Essays in Labour Economics

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IN APPLICATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

BY

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Supervised by

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Declaration

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Dora Tuda

Summary

This dissertation consists of three essays in labour economics. Its primary focus is labour supply and individual preferences for labour in European countries during recessions.

The first essay (Chapter 2) documents stylised facts on desired hours per employed worker in European countries and identifies the effect of recessions on desired hours. Actual hours worked are usually used to estimate preferences on the labour market. However, actual hours are constrained by labour demand and therefore measure hours worked in the general equilibrium. Descriptive statistics from EU Labour Force Survey show that desired hours are countercyclical and that the underemployment gap increases due to higher desired hours worked of employed individuals. I identify the effect of recessions on desired hours using variation in regional unemployment rates from 2000 to 2017. I find that a 1 percentage point higher unemployment rate increases desired hours, on average, by 2–8 hours on a yearly level (3–5 minutes in the reference week). The results offer a lower bound estimate for the whole sample period of booms and busts. To narrow the sample period, I use a panel of individuals from the French LFS (EEC) and find even bigger effects. In France, from 2007q4 to 2009q1, an increase in regional unemployment rate by 1 percentage point increases desired hours by 1.6 hours in the reference week. Bottom decile of the income distribution significantly increases desired hours in all countries, suggesting an income effect labour supply response in recessions.

The second essay (Chapter 3) studies the effects of overtime tax introduction. Income from overtime work is subject to income tax in most European countries. However, the effect of higher overtime tax on hours worked has largely remained an unanswered question. This essay examines the re-introduction of French overtime tax in 2012, by comparing workers in large (treated) and small firms (control), before and after 2012. I find that overtime tax reduced actual hours worked, but increased reporting of overtime hours. The result is confirmed using synthetic control estimates for actual hours worked. On the other hand, after the reform, part-time and temporary workers increase their actual hours worked, but not overtime hours. This result suggests that firms adjusted hours of workers whose hours are more flexible, while avoiding the higher cost of overtime hours.

The third essay (Chapter 4) examines the effect of an unemployment shock and unemployment benefit reform to income inequality, through the labour supply channel. The approach to this question contributes to the macroeconomic literature by estimating the labour supply responses to labour market shocks and by simultaneously estimating an ambiguous effect of labour market reform on income inequality. I build a labour supply model which accounts for involuntary unemployment, conditional on country-specific and individual characteristics, and includes preference heterogeneity. The results show that income inequality increases after an unemployment shock, which is largely driven by the upper tail of the income distribution and higher hours worked of employed individuals in the European North. Implementing a higher unemployment benefit reform as a stronger safety net shows a large decrease in income inequality in Germany, driven by the bottom tail of the income distribution. I find a negligible decrease in income inequality in Belgium and Italy and an increase of inequality in Spain.

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Chapter 1

General introduction

This dissertation consists of three essays in labour economics. Its primary focus is labour supply and individual preferences for labour in European countries during recessions. In addition, the thesis examines agents' decisions as a consequence of labour market policies.

The first essay (Chapter 2) documents stylised facts on desired hours per employed worker in European countries. Desired hours worked reveal true preferences on the labour market: how many hours would individuals like to work, in contrast to how many hours they actually work. Desired and actual hours usually differ due to constraints on the labour market: set contracts between the firm and the employee, business cycle adjustments by the firm, or access to childcare. This essay focuses on desired hours changes over the business cycle and finds that recession periods increase average desired hours worked in 12 European countries. I identify the effect of recessions on desired hours using variation in regional unemployment rates from 2000 to 2017. I find that a 1 percentage point higher unemployment rate increases desired hours, on average, by 2–8 hours on a yearly level (3–5 minutes in the reference week). The results offer a lower bound estimate for the whole sample period of booms and busts. To narrow the sample period, I use a panel of individuals from the French LFS (EEC) and find even bigger effects. In France, from 2007q4 to 2009q1, an increase in regional unemployment rate by 1 percentage point increases desired hours by 1.6 hours in the reference week.

The main implication of this finding is that during recessions, workers would like to work more hours than they are contracted for. In other words, the national unemployment rate does not measure the total labour supply pool available for hire, and the difference between desired and actual hours worked should be taken into account if we are interested in knowing how many people are underemployed (not working or working less hours than contracted for). However, it also implies that once the recovery period begins and firms would like to increase their labour demand quickly, they could do this by increasing contractual hours of their employees.

Among several possible reasons for higher labour supply in recessions, I investigate the income effect: are workers at the bottom of the income distribution, part-time and temporary workers more likely to increase labour supply in recessions? This is true for all countries in the sample, with some heterogeneity between them. The bottom decile of the income distribution significantly increases desired hours in all countries, suggesting an income effect labour supply response during recessions.

The second essay (Chapter 3) studies the effects of overtime tax introduction. Income from overtime work is subject to income tax in most European countries. However, welfare effects of higher overtime tax remains an unanswered question. As with any tax, overtime tax could affect the government revenue and potential redistributive effects in the economy. At the same time, overtime tax can be used to incentivise employment. The general mechanism is that firms demand labour through either hiring new workers (employment) or more hours worked (overtime hours). Overtime tax increases the cost of overtime hours, and firms are likely to hire new workers instead, therefore increasing employment. The overall effect of overtime tax is complex and difficult to disentangle due to many interlinked effects on unemployment, hours worked and government revenue. Identifying the effect of overtime tax on hours worked can be the first step towards understanding the overall welfare effects.

This essay examines the re-introduction of French overtime tax in 2012, by comparing workers in large (treated) and small firms (control), before and after 2012. I find that overtime tax reduces actual hours worked, but increased reporting of overtime hours. On the other hand, after the reform, part-time and temporary workers increase their actual hours worked, but not overtime hours. This result suggests that firms adjusted hours of workers whose hours are more flexible while avoiding the higher cost of overtime hours.

The third essay (Chapter 4) examines the effect of an unemployment shock and unemployment benefit reform on income inequality. It is expected that higher unemployment in a country would increase income inequality by extending the bottom tail of the distribution. On the other hand, higher unemployment benefits increase the labour income at the bottom of the income distribution, therefore decreasing income inequality, but could also disincentivise employment and increase unemployment, therefore increasing income inequality. Macroeconomic literature dealing with the relationship between labour markets and income inequality often does not take into account behavioural response to shocks on the labour market due to data limitations. However, among other literature, Chapter 2 of this thesis offers evidence that individuals increase labour supply in recession periods. These findings have important implications for labour supply responses and income distribution. If employed individuals in a recession can increase their hours worked and incomes, they could further amplify income inequality changes which resulted from the unemployment shock.

To answer this question, I estimate the labour supply responses to unemployment shock and simultaneously estimate a potentially ambiguous effect of labour market reform on income inequality. The model accounts for involuntary unemployment, conditional on country-specific and individual characteristics, and includes preference heterogeneity. The results show that income inequality increases after an unemployment shock, which is largely driven by the upper tail of the income distribution and higher hours worked of employed individuals in the European North. Implementing a higher unemployment benefit reform as a stronger safety net shows a large decrease in income inequality in Germany, driven by the bottom tail of the income distribution. I find a negligible decrease in income inequality in Belgium and Italy and an increase in inequality in Spain.

Chapter 5 offers general concluding remarks.

Chapter 2

Desired hours worked over the business cycle: Stylised facts for European countries

2.1 Introduction

Desired hours reveal true individual preferences on the labour market, as they are unconstrained by labour demand, which makes them fundamentally different from actual hours. Actual hours, usually used in the estimation of preferences, are a result of *both* labour supply and labour demand at a given point in time. It is common, especially during recessions, that individuals would like a full-time paying job; however, they settle for a part-time job, due to the lack of availability of full-time jobs or other outside options.

This paper documents stylised facts on desired hours per employed worker, *over time and cross-country*; identifies the effect of recessions on desired hours; and investigates possible reasons for the patterns found. I find that desired hours (true labour supply) are increasing in recession periods and decreasing in boom periods in 12 European countries.

This paper contributes to multiple literature strands: first, descriptive facts presented in the first part of this paper show that there is labour market slack in Europe (defined as the difference between desired and actual hours worked). If the labour market is slack, the unemployment rate does not fully capture the available labour supply in the economy. To shed light on where the slack comes from, I break down desired hours by individual characteristics. Second, precautionary savings theory states that in the presence of an income risk, individuals would consume less and save more. Changes in desired hours during recession periods, when income risk is higher, could signal the precautionary labour supply and explain the precautionary savings mechanism. Jessen, Rostam-Afschar, and Schmitz (2018) use German socio-economic panel data to show that German individuals choose to work 2.8% hours more to shield themselves against wage shocks. Third, it is common to assume that underemployment in recessions increases due to labour demand adjustments. However, if desired hours increase during recessions, the underemployment gap would be driven by the higher labour supply. Similar was shown by Bell and Blanchflower (2018) who also use desired hours worked to calculate over- and under-employment and use it in their Phillips curve estimation. Fourth, real business cycle literature assumes that substitution effect is possible only for a higher wage. Assuming that wage = marginal product of labour, an increase in wages increases the opportunity cost of leisure. This paper shows evidence of the opposite: employees from the bottom of the income distribution would like to work more hours during recession periods.

I analyse desired hours, 1998–2017, in 12 European countries – Austria, Belgium, Czech Republic, Germany, Spain, France, Greece, Ireland, Poland, Portugal and the UK – using EU Labour Force Survey (LFS).[1] The first part of the paper presents descriptive statistics on desired hours per

[1] I selected these countries because there were the least missing observations in variables of interest and there was enough variation in desired hours within each country.

employed individual: descriptive statistics show that desired hours are countercylical. In addition, the underemployment gap is driven by changes in desired hours, rather than actual hours.

The effect of recessions on desired hours is identified using the variation in regional (NUTS 2) unemployment rates over time, for each country in my sample. Desired hours on average increase for an increase in the regional unemployment rate, during the period 1998–2017 for most countries. The magnitude of the effect varies from 3–5 minutes in the reference week in Germany, Czech Republic and Poland, to 9 minutes in Spain. Assuming the same for the whole year, the effect would vary from 2–8 hours per year. However, the effect is negative or statistically insignificant for some countries, like France and the UK. Using a panel of individuals from French LFS (Enquête emploi en continu - EEC), I show that higher unemployment rates increase desired hours by 1.6 hours in the reference week, in the period when the Great Recession started (2007q4–2009q1). This suggests that relatively small effects of 3–5 minutes per week are much larger during recessions.

Desired hours are collected for employed individuals, regardless of whether they would like to work more or less than their current actual hours. Since desired hours are not collected for unemployed individuals, labour market slack, underemployment and the effect of recessions on desired hours are only the lower-bound estimate of the true effect. Any concerns that unobservable characteristics could affect the employment status (for example, that more conscientious individuals remain employed in recessions) are controlled for in the estimation for France using panel data, by adding individual fixed-effects. The effect in France at the onset of the Great Recession, is even larger than the average effect over the whole sample period and without controlling for individual unobservable heterogeneity. This indicates that the sample selection biases the average estimations down.

There are several possible explanations for this pattern of desired hours. One is precautionary labour supply, as discussed above. Second is a wealth effect: if an individual's assets (housing or financial assets) lost value during recessions, she would likely want to work more hours to compensate for the wealth loss. Third, income effect could be in place: for lower labour income, individuals would want to work more hours. In this paper, I focus on the income effect due to data limitations – EU LFS provides only income decile from 2009, and there is no wage or asset information available. However, labour income loss can come from different sources: in recessions part-time work becomes more prevalent (as discussed in Borowczyk-Martins and Lale, 2019 for the US and UK), temporary contracts are more common, partners lose jobs so the household income declines, paid overtime work is less common, while unpaid becomes more common. Results show that individuals in the lower part of the income distribution desire more hours worked for an increase in unemployment rate. The magnitude of the effect is even larger than the average effect, ranging from 8 minutes in the reference week in France to 42 minutes in Ireland. Additionally, part-time and temporary workers increase desired hours, for a higher unemployment rate, in countries where part-time and temporary work was a common adjustment to the recession shock.[2] In Ireland, part-time workers account for almost half of the effect in the bottom part of the income distribution. Similarly, in Portugal, where temporary work is among the highest in Europe, temporary workers desire 10 minutes more in the reference week, for a higher unemployment rate.

The paper that is the closest to my paper in methodology and results is Lazear, Shaw, and Stanton (2016). The authors use state-level variation in unemployment rates to show the effect of the recession on productivity in the US. The increase in productivity is mostly attributed to higher effort in the recession, because upskilling accounts for only 30% of the productivity increase. The authors speculate that higher effort in recessions could be a result of lower outside options when labour demand is low. If leisure is the next best thing, workers are likely to increase effort for a constant wage. My analysis confirms this story for countries where wages have remained constant over the business cycle.

The rest of the paper is as follows: Section 4.3 details the variable desired hours worked and the sample, Section 2.3 presents descriptive statistics on desired and actual hours over time, for each country in the sample and Section 4.4 complements these stylised facts with institutional framework relevant in the interpretation of the results. Section 2.5 discusses the effect of recessions on desired hours and Section 2.6 investigates the income effect. Section 2.7 concludes.

2.2 Data

This paper uses yearly repeated cross-sectional Labour Force Survey (LFS) data, published by Eurostat.[3] Respondents are individuals older than 15, which is the lower working age limit in most European countries. Desired hours are collected from 1998 onwards, although most countries collect them in later years. In this paper, I focus on 12 European countries. Table 2.1 shows the full sample for each country, from the sample beginning indicated in the table until 2017.

The sample is restricted to employed individuals, because the variable of interest – desired hours worked – is not collected for the unemployed. At this point, it is important to address valid concerns that sample selection would bias the results in this paper. If labour market slack and underemployment are higher during recessions, due to changes in desired hours of employed individuals, we can expect that true amounts are even bigger in reality, as more unemployed individuals would like to work some positive number of hours. Similarly, the effect of recessions

[2] Borowczyk-Martins and Lale (2019) find that in the US and UK recessions, labour demand was adjusted on the intensive margin.

[3] LFS also publishes quarterly data, however some variables relevant for my analysis are not available in the quarterly datasets.

on desired hours is only the lower-bound estimate of the true effect. Any concerns that unobservable characteristics could affect the employment status (for example, that more conscientious individuals remain employed in recessions) are controlled for in the estimation for France using panel data, by adding individual fixed-effects. The effect in France at the onset of the Great Recession, is even larger than the average effect over the whole sample period, and without controlling for individual unobservable heterogeneity. This indicates that the sample selection biases the estimations down.

LFS questionnaire contains questions related to desired hours worked and is asked to employed individuals. Individuals are flagged as employed if they worked any positive number of hours in the reference week.

Three questions are asked in the following order:
1. Do you wish to work more than the current number of hours?
2. What is the way you would like to work more hours?
3. What is the total number of hours you would ideally like to work?

Desired hours could be affected by many confounding factors, therefore it is important to note that the questions on desired hours are asked in a way to indicate a corresponding increase in labour income, for a given wage rate. If an individual answers yes to the first question, they indicate how they would like to achieve those hours: through an additional job, current job, different job offering more hours worked or all of the above. Table 2.1 shows that most individuals who want to work more hours, would like to do so through their current job. This is probably due to the cost of job search. The second most common choice is any of the ways offered in the survey.

The next section establishes stylised facts on desired hours graphically over time and cross-country. These stylised facts are then formally tested in Section 2.5.

2.3 Desired hours worked over the business cycle

Table 2.1 shows there is substantial heterogeneity in average desired hours across countries. However, time dimension is more informative, as it offers a common pattern for all countries in the sample. This section establishes two stylised facts on desired hours over the business cycle in selected European countries:

Stylised fact 1. Average desired hours per employed individual are negatively correlated to GDP per capita growth rate.
Stylised fact 2. During recession periods, the gap between average desired and actual hours per employed individual widens, primarily due to an increase in desired hours.

The left column of Figure 2.1 plots average desired hours worked per employed individual on the left axis and GDP per capita growth rate on the right axis. GDP per capita growth rate is a measure of the business cycle comparable across countries. Other measures, for example unemployment rate, can be used in determining a period of a recession in one country over time; however, it is more difficult to determine it cross-country. Figure 2.5 in Appendix 2.A shows the comparison of unemployment rate and average desired hours. For example, it is visible that in the UK, unemployment rate follows the patterns of the Great Recession – increasing in 2008 and decreasing in 2014 – whereas that is not the case in Germany.

During the period observed in the sample, 1998–2017, there were two recessions in Europe: the first one at the beginning of 2000s and the Great Recession, starting in 2009. Average desired hours are countercyclical – whenever the GDP growth rate falls, average desired hours increase. Early 2000s recession was relatively smaller than the Great Recession, therefore it is reasonable to observe that desired hours do not necessarily correspond as much to changes in GDP per capita. This phenomenon could be easily explained by a decrease in actual hours in recessions. However, actual hours worked do not fall significantly during the Great Recession. The right-hand side panel of Figure 2.1 shows that, after 2009, actual hours remain relatively stable or decrease by 1 hour over a few years, at the most. On the other hand, average desired hours increase sharply, therefore widening the gap between actual and desired hours. Therefore, during the Great Recession, underemployment increased primarily due to an increase in desired hours. The fall in actual hours before the Great Recession happened mostly during the economic boom leading up to the Great Recession. This is consistent with findings from Bick, Fuchs-Schuendeln, and Lagakos (2018), where the authors show that actual hours worked decrease with income on the aggregate and individual level.

There is a number of possible explanations for the desired hours pattern. One is precautionary labour supply, as discussed in Jessen, Rostam-Afschar, and Schmitz (2018) for Germany, which means that in a high-income risk situation, individuals would like to work more hours for a given wage rate, to compensate for the future expected income losses. Second is a wealth effect: if an individual's assets (housing or financial assets) lost value during recessions, she would likely want to work more hours. Third, income effect could be in place: for lower-labour income, individuals would want to work more hours to compensate for the loss. In this paper, I focus on the income effect, due to data limitations (there is no wage or asset information in the EU LFS). Labour income loss can come from many different sources: in recessions part-time work becomes more prevalent (as discussed in Borowczyk-Martins and Lale, 2019 for the US and UK), temporary contracts are more common, partners lose jobs so the household income declines, paid overtime work is less common, while unpaid becomes more common. All of these sources of income loss could drive an increase in desired hours for employed individuals during recessions and will be discussed further in Section 2.6. Additionally, the question in the LFS questionnaire is asked to indicate desired hours, for a corresponding income increase and a given wage rate. Therefore, an increase in desired hours on the aggregate level is likely to be a consequence of the desire to increase earnings.

The rest of the paper briefly discusses the historical background of recessions for each country, identifies the effect of the recession on desired hours (test of the Stylised fact 1) and then identifies the income effect.

2.4 Historical background

In Section 2.3, I briefly discuss the existence of two recessions in Europe over the period from 2000 to 2017. In general, the recession at the beginning of 2000s had a much smaller impact on most European economies than the Great Recession and it mostly affected continental Europe. In addition, the Great Recession was a "W-recession", with a brief recovery around 2010, and a consequent dip. We usually measure recessions in terms of negative GDP growth rate; however, in many countries high unemployment rates persisted well after the Great Recession ended in terms of GDP growth rate. Since the two recessions had idiosyncratic effects in European countries, this section outlines country-specific labour market characteristics that could matter in interpretation of desired hours pattern over time, and justify the use of unemployment rates in identifying the effect of a recession *within* one country.

Germany is one of the rare countries, where the recession from 2001 to 2005 had a much larger effects on the labour market than the Great Recession, in terms of both unemployment rates and its persistence. The German unemployment rate was 10% in 2005, steadily decreasing thereafter, being 6% in 2009 and below 4% in 2017. Burda and Hunt (2011) argue that the labour market reforms from 2003 to 2005 reduced unemployment rates and acted as a break on the rising unemployment in the Great Recession. In terms of desired hours worked, I would expect to see that desired hours are much higher around 2005 than 2009 in Germany, which is confirmed on Figure 2.1.

Czech Republic was affected by the recession at the beginning of 2000s, when the unemployment rate was close to 9%. However, in the middle of the Great Recession, unemployment rates never surpassed that number and have declined ever since 2013, amounting to 2% in 2019. Figure 2.1 shows how desired hours start to decrease around 2013 as well.

Similarly, Belgium was affected by the early 2000s recession, where unemployment rates almost reached 9%, which was also true in 2015. Bodart, Dejemeppe, and Linden (2016) argue that this is due to the large differences in Belgian regions, with Southern labour markets performing worse. Additionally, real earnings have been steady since 2000. Real disposable income per capita has surged after 2009 to the level of the 2000.

Austrian unemployment rate has been fluctuating around 4% ever since 2000. Employment has slightly increased since 2005, due to increase in part-time work, as noted by Rene (2016). The effect of the early 2000s recession can be seen in the unemployment insurance recipients around 2004, increasing by around 2 percentage points. There were no significant increases until 2013, when it increased by large 10 percentage points. Real wages have been increasing throughout the 2000s, never falling below the 2000 level.

Prior to the explanation of French recessions, it is important to outline the peculiarities of the French labour law, which are important in the context of desired hours. In 1998 and 2002, for large and small companies respectively, France re-implemented a 35-hour weekly cap on hours worked (Askenazy, 2013). In addition, Sarkozy incentivised longer work hours by detaxing overtime hours in 2007, which was then abolished in 2012 by Hollande, due to high unemployment rate and a high budget deficit. Due to these changes which could directly affect individual desired hours, it is difficult to identify the effect of recessions on desired hours in France. However, it seems that unemployment rates were higher after the Great Recession, peaking at 11% in 2014.

