Standard errors in parentheses are clustered at federal states, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Source: European Labour Force Survey and Eurostat, own calculations

suggests that the relevant labor market mechanisms affect the Western labor market more strongly and have been amplified by the crisis. Meanwhile, our findings do not hint at any relevant changes regarding the connection between unemployment and IPT that could be attributed to the Hartz reforms. In Additional file 4, we make use of the individual-level dimension of our data. First, we show that our main findings are reinforced when we use IPT status as the dependent variable and control for individual worker characteristics in logit regressions. Thus, this exercise shows that the connection between labor market conditions and IPT is prevalent across workers. Second, we consider the individual probability of being inactive in the labor market as dependent variable which is relevant for understanding the mechanisms underlying the relationship between unemployment and IPT as we explain in the next section. Moreover, we investigate micro level heterogeneity in the correlation between unemployment and IPT. A notable finding here is that the probability of working in IPT when unemployment is high is much larger for women than for men.

4.2 Unemployment and involuntary part-time employment: underlying mechanisms

In this section, we explore the underlying mechanisms of the positive relation between unemployment and involuntary part-time work. In the US, unilateral adjustments by employers of their workers' hours from full- to part-time play a major role for the countercyclicality of IPT (see for example Warren 2016; Lariau 2017;

Borowczyk-Martins and Lalé 2019). Downward adjustments of hours become attractive for firms when the demand for their products weakens in a downturn. At the same time, firms face little resistance from their employees as a slack labor market offers them fewer alternatives. By contrast, German regulation makes reductions in working hours difficult as they usually require employees' consent. Consequently, involuntary hours reductions at the same employer are a less relevant margin of labor adjustment in Germany than in the US. To illustrate this point, Table 3 shows the share of transitions from full-time to IPT in all IPT inflows and the probability of staying with the same employer when transitioning from full-time to IPT for these two countries (the latter is taken from Borowczyk-Martins and Lalé 2016). The figures show that the share of transitions from full-time to IPT that take place at the same employer in all IPT inflows is about three times higher in the US than in Germany. While it accounts for about one third of those transitions in the US, it is 11% in Germany. This raises the question which alternative mechanisms explain the relationship between unemployment and IPT. In Sect. 4.2.1, we present different channels and investigate their relevance. To this end, we first conduct additional regression analysis for a broader set of dependent variables (Sect. 4.2.2). Secondly, we look at yearly transition rates between employment states Sect. (4.2.3).

Table 3 Hours reductions at the same employer in Germany and in the US

	Share transitions FT-IPT in all IPT inflows	Probability of staying with same employer at transition	Share transitions FT-IPT at same employer in all IPT inflows
Germany	≈ 18%	≈ 64%	≈ 11%
US (BML 2016)	≈ 31%	≈ 95%	≈ 29%

Transition rates of workers between full-time and involuntary part-time employment for Germany and the US. Source for German data: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Mikrozensus 2001–2004 and 2012–2015, own calculations. Information on the US is taken from Borowczyk-Martins and Lalé (2016), Table 5 and applies to the years 2009–2015 based on monthly CPS data. The numbers are very similar for the longer period 1994–2019 (see Borowczyk-Martins and Lalé 2019, Tables 2 and 6)

4.2.1 Alternative channels of labor adjustment in regulated labor markets

The three candidate explanations we consider are composition effects between sectors that have different intensities in their use of full-time and part-time work, added labor supply effects that result from higher unemployment of a household member leading to higher hours supply by other members, and the effect that a weaker labor market has on jobseekers' and workers' opportunities to gain full-time employment.

4.2.1.1 Composition effect A higher unemployment rate could be associated with a higher share of involuntary part-time work due to sectoral reallocation. The argument runs as follows. In Germany, the Great Recession primarily affected employment in manufacturing (see for example Burda and Hunt 2011). As manufacturing firms use relatively little part-time labor (see Table 1), this could have caused an increase in IPT's share in employment. Not only does a decrease in the employment share of full-time intensive industries lead to a decline in employment without a proportional decrease in IPT in all sectors, but it potentially also leads to additional employment in sectors that are comparatively part-time intensive. However, by controlling for the industry composition in our regression analysis, we rule out that the connection between unemployment and IPT is driven by this kind of interaction between cyclical and sectoral developments.

4.2.1.2 Added labor supply effect Another potentially relevant mechanism is based on increased labor supply in times of high unemployment. It has primarily been discussed with regard to the labor supply of married women in the literature (see for example Mincer 1962; Heckman and MaCurdy 1980; Stephens 2002; Bredtmann et al. 2018). In the respective literature, labor supply of individuals is put in the context of family decision-making. If a household member becomes unemployed, this leads other, formerly inactive household members to enter the labor market in order to compensate for the transitory income loss. This *added worker effect* could explain the positive association of unemployment and IPT if the additional workers were particularly prone to becoming involuntary part-time employed. Given that they were only marginally attached to the labor force, this is not unlikely. By the same reasoning, there could be an *added hours effect* on the intensive margin of those household members who are already employed but have been working part-time and want to increase their hours when their spouse loses their job. We present suggestive evidence for this channel on the macro and micro level.

4.2.1.3 Reservation hours effect From the perspective of the search and matching theory of the labor market, it is plausible to expect workers' bargaining positions to positively depend on labor market tightness. That is, the higher the number of vacancies is relative to the number of job seekers, the better the position of an employee vis à vis their employer. We therefore expect a negative correlation between unemployment and the probability of workers realizing their desired hours. Our findings suggest that

job seekers actually make concessions with regard to their desired hours when labor market conditions are not in their favor. Analogous to reservation wages, *reservation hours* then appear to be lower. Consequently, unemployed individuals who prefer a full-time position are more likely to accept a part-time position during economic downswings. Along the same lines, those who are already involuntarily part-time employed have fewer opportunities to transition to full-time positions.

4.2.2 Different dependent variables

Table 4 shows additional regression results at the same aggregation level as in Sect. 4.1, which help to evaluate whether the above mechanisms of employment adjustment play a role in the German labor market.

In the first column, we repeat the full specification from Table 2 (column 3) but add the labor force participation rate. If workers who are marginally attached to the labor market were especially prone to become involuntary part-time employed, we would expect a positive coefficient of the labor force participation rate. In addition, the inclusion of this variable would affect the coefficient of the unemployment rate if there was an *added worker effect* as described above. However, this is not the case as the variable itself has no explanatory power for the incidence of IPT and the marginal effect of the unemployment rate remains about the same. Thus, there might be no significant *added worker effect*. Another explanation might be that it is just compensated by a *discouraged worker effect*, implying that groups which often work part-time involuntarily are discouraged in times of high unemployment and completely withdraw from the labor market. In Additional file 4, we examine the relationship between unemployment and the individual probability of becoming inactive. There is no significant association between the two variables in our data, implying that there is indeed no (predominating) added worker effect.

Columns (2)–(4) present the same specification as before, but with different dependent variables. First we look at the effect of unemployment on the absolute number of IPT workers. If there is a *reservation hours effect*, the number of IPT workers will rise when unemployment increases. As expected, the marginal effect of unemployment on the absolute number of IPT workers in column (2) is positive and precisely estimated. We next look at the share of PT workers in all workers (column (3)) and the share of IPT workers in all part-timers (column (4)). This provides an indication as to whether the positive association between unemployment and the share of IPT hinges on the overall relevance of part-time employment or on shifts within the group of part-time employed. The coefficient of the unemployment rate in column (3) is not significant, suggesting that movements in overall part-time work are not correlated with unemployment. While this might be surprising, it is consistent with the finding by Carrillo-Tudela et al. (2021) that the role of part-time employment in directly reducing unemployment in Germany was negligible. The share of IPT workers in all part-time employed is, however, significantly positively associated with unemployment. Together, these results suggest that changes in unemployment come with a compositional shift within the group of part-time workers rather than with an overall rise in part-time employment. This speaks to the low relevance of transitions from full-time to part-time as argued at the beginning of this section. Instead, an increase in unemployment is not only associated with an increase in involuntary but also with a decrease in voluntary part-time work. This is in line with added labor supply at the intensive margin (*added hours effect*).