In Portugal, unemployment rates soared from below 5% in 2000 to above 15% in 2013. As noted by ILO (2018) report, Portugal has a long history of common temporary and fixed-term contracts, which became even more common during the Great Recession. Additionally, even after unemployment rates lowered to pre-crisis levels, job quality and wages remained low. Therefore, we can expect that temporary workers could help explain desired hours pattern, even though the breakdown of average desired hours by temporary and permanent work does not show large differences between the two groups.

Spanish labour markets were hit by the Great Recession the hardest in Europe. Spanish unemployment rate soared to above 25% in 2013, from a relatively low 10% at the beginning of the 2000s. As noted by Teraskaya and Galdeano (2017), temporary work was common among young workers, however the overall rate of temporary work decreased in the wake of the Great Recession. One of the main issues is that real wages decreased after 2010 and have not yet returned to pre-crisis levels. Therefore, desired hours should increase with unemployment.

Alongside Spain, Greece had the second-highest unemployment rate in Europe, post-2008, peaking at 25% in 2013. Even in 2017, the unemployment rate is at high 20%. Wages fell due to decentralising collective bargaining from the sector level to individual companies, alongside the fall of the minimum wage purchasing power by almost 25% from 2010 to 2014. Labour market indicators still show the effects of the recession, over 10 years since its beginning (OECD, 2017).

In the UK, there was no visible effect of the early 2000s recession. The Great Recession seemed to have a lower effect then the recessions in the 1980s and 1990s, however it persisted for longer.

Unemployment rates peaked at just above 8%, which is lower than even the EU average – 12% (Coulter, 2016). Real wages have decreased by 1.2% in 2008, one year before the recession affected the rest of European countries. Figure 2.1 shows that the increase in desired hours coincides with the start of the recession in 2008.

The Irish economy suffered from 10 percentage points' change in unemployment rates, peaking in 2012 at around 14%. At the same time, real and nominal wages were decreasing from 2009 to 2011 (Barret and McGuiness, 2012). The Great Recession affected all of the economy, but more so highly skilled individuals (Berscholz and Fitzgerald, 2016) and increased the number of part-time workers, especially those under 25. Roughly 40% of the part-time workers worked part-time because they could not find a full-time job (Walsh, 2015). Therefore, I expect to see changes in desired hours worked overall because of the wage decreases, but from part-time workers as well.

Poland is the only country where GDP growth rates never turned negative. Unemployment rates decreased by 10 percentage points from the beginning of 2000s to 2010. Regardless, real wage growth dropped from 6% to 0 in 2012. Employment protection was less, increasing the share of temporary work, which stopped growing only after 2015 (Lewandowski and Magda, 2018). Therefore, regardless of the fact that Poland has not officially suffered a recession, I expect to see increases in desired hours after 2009.

In Finland, unemployment rate increased by over 2 percentage points in just one year, from 2008 to 2009, and continued to rise until 2015, reaching almost 10%. Kyyra and Pesola (2016) note that long-term unemployment and underemployment seem to be of particular concern since the onset of the Great Recession. These concerns are accompanied by non-increasing real earnings since 2010, possibly as a consequence of a highly centralised bargaining system. Additionally, NOKIA used to be an important pillar of the Finnish economy, but has not adjusted to the new market of smartphones. Suni and Vihriala (2016) report that NOKIA's performance contributed to 1/3 of the GDP decline and 1/5 of the reduction of total employment from 2008 to 2014.

2.5 The effect of recessions on desired hours

This section tests Stylised fact 1 – the effect of recessions on desired hours is positive. A measure of recession should be exogenous, have variation within a country and over time and its marginal effect on desired hours should be comparable across countries. Therefore, I use regional unemployment rates within each country. The regressions are done country by country and not pooled together because recessions were idiosyncratic in Europe, with different labour market institutions at play which could all affect the unemployment rates and bias the estimates.

I first estimate the effects of regional unemployment rates using EU LFS data for all European countries. However, EU LFS does not contain a panel component and the results could potentially be driven by the composition effect – simply that more individuals who would like to work more hours are being surveyed. To address this concern, I estimate the same marginal effect for France using French Labour Force Survey (Enquête emploi en continu - EEC), obtained from the producer Insee through the platform Quetelet. The big advantage of the data sourced from the national producer is the availability of the panel component. The results from France confirm the cross-country analysis for other countries.

2.5.1 The effect of recessions on desired hours – cross-country analysis

To be able to identify the effect of recessions on desired hours, (i) regional unemployment rates should vary within a country and (ii) unemployment rate changes over time should vary between regions. For example, in the UK's Northern Ireland, unemployment rate grew by 3 percentage points: from 4.4% in 2008 to 7.4% in 2012, while in the East of England it grew by only 0.5 percentage points: from 6.2% in 2008 to 6.7% in 2012. Variation in regional unemployment rates and their changes over time can be found in all countries in the sample.[4]

The effect of recessions on individual desired hours is estimated in the most general specification for each country separately:

$$hours_{irt} = \alpha_0 + \alpha UR_{rt} + \beta^{'} X_{irt} + \mu_r^1 + \mu_t^2 + X_{irt} * \mu_r^1 + \mu_r^1 * \mu_t^2 + \epsilon_{irt} \tag{2.1}$$

$hours_{irt}$ are desired hours for each individual i in region r in year t. The marginal effect of interest is α as it captures the effect of regional unemployment rate UR_{rt} on individual desired hours. I control for individual characteristics X_{irt}: quadratic age polynomial, education, gender, part-time work, number of employed individuals in the household, sector and occupation dummies, temporary work, urban area dummy. Regional fixed effects μ_r^1 account for between-regional differences, constant over time. Year fixed effects μ_t^2 remove time-varying unobservables to desired hours. $\mu_r^1 * \mu_t^2$ remove unobservable trends between regions, like country-level institutional changes on the labour market. Interactions between observable characteristics and regional fixed effects account for possible differences between regions in terms of individual labour market preferences. Therefore, the model is identified using the variation in regional unemployment rates UR_{rt}, for a given year.

The only possible variation this specification does not capture are individual fixed effects, potentially capturing time-invariant individual unobservable heterogeneity, like ability. This variation,

[4] Regional unemployment rates are available on Eurostat Database, retrieved 11/02/2020.

therefore, might affect the *level* of desired hours within a country, but not the marginal effect of the unemployment rate on desired hours *over time*. The next subsection, on the French panel data is estimated controlling for the individual fixed effects and therefore solves this potential source of the bias in the model.

The results are presented in Figure 2.2 and Table 2.2, upper panel. Figure 2.2 shows that regional unemployment rate (UR), *on average, over the whole sample period* has a positive effect on desired hours in half of the countries in the sample. The coefficient ranges from around 0.05 in Germany, Czech Republic and Poland, to 0.15 in Spain. This means that for a 1 percentage point higher unemployment rate in a region, individuals increase their desired hours worked by 0.05 x 60 minutes = 3 minutes in a reference week (Germany, Czech Republic, Poland) to 0.15 x 60 minutes = 9 minutes, in Spain. On a yearly level, this amounts to 2.6–7.8 hours. I find a negative or insignificant effect in France, the UK, Austria, Portugal, Greece and Belgium.

The effects from equation (2.1) are estimated on pooled periods, similar to Lazear, Shaw, and Stanton (2016), where boom and bust periods are pooled. Therefore, these effects are the conservative estimation of the desired hours changes for an increase in the regional unemployment rate.[5]

To decrease the bias of time fixed effects and estimate the effect of recessions on desired hours, I include a recession dummy variable in the equation 2.1 from above:

$$hours_{irt} = \alpha_0 + \alpha_1 UR_{rt} + \alpha_2 recession_t + \beta^{'} X_{irt} + \mu_r^1 + \mu_t^2 + X_{irt} * \mu_r^1 + \mu_r^1 * \mu_t^2 + \epsilon_{irt} \quad (2.2)$$

As before, $hours_{irt}$ are desired hours for each individual i in region r in year t, UR_{rt} is the regional unemployment rate, X_{irt} are individual characteristics: quadratic age polynomial, education, gender, part-time work, number of employed individuals in the household, sector and occupation dummies, temporary work, urban area dummy. μ_r^1 are regional fixed effects and μ_t^2 are time fixed effects. $recession_t$ is equal to 1 if national GDP per capita growth rate is negative and 0 otherwise. α_2 captures the effect of the national level dip in GDP per capita, which was captured by time fixed effects in equation (2.1).

The results are presented in Table 2.2, bottom panel. I focus first on the countries where there was no effect of regional unemployment rates on desired hours: France, the UK, Austria, Portugal,

[5]This is confirmed on the French panel data, where the effect on desired hours during the recession period is positive and statistically significant, even though the average effect for France in this specification is not.

Greece[6] and Belgium. In France, recession increases desired hours by 22.5 minutes in a reference week or 19 hours on a yearly level. Even larger effects are found in Austria and Portugal. In countries where higher unemployment rates increased desired hours, the magnitude of the effect increases, confirming that the previous specification underestimated the effect.

The empirical model above is identified with regional unemployment rates. It is fairly straightforward to see that, using regional unemployment rates, the model does not suffer from reverse causality, as individual desired hours will not affect the unemployment rate. Omitted variable bias can come from anything that would affect desired hours and vary with the regional unemployment rate. On the country level, vacancy rates could have a negative effect on desired hours, and negatively correlate with unemployment rates. Changes in vacancy rates over time will be removed by time fixed effects. On the regional level, labour pooling could have an effect on desired hours. For example, if one region specialises in a sector where people would like to work more hours, which is usually the case in IT or start-up industries, this would cause endogeneity of my estimates. Any differences between regions are being removed by region fixed effects. If there are any institutional changes on the regional level, they will be removed by the interaction between time and region fixed effects. The only variation that I am not able to capture with the existing specifications is individual unobservable variation, constant over time. This variation might affect the level of desired hours within a country, however not the marginal effect of the unemployment rate on desired hours over time. Therefore, I estimate the same specification as in equation (2.1) on a panel of individuals in France in the next section.

2.5.2 Panel analysis of the effect of the Great Recession on desired hours in France

This section replicates the results from the previous subsection 2.5.1, on a panel of individuals, to solve the potential issue of endogeneity and composition effect discussed above. I utilise panel data from the French Labour Force Survey (Enquête emploi en continu - EEC), obtained from the producer Insee through the platform Quetelet. Data is published on a quarterly level, and consists of a rolling panel of individuals. Individuals are interviewed for 6 waves. Each quarter, 1/6 of individuals from the previous wave is replaced by new individuals.

The goal of this section is to estimate the effect of the Great Recession on desired hours using a panel of individuals. The Great Recession in France started in the second quarter of 2008. I use a period of 6 quarters, from 2007q4 to 2009q1, covering the time just before the onset of the recession and its beginning. The regression will estimate the average effect of the change in regional unemployment rate on desired hour, over that period. As a comparison of the effect, I add 3 additional time periods: before the Great Recession (2006q1–2007q2), during the recession

[6] In Greece, the sign of the unemployment rate changed, compared to the previous specification, pointing to multicollinearity, which is confirmed by a very high VIF.

and a small recovery (2009q4–2011q1), and after the recession (2015q1–2016q2). I expect to see a positive and significant effect of the recession in the period of interest (2007q4–2009q1), but a negative and/or insignificant effect in other periods.

Summary statistics of the panel individuals included in the empirical specification is presented in Table 2.3. There are over 1000 individuals in all 4 samples.

Some individuals do not answer the question on desired hours in all waves, hence the lower number of individuals in the regression results. It is interesting to note that desired hours are consistently higher than actual hours, probably due to the national cap on hours worked in France. Actual hours decline in the post-recession sample from 2015, consistent with Bick, Fuchs-Schuendeln, and Lagakos (2018).

Similar to equation (2.1), I use the four samples from Table 2.3 to estimate the effect of the Great Recession on labour supply:

$$hours_{irt} = \alpha_0 + \beta_0 UR_{rt} + \beta^{'} X_{irt} + \alpha_i + \mu_r^1 + \mu_t^2 + X_{irt} * \mu_r^1 + \mu_r^1 * \mu_t^2 + \epsilon_{irt} \tag{2.3}$$

$hours_{irt}$ are desired hours for each individual i in region r in quarter t. β_0 is the marginal effect of regional unemployment rate UR_{rt} on individual desired hours. X_{irt} is a vector of individual characteristics: quadratic age polynomial, education, gender, part-time work, 3-digit ISCO occupation dummies, type of contract and population density dummies. Regional fixed effects μ_r^1 account for between-regional differences, constant over time. Time fixed effects μ_t^2 remove time-varying unobservables to desired hours. $\mu_r^1 * \mu_t^2$ remove unobservable trends between regions, like country-level institutional changes on the labour market. Interactions between observable characteristics and regional fixed effects account for possible differences between regions in terms of individual labour market preferences. α_i are individual fixed effects, which capture any potential unobservable time-invariant characteristics. Therefore, the model is identified using the variation in regional unemployment rates UR_{rt}, for a given year.

Equation (2.3) is estimated using the random effects model,[7] because the variation in desired hours comes from both within (over time) and between individuals. Figure 2.3 shows the coefficient β_0 from equation (2.3) in all 4 time periods. The period of interest is 2007q4 to 2009q1, because it covers the time before the onset of the recession and its beginning in 2008. The average increase in desired hours as a consequence of 1 percentage point higher unemployment rate is statistically significant and is 1.6 hours in the reference week. There are two interesting things to note about this finding. First is the comparison of this effect to the result in Table 2.2, where the effect of the

[7] Table 2.4 shows a comparison of the random effects model to the fixed effects and OLS estimators.

recession *decreases* average desired hours. This suggests that the average effect over the entire period (2003–2017) is biased downwards and that the true effect of the recession on desired hours is larger. This likely explains the differences in magnitudes of the effect for other countries as well. Second, the downward bias is further confirmed by looking at the effects in other (non-recession) periods in Figure 2.3, which are either statistically insignificant and/or negative.

The choice of random effects as a preferred specification is easily justified by poor estimates produced by OLS and FE models in Table 2.4. OLS is biased in the opposite direction of the RE estimates: in the period of interest (2007–2009), OLS is much lower and statistically insignificant. However, this is comparable to the estimates from the EU LFS data, where the effect is of similar size and also statistically insignificant. The bias comes from the fact that OLS cannot pick up the variation in both between and within variation in desired hours. Furthermore, FE estimates have a very low R^2, due to low within variation, coming from variables that do not vary over time, for example gender and occupation. This is confirmed by a very high fraction of variance coming from the time-invariant fixed effect – ρ in the table. There is also variation in desired hours between individuals, which is not captured by the FE model. Hausman test confirms the choice of the RE over the FE model.

2.6 Desired hours and the income effect

This section discusses income effect as a possible driver of desired hours increases during recessions. The first subsection presents descriptive statistics of possible income effect mechanisms (part-time and temporary work, overtime hours and number of employed individuals in the household). The second part of this section tests the income effect hypothesis in an empirical model.

2.6.1 Income effect mechanisms

European LFS, instead of wage information, contains individual income decile information from 2009. The variable consists of imputed values from 1 to 10, based on the individual labour income and national income distribution. Figure 2.6 in Appendix 2.B shows country-level average desired hours by each decile.[8] Without detailed income information, changes in desired hours by income deciles could be driven by the composition effect – more individuals surveyed at the bottom of the distribution. The right-hand side panel of Figure 2.6 shows the share of individuals in each income decile, where the shares change in a similar direction over time in most countries. Therefore, it is informative to observe country-level average desired hours by each decile. In most countries, desired hours at the bottom are the lowest, while the top decile has the highest desired hours. In some countries it is visible, even on the country level, that the bottom of the

[8] I use this variable in Section 2.6.2, on the regional level, which offers more variation within each country.

income distribution changes desired hours more than the rest of the distribution (Poland, Ireland, Portugal, Greece). In Spain, median earners desire the highest hours worked, but the top of the distribution increases their desired hours the most after 2009. One possible explanation could be that they have lost the most income in absolute terms and that income elasticities are higher for the top of the distribution. If this is compounded with wealth losses (housing prices, financial wealth), the richest individuals would increase desired hours the most. I cannot disentangle these effects due to the lack of information on wealth, however income and wealth distributions in European countries positively correlated (HFCN, 2016).

Borowczyk-Martins and Lale (2019) find that labour demand adjusted on the intensive margin during the Great Recession in the US and UK, rather than on the extensive margin. If this holds for other countries except the US and UK, new part-time workers would probably desire to work their previous full-time hours. In that case, my first stylised fact – that desired hours are countercyclical – could be driven by part-time workers. Figure 2.7 in Appendix 2.B shows average desired hours for part-time and full-time workers over time. Part-time workers, rather than full-time, increase desired hours in only a few countries during recession times: the UK, Ireland and Sweden. This is consistent with the findings from Borowczyk-Martins and Lale (2019). In the remaining 10 countries, both full-time and part-time workers increase desired hours simultaneously. In Spain during the Great Recession and in Austria at the beginning of 2000s, full-time workers are the ones who primarily increased their desired hours worked. These descriptive statistics go against the literature findings and predictions of an income effect theory.

On the other hand, paid and unpaid overtime hours could correlate with desired hours in different directions. Unpaid overtime hours often increase during recession periods, due to labour demand adjustments and firms' financial constraints. This could be exacerbated if the legislative mandates higher wage rates for overtime work, but does not regulate unpaid overtime hours. Individuals working unpaid overtime hours would potentially like to work more hours, to receive compensation for their unpaid hours. On the other hand, paid overtime hours mostly require a higher wage rate in European countries. If there is less paid overtime work available during recession periods, individuals will desire more hours worked, as they otherwise lose earnings from overtime hours. On the other hand, if overtime hours are necessary due to labour demand adjustments, paid overtime hours could be higher during recessions and correlate with desired hours ambiguously.

To observe these mechanisms between overtime and desired hours, I plot average desired hours with average paid and unpaid overtime hours on Figure 2.8, Appendix 2.B. Since we can expect different relationships between overtime and desired hours, I group countries based on Figure 2.8: i) paid and unpaid overtime hours negatively correlate with desired hours (Germany, France, Belgium, Greece); ii) unpaid overtime and desired hours positively correlate (UK, Spain); iii) paid overtime negatively correlates with desired hours (Portugal); iv) paid and unpaid overtime hours positively correlate with desired hours (Ireland, Poland, Austria, Finland). Correlations in groups ii) and iii) could indicate an unambiguous income effect. In most countries however, the figure suggests an ambiguous relationship between overtime and desired hours. Due to small shares of individuals in each country working overtime hours, I will not discuss the relationship between overtime and desired hours further.

Temporary contracts were on the rise in European countries during the Great Recession. For employees on temporary contracts, the future is uncertain. It is possible that they would like to work more hours now out of precautionary reasons. Figures 2.9, Appendix 2.B show that this is true for Greece, Ireland, Austria and Germany after the early 2000s recession. Spanish temporary workers desire more hours than permanent, however permanent increase their desired hours more at the onset of the Great Recession. In the UK, Czech Republic and France, the opposite is suggested: temporary workers react during the recession more; however, the level of desired hours is lower than permanent workers' hours. In Poland and Portugal, both permanent and temporary workers increase their amount of desired hours. This suggests that there is a lot of heterogeneity cross-country, because temporary work regulation depends on the country-specific employment protection legislation, similar to overtime work discussed in the previous paragraph.

Individuals could also target household level incomes. In a scenario where an individual's partner loses a job, she could increase desired hours to compensate for her partner's lost income. LFS does not collect information on the labour status of the workers' partners. However, variable *hhnbwork* counts the number of individuals working in the household. Average desired hours by the number of working individuals in the household move together, and there are no changes around the recession period that would suggest otherwise (Figure 2.10). Desired hours by age, educational levels and gender, even though interesting, do not show any pattern relevant for this discussion. Figures 2.11, 2.12, and refgender in Appendix 2.B show average desired hours by age, education and gender.

2.6.2 Desired hours and the income effect during the Great Recession

The previous section discusses that a positive effect of recessions on desired hours holds in most countries from the sample. This section aims to discuss the income effect: do poorer individuals in high-unemployment areas and years, have higher marginal effect on desired hours worked? I use income decile information, for the available period (2009–2017) and include income decile dummies, alongside interaction terms with the regional unemployment rate. Regression 2.1 can be modified in the following way:

$$hours_{irt} = \alpha_0 + \alpha UR_{rt} + \gamma' UR_{rt} * decile_{irt} + \beta' X_{irt} + \mu_r^1 + \mu_t^2 + \mu_r^1 * \mu_t^2 + X_{irt} * \mu_r^1 + decile_{irt} * \mu_r^1 + \epsilon_{irt} \tag{2.4}$$

Income effect is captured by marginal effects of the interaction terms $UR_{rt} * decile_{irt}$ between income deciles and regional unemployment rates. I add the interaction between income deciles and region fixed effects, $decile_{irt} * \mu_r^1$ to remove the differences between regions and income deciles (for example, if richer individuals cluster in one region, which could be driven by sector activity).

Figure 2.4 presents key coefficients from regression 2.4, particularly the interaction terms between income decile and regional unemployment rates. Decile 5 is left out, so all the coefficients should be interpreted compared to the median. In most countries, the poorer income deciles increase their desired hours alongside an increase in the unemployment rate. This is now also true for countries in which the average effect of higher unemployment does not increase desired hours. In France, Portugal and Greece, a higher unemployment rate significantly increases desired hours, for the first decile; in Austria this holds for the second and third decile. The income effect does not seem to hold in Finland – an unemployment rate increase does not significantly affect desired hours at the bottom of the distribution, but rather for the tenth decile, the richest individuals in Finland. The same is true in Spain. Ireland is an exception, as both tails of the income distribution seem to react to higher unemployment rates by increasing desired hours.

Magnitudes on the income decile level are much higher than the average effect discussed in the previous section. In the first income decile, marginal effects range from 0.132 in France to 0.67 in Ireland, translating to 8–40 minutes in the reference week or 6.8–36.4 hours on a yearly level. In Ireland, the magnitude of the effect means that the poorest individuals would like to, on average, work an entire week more per year. It is likely that the effect from income deciles is driven by other mechanisms of the income effect, discussed in Section 2.6 – part-time and temporary work.

In order to capture the effect of part-time and temporary work in a recession, I include interaction terms between part-time dummy and regional unemployment rates and temporary work and regional unemployment rates in equation (2.4). The results are presented in Table 2.6. Part-time workers would like to work more hours, for a higher unemployment rate in half of the sample: France, Austria, Poland, Greece, Czech Republic and Ireland. Ireland is one of the countries where this results was suggested even by the descriptive statistics from Figure 2.7. In Portugal temporary workers want to work more hours, since Portugal has a long history of temporary work and one of the highest shares of temporary employees in Europe (discussed in Section

4.4). As in the previous specification, which included only the income deciles, in Germany, the UK and Finland, adding part-time and temporary work did not change the effects I find in the previous specification. Spain is the exception, as the income effect does not seem to explain the countercyclicality of desired hours. On the contrary, including additional interaction terms to the specification, increased the coefficient on regional unemployment rates, and it now translates to almost 10 hours more on a yearly level, for a higher unemployment rate.

Similar endogeneity discussion to the one in Section 2.5.1 can be added here. For the sake of brevity, there are only a few notes that should be added here. On the individual level, wealth effect could explain desired hours: if rich individuals' wealth lost value during recessions (for example, financial wealth or housing), they would like to work more during recessions. According to HFCN (2016), income and wealth inequality are highly correlated in Europe. Therefore, by including income deciles in equation (2.4), I approximate the wealth effect on desired hours. The only country where the richest individuals desire more hours is Finland. However, income deciles are not able to estimate the wealth effect, and due to the lack of wealth information, any changes on the individual level over time are removed by time fixed effects. The same is true for changes in household-level incomes as well (for example, if a spouse or a partner lost their job).

2.7 Discussion and conclusion

In this paper, I show that, in 12 European countries, desired hours worked fall in the boom periods and increase in the recession times, in 12 European countries. Using regional variation in unemployment rates and idiosyncratic changes of regional unemployment rates over time, I identify the effect of the recession on desired hours worked, using a repeated cross-section of individuals using EU LFS panel data. The magnitude of the effect is quite large on the yearly level, varying from 2.6 hours in Germany, Czech Republic and Poland, to almost 8 hours in Spain. These results are biased because of the possible composition effect, and they represent an average effect over the entire period of booms and busts. This drawback is circumvented by using a panel of individuals in the French LFS. The results confirm that desired hours increase at the recession beginning (2007q4–2009q1), while the effect is negative and insignificant in other periods (before and after the Great Recession). This finding supports the idea that OLS results on all countries using EU LFS are biased down and therefore offer a conservative estimate of the effect of recessions on labour supply (desired hours).

Out of several possible explanations of this pattern, I focus on the income effect: poorer individuals or individuals could desire more hours during recessions. This is true in all countries, with even larger effects on desired hours, ranging from 6.8 hours on a yearly level in France to 36.4 hours in Ireland. An exploration of the potential mechanism of the income effect confirms the income effect in countries where part-time and temporary work was a common adjustment to the recession. In Ireland, part-time workers account for almost half of the effect in the bottom part of the income distribution. Similarly, in Portugal, where temporary work is among the highest in Europe, temporary workers desire 10 minutes more in the reference week, or 8 hours more on a yearly level, for a higher unemployment rate.

There are two exceptions to the income effect finding. In Spain, adding part-time and temporary workers increases the average effect of regional unemployment rates on desired hours to almost 10 hours on a yearly level. The second exception is Finland, where the richest decile increases desired hours by 22 hours per year. This could possibly be due to changes in non-labour income, which is left to be investigated in future work. Ideally, income and wealth effect of the labour supply should be shown using a reliable tax-administrative income and wealth information. Surveyed, self-reported incomes suffer from substantial measurement error. I hope this opens a path for new and exciting future work using LFS desired-hours-worked variable, merged with reliable income and wealth sources.

There are several implications of the findings presented in this paper. Desired hours measure true preferences on the labour market, because they are not constrained by the labour demand, as actual hours are. This implies that preferences change over the business cycle, in particular, with the unemployment rate. Even though the business cycle literature assumes that the opportunity cost of leisure decreases in recessions, individuals are likely to want to work more hours due to restricted outside options or lost income. The lost income could be driven by lower wages, lower actual hours worked available or more uncertain contracts prevalent on the labour market. Therefore, the empirical finding offers a labour-market puzzle to be further modelled in the theoretical literature. Finally, I find that the underemployment during recessions is driven by labour supply changes, in addition to the demand adjustments. The Great Recession clearly was a labour demand shock. However, it also caused a positive labour supply shock, as identified in this paper.

Table 2.1: Descriptive statistics on desired hours worked

Statistic	AT	BE	CZ	DE	ES	FI	FR	GR	IE	PL	PT	UK
Sample beginning	1998	1999	2002	2005	1999	1998	2003	1999	1998	2000	1998	1999
Average desired hours	36.3	40.8	39.4	36.2	39.3	37	37.7	41.6	36.9	40.5	40.3	38.2
SD desired hours	1	1.6	.3	.5	1.3	.3	.2	.7	.5	.3	1.2	.4
Average actual hours	37.4	36.5	40.8	36.2	37.9	36.3	36.7	41.4	36.4	39.7	38	35.5
SD actual hours	1.6	.5	1.3	1.1	.7	.6	1.1	.5	1.5	.4	.7	.3
Employment rate	95.9	91.9	93.3	93.2	85.5	91.8	90.2	85.1	91.3	89.9	90.2	94.5
% wish to work more hours	6.8	8.2	1.1	5.6	6	5	15.1	6.4	9.1	7.3	12.6	7.2
...through an additional job	13.7	7	5.4	14	3.7	4.6	4.6	14.5	.7	19.2	4.6	9
...through a different job	16.2	9.2	23.1	10.9	14.1	12.1	5.7	11.9	1.9	20.6	9.7	16.3
...through current job only	58.3	70.7	54	59.2	40.2	60.9	68.6	34.9	46	47.1	62.7	55.7
...any of the above	11.8	13.1	17.6	15.9	35.7	22.2	18.7	38.7	47.1	13.1	22.6	18.7

Notes: The sample period for each country starts in the *Sample beginning* year and ends in 2017. Employment rate is included for cross-country comparison only. Average desired and actual hours are calculated per employed individual. *% wish to work more hours* is a share of employed individuals who want to work more hours.

Figure 2.1: Countercyclicality of desired hours and actual hours worked

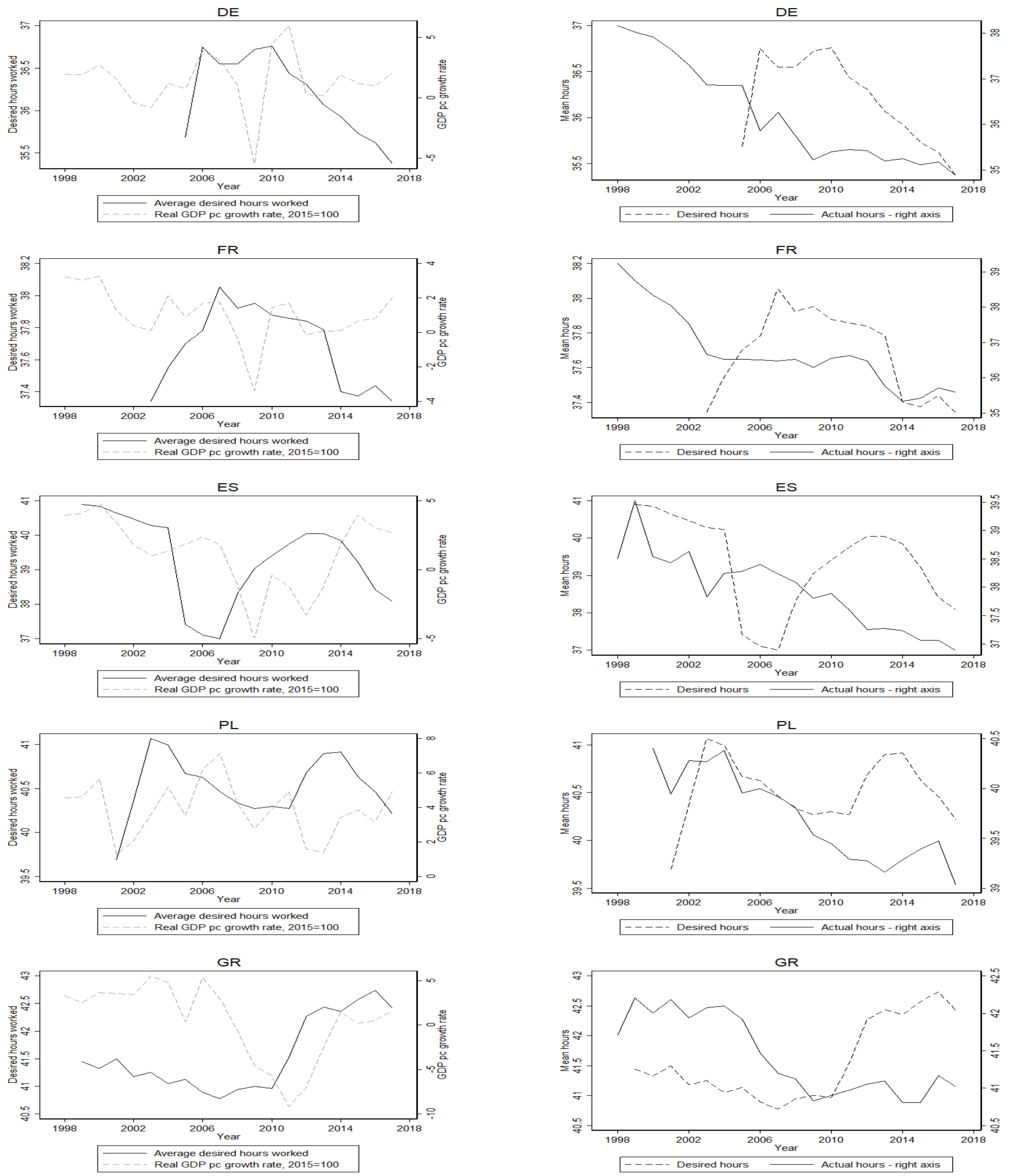


Figure 2.1: Countercyclicality of desired hours and actual hours worked (continued)

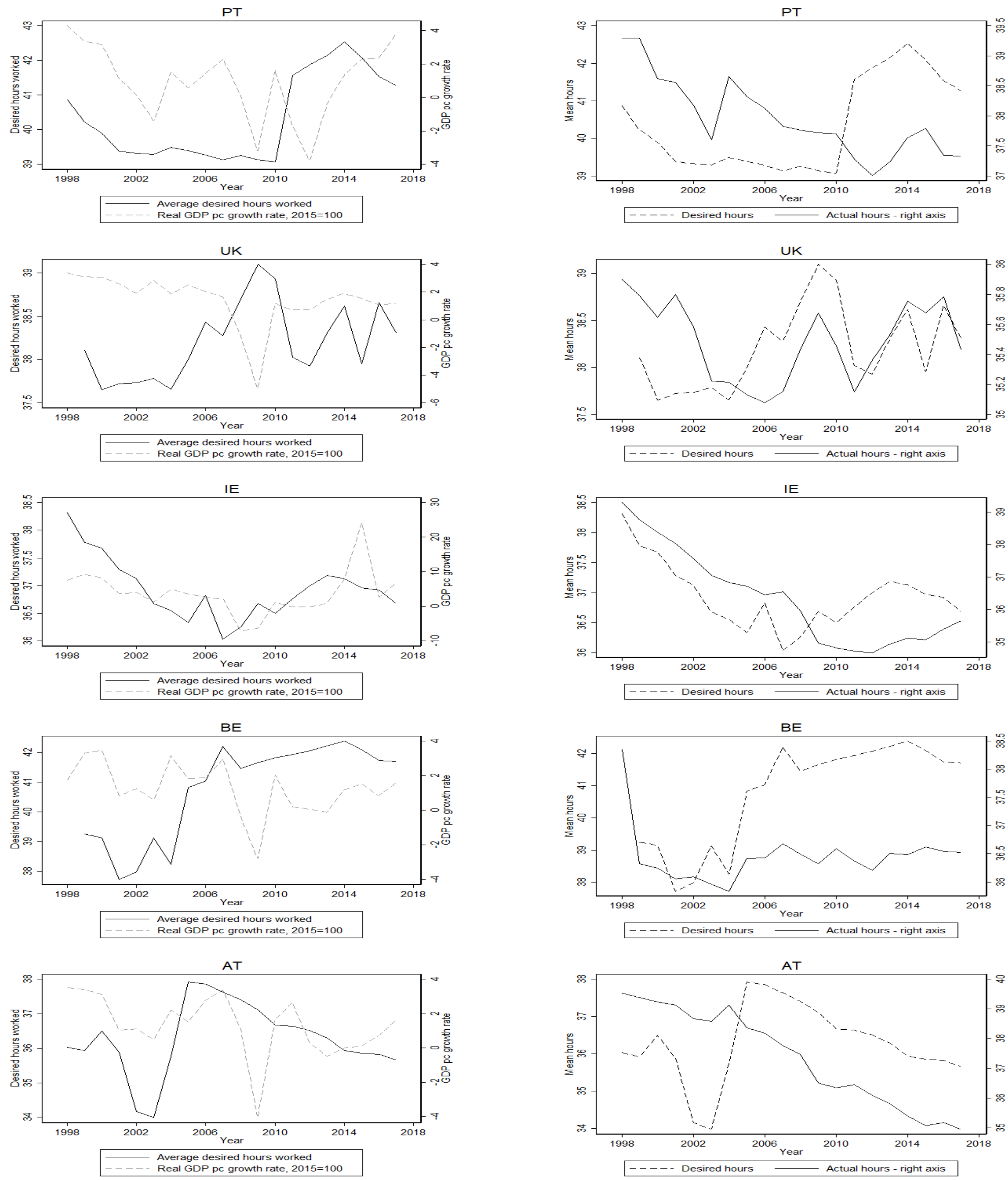
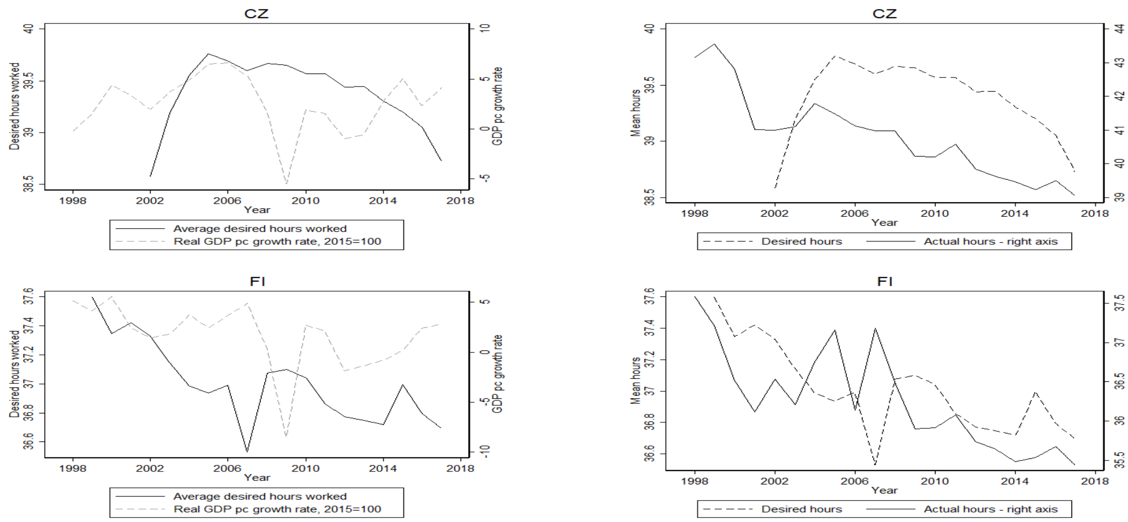
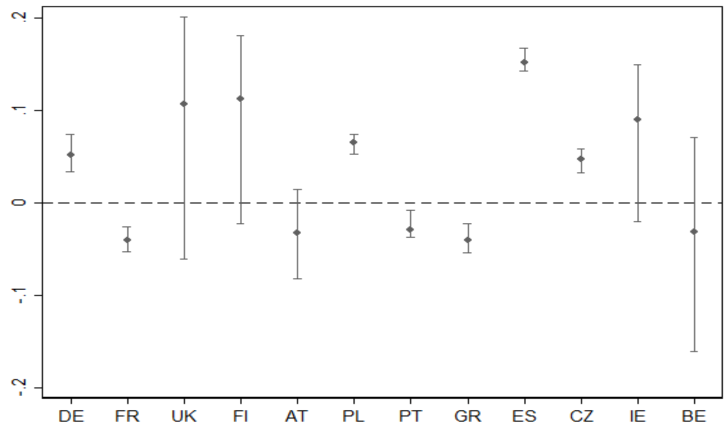


Figure 2.1: Countercyclicality of desired hours and actual hours worked (continued)



Notes: The left column plots average desired hours worked for employed individuals in each country in each time period, with GDP per capita growth rate. The column on the right plots average actual and desired hours worked of employed individuals. Average hours worked are calculated from the EU LFS dataset, and GDP per capita is retrieved from Eurostat Database.

Figure 2.2: The effect of regional unemployment rate on desired hours



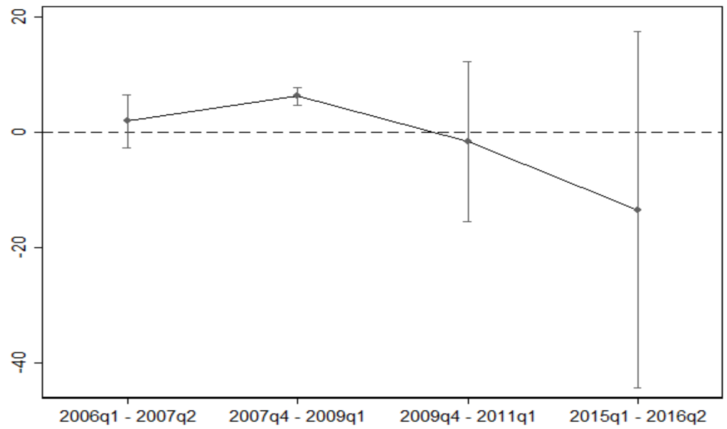
Notes: This figure shows the average marginal effect of regional unemployment rate on desired hours over the available time period for each country. It plots the coefficient α from equation (2.1) and the corresponding 95% confidence intervals. Dependent variable is desired hours worked. Additional specification of the same equation is presented in Table 2.2.

Table 2.2: The effect of recessions on desired hours worked
Dependent variable: desired hours

	DE	FR	UK	FI	AT	PL	PT	GR	ES	CZ	IE	BE
Regional UR	0.0523***	-0.0401***	0.107	0.112**	-0.0326	0.0656***	-0.0287**	-0.0400***	0.152***	0.0473***	0.0896*	-0.0316
	(0.00985)	(0.00729)	(0.0668)	(0.0427)	(0.0250)	(0.00482)	(0.00888)	(0.00799)	(0.00745)	(0.00661)	(0.0375)	(0.0768)
N	1427331	1942849	77798	189835	1187712	1632316	999702	1027185	523613	839814	804519	53210
adj. R^2	0.591	0.323	0.467	0.352	0.470	0.306	0.403	0.274	0.275	0.341	0.534	0.331
Regional UR	0.241***	-0.505	-0.873	1.197	-0.201	1.975***	-0.339***	1.940***	0.425***	0.201***	0.410*	0.680
	(0.0576)	(0.412)	(0.920)	(0.674)	(0.151)	(0.288)	(0.0592)	(0.239)	(0.0686)	(0.0441)	(0.194)	(1.540)
Recession = 1	-4.893***	0.375	0.0629	5.236	1.595***	0	6.546***	-29.96***	0.362	0.928***	-3.263	0.582
	(0.424)	(0.222)	(1.131)	(2.807)	(0.211)	(0)	(0.748)	(4.078)	(0.603)	(0.234)	(1.856)	(4.670)
N	1427331	1942849	77798	189835	1187712	1632316	999702	1027185	523613	839814	804519	53210
adj. R^2	0.591	0.323	0.467	0.352	0.470	0.308	0.404	0.276	0.280	0.342	0.534	0.334

Notes: This table presents the results of equations (2.1) in the upper panel and (2.2) in the bottom panel. Bootstrap standard errors are in parentheses. The sample is a repeated cross-section of working-age, employed individuals who answered the question on desired hours. Regressions include individual characteristics (quadratic age polynomial, education dummies, gender, part-time work, temporary contract, population density, occupation and sector dummies), region and time fixed effects and the interactions between them. Interacting the recession dummy with the regional unemployment rate yields similar results, apart from the UK where the interaction coefficient is 1.2 and statistically significant. I do not show the results here because of high collinearity that the interaction imposes in the regression.