4.2.3 Transitions

On the aggregate level, the results are indicative of a *reservation hours effect* and an *added hours effect*. To inspect both effects in more detail, we look at transitions between different employment states (EMPST), specifically between the different employment states involuntary part-time (IPT), voluntary part-time (VPT) and full-time (FT) and the non-employment states unemployment (U) and non-participation (NE), and how these depend on labor market conditions. For this purpose we use Mikrozensus data from survey years 2001–2004 and 2012–2015 which can be combined to panel data sets.[16]

We pool the observations from the two 4-year-periods together. While the earlier time period lies only partly within our sample period, using it means that an economic downturn in terms of GDP growth is included in this part of the analysis. This also means that half of the observations are before the Hartz IV reform of 2005 and the other half after the reform. As mentioned before, the Hartz reforms are the most important set of reforms of the German labor market in the last decades. The Hartz IV reform of 2005 fundamentally changed the generosity of the unemployment insurance system, increasing the incentives of unemployed workers to accept jobs. This has caused the unemployment rate to decline substantially, leading to a structural break in the time series of the unemployment rate (see e.g. Krause and Uhlig 2012). Therefore, the unemployment rates before and after the reform cannot be readily compared. To deal with this

[16] The German EU-LFS is based on the Mikrozensus, so this data actually stems from the same source as our main data. Unfortunately, the Mikrozensus allows for the construction of a panel only over certain time periods. See Additional file 5 for further information.

Table 4 Different dependent variables, regression results

	(1) Share IPT	(2) Number IPT	(3) Share PT	(4) Share IPT/PT
Unemployment rate	0.245**	5.066***	− 0.181	1.674***
	(0.0960)	(1.699)	(0.170)	(0.239)
Unemployment rate squared	− 0.550***	− 12.56***	− 0.218	− 2.799***
	(0.167)	(3.088)	(0.520)	(0.504)
Labor force participation	0.0146			
	(0.115)			
Demographic group shares	Yes	Yes	Yes	Yes
Industry shares	Yes	Yes	Yes	Yes
GDP growth	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N = 256				

Linear or fractional regressions with different dependent variables indicated in columns. Mean of state employment used for regression weights. Standard errors in parentheses clustered at federal states, $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Sources: European Labour Force Survey and Eurostat, own calculations

problem, we first harmonize the two samples by subtracting the mean unemployment rate of the respective 4-year-period. In this way, we remove the level differences in unemployment that are due to the reforms.[17]

We calculate yearly transition probabilities between the five different states and relate them to regional unemployment in the initial year, formally speaking:

$$corr\,(U_{t-1}, P(EMPST_t|EMPST_{t-1})).$$

The *reservation hours effect* implies that workers are more likely to accept a part-time position despite preferring a full-time position when labor market conditions are not in their favor. Unemployed workers who start a job, i.e. transition from unemployment to employment, more often become IPT, indicating that

$$corr\,(U_{t-1}, P(EMPST_t = IPT|EMPST_{t-1} = U)) > 0,$$
$$U_{t-1} \uparrow \Longleftrightarrow P(EMPST_t = IPT|EMPST_{t-1} = U) \uparrow .$$

This is all the more remarkable given that outflows from unemployment to employment are lower when unemployment is high. Accordingly, fewer unemployed workers find full-time jobs, i.e., that is

$$corr\,(U_{t-1}, P(EMPST_t = FT|EMPST_{t-1} = U)) < 0.$$
$$U_{t-1} \uparrow \Longleftrightarrow P(EMPST_t = FT|EMPST_{t-1} = U) \downarrow .$$

Figure 3 shows these transition probabilities and corresponding initial unemployment rates. They support the assumed mechanisms for the German labor market.

In this context, it is also noteworthy that our data confirms that the probability of transitioning between IPT and a full-time position is lower when economic conditions are unfavorable. However, the link is rather weak. This again suggests that transitions at the same employer are less crucial for the cyclicality of IPT than they are in less regulated labor markets.