Figure 2.3: The effect of unemployment on desired hours in France



Notes: This figure shows marginal effects of regional unemployment rate on desired hours from 4 regressions in the labelled time periods. It plots the coefficient β_0 from equation (2.3) and the corresponding 95% confidence intervals. Dependent variable is desired hours worked. Additional specifications of the same equation is presented in Table 2.4.

Table 2.3: Descriptive statistics on desired hours worked for French panel data

	2006q1 - 2007q2	2007q4 - 2009q1	2009q4 - 2011q1	2015q1 - 2016q2
Average desired hours	39.6	39.1	39	38.6
SD desired hours	8.5	10.2	9.3	9.6
Average actual hours	35	34.3	34.1	32.9
SD actual hours	12.2	12.2	12.2	13.2
N groups	1332	1254	1634	1790
N	7992	7524	9804	10740

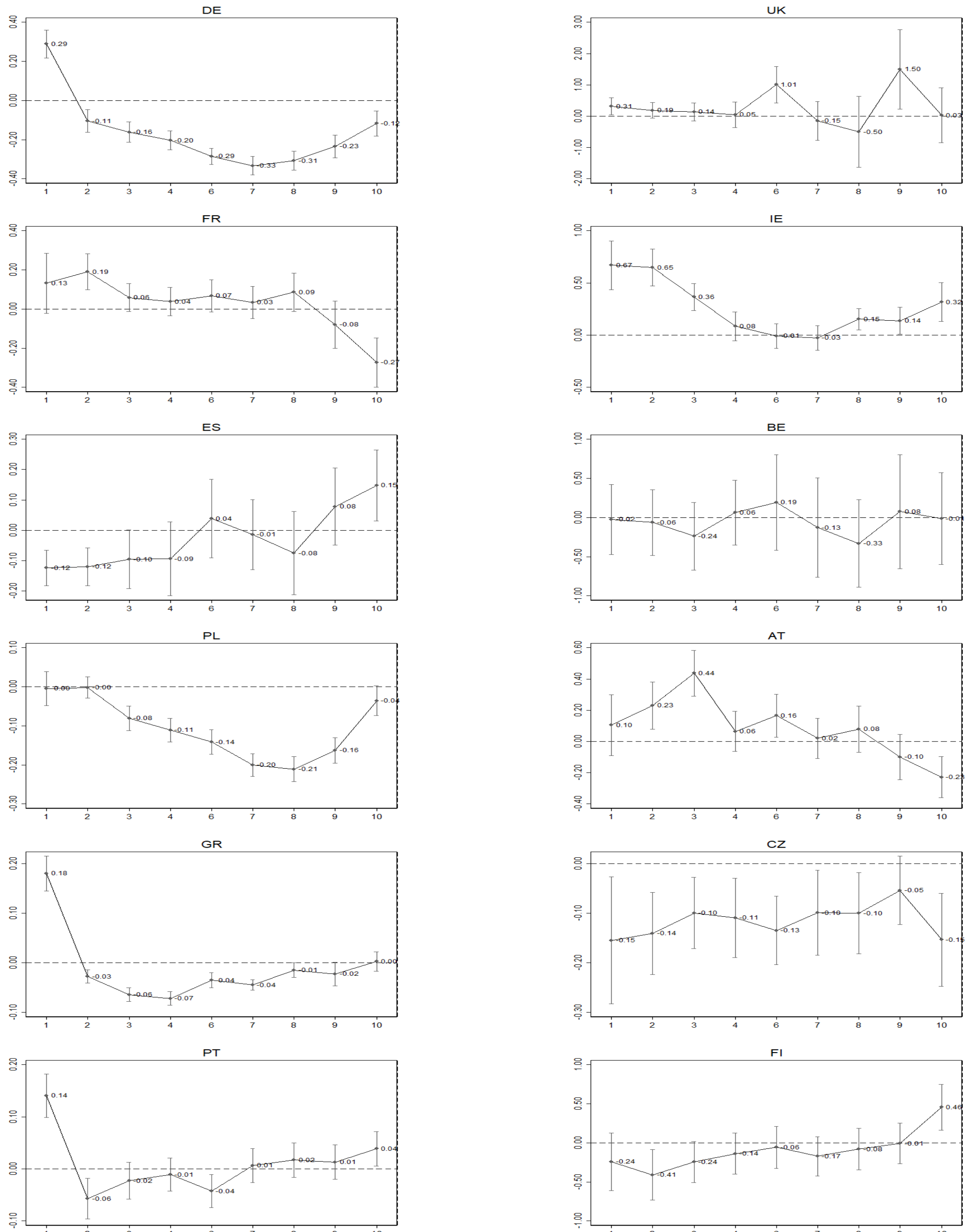
Notes: The four samples consist of employed individuals over the 6 waves they were interviewed in. They answered the question on desired hours at least in two waves. Average desired and actual hours are calculated by employed individuals.

Table 2.4: The effect of recessions on desired hours worked in France
Dependent variable: desired hours

	2006q1-2007q2			2007q4-2009q1			2009q4-2011q1			2015q1-2016q2		
	RE	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE	OLS	FE
Regional UR	1.894	-0.570	2.568	6.209***	0.503	-140.8	-1.675	4.802	-4.928	-13.51	-8.906	-18.61
	(2.328)	(3.509)	(2.232)	(0.791)	(888794.6)	(210.0)	(7.087)	(7.634)	(7.058)	(15.79)	(17.53)	(18.36)
N	2847	2847	2847	2479	2479	2479	3082	3082	3082	3582	3582	3582
N of groups	1016		1016	961		961	1235		1235	1529		1529
Adjusted R2		0.331	0.0482		0.316	0.0577		0.322	0.129		0.335	0.0755
Overall R2	0.367		0.00131	0.365		0.00106	0.346		0.000630	0.387		0.00863
Rho	0.644		0.950	0.632		1.000	0.709		0.962	0.676		0.978

Notes: Standard errors in the brackets, clustered on the individual level. The sample is a panel of individuals interviewed and employed in 6 consecutive waves, who answered the question about desired hours in at least two waves. Regressions include individual characteristics (quadratic age polynomial, education dummies, gender, part-time work, type of contract, 3-digit ISCO occupation dummies and population density), region and time fixed effects and the interactions between them.

Figure 2.4: Income effect and desired hours worked



Notes: This figure plots the coefficient γ – the interaction between regional unemployment rate and each income decile. To calculate the total effect for each income decile, regional unemployment rate and income decile dummy coefficients are presented in Table 2.5. Bootstrap standard errors are in the brackets. The sample is pooled and consists of working-age, employed individuals who answered the question on desired hours. Regressions include individual characteristics (quadratic age polynomial, education dummies, gender, part-time work, temporary contract, population density, occupation and sector dummies), region and time fixed effects and the interactions between them.

Table 2.5: Income effect and desired hours worked
Dependent variable: desired hours

	DE	FR	UK	FI	AT	PL	PT	GR	ES	CZ	IE	BE
Regional UR	0.178***	-0.0185	-0.121	0.145	-0.0288	0.129***	-0.0422**	-0.00342	0.106**	0.0894***	-0.0986	-0.165
	(0.0200)	(0.0115)	(0.158)	(0.101)	(0.0529)	(0.0113)	(0.0148)	(0.0114)	(0.0378)	(0.0238)	(0.0861)	(0.197)
Decile1	-6.205***	-2.631*	-6.511***	0.307	-6.711***	-0.204	0.923**	-0.715	2.842**	-0.905	-14.53***	-1.747
	(0.310)	(1.218)	(1.089)	(1.901)	(0.377)	(0.230)	(0.344)	(0.461)	(1.026)	(0.631)	(1.691)	(2.175)
Decile2	-1.123***	-0.307	-0.576	4.092*	-1.589***	-0.0470	0.00360	0.646**	2.850*	-0.354	-10.39***	-0.338
	(0.220)	(1.289)	(1.170)	(1.672)	(0.279)	(0.164)	(0.330)	(0.212)	(1.113)	(0.427)	(1.285)	(2.173)
Decile3	-0.719***	-1.417*	1.372	1.754	-0.996***	0.568***	-0.362	-0.0517	2.451	-0.738	-5.476***	1.429
	(0.181)	(0.552)	(1.436)	(1.354)	(0.260)	(0.163)	(0.272)	(0.186)	(1.593)	(0.384)	(0.927)	(2.320)
Decile4	-0.357*	-0.779	1.110	0.0847	0.178	1.045***	-0.455*	-0.205	2.653	-0.631	-1.486	-1.476
	(0.168)	(0.444)	(1.534)	(1.322)	(0.236)	(0.166)	(0.218)	(0.169)	(2.137)	(0.406)	(0.996)	(2.275)
Decile6	-0.175	0.635	0.676	-0.477	-1.230***	0.787***	-0.409	-1.475***	-2.601	0.0110	-0.129	-3.726
	(0.159)	(0.720)	(4.002)	(1.408)	(0.246)	(0.141)	(0.225)	(0.181)	(1.912)	(0.348)	(0.845)	(3.117)
Decile7	0.00715	-1.426*	1.976	0.402	-0.995***	1.042***	-1.272***	-1.916***	-3.743*	-0.503	-0.341	1.733
	(0.175)	(0.614)	(3.150)	(1.287)	(0.238)	(0.141)	(0.239)	(0.123)	(1.907)	(0.431)	(0.828)	(3.303)
Decile8	-0.370	-2.575**	4.669	-0.469	-1.602***	1.303***	-1.316***	-2.837***	1.054	-0.328	-2.812***	3.242
	(0.200)	(0.867)	(4.169)	(1.361)	(0.265)	(0.195)	(0.218)	(0.166)	(2.733)	(0.392)	(0.721)	(3.182)
Decile9	-0.812***	-0.646	-6.685	-1.206	-0.831**	0.692***	-1.281***	-2.186***	-6.523**	-0.587	-2.520**	-0.663
	(0.220)	(1.036)	(5.732)	(1.349)	(0.272)	(0.160)	(0.262)	(0.303)	(2.280)	(0.369)	(0.902)	(3.906)
Decile10	-0.743*	4.416**	5.411	-4.689**	1.014***	0.488**	-1.140***	-0.417	-10.60***	0.254	-3.546**	3.315
	(0.308)	(1.557)	(6.722)	(1.506)	(0.223)	(0.155)	(0.295)	(0.310)	(2.710)	(0.459)	(1.299)	(3.409)
N	1387009	1415503	29179	109215	791533	1231532	593371	373607	60083	330701	268384	34226
adj. R^2	0.616	0.330	0.443	0.392	0.498	0.305	0.380	0.278	0.203	0.405	0.494	0.404

Notes: This table presents the coefficients for regional unemployment rate and income decile dummies from equation (2.4). These coefficients can be used with coefficients from Figure 2.4 to calculate the total effect of recessions for each income decile. Bootstrap standard errors are in the brackets. The sample is pooled and consists of working-age, employed individuals who answered the question on desired hours. Regressions include individual characteristics (quadratic age polynomial, education dummies, gender, part-time work, temporary contract, population density, occupation and sector dummies), region and time fixed effects and the interactions between them.

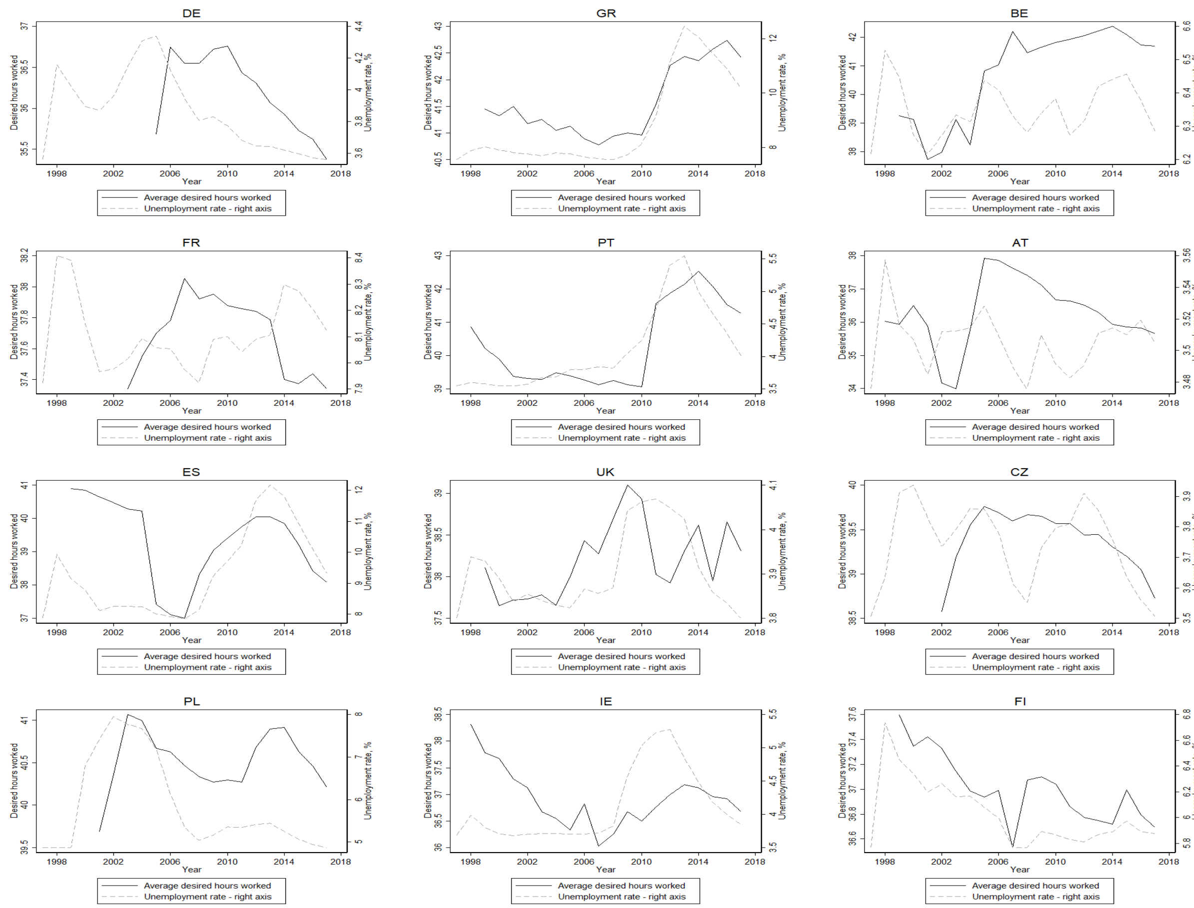
Table 2.6: The effect of recessions on desired hours worked - part-time and temporary workers
Dependent variable: desired hours

	DE	FR	UK	FI	AT	PL	PT	GR	ES	CZ	IE	BE
Regional UR	0.0382***	-0.0374***	0.172	0.106	-0.143***	0.0640***	-0.0446***	-0.0380***	0.180***	0.0243	-0.129	-0.171
	(0.0111)	(0.0105)	(0.180)	(0.0662)	(0.0334)	(0.0102)	(0.0118)	(0.0106)	(0.0318)	(0.0215)	(0.0950)	(0.104)
Part time * UR	-0.0436*	0.196***	-0.255**	-0.0593	0.627***	0.133***	-0.184***	0.327***	-0.168***	0.270***	0.395***	-0.110
	(0.0212)	(0.0232)	(0.0960)	(0.146)	(0.0383)	(0.0190)	(0.0153)	(0.0115)	(0.0167)	(0.0458)	(0.0366)	(0.105)
Temporary * UR	0.129***	-0.0735**	0.0622	-0.118	0.0804	0.0314***	0.160***	-0.00738	-0.102***	0.0346	-0.00291	0.0841
	(0.0199)	(0.0224)	(0.135)	(0.126)	(0.0655)	(0.00681)	(0.0113)	(0.00825)	(0.0172)	(0.0266)	(0.0521)	(0.109)
PT = 1	-13.22***	-11.01***	-8.698***	-12.60***	-18.29***	-14.40***	-14.97***	-15.72***	1.629**	-15.40***	-19.28***	-6.122***
	(0.200)	(0.484)	(1.045)	(1.430)	(0.145)	(0.204)	(0.270)	(0.283)	(0.570)	(0.441)	(0.508)	(1.290)
Temporary = 1	0.212	2.126***	-1.252	1.736	1.890***	0.525***	-1.288***	0.340	3.342***	-0.451	-0.203	-0.956
	(0.166)	(0.482)	(1.212)	(1.233)	(0.240)	(0.0893)	(0.158)	(0.179)	(0.604)	(0.259)	(0.747)	(1.149)
N	1387009	1415503	29179	109215	791533	1231532	593371	373607	60083	330701	268384	34226
adj. R^2	0.616	0.330	0.442	0.392	0.498	0.305	0.380	0.280	0.204	0.405	0.494	0.405

Notes: This table shows the the effect of unemployment rate on desired hours for part-time and temporary workers. Bootstrapped standard errors in parentheses. Dependent variable is desired hours worked. The sample is pooled and consists of working-age, employed individuals who answered the question on desired hours. Regressions include individual characteristics (quadratic age polynomial, education dummies, gender, part-time work, temporary contract, population density, occupation and sector dummies, income decile dummies), region and time fixed effects and the interactions between them.

2.A Desired hours over the business cycle

Figure 2.5: Countercyclicality of desired hours: unemployment rate



Notes: This figure plots average desired hours worked for employed individuals in each country in each time period, with the unemployment rate as an alternative measure of recessions. As can be seen, the unemployment rate and average desired hours co-move over time.

Table 2.7: Pearson correlation coefficients with desired hours worked

	DE	FR	AT	UK	FI	PL	PT	GR	ES	IE	BE	CZ
GDP pc growth rate	0.0696	-0.210	0.0926	-0.666	0.135	0.123	0.0192	-0.201	0.0446	0.399	-0.341	-0.0342
Unemployment rate	0.296	-0.630	-0.215	0.367	0.829	0.144	0.782	0.925	0.277	-0.0291	0.430	0.398

Notes: This table shows the Pearson correlation between average desired hours and macroeconomic indicators of recessions over time. It supplements Figures 2.1 and 2.5 and stylised fact 1, which says that desired hours are countercyclical. I test this hypothesis formally in the empirical section.

2.B Desired hours breakdowns

Figure 2.6: Average desired hours by income decile and income decile composition

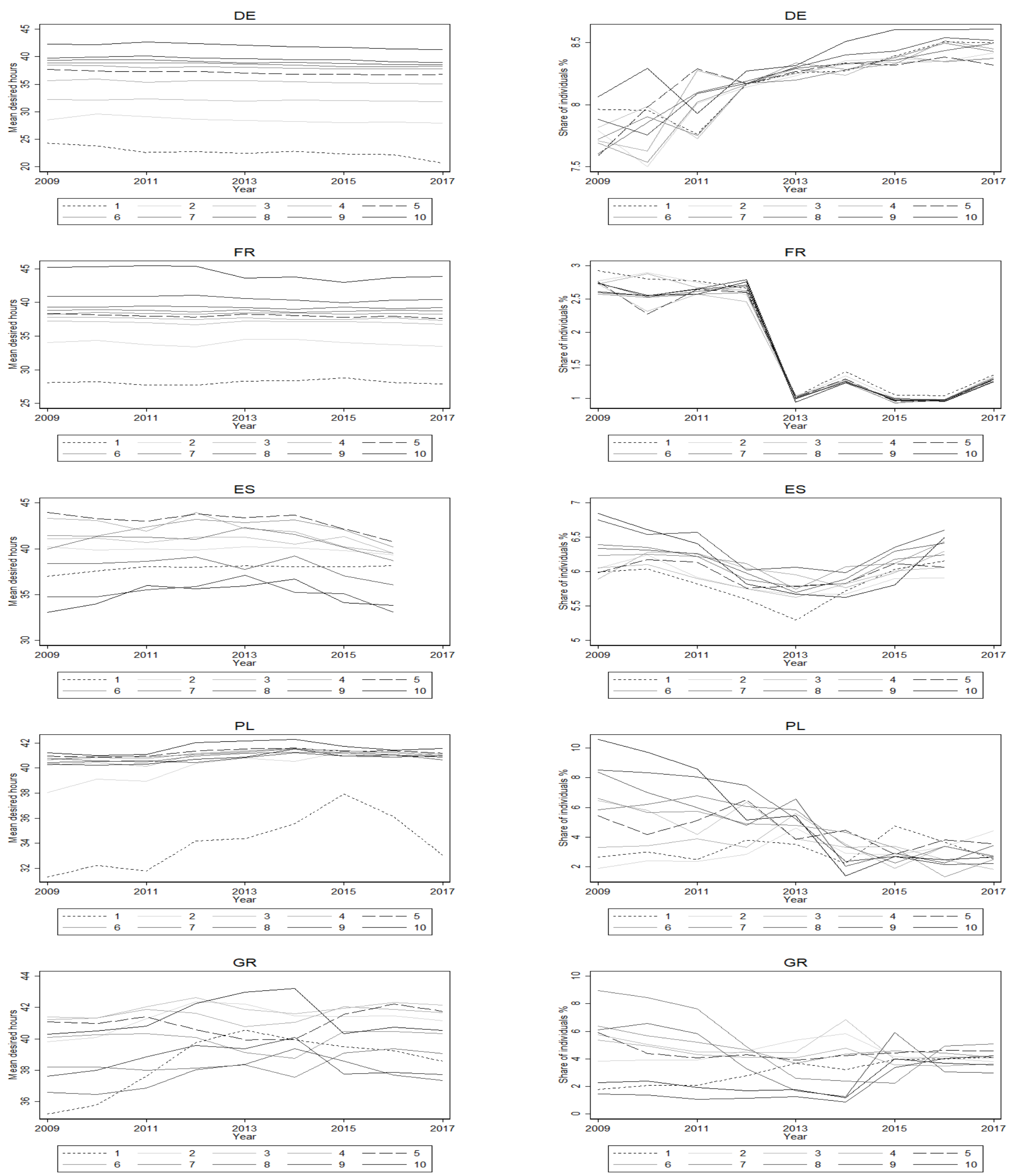


Figure 2.6: Average desired hours by income decile and income decile composition (continued)

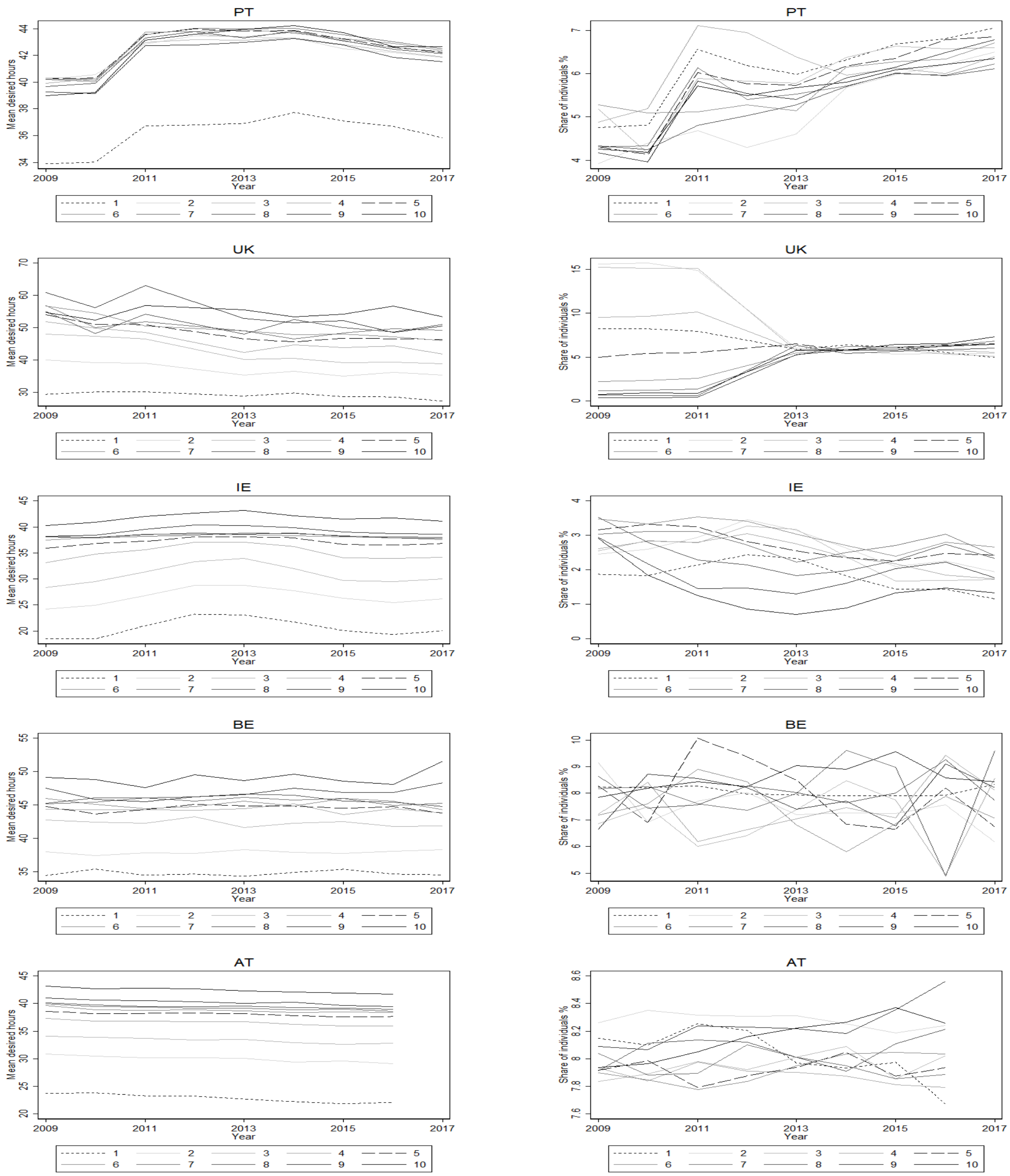
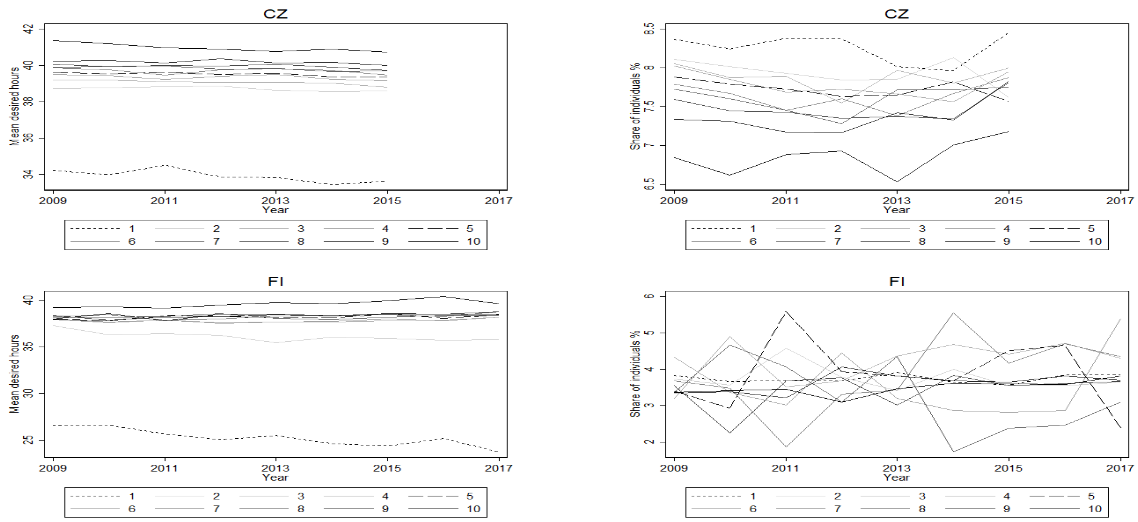
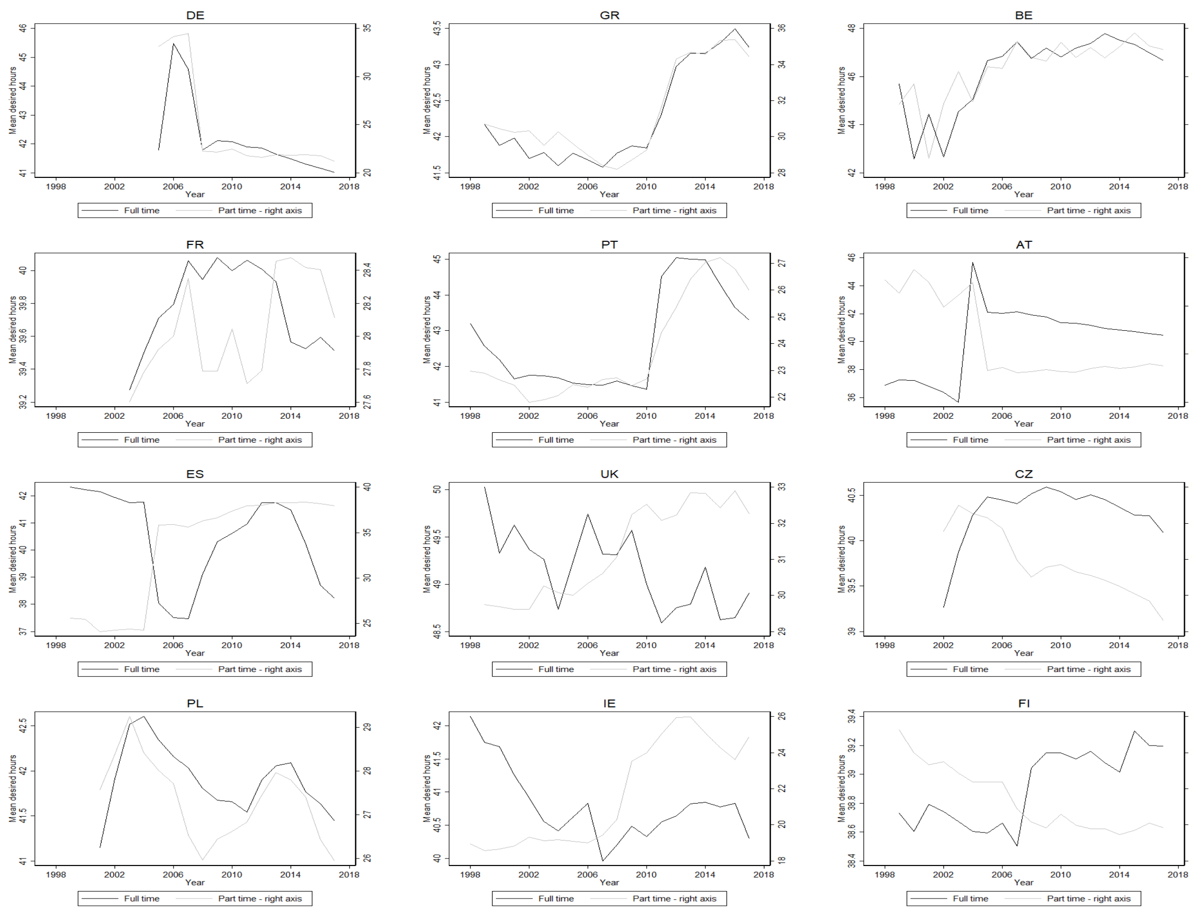


Figure 2.6: Average desired hours by income decile and income decile composition (continued)



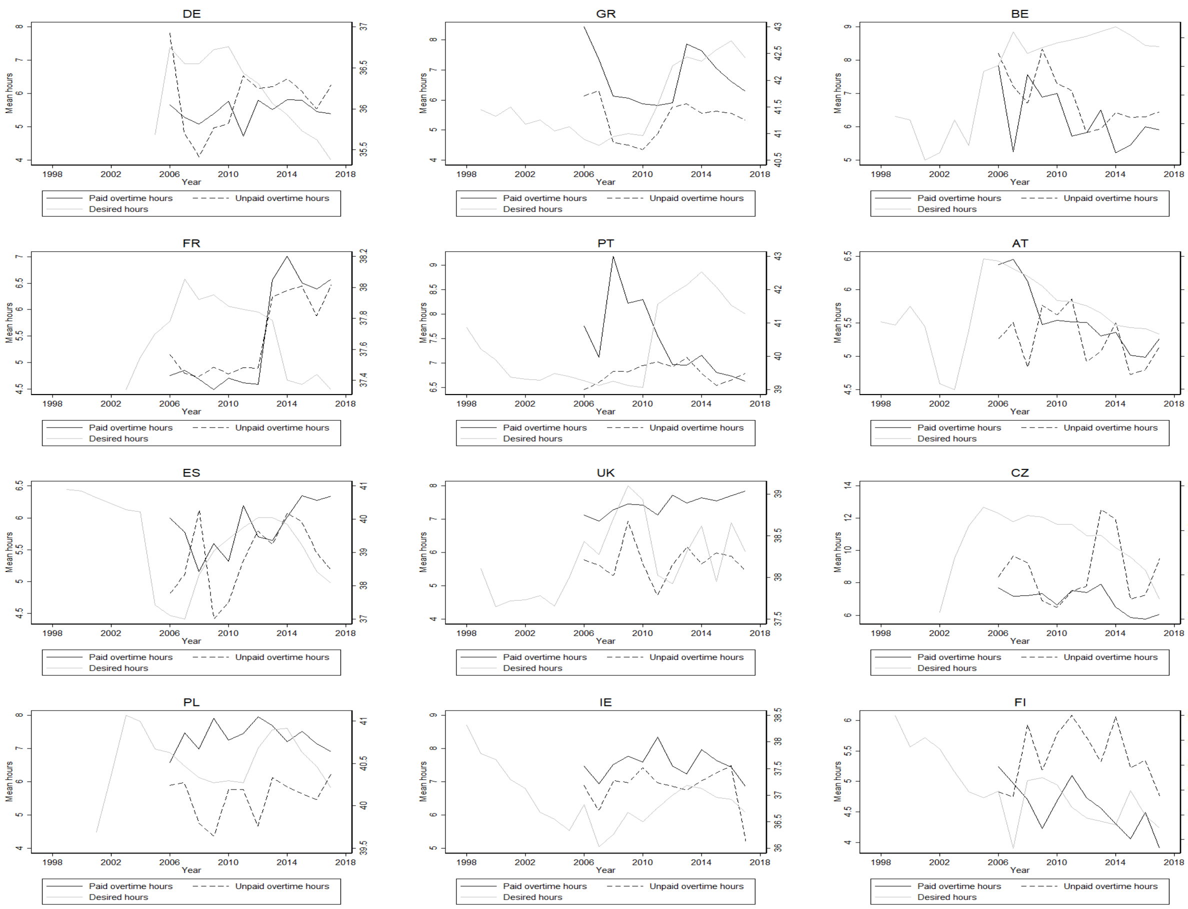
Notes: This figure plots average desired hours worked per each income decile, in each country over time in the left column. On the right are plotted shares of employed individuals in each income decile. Since the samples are not panel, it is possible that the changes in desired hours worked for each decile occur due to the composition effect. However, the right-hand column shows mostly stable shares of individuals in each income decile or patterns of income decile shares which do not correspond to the patterns of desired hours by income decile.

Figure 2.7: Average desired hours for part-time and full-time workers



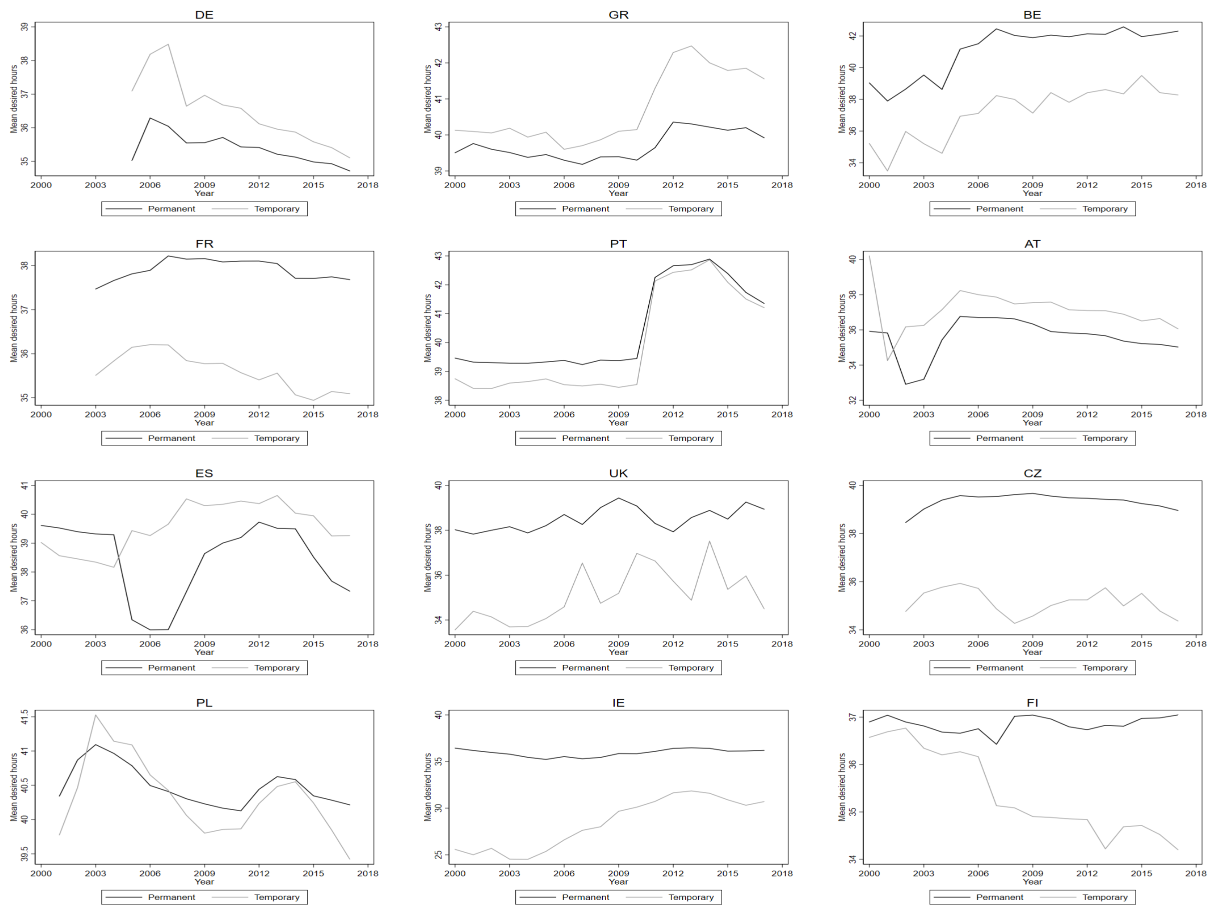
Notes: This figure plots average desired hours worked for full-time and part-time workers. In most countries, a change in desired hours of part-time workers is accompanied by the change in desired hours of full-time workers. These statistics descriptively signal that part-time workers may not be the main drivers of the desired hours countercyclicality.

Figure 2.8: Average overtime (from 2006) and desired hours worked



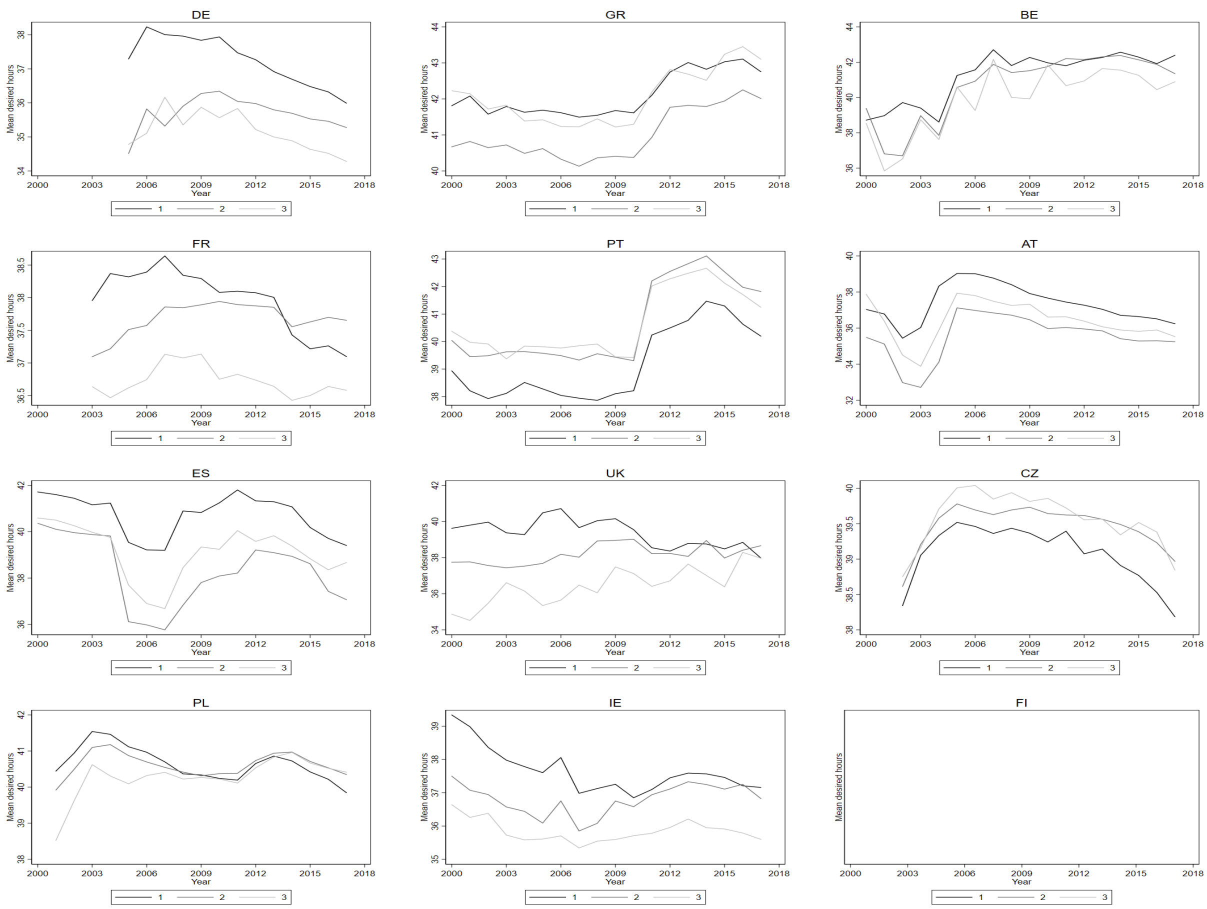
Notes: This figure plots average desired hours worked and average overtime hours over time. The correlation of desired and overtime hours seems to be idiosyncratic and depend on the type of overtime hours (paid or unpaid).