The *added hours effect* implies that part-time workers extend their labor supply in times of high unemployment. If they succeed, this leads to higher transition probabilities from voluntary part-time to full-time, that is

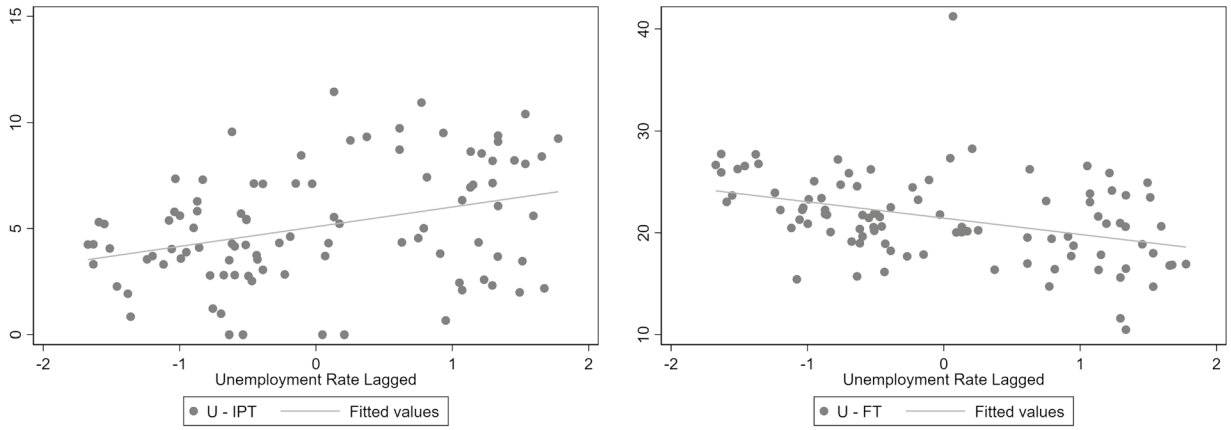
$$corr\,(U_{t-1}, P(EMPST_t = FT|EMPST_{t-1} = VPT)) > 0.$$
$$U_{t-1} \uparrow \Longleftrightarrow P(EMPST_t = FT|EMPST_{t-1} = VPT) \uparrow .$$

If they do not succeed, they will become involuntary part-timers, such that

$$corr\,(U_{t-1}, P(EMSPT_t = IPT|EMPST_{t-1} = VPT)) > 0.$$
$$U_{t-1} \uparrow \Longleftrightarrow P(EMPST_t = IPT|EMPST_{t-1} = VPT) \uparrow .$$

Again, the respective scatter plots, which are shown in Fig. 4, suggest that both adjustments are relevant. In fact, 85% of transitions from voluntary to involuntary part-time happen at the same employer, thereby reflecting changes in desired hours under presumably unchanged working circumstances. We furthermore find that there are stronger connections for women between

[17] The sample period for our main analysis also includes three pre-reform years. Here, we include year fixed effects to account for common unobserved shifts in the unemployment rate across federal states. In addition, we conduct a robustness check by repeating our regression for a sample excluding those years in Additional file 3. The results are qualitatively similar.



Notes: Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Mikrozensus 2001-2004 and 2012-2015. Own calculations using the weighting factor of the Mikrozensus.

Fig. 3 Reservation hours effect. Correlations between unemployment in previous period and transitions from unemployment to involuntary part-time (left) and to full-time (right). *Sources*: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Mikrozensus 2001–2004 and 2012–2015. Own calculations using the weighting factor of the Mikrozensus

unemployment and the probabilities of transitions from voluntary to involuntary part-time as well as to full-time (figures available from the authors upon request). This is in line with the interpretation that it is often women who try to compensate for a transitory household income loss during economic downswings (see Sect. 4.2.1).