Figure 2.9: Average desired hours for temporary and permanent workers



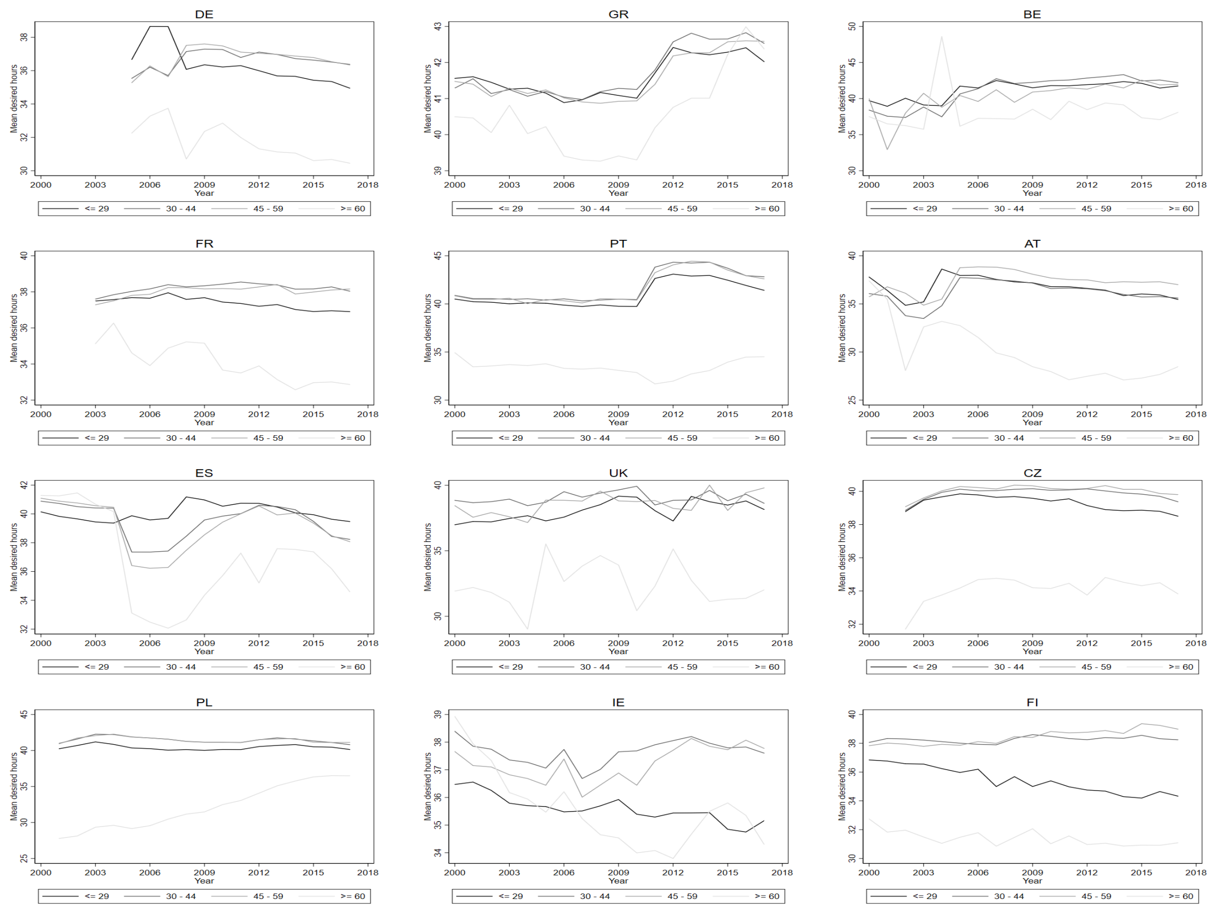
Notes: This figure plots average desired hours worked by the type of contract. I assume that temporary workers would want to work more hours before their contract ends. In some countries, like Portugal, temporary contracts were very common during the Great Recession. Even though it seems that there is no apparent pattern for desired hours over time, the empirical analysis is more revealing and shows that temporary workers would increase desired hours in high-unemployment areas, at least in some countries.

Figure 2.10: Average desired hours by the number of workers in the household



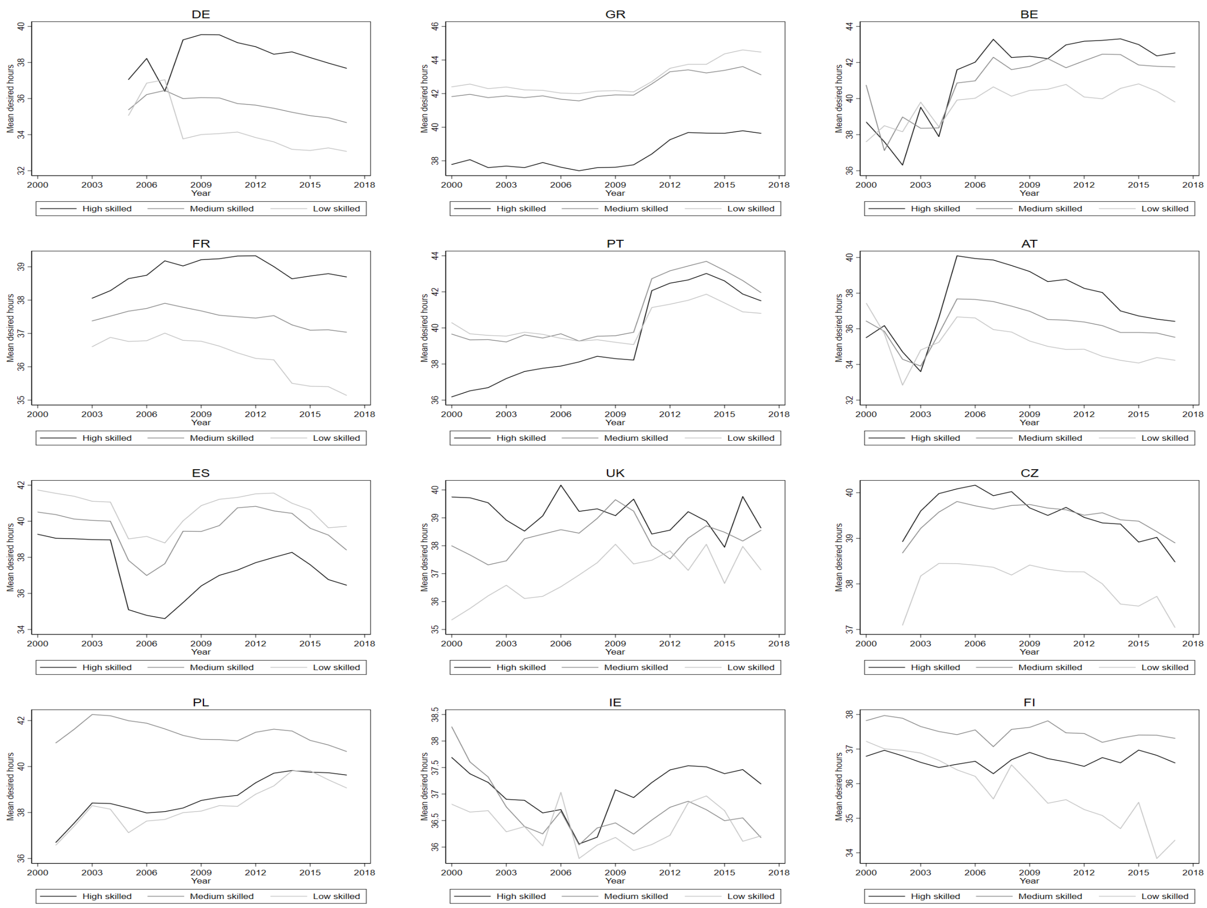
Notes: This figure plots average desired hours worked by the number of employed individuals living in one household. The hypothesis is that if a partner of the interviewee lost a job in a recession, she would want to work more hours to compensate for the lost income on the household level. There is no common pattern of the desired hours given this breakdown, however I use this variable as a control in the empirical specification.

Figure 2.11: Average desired hours by age groups



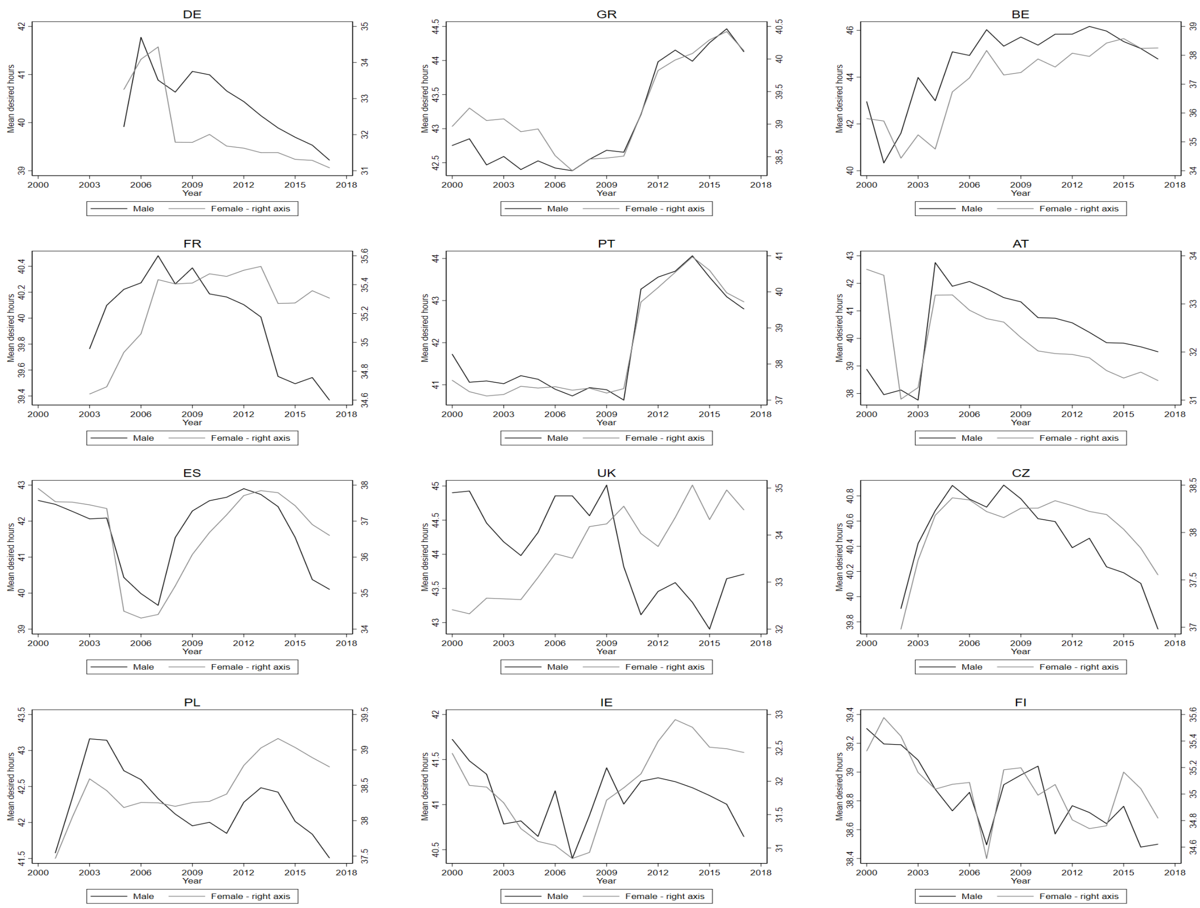
Notes: This figure plots average desired hours worked by age groups. There is no common pattern of the desired hours given this breakdown, however I use this variable as a control in the empirical specification.

Figure 2.12: Average desired hours by the level of education



Notes: This figure plots average desired hours worked by levels of education. There is no common pattern of the desired hours given this breakdown, however I use this variable as a control in the empirical specification.

Figure 2.13: Average desired hours by gender



Notes: This figure plots average desired hours worked by gender. There is no common pattern of the desired hours given this breakdown, however I use this variable as a control in the empirical specification.

Chapter 3

The effects of overtime tax on hours worked: Evidence from France

3.1 Introduction

In most European countries and the US, overtime pay is taxed at the same rate as earnings from regular earnings. In recent years, countries like Spain and Malta started taxing overtime pay at different rates than earnings from regular hours worked.[1] To date, there is very little known on the overall welfare effects of overtime tax introduction/increase.

As with any tax, overtime tax could have an effect on the government revenue and potential redistributive effects in the economy. At the same time, overtime tax can be used to incentivise employment. The general mechanism is that firms demand labour through either hiring new workers (employment) or more hours worked (overtime hours). Overtime tax increases the cost of overtime hours, and firms are likely to hire new workers instead, therefore increasing employment. The overall effect of overtime tax is complex and difficult to disentangle due to many interlinked effects on unemployment, hours worked and government revenue. Identifying the effect of overtime tax on hours worked can be the first step towards understanding the overall welfare effects.

This paper studies the effect of overtime tax introduction on hours worked. In the fall of 2012, the French government has re-introduced overtime income tax and the corresponding employee and employer social contributions in large firms, making income from overtime hours subject to the income tax. The reform allows for identification of the overtime tax effects by comparing employees' hours worked in small and large firms, before and after 2012, if employees in small and large firms are similar and their hours follow a similar trend over time. The main threat to this identification is the contamination of the control group by two previous labour reforms in France. One implemented a 35-hour weekly cap on regular hours worked for small-firm employees in 2002, and the other de-taxation of all overtime work in 2007 for all employees. The nature of this contamination is visible in the change of hours worked in the control group after the reform. The true counterfactual is therefore unknown, and the nature of the estimation bias is difficult to establish.

To reduce the bias in the difference-in-difference specification, I estimate the synthetic control for large-firm employees. I find that the introduction of overtime tax increased overtime hours through higher reporting of overtime hours, while actual hours worked decreased by almost 2 hours in the reference week. This result is confirmed by the synthetic control estimation, although the effect on overtime hours is less prominent.

Furthermore, it is possible that overtime tax affected subgroups on the labour market differently. More vulnerable workers on the labour market – part-time and temporary workers – would

[1] For more details on overtime tax in Malta, please see: https://home.kpmg/mt/en/home/insights/2020/06/tax-on-overtime-rules-published.html; and in Spain: https://www.gpminstitute.com/publications-resources/Global-Payroll-Magazine/january-2019/what-you-need-to-know-about-payroll-in-spain

potentially work more hours for a higher overtime tax, as their hours are easier to manipulate and their outside options are limited. Unlike employees in small and large firms, part-time and temporary workers have not been explicitly treated in the labour market reforms in France, and the control group is likely to be less contaminated. To disentangle the effect of overtime tax on subgroups' hours worked from the total effect, I estimate the triple difference specification for part-time and full-time workers. I find no effect on overtime hours, but a large positive effect on actual hours worked for part-time workers.

One possible explanation for the opposite effect of overtime tax on part-time workers' hours is the following: Overtime tax increases the cost of overtime hours for firms, which incentivises them to hire new employees. However, in times of high economic uncertainty but at the beginning of an economic boom (as was the case in France 2013), they are unlikely to hire new employees. Therefore hiring more part-time and temporary workers, who on average work below the 35-hour weekly cap, and increasing their regular (non-overtime) hours might seem like the least costly way of hiring more labour.

Actual and overtime hours worked measure the labour market equilibrium hours worked. To distinguish between equilibrium and labour supply effects, I use the variable desired hours worked to measure labour supply. The main result shows that overtime tax decreases labour supply for all workers, although the effect is smaller than the effect on actual hours worked. On the other hand, part-time workers increase their desired hours, post-2012. There is no statistically significant labour supply effect for temporary workers. In other words, on average, for all workers, overtime tax incurs lower labour supply (substitution effect), but higher labour supply for part-time workers (income effect).

The effects of *overtime tax* reforms on hours worked have not been largely investigated so far. The paper closest to this one is Cahuc and Carcillo (2014), who investigate the effects of overtime detaxation (France, 2007) on overtime and actual hours. The authors compare individuals working in France, subject to the reform, and French nationals working in bordering countries, not subject to the reform. This identification strategy finds no effect on actual and small positive effect on overtime hours, primarily for highly qualified wage earners. An older study by Brown and Levin (1974) in the UK finds correlational evidence that a general income tax increase could have a positive effect on overtime hours, suggesting a small income effect on the supply side.

The literature on overtime hours has previously mostly investigated the effects of overtime pay on hours worked. Two of the most prominent papers by Costa (2000) and Trejo (2003) find that increasing overtime pay has little or no effect on the length of the working time. In recent years, the literature on overtime hours is mostly interested in the effects on employment. Andrews et al. (2015) find that an increase in standard hours in Germany has led to more overtime hours and higher employment for firms which allowed overtime hours. Similarly, Martins (2016) shows that a reduction of overtime pay in Portugal, increases overtime hours and employment. On the other hand, Yu and Peetz (2019) find that an increase in Sunday wage premiums in Australia caused a decline in hours per employee, but no effect on employment. Similar to the findings of this paper, recent literature suggests that manipulating overtime pay/cost (through taxes, overtime wage rate or standard hours worked) has an effect on hours worked only for employees who have some degree of flexible hours.

The rest of the paper is organised as follows: Section 3.2 describes the 2012 reform in detail and discusses potential welfare effects of overtime tax. Section 3.3 lays out a simple theoretical framework for the supply and the demand side of overtime taxation. Section 4.3 describes data and potential challenges in the empirical strategy (Section 3.5). Section 3.6 estimates the equilibrium effects of overtime tax, while Section 3.7 deals with the control group contamination through synthetic control estimation. Section 3.8 discusses heterogeneous effects of overtime tax introduction. Section 3.9 estimates the effect of overtime tax on labour supply, and Section 3.10 concludes.

3.2 Background

3.2.1 Working hours regulations in France

The modern history of French labour regulations dates back to the beginning of 1980s, as noted by Askenazy (2013), when the main goal was to gradually reduce weekly working hours from 40 to 35. This goal was finally achieved in 1998, when the mandatory 35-hour work week was introduced for large companies (with 20 or more employees). Small companies (with fewer than 20 employees) were given a transition period until 2002, after which the standard work week was up to 35 hours per week. Any hours worked over the limit were deemed as overtime and paid an overtime bonus of 10-25%. It was not possible to work more than 130 overtime hours per year.

In 2007, just before the Great Recession, then president Nicolas Sarkozy, promoted a campaign "work more to earn more" (*Travail, Emploi et Pouvoir d'Achat*). He introduced a 25% bonus on overtime hours, de-taxed overtime income for employees and removed employer social contributions on overtime pay. The policy was introduced for everyone, regardless of the firm size. Cahuc and Carcillo (2014) analysed the effect of this policy on actual (total weekly) hours and overtime hours. The authors compared individuals working in France to individuals working in bordering countries (Belgium, Switzerland, Luxembourg and Germany) where the reform was not in place, and found a positive effect on overtime hours and negligible effect on actual (total) hours worked.

During the Great Recession, Francois Hollande re-introduced tax on overtime pay. Overtime tax was announced in July 2012, in effect from August 2012.[2] From August 1, employees had to include overtime income in the income tax base, and from September 1, both firms and employees had to pay social contributions on overtime hours. Income from overtime was not taxed at a different rate than income form regular hours, but was not tax exempt from 2012. Individuals working in large companies (with 20 or more employees) have to include overtime income in their income tax base – overtime income is no longer tax deductible.[3] Employees in small companies continued to work overtime tax-free.

Unless there is a collective agreement in place, hours worked are deemed as overtime if they are over the 35-hour legal limit per week or annualised 1607 hours per year.[4] The individual can work a maximum of 220 overtime hours per year, but no more than 44 total hours per week over a 12-week period. Overtime hours have to be paid. Overtime hours cannot be paid below 10% more than the regular hourly wage. Overtime hours are paid 25% more than the regular wage rate for 36–43 hours per week. Over 44 hours, overtime pay increases to 50% of the wage rate. Part-time workers can work overtime, up to 10% of their contractual hours and it is paid 25% more than their regular wage rate. Overtime tax reform applies to part-time workers' pay the same way as for full-time workers. If part-time workers work over their contractual hours, those extra hours are deemed as overtime and overtime tax applies.

It is important to note that it is the employer's responsibility to note overtime hours on the employee payslip. As recorded by several blog outlets in France, employees were taken by surprise when they received their payslips with lower net earnings after the reform in the fall 2012.[5] Therefore, it is likely that observed changes in overtime hours are initial labour demand changes, with possible consequent labour supply adjustments.

3.2.2 Potential welfare effects of overtime tax

An increase in overtime tax can potentially have large welfare effects. In fact, the overtime tax introduction in France in 2012 was motivated by high unemployment and budget deficit around the time.[6] This section descriptively discusses potential effects of overtime tax on unemployment and the government budget.

[2] The Guardian reported the French overtime tax introduction on July 17: https://www.theguardian.com/world/2012/jul/17/french-government-reinstate-overtime-tax-hollande. I accessed the article in May 2020.

[3] Details about the reform were taken from Askenazy (2013), International Labour Organization and *The Global Employer: Focus on France*, written by Baker and McKenzie.

[4] According to Boudjemaa (2018), collective agreements in France covered around 60% of all employed in 2015.

[5] http://www.economiematin.fr/amp/news-defiscalisation-heures-supplementaires or https://impots.dispofi.fr/heures-supplementaires/impot-revenu

[6] See, for example, https://www.reuters.com/article/us-france-economy-tax/france-scraps-tax-breaks-that-symbolized-sarkozy-era-idUSBRE86I11G20120719

Figure 3.1a shows government revenue from payroll and workforce in million euro. Although the revenue from payroll increases steadily over the years, there is a jump from 2012 to 2013, just after implementing overtime tax. Figure 3.1b further plots the percentage change in payroll revenue against the budget deficit, where the two vertical lines mark the two reforms in overtime tax: 2007 and 2012. Percentage change in payroll revenue slightly decreased after de-taxation of overtime tax in 2007. On the other hand, the jump from 2012 to 2013 is over 10%. This is the largest increase in payroll revenue from 2003 to 2017. On the other hand, budget deficit does not show any particular changes around the time of the 2012 reform.

The increase in payroll revenue can come from other macroeconomic changes in France, rather than overtime tax introduction. For example, the beginning of the economic boom (Figure 3.3) could imply more employed individuals – lower unemployment rate or higher participation rate. Figure 3.2 shows that unemployment rate continued to increase after 2012, although recession indicator marked the beginning of 2013 as the end of the recession. Participation rate did increase steadily from 2011. However, the participation percentage change from 2012 to 2013 is smaller relative to the unemployment rate change and is possibly not large enough to increase the employment enough to cause the large increase in the payroll revenue in those years.

In addition to budget deficit concerns, another goal of the overtime tax introduction in France was to reduce unemployment. The general mechanism is that firms demand labour through either hiring new workers (employment) or more hours worked (overtime hours). Overtime tax increases the cost of overtime hours, and firms are likely to hire new workers, therefore increasing employment (reducing unemployment, *ceteris paribus*). From Figure 3.2, unemployment rate has continued to increase and peaked only 3 years after the overtime tax reform. Best-case scenario, overtime tax reduced unemployment with a relatively large time lag.

If overtime tax did not reduce unemployment in 2013, and France was entering an economic boom the same year (Figure 3.3), firms had to increase labour demand in a different way, potentially by employing more hours worked.[7] Figure 3.4 plots average actual and overtime hours per employed individual.

Average actual hours remain roughly stable until 2012, and fall by more than 1 hour in 2013. To show that this fall is not driven by the composition effect (for example, more full-time employees), Figure 3.4a plots the share of full-time employees on the right axis which is also decreasing. Average overtime hours, on the other hand, increase sharply after 2012. On average, French workers

[7] The recession indicator published by OECD (Figure 3.3) shows that in February 2013, France was still in a recession, but exited the recession in the second quarter of 2013. The result is confirmed by Doz and Petronevich (2015), using an alternative measurement of the recession period. As most of the 2013 was recession-free, it is possible that the demand for goods and services started to increase. Numbers published by EC (2015) confirm that the growth of domestic demand turned positive from -0.2% in 2012 to 2% in 2013. Some indication of the economic recovery is visible in private consumption growth as well: from -0.4% in 2012 to 0.2% in 2013.

worked roughly 2.5% more overtime than before the overtime tax introduction. In addition, more workers worked overtime – the share of overtime workers increases by 7 percentage points from 2012 to 2013.

A decrease in actual hours and increase in overtime hours is puzzling, since actual hours include overtime hours if a workers worked overtime in the reference week. From 2007–2012, overtime tax and social contributions on overtime were not being paid. If overtime hours were not strictly reported, there were no legal consequences to it. As discussed in the previous subsection, widespread collective agreements in France allow for overtime work to be paid in a subsequent additional time off. However, once overtime tax and social contributions were introduced, potential legal consequences of not reporting overtime could have been large, which thus incentivised reporting of overtime work.

Stronger fiscal responsibility with respect to overtime hours could then explain the increase in payroll revenue from the beginning of this section. This shows that the effects of overtime tax can have many effects on not just hours worked, but also fiscal behaviour of firms and government budget. Because of the complexity of this issue, identification of overtime tax effects becomes a challenge.

This paper is not able to identify effects of overtime tax on fiscal behaviour or budget deficit, but is able to identify effects on hours worked, because of the variation in treatment by firm size. The rest of the paper discusses the theoretical framework of overtime tax effects and the identification strategy in estimating overtime tax effects on overtime hours.

3.3 Theoretical framework

Overtime and actual hours worked are the equilibrium hours on the labour market. Employees might possibly like to work different hours than their contractual hours, however contracts with the firm, legislation or business cycle effects impose a restriction on the labour supply. In the absence of outside options and with a job-search cost, employees will work hours imposed by the demand side. Therefore, the effect of overtime tax should be examined in the context of both labour supply and demand.

This section presents a simple general equilibrium labour market model for hours worked, showing that higher overtime tax would decrease supplied and demanded hours. However, there are some conditions under which this expected result does not have to hold. I use simple static models of representative agents for labour demand (in line with Trejo, 2003) and labour supply (in line with Costa, 2000 and Cahuc and Carcillo, 2014) and discuss the general equilibrium effects of overtime tax on hours worked.

3.3.1 Labour supply

The labour supply model uses a simplified version of the Cahuc and Carcillo (2014) model, by not including productivity. A representative, *full-time* worker decides how to split her time endowment (L_0) between leisure (L) and work (H): $L = L_0 - H$. There is a legal limit defining full-time hours ($\overline{H}$), and any hours worked over that legal limit are considered overtime hours. Overtime premium (b) is paid on each hour worked over the legal limit ($\overline{H}$) and is higher than the hourly wage rate, w: $(1+b)w$. Workers pay a flat tax rate (t) on taxable income (R_t), which is gross income minus the amount that can be deducted from the compensation of overtime hours: $R_t = R - \sigma max(H - \overline{H}, 0)$. Therefore, $0 \leq \sigma \leq bw$, if overtime pay cannot be deducted from taxable income, $\sigma = 0$ and workers have to pay taxes on total income earned; if overtime pay can be deducted from taxable income, $\sigma = bw$ and workers do not pay tax on overtime income. Workers are identical and their hourly wage rate (w) does not depend on productivity.

Workers trade off leisure hours and income by maximising utility function, which is quasi-concave and strictly increasing in C and L.[8] In the static framework, I denote consumption as income, meaning that workers consume everything they earn, $C = Y$.

$$\begin{aligned} \max_{L,Y} \quad & U = L^{\alpha} Y^{(1-\alpha)} \\ \text{s.t.} \quad & Y = wH + bw(H - \overline{H}) - t[wH + (bw - \sigma)(H - \overline{H})], \\ & L = L_0 - H, \\ & H - \overline{H} \geq 0 \end{aligned} \tag{3.1}$$

$0 < \alpha < 1$ denotes the elasticity of worker's utility with respect to leisure – the lower it is, the higher the utility from income for the worker. Income (and consumption) is equal to gross income from regular hours work (wH) and overtime hours (bwH) minus total tax, paid on taxable income.

Optimal hours worked and income are found by taking the first order conditions and solving for H, Y. If $H > \overline{H}$, optimal hours worked and income are equal to:

$$Y^* = \left(\frac{1-\alpha}{\alpha}\right)\left[\frac{wL_0 + bwL_0 - twL_0 - tbwL_0 + t\sigma L_0 - bw\overline{H} + tbw\overline{H} - t\sigma\overline{H}}{\frac{1-\alpha}{\alpha} + w + bw - tw - tbw + t\sigma}\right] \tag{3.2}$$

$$H_s^* = \frac{\frac{1}{\alpha}L_0 - L_0 + bw\overline{H} - tbw\overline{H} + t\sigma\overline{H}}{\frac{1}{\alpha} - 1 + w + bw - tw - tbw + t\sigma} \tag{3.3}$$

[8]For simplicity I chose the Cobb-Douglas utility function, but it can be generalised to CES.

Full-time workers can also work the legal limit: $H = \overline{H}$, so the optimal choice of hours for a full-time employee will be in the range $[\overline{H}, H_s^*]$. From equation (3.3), optimal hours for each worker will depend on the wage (w), overtime pay (b), overtime tax (σ), income tax rate (t) and elasticity of worker's utility with respect to leisure (α).

The 2012 policy in France introduced overtime tax; in other words, individuals could not deduct overtime pay from the income tax base. Translating the policy change in the framework of this model, σ decreases and we are interested in its effects on optimal hours supplied by the workers:

$$\frac{\partial H_s^*}{\partial \sigma} = \frac{t\overline{H} - t\alpha\overline{H} + wt\alpha\overline{H} - t^2 w\alpha\overline{H} + \frac{1}{2}t\alpha L_0}{\alpha(\frac{1}{\alpha} - 1 + w + bw - tw - tbw + t\sigma)^2} \tag{3.4}$$

It is not straightforward to conclude if $\frac{\partial H_s^*}{\partial \sigma}$ is positive or negative, as it will be determined by more than one parameter. Wages, overtime pay, cap on weekly hours worked and taxes are set up by the legislation and the labour market. However, each worker has their own α – the elasticity of that worker's utility with respect to leisure. For $\alpha = 1$, where utility will change for exactly the same amount as leisure change, $\frac{\partial H_s^*}{\partial \sigma} > 0$, the worker will work less if the overtime tax is introduced and the substitution effect prevails. For $\alpha = 0$, the individual's utility will not change for any change in leisure and $\frac{\partial H_s^*}{\partial \sigma} < 0$. In this case, the worker will work more hours if the overtime tax is introduced, with an income effect prevailing over the substitution effect.

If parameters in the labour supply model are calibrated, similar result can be shown for other values of α. Table 3.1 shows the assumed parameter values, which although simplified, correspond to France in 2012.[9] The substitution effect will dominate the income effect if $0.3 < \alpha \leq 1$ – for an increase in overtime tax, workers will decrease their hours worked. Income effect will dominate only if $0 \leq \alpha \leq 0.3$. This theoretical prediction corresponds with reality: Cahuc and Carcillo (2014) note that, normally, income effect is fairly small and it is more likely that the substitution effect will prevail over the income effect.

3.3.2 Labour demand

Trejo (2003) discusses a model of the firm's demand for workers and hours, which is extended for overtime tax. In a static framework, each representative firm decides between hiring a number of

[9] The legal limit for full-time hours worked in France is 35, since 1998 for large firms and 2002 for small firms Askenazy (2013). Total endowment of time, which workers split between leisure and labour, is assumed to be 80. If there is no collective agreement, overtime hours in France are paid 25% over the regular wage. The average wage rate in 2012 France was around €21 (Eurostat Database, accessed May 2020). France has a progressive income tax system, which imposes higher tax rates for higher income tax. In 2012, tax rates were 0%, 5.5%, 14%, 30% and 41%. The model assumes a flat tax rate of 30%.

workers (N) or increasing hours worked (H) for existing employees, in order to produce a fixed output (Q_0). Workers can be hired from an infinite pool of employees. The trade-off between the two comes from different costs attached to them. Hiring new employees incurs a cost (v), which can include interviews, training, etc. Hours worked cost a gross hourly wage rate (w) and an employer tax/contributions (t_e) on regular hours pay, if hours are below the national legal working hours limit ($\overline{H}$). Above the legal hours limit, firms have to pay overtime premium b and an overtime tax (δ). For a firm assigning overtime hours, the optimisation problem can be formulated in the following way:

$$\begin{aligned} \min_{N,H} \quad & C = (1+t_e)wNH + (1+\delta)bwN(H-\overline{H}) + vN \\ \text{s.t.} \quad & Q_0 = NH, \\ & H - \overline{H} \geq 0, \\ & 0 \leq H \leq L_0, L_0 = 80, \\ & 0 < \delta, t_e < 1 \end{aligned} \tag{3.5}$$

The firm's cost consists of the cost of regular hours worked ($(1+t_e)wNH$), the cost of overtime hours ($(1+\delta)bwN(H-\overline{H})$) and the cost of hiring new workers (vN).[10] Similar to the supply model, workers cannot work more than the time endowment, $L_0 = 80$.

The firm will choose optimal hours worked in the range $[\overline{H}, H_d^*]$. If the firm chooses to employ overtime hours ($H_d^* > \overline{H}$), optimal hours and employment can be written as:

$$H_d^* = \frac{v}{(1+\delta)bw\overline{H}} \tag{3.6}$$

$$N^* = \frac{Q_0(1+\delta)bw\overline{H}}{v} \tag{3.7}$$

The 2012 overtime tax introduction, in this model, translates into an increase of δ, which would decrease total demand hours and increase new hires, which can be formally written as:

$$\frac{\partial H_d^*}{\partial \delta} = \frac{-bw\overline{H}v}{((1+\delta)bw\overline{H})^2} < 0$$

$$\frac{\partial N^*}{\partial \delta} = \frac{Q_0 bw\overline{H}v}{v} > 0 \tag{3.8}$$

[10] Note that if $H \leq \overline{H}$, the cost function will be $C = (1+t_e)wNH + vN$

However, if the cost of hiring new employees (v) increases at the same time, it would have the opposite effect on hours worked:

$$\frac{\partial H_d^*}{\partial v} = \frac{(1+\delta)bw\overline{H}}{((1+\delta)bw\overline{H})^2} > 0 \tag{3.9}$$

In other words, overtime tax would increase employment and decrease overtime hours that the firm demands, unless there is a high(er) cost of hiring. High cost of hiring during high unemployment periods can come due to high level of applications for each position advertised. Therefore, the time cost becomes higher as it takes time to review applications and interview more candidates than normal.

Another possible explanation for firms to increase the demand for hours during recession periods is a business cycle effect. Although I do not model the business cycle effect in this paper, Hart (2004) notes that after recessions, when the business cycle starts to pick up and in the presence of high uncertainty, firms are more likely to hire more hours (employ overtime hours) rather than hire new employees. In case the business cycle does not turn up, it is much easier to reduce overtime hours to regular hours than to fire new hires. Section 3.2 showed some evidence that this was the case in France around 2012/2013.

3.3.3 General equilibrium remarks

The European Labour Force Survey (EU LFS) does not report individual wages, and I cannot explore the effect of overtime tax on wages. However, it is worth noting the possible theoretical predictions of this effect. For $H_s^* = H_d^*$, the equilibrium wage will be $w^* = f(\alpha, L_0, \overline{H}, t, b, \delta, \sigma, N, Q_0)$. For a change in both employee (σ) and employer (δ) overtime tax, equilibrium demand and supply hours will change and as a consequence adjust the equilibrium wage. From equations (3.6) and (3.3), a wage change will in turn adjust optimal hours. For a higher wage rate, firms will demand less hours and individuals will supply more hours (income effect prevails):

$$\frac{\partial H_s^*}{\partial w} = \frac{\overline{H}(\frac{1}{\alpha}b - b - \frac{1}{\alpha}tb + tb - t\sigma + t^2\sigma) + L_0(1 - \frac{1}{\alpha} - \frac{1}{\alpha}b + b + \frac{1}{\alpha}t - t + \frac{1}{\alpha}bt - tb)}{(\frac{1}{\alpha} - 1 + w + bw - tw - tbw + t\sigma)^2} > 0 \tag{3.10}$$

$$\frac{\partial H_d^*}{\partial w} = \frac{-v(1+\delta)b\overline{H}}{((1+\delta)bw\overline{H})^2} < 0 \tag{3.11}$$

3.4 Data

This paper uses yearly repeated cross-sectional EU LFS data, published by Eurostat. The country of interest is France in the sample period 2003–2017. Respondents are individuals older than 15, which is the lower working age limit in most European countries. EU LFS collects detailed information on working conditions for employed individuals, training and education of all respondents and job search for the unemployed.

The sample is restricted to employed individuals, who work some positive number of hours. The variable which allows for identification of overtime tax effects on hours worked is *firm size*. EU LFS supplies firm size in the following brackets: 1–10 employees, 11–19 , 20–49, 50 and more, less than 10 but not sure and more than 10 but not sure. The variable firm size is self-reported and subject to measurement error. To alleviate measurement error to some extent, individuals who do not report firm size, or are not sure of the size of the firm they are employed in, are excluded from the sample. Table 4.1 shows descriptive statistics by firm size, where small companies (size 1–10 and 11–19) are grouped in column (1). Column (1) is the group of employees which continued to work overtime tax-free and serves as a control group. Columns (2) and (3) are the treated ones: employees in firms with 20 or more employees start paying tax on overtime hours in 2012.

As described in Sections 3.2 and 3.3, there are three outcome variables of interest: actual hours worked, paid overtime hours available from 2006 and the share of overtime workers. EU LFS collects several variables measuring hours worked: usual hours (number of hours per week usually worked), actual hours (number of hours actually worked during the reference week), paid and unpaid overtime hours (hours worked over the legal limit or contractual hours), desired hours (total number of hours the individual would like to work).[11] Usual hours worked are normally higher than actual hours as they do not include, for example, annual or sick leave. On the other hand, actual hours measure hours actually worked in the reference week, conditional on all labour market restrictions – access to childcare, labour demand, legislation Therefore, actual hours will be used to measure equilibrium labour market hours. Paid overtime are used instead of unpaid overtime, due to even larger measurement error in unpaid hours. Desired hours are used to measure the labour supply, unrestricted by labour market conditions.

Average years employed in the employee firm is around 10–13, depending on the firm size group. For the empirical analysis and ease of interpretation, the variable is transformed into a dummy equal to 1 if the employee is employed in the same firm 5 years or less, and 0 otherwise. Gender, education, part-time and temporary variables are presented as shares in the sample, for each firm size group. In the empirical specification, these variables are included as dummies.

[11]Desired hours worked are discussed in more detail in Section 3.9. For analysis of desired hours in European countries, see Bell and Blanchflower (2018) and Tuda (2020).

Very large and small firms can be different in aspects other than the overtime tax policy change, for example, adjustments to macroeconomic shocks, hiring overtime hours or hiring new workers. This is confirmed by the t-test of differences in means between columns (1) and (3): the largest firms have statistically significantly different means than the small firms.

Employees in firms sized 20–49, from column (2) seem like a better treatment group then firms larger than 50 employees, because differences between columns (1) and (2) are smaller than (2) and (3). However, column (4) shows that differences in outcome variables (hours worked) are statistically significant. This is driven by changes in hours worked overtime, due to institutional changes and the business cycle adjustments. I further discuss the parallel trends of hours worked between treatment and control groups in the next section.

A dataset that would allow the comparison of truly similar employees in all aspects but the tax reform, would offer a disaggregated firm size variable. In that case, I would be able to compare workers in firms with 18 or 19 employees with workers in firms with 20 or 21 workers. In other words, by comparing workers' hours worked just below the threshold set by the policy and above it, other aspects like macroeconomic adjustments would not affect hours worked, and any discontinuity would be attributed to the policy change. A dataset like that is available from the producer INSEE, France, but not obtained for this draft due to funding constraints and COVID-related difficulties.

3.5 Empirical strategy

The introduction of overtime tax in France was an unanticipated shock to large firms and workers in those firms, as discussed in Section 3.2. The theoretical prediction is that both firms and workers adjusted the hours worked after the overtime tax introduction in 2012. The empirical strategy exploits the the unanticipated introduction of the reform, and estimates the effect of overtime tax on hours worked, by comparing small and larger companies.

To identify only the effect of overtime tax, hours worked should follow a similar trend over time. Otherwise, diverging trends in hours worked would mistakenly be attributed to the policy change. In addition, hours worked in France are potentially contaminated by previous labour market reforms, as discussed in Section 3.2. This is also visible in the descriptive statistics in Table 4.1, where means of outcome variables statistically significantly differ in the control and treatment group. Although hours worked differ between the treatment and control group and there is visible contamination of the control group before 2009 (Figure 3.5), the parallel trend assumption holds from 2009 until the pre-treatment period 2011. This suggests that before the treatment in 2012, hours worked were on a parallel trend, and that the estimated effect after the treatment is the effect of the overtime tax reform.

To alleviate the bias from the control group contamination, I apply the synthetic control estimation to the treatment group, which confirms the main result. However, the synthetic control approach uses data-driven weights in the estimation, which are generated from the contaminated control groups. Therefore, the bias in the average effect of overtime tax for all workers in France, remains unsolved, using the available EU LFS data set.

Furthermore, it is possible that overtime tax affected subgroups on the labour market differently. More vulnerable workers on the labour market, like part-time and temporary workers, would potentially work more hours for a higher overtime tax, as their hours are easier to manipulate. Unlike employees in small and large firms, part-time and temporary workers have not been explicitly treated in any of the labour market reforms in France, and the control group is likely to be less contaminated. To disentangle the average effect of overtime tax on hours worked, I estimate the triple difference specification for part-time and full-time workers. The main identifying assumption is that the difference between treated and untreated evolves on the same trend between part-time and full-time workers (or temporary and permanent workers). Figure 3.9 shows that the identifying assumption holds for actual hours worked.

Measurement error challenges are somewhat alleviated by excluding observations without reported firm size variable and if respondents are not sure of the firm size, as discussed in the previous section.

3.6 The effect of overtime tax on equilibrium hours worked

Theoretical framework suggests that the introduction of overtime tax would decrease (overtime) hours worked on both labour supply and demand. However, descriptives from Figure 3.4 show that, post-2012, overtime hours increase, while actual hours decrease, which is not in line with the theoretical predictions. This section investigates the effects of overtime tax introduction in 2012 on hours worked for larger companies.

3.6.1 Empirical specification and main results

The goal is to estimate the effects of overtime tax introduction in 2012 on overtime and actual hours worked. I exploit the variation in the treatment of overtime tax payment created by the reform and estimate the difference-in-difference equation:

$$Y_{it} = \alpha_0 + \sum_{t \neq 2011} \beta_t \cdot Year_t \cdot Treat_{it} + Treat_{it} + \delta' X_{it} + \alpha_t + \epsilon_{it} \tag{3.12}$$

where Y_{it} is the outcome variable for individual (i) in time (t): overtime, actual hours and the probability of working overtime. $Year_t$ is equal to 1 when the year equals t. $Treat_{it}$ is equal to 1 if the individual is employed in a larger company (20–49 employees) and 0 if employed in a small company (below 20 employees). X_{it} is a vector of controls: second-order polynomial of age, education dummies (equal to 1 for low, medium and high levels of education; to interpret in comparison to individuals without obtained education), gender dummies, dummies for part-time and temporary contracts and a dummy representing seniority in the firm, equal to 1 if the individual worked in the firm for 5 years or less. α_t is the year fixed effect and ϵ_{it} is the error term. Standard errors are bootstrapped.