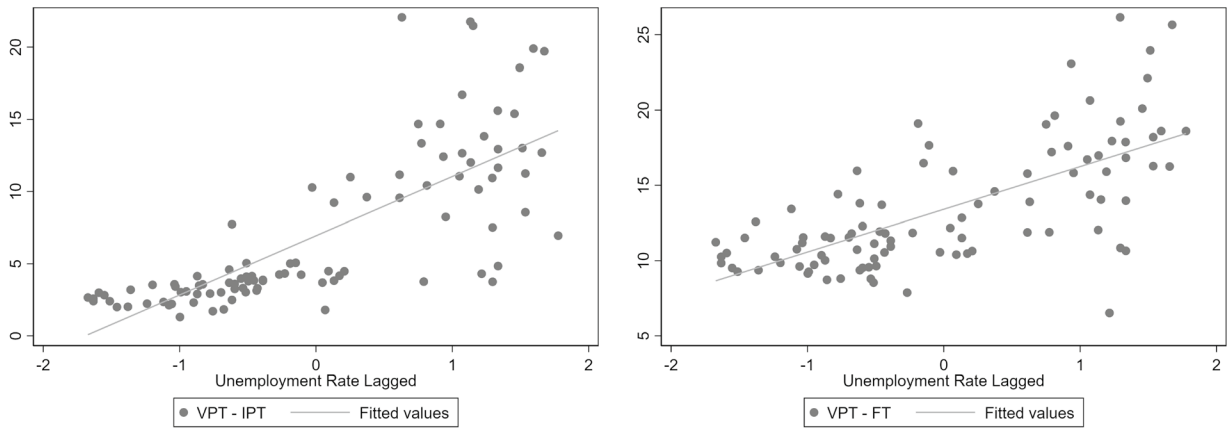
Summarizing, the transition probabilities between the different relevant employment states are convincing indications of procyclical dynamics in the reservation level of hours and and anticyclical patterns in labor supply on the intensive margin.

5 The influence of institutions on the cyclicality of involuntary part-time work

Our analysis so far stresses the importance of institutions for the incidence of involuntary part-time work in Germany. As mentioned in Sect. 3.2, there are further institutional particularities that might be worth controlling for as the association between IPT and unemployment could in fact (also) be driven by changes in these particular forms of employment. Since labor market regulation is mandated at the national level, there are no relevant differences in regulation at the federal state level. However, the incidence of relevant forms of employment differs between federal states and over time. We again exploit within state variation to evaluate the relevance for IPT of the share of marginally employed, the share of employees using working time accounts and the share of short-time workers. Adding the additional variables does not qualitatively change our findings from Sect. 4.1.

In 2003, the Hartz reforms expanded the possibilities to hire marginal employees, which means lower non-wage labor costs for the employer than for other employees (see Sect. 3.2). Some suspect that marginal employment has been used as a substitute for non-marginal employment. However, there has not been a clear trend in the use of marginal employment since the early 2000s and its role remains controversial (see for example Burda and Hunt 2011). A priori, the effect of the share of marginal employment on IPT is unclear. A positive effect would be expected if a relatively large share of minijobbers was seeking full-time employment. However, it is also conceivable that minijobbers are satisfied with a small number of working hours or that they use an additional minijob to achieve the desired number of hours. We therefore differentiate between those who have a minijob in addition to a regular job and those who are exclusively marginally employed. The LFS does not include information on marginal employment as this is a form of employment specific to Germany. Therefore, we use administrative data from the Federal Employment Agency on the year and state specific shares of marginal employment.

Moreover, we control for the incidence of working time accounts. If a firm uses working time accounts, the distribution of employees' working hours over the business cycle becomes more flexible. On the one hand, an increase in the spread of this instrument could lead to a heavier use of (involuntary) part-time as employers can ask part-time employees with working time accounts to



Notes: Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Mikrozensus 2001-2004 and 2012-2015. Own calculations using the weighting factor of the Mikrozensus.

Fig. 4 Added hours effect. Correlations between unemployment in previous period and transitions from voluntary to involuntary part-time (left) and to full-time (right). *Sources*: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Mikrozensus 2001–2004 and 2012–2015. Own calculations using the weighting factor of the Mikrozensus

work full-time hours when needed without paying overtime premia as long as the accounts are balanced over time. On the other hand, employers might be more willing to employ full-time labor, when working time can be saved that is not needed at the moment. Again, the LFS does not provide information on working time accounts. We use data from the Socio-Economic Panel, a representative survey with about 30,000 respondents, to calculate the year and state specific shares of employees who use those accounts.

Lastly, we control for the incidence of short-time work using respective data from the Federal Employment Agency. As mentioned in Sect. 3.2, it cannot be predicted easily whether short-time work results in IPT because this depends on employees' preferences regarding hours/wage combinations. As the incidence of short-time work is a rather countercyclical phenomenon overall (Balleer et al. 2016), it appears worth controlling for. It is important to note that our IPT measure most probably does not capture those employees who are (involuntarily) in a short-time work scheme. Short-time workers who usually work full-time hours will not report being part-time employed because contractual working hours do not change due to short-time work.

Table 5 shows the regression results using the full specification from before (structural variables and GDP growth are not shown), additionally including (1) the share of exclusively marginally employed, (2) the share of all marginally employed, (3) the share of employees using working time accounts, (4) the share of short-time workers and (5) variables (1), (3) and (4). Some of the variation in the incidence of IPT can be attributed to the use of working time accounts. The positive marginal effect suggests that employers hire more part-time instead of full-time employees when the firm uses working time accounts and that this comes with a higher incidence of IPT. The effect of unemployment remains comparable in magnitude and significance to our findings from Sect. 4.1.

6 Conclusion

In Germany, labor market regulation interferes with the adjustment of labor at the intensive and extensive margins. Workers are protected both from dismissals and from reductions in paid working hours. In contrast to less regulated labor markets, employers cannot unilaterally reduce working hours to adjust to business cycle fluctuations. We evaluate the effectiveness of these regulations in protecting the work force from involuntary part-time employment during economic downswings.

We first assess the relevance of cyclical and structural factors for the incidence of IPT by applying a state panel regression approach to data on the German labor market. The incidence of IPT is associated with the unemployment rate, i.e., it behaves anticyclically in Germany as well. However, the effect is less than one third of the US effect at respective sample means. The connection is not driven by specific industries, but is prevalent across the economy. Given the institutional constraints that firms and workers face, we investigate the underlying

Table 5 Involuntary part-time and particular employment, regression results

Share IPT	(1) Mini (Excl.)	(2) Mini (All)	(3) WTA	(4) STW	(5) All
Unemployment rate	0.264***	0.225***	0.236***	0.256***	0.249***
	(0.0718)	(0.0813)	(0.0711)	(0.0711)	(0.0728)
Unemployment rate squared	− 0.582***	− 0.463**	− 0.486***	− 0.555***	− 0.523***
	(0.189)	(0.202)	(0.176)	(0.168)	(0.192)
Share Minijobbers (Excl.)	− 0.0549				− 0.0569
	(0.158)				(0.160)
Share Minijobbers (All)		− 0.0548			
		(0.131)			
Share working time accounts			0.0197***		0.0197**
			(0.00764)		(0.00780)
Share short-time workers				− 0.0476	− 0.0397
				(0.120)	(0.113)
Demographic group shares	Yes	Yes	Yes	Yes	Yes
Industry shares	Yes	Yes	Yes	Yes	Yes
GDP growth	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
AIC	0.258	0.262	0.258	0.258	0.258
N = 256					

Dependent variable is the share of IPT at federal state level in the years 2002–2017. Marginal effects at the mean reported. Mean of state employment used for regression weights. Standard errors in parentheses clustered at federal states, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Sources: European Labour Force Survey, Eurostat, the Federal Employment Agency, and the Socio-Economic Panel, own calculations

mechanisms which lead to the positive connection between unemployment and IPT, as we suspect them to be very different from those in less regulated labor markets. In a first step, we show that transitions from full-time to IPT at the same employer indeed only play a minor role. In a second step, we analyze transition probabilities between relevant employment states to provide an alternative explanation. We find convincing indications of procyclical dynamics in the reservation level of hours ("reservation hours effect") and anticyclical patterns in labor supply on the intensive margin ("added hours effect"). The reservation hours effect refers to the observation that job seekers make concessions with regards to their desired hours when labor market conditions are not in their favor. Unemployed individuals are hence more likely to accept a part-time position even though they prefer a full-time position. The added hours effect refers to the phenomenon that some individuals would like to work more in economic downturns. Apparently, recessions increase the probability of former voluntary part-timers then preferring full-time positions. We are the first to document these margins of cyclical hours adjustments. Lastly, we incorporate the incidence of particular forms of employment into the analysis and find that our main results remain unaffected. Of the employment forms considered, only working time accounts are relevant for the incidence of IPT.

It appears that the rather strict regulation of the German labor market does not prevent unemployment from reducing the chances of employees realizing their desired working hours. From a welfare perspective, it is not clear that preventing IPT is an appropriate policy goal. On the one hand, IPT can be assumed to come with substantial disadvantages. Involuntary part-time jobs are associated not only with an overall lower income, but also lower hourly wages compared to workers in similar full-time jobs (see for example Golden 2016; Glauber 2017). On the other hand, the welfare effects of regulation that aims to prevent IPT cannot be assessed without knowing the resulting outcomes for the workers in question and other market participants. In particular, without the option of (involuntary) part-time, the alternative might be unemployment for some workers.

There are a number of interesting open questions to address in future research. One is whether there is a relationship between IPT and other macroeconomic variables in Germany, such as wage growth. Hong et al. (2018) find that IPT has recently weakened wage growth across countries, even in economies where unemployment rates are now at or below their averages

before the Great Recession, like Germany. Nevertheless, special analysis for Germany seems worthwhile because of its institutional peculiarities. Another aspect to consider is the assessment of the impact of recent reforms that directly target the incidence of IPT. Since 2019, employees can opt for a temporary reduction of hours under certain circumstances ("Brückenteilzeit"). The right to return to full-time work could prevent involuntary part-time work in some cases. It will be some time before data are available to study this question, especially its long-term consequences.

Not only in rather liberal labor markets, but also in a regulated labor market like Germany, market mechanisms lead to a countercyclical occurrence of IPT. Apparently, working time regulation is not entirely effective. While reductions in hours at the same employer play a much smaller role, other mechanisms lead to an increase of IPT in downswings, as we have explored in this paper.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12651-024-00363-0.

Additional file 1. We conduct analyses similar to Sect. 4.1 within industries and account for interactions between the national business cycles and structural variables.

Additional file 2. We explore different specifications of the cyclical indicators used in this study and of alternative indicators.

Additional file 3. We conduct heterogeneity analyses to explore potential differences in the association between unemployment and IPT between Western Germany and Eastern Germany, before and after the Great Recession and before and after the Hartz reforms.

Additional file 4. We make use of the individual-level dimension of our data showing that our main findings are reinforced when we use IPT status as the dependent variable and control for individual worker characteristics in logit regressions. We also take a look at the probability of becoming inactive in the labor markt and investigate micro level heterogeneity in the correlation between unemployment and IPT.

Additional file 5. Provides an overview of our data sources.

Additional file 6. Provides information regarding movement of people between states as well as commuting behavior

Acknowledgements
We thank Michael Krause, Christian Bredemeier, Anna Hartmann, Philipp Markus, Antoine Bertheau, Tobias Herbst and colleagues at the Institute for Economic Policy at the University of Cologne for valuable comments. We also thank audiences at the seminar of the FAU Nürnberg as well as participants at the 13th RGS Doctoral Conference in Economics, the Annual Conference of the Verein für Socialpolitik 2020, the BeNA Labor Economics Winter Workshop 2020, the 13th IAAEU Workshop on Labour Economics and the EALE 2021 annual conference for their input.

Author contributions
TM conducted the empirical analyses and created the graphs and tables. Both authors are responsible for conception of the research question and discussing the findings and read and approved the final manuscript.

Funding
Funding was provided by Harald and Gertrud Kühnen Stiftung.

Availability of data and materials
The data analyzed during this study comprises various confidential micro-level datasets: the European Labour Force survey, the German Mikrozensus and the Socio-Economic Panel. The confidentiality agreements signed with the providing institutions prohibit us from granting access to the data-both raw and modified-to anyone else other than ourselves. We will gladly provide precise information on these data sources on request. The other data we used can be accessed freely on the providing institutions' websites. Links to the respective websites can be found in Additional file 5. We are happy to provide these data as well as the replication package used for modification and analysis on all datasets. Please contact the first author if you have any questions regarding the data.

Declarations

Competing interests
The authors declare that they have no competing interests.

Received: 3 January 2023 Accepted: 14 February 2024
Published online: 10 March 2024

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