Dummy variable $Treat_{it}$ is interacted with each pre-treatment period, except 2011, and with each post-treatment period. Coefficients β_t represent the effect of the overtime tax reform on outcome variables, in year t relative to the pre-reform year, 2011. In comparison to the standard difference-in-difference specification with dummy for post-treatment, this specification has two main advantages: First, it allows the estimation of potential leads before 2011, in case the treatment has a significant effect before the treatment and could indicate the bias in the difference-in-difference estimates. Second, it allows the observation of the effects of the treatment in each period after the treatment. As discussed in Section 3.2, after 2012 France exited the recession, and changes in hours worked could be driven from the business cycle effect. Interaction of the dummy for each year with the treated group dummy controls for such business cycle effects.

Parameter β_t can be written as:

$$\beta_t^{DD} = (\overline{Y}_{treat,after} - \overline{Y}_{treat,before}) - (\overline{Y}_{control,after} - \overline{Y}_{control,before}) \tag{3.13}$$

The unbiasedness of β_t depends on parallel trend assumption between the treatment and control means of the outcome variables. The first row of Figure 3.5 shows average actual and overtime hours and the share of overtime workers for the treatment and the control group. Actual hours worked plummet for small firms around the beginning of the recession, which violates the parallel trend assumption until 2009. Before 2009, actual hours were also affected by previous labour regulations: a 35-hour weekly cap in 2002 was introduced for small firms, and overtime hours were de-taxed in 2007 for everyone. However, from 2009 until the treatment in 2012, average actual hours for small and larger firms co-move perfectly – the parallel trend holds for several years before the treatment. After the treatment in 2012, actual hours of the treated decrease, while actual hours of the control increase, even though the control group was not affected in this reform. The control group seems to be contaminated by previous reforms in 2002 and 2007, which implies that $\overline{Y}_{control,after}$ in equation (3.13) is not reliable and that the estimation of β_t^{DD} will be biased.

Average paid overtime hours in the treatment and the control group move together until 2012, when overtime hours of the treated increase more than those of the control. Although parallel trend assumption holds, overtime hours of the control group are increasing even though these individuals are not treated. From equation 3.13, this means that $\overline{Y}_{control,after}$ is changing and that the estimation of β_t^{DD} will be biased. The same is true for the probability of working overtime.

The bottom row of Figure 3.5 plots the difference-in-difference estimates of β_t from equation (3.12). Panel 3.5a shows that overtime tax decreased actual hours worked. Overtime tax decreased actual hours worked for employees in large companies by almost 2 hours per week, compared to 2011, the pre-treatment period. The effect is large and persists until 2017. There are visible statistically significant leads, confirming that parallel trends assumption does not hold before 2009, while the effect is insignificant before the treatment. The bottom panel of Figure 3.5b shows the effect of overtime tax on overtime hours worked. Overtime tax increased overtime hours worked compared to the pre-treatment period 2011. The effect persists until 2017 and is statistically significant. In 2013, overtime hours of employees in large companies increased by 0.25 hours compared to 2011, which translates into $0.25 \cdot 60$ minutes $= 15$ minutes in the reference week. There are no significant leads in the pre-treatment period. However, this result is likely driven by more individuals reporting overtime hours: the probability of working overtime increases by 5 percentage points after the treatment.

It is useful to summarise the main result here: overtime tax decreased actual hours by almost 2 hours per week. From the theoretical framework, overtime tax would decrease actual hours worked if both firms and workers decrease their demand and supply of hours. Labour supply would decreased if the substitution effect prevails over the income effect, and firms would decrease the demand (and hire new employees) if overtime became too costly, compared to the cost of hire. This result is in line with the theoretical predictions and the related literature.

On the other hand, overtime hours *increase* as a consequence of overtime tax. There are two important points to note here. First is that overtime hours are recorded in actual hours if they are reported as positive. If the individual did not work overtime, overtime hours in the survey will be recorded as 0. However, in France it is possible to work over the legal limit of 35 hours per week and not work overtime hours, due to annualisation of overtime hours and exceptions from the Labour Law through collective agreements. Second, overtime hours are equilibrium hours, similar to actual hours: both demand and supply side should agree on these hours. If overtime hours were to increase due to the overtime tax, income effect should be stronger than the substitution effect (supply side) and firms should hire more overtime hours, despite it being costlier for them. From the theoretical framework, firms would increase the demand for (costlier) overtime hours if cost of hiring new workers or uncertainty about the business cycle are high. However, even if both were true and firms did hire more overtime, this would be recorded in actual hours worked as well, which is not. A more plausible explanation for the increase in overtime hours (rather than the demand effect) is that more workers reported overtime hours. 2012 overtime tax introduction, led to a *five-fold* increase in the probability of overtime. However, firms are the ones responsible for reporting overtime hours on the employee payslip. This implies that, in addition to lower hours demand, one of the effects of the overtime tax reform was fiscal responsibility.

3.6.2 Robustness analysis

To further investigate the extent of the bias in estimates from Figure 3.5, in this section I perform a number of placebo and robustness checks which should add to the internal validity of the DD estimates. I perform a placebo test of the treatment on two outcomes which should not be affected by the treatment. This test should add to the parallel trend assumption validation. Additionally, I estimate equation (3.12) with alternative treatment groups, described in Table 4.1.

In order to show that the parallel trend assumption holds, I estimate equation (3.12) on outcomes which should not be affected by the overtime tax reform in 2012. The number of individuals living in a household and the number of employed individuals in the household should not be affected by overtime tax. Individuals normally do not make a decision on who to live with, divorce or marry because of the overtime income tax, especially because the level of tax does not depend on the personal background. Table 3.3 shows the results of the treatment and should be interpreted compared to 2011, the pre-treatment period. The results are all statistically insignificant, which suggests that the parallel trend assumption for Figure 3.5 estimates holds.

The choice of the treatment group may also cause bias in my estimates. I estimate two regressions where the treatment group consists of employees in companies with over 50 employees (column 3 in Table 4.1) and employees in companies bigger than 20 (column 2 and 3 from, Table 4.1). Table 3.4 shows that the baseline results from Figure 3.5 are robust to the choice of treatment group, although slightly less statistically significant. As expected, employees working in companies with more than 50 employees, work different hours than the control group, therefore the effect of treatment is smaller than the treatment effect when treated are individuals from companies with 20–49 or 20 or more employees.

To conclude this section, overtime tax seems to have decreased hours worked in the equilibrium, suggesting a substitution effect on the labour supply side and a decreased demand from firms. On the other hand, overtime hours increase after the introduction of overtime tax, but that seems to be driven by more reporting of overtime hours. The result is robust to the choice of treatment group, and placebo regressions are insignificant. However, the control group remains contaminated, which I will address in the next section.

3.7 Synthetic control estimates

Section 3.6.1 discussed the difference-in-difference estimates of the overtime tax on actual and overtime hours. I show that overtime hours increase due to higher reporting of overtime hours but that actual hours worked decrease. However, the control group seems to be contaminated by previous reforms of hours worked in France: the 2002 reform of the weekly cap and the 2007 overtime de-taxation. To reduce the contamination from the control group, I estimate synthetic control groups for actual and overtime hours worked.

As in a comparative study like this one, where it is difficult to find unaffected units due to contamination and there is uncertainty about aggregate values of variables due to the use of survey data, synthetic control provides a better estimate of the comparison group (Abadie, Diamond, and Hainmueller, 2010, Abadie, forthcoming). Synthetic control uses weighted average of available control units because it is more likely that the weighted average provides a better comparison for the treated group, than any single unit alone. Although I use both control groups in the difference-in-difference analysis, the group of very small firms, with 1–10 employees, shows large changes in actual hours worked, where employees in firms 11–19 or 20–49 do not.[12] Instead of using both control groups together, synthetic control will re-weigh their relative contribution to the counterfactual, based on their explicit similarities in terms of control variables and pre-treatment hours worked. It is important to note that synthetic control uses only pre-treatment values of hours worked to estimate post-treatment values.

Following Abadie, Diamond, and Hainmueller (2010), I assume that $\alpha_{jt} = Y^I_{jt} - Y^N_{jt}$ is the gap between treatment and control group, where $j = 2, ..., J+1$ is the number of units (in my case firms with 1–10 and 10–19 employees), in time (t). Y^I_{jt} is the value of hours worked of the treated, which is observable, and Y^N_{jt} of the control, which is unobservable and is aimed to be estimated:

$$Y^N_{jt} = \delta_t + \theta' X_{jt} + \lambda_t \mu_j + \epsilon_{jt}$$

where δ_t is the common unknown factor, X_{jt} are covariates from equation (3.12) and pre-treatment values of the outcome variable for periods 2009–2011, λ_t is a vector of unobserved common factors, μ_i is a vector of unknown factor loadings and ϵ_{jt} are unobserved transitory shocks with mean 0. For some vector of weights $w_j \leq 0$ and $\sum w_j = 1$, we can rewrite the outcome variable as:

$$\sum w_j Y_{jt} = \delta_t + \theta' \sum w_j X_{jt} + \lambda_t \sum w_j \mu_j + \sum w_j \epsilon_{jt} \tag{3.14}$$

[12] Table 3.5 in Appendix 3.A shows detailed descriptives by firm size.

In other words, equation (3.14) will estimate the synthetic control by re-weighing the outcome variable based on the observable covariates in the two comparison units, and $\hat{\alpha}_{1t} = Y_{1t} - \sum w_j Y_{jt}$ is the estimator for the gap α_{1t}.

The first row of Figure 3.6 repeats actual and overtime hours for the treatment and control groups as found in the data. In the second row, I plot the treatment group with the estimated synthetic control groups.[13] By re-weighing the contribution of control groups to the treatment, actual hours in the treatment and synthetic control group follow each other closely from 2009 until the treatment period. Post-treatment actual hours of the two groups do not move in opposite directions (as is the case with the control group from the data); rather, they both fall. This suggests that the effect of overtime tax on actual hours worked is negative, as shown in Section 3.6. However, the gap between the treatment and synthetic control group is around 1 hour per week, suggesting that the estimates from Figure 3.5 were overestimated. Similar is true for overtime hours – the gap between treated and synthetic control is smaller than between treated and control group from the data, suggesting that previous estimates were biased upwards.

To show that this gap between treatment and synthetic control is not driven by chance, I use the same method from equation (3.14) and run two placebo analyses, where the "treated" group are employees from small firms (1–10 and 11–19 employees). I re-assign the overtime tax reform to each of the groups, which in reality were not treated in 2012. We should not see the same gap for those groups as we see for the group that was treated in actuality. Figure 3.7 plots gaps between treated and synthetic control for the actually treated group (20–49 employees) and two placebo groups.

Figure 3.7 shows that the gap in actual hours between treatment and synthetic control *falls* for the true treatment group but *increases* for the placebo groups. This suggests that the negative effect of overtime tax on actual hours we see in Figure 3.6 is not random, because we don't see the same effect using the placebo analysis. The same holds for overtime hours – the gap between treated and synthetic control increases in the group that had to pay overtime tax, but falls in the two placebo groups.

One final way to evaluate the hours in large companies relative to the placebo groups is to calculate the ratio between post- and pre-intervention mean squared prediction error (MSPE). MSPE is the average of the squared hours differences in the treated group and its synthetic counterpart. The larger the ratio for the synthetic control of the real treatment group relative to placebo groups, the more convincing the synthetic control estimate. Excluding the periods before 2009, which were not used in the synthetic control estimate of actual hours, the ratio for the treated group is over 10, whereas it is not bigger than 4 for the placebo groups. In other

[13] Synthetic controls are estimated using Stata package *synth*, where the chosen weights are data-driven.

words, the synthetic control estimate for large companies has post-reform MSPE 10 times larger than the pre-reform MSPE. This ratio is 2.5–10 times bigger than the placebo groups' ratios. For overtime hours estimates, the ratio for the treated group is around 3, but around 2 for placebo groups. The difference in ratios post-/pre-MSPE is much smaller for overtime hours because the gaps in synthetic control and treatment groups are also much smaller.

In summary, synthetic control estimates confirm the results from the DD estimates: overtime tax decreases actual hours worked and increases overtime hours. The differences between treated and the synthetic control hours are smaller than before, therefore reducing the bias from DD estimations.

3.8 Heterogeneous effects of overtime tax

So far, this paper has discussed the effects of overtime tax on hours worked for all employed individuals. However, part-time and temporary workers are usually the ones facing most uncertainty on the labour market and have fewer outside options than full-time workers. Figure 3.8 shows the share of part-time and temporary workers, with the average actual hours worked of part-time and temporary workers, respectively. The share of part-time workers increases by 1 percentage point from 2011 to 2012, whereas the share of temporary workers follows an increasing trend even before the 2012 reform. Average actual hours for both part-time and temporary workers is well below the 35-hour weekly cap. Although it is expected that average hours for part-time workers will be lower than the 35-hour weekly cap designed for full-time workers, their average actual hours fall after the 2012 reform. As discussed in Section 4.4, part-time workers can work overtime and will be subject to the overtime tax from 2012 onwards if they work more than their contractual hours. On the other hand, temporary workers work on average 30 hours per week. On average, temporary workers could increase their actual hours and not pay overtime tax as it would not exceed the threshold of 35 hours per week. However, their actual hours decrease after 2012. This section investigates possible effects of the overtime tax for part-time and temporary workers, which could be different than the average effects from Figure 3.5, as is indicated by the increasing share of these workers.

To analyse the causal effect of overtime tax on hours worked for the two groups – part-time and temporary workers – I estimate a triple difference regression:

$$Y_{ijt} = \alpha_0 + \sum_{t \neq 2011} \gamma_t \cdot Year_t \cdot Treat_{ijt} \cdot Group_{ijt} + \sum_{t \neq 2011} \beta_t \cdot Year_t \cdot Treat_{it} + Treat_{ijt} \cdot Group_{ijt} + Treat_{it} + Group_{ijt} + \delta' X_{ijt} + \alpha_t + \epsilon_{it} \quad (3.15)$$

where Y_{ijt} is the outcome variable (overtime or actual hours) for individual (i) in time (t) and part of the $Group_j$ which is either part-time or temporary worker. $Year_t$ is equal to 1 when the year equals t. $Treat_{ijt}$ is equal to 1 if the part-time or temporary individual is employed in a larger company (20–49 employees) and 0 if employed in a small company (below 20 employees). The coefficient of interest is γ_t, capturing the effect of the group treatment in each year, compared to the pre-treatment period 2011. X_{ijt} is a vector of controls – second-order polynomial of age, education, gender, dummies for part-time and temporary contracts and a dummy representing seniority in the firm, equal to 1 if the individual worked in the firm for 5 years or less. α_t is the year fixed effect and ϵ_{it} is the error term.

The main identifying assumption for the triple difference model is that the differences between treatment and control evolve similarly for the group in question. In this case, the assumption is that the difference in hours between larger- and small-firm employees evolved similarly for part-time and full-time workers (and temporary and permanent workers). The first row of Figure 3.9 plots this identifying assumption for part-time workers.[14] The differences in actual hours between treated and control group evolve in a similar way for both part-time and full-time workers. This is, however, not true for overtime hours and the probability of working overtime. Therefore, the identifying assumption holds for actual hours but not overtime hours.

The second row of Figure 3.9 plots the marginal effect of the treatment on hours worked for part-time workers – coefficient γ_t. Overtime tax increases actual hours worked for part-time workers in large firms by 1.6 hours in 2013, compared to the pre-treatment period. This large and positive effect on actual hours persists until 2017. The effect on overtime hours is statistically insignificant. The effect on the probability of working overtime hours seems to be negative, however the identifying assumption does not hold and the effect should not be interpreted as valid.

Very similar effects of overtime tax can be seen for temporary workers – Figure 3.10. The differences between treatment and control for temporary and permanent workers (first row) evolve similarly for actual and overtime hours, although the validity of the identifying assumption is less clear compared to part-time workers. The bottom row of Figure 3.10 plots the marginal effect of the treatment on hours worked for temporary workers – coefficient γ_t from equation (3.15). Temporary workers in large firms increase their actual hours by 1.65 hours in 2013, compared to the pre-treatment period. The effect on overtime hours and the probability of overtime is statistically insignificant.

As a comparison, the treatment effect on actual hours for all workers (Figure 3.5a) is negative – employees in large companies, as a consequence of overtime tax, work less hours per week.

[14] Average hours used to calculate the differences between treatment and control groups can be found in Appendix 3.B.

However, the effect of the treatment for part-time and temporary workers is *positive* – these workers work more actual hours, without increasing their overtime hours, which is the opposite effect from what is found for all employed.[15] To explain this result, it is useful to remember that actual and overtime hours are a consequence of both labour supply and demand forces and the macroeconomic context of France 2012 (Section 3.2.2). Around 2012/2013, there is evidence that the firms were faced with increasing domestic demand for goods and services, while the uncertainty of the future business cycle was still relatively high. This puts firms in a position to demand more labour in order to satisfy the higher demand,[16] while at the same time it is still costly to hire new workers in case the recession is not over yet. Adding overtime tax to the production cost in 2012, firms would be unlikely to allow overtime hours. Therefore hiring more part-time and temporary workers, who on average work below the 35-hour weekly cap, and increasing their regular (non-overtime) hours might seem like the least costly way of hiring more labour. Additionally, Borowczyk-Martins and Lale (2019) suggest that labour demand in the US and UK during the Great Recession was adjusted on the intensive margin rather than the extensive margin. If the same was the case in France, it is only natural that part-time workers are willing to work more hours, while at the same time avoiding the cost of overtime tax.

3.9 Labour supply effects

This paper finds that overtime tax on average decreased hours worked, while part-time workers started working more hours as a consequence. Changes in overtime hours are driven by more diligent reporting of overtime hours, rather than the actual behavioural response. Actual (and overtime) hours are the result of the interplay between labour demand and labour supply. It is possible that in 2012/2013, when France was still undergoing the Great Recession, outside options for employees were limited and any change of hours worked imposed by the employer was likely to be internalised by the employer. Therefore, this section investigates potential labour supply responses to the overtime tax reform.

The EU LFS questionnaire contains 3 questions related to desired hours worked, and is asked to employed individuals. The questions are asked in the following order:

1 Whether the individual wishes to work more than the current number of hours

2 The way the individual would like to work more hours

[15]This suggests that the effect found for all workers would be even larger for full-time workers. I repeat the difference-in-difference analysis for full-time workers in Appendix 3.C. It shows that overtime tax caused full-time workers to decrease their actual hours by 2.2 hours in the reference week, which is larger than the effect for all employed.

[16]Bauer and Zimmermann (1999) find some indication that overtime hours are used to adjust to economic booms in Germany.

3 Total number of hours the individual would like to work

As discussed by Tuda (2020), desired hours are affected by many confounding factors, so it is important to note that the questions on desired hours are asked in a way to indicate a corresponding increase in labour income, for a given wage rate. If an individual answers yes to the first question, they indicate how they would like to achieve those hours: through an additional job, current job, with a different job offering more hours worked or all of the above. The most common answer of the respondents who want to work more hours than their actual hours is that they would like to do so through their current job. This is probably due to the cost of job-search.

Figure 3.11 plots average desired and actual hours per employee in France over time. Desired hours are consistently higher than actual hours in France. There is a small increase in average desired hours around the beginning of the Great Recession and a decrease in 2013/2014. I use desired hours worked as a measure of labour supply because they are unrestricted by labour demand or macroeconomic conditions. As is visible from the comparison with actual hours, desired hours do not exhibit any inexplicable jumps or drops in the time series.

Figure 3.12 plots the effect of overtime tax introduction on desired hours worked for: (3.12a) all employees, (3.12b) part-time workers and (3.12c) temporary workers. The first row of Figure 3.12a plots the parallel trends between the treated (larger firms) and the control group (small firms). Desired hours in small firms increase from 2003, faster than desired hours in medium companies. It is possible that the increase in desired hours in the control group from 2003 comes as a consequence of the 35-hour weekly cap on hours worked from 2002, which was introduced for small firms only. This is followed by a large drop in desired hours for small companies in 2008, a year after overtime work was de-taxed for everyone and the beginning of the Great Recession.

Regardless of the changes in desired hours worked at the beginning of 2000s, from 2009 until the overtime tax reform in 2012, average desired hours in the treatment and control group follow a similar trend. However, in 2013, desired hours in the treatment and control group move in the opposite directions, suggesting that the effect of overtime tax on desired hours will be overestimated. The bottom row of Figure 3.12a plots the coefficient β_t from equation (3.12), repeated here:

$$Y_{it} = \alpha_0 + \sum_{t \neq 2011} \beta_t \cdot Year_t \cdot Treat_{it} + Treat_{it} + \delta' X_{it} + \alpha_t + \epsilon_{it}$$

Overtime tax decreased desired hours worked, compared to the pre-treatment period 2011. The effect is statistically significant and persists until 2016. In 2013, desired hours of employees in large companies, decreased by $0.27 \cdot 60$ minutes $= 16.2$ minutes in the reference week. It is visible that there are statistically significant leads from 2003 to 2007, which corresponds to the period when the parallel trend assumption does not hold.

Figures (3.12b) and (3.12c) show the results of equation (3.15), repeated here:

$$Y_{ijt} = \alpha_0 + \sum_{t \neq 2011} \gamma_t \cdot Year_t \cdot Treat_{ijt} \cdot Group_{ijt} + \sum_{t \neq 2011} \beta_t \cdot Year_t \cdot Treat_{it} \\ + Treat_{ijt} \cdot Group_{ijt} + Treat_{it} + Group_{ijt} + \delta' X_{ijt} + \alpha_t + \epsilon_{it}$$

The first row shows the identifying assumptions for the triple difference model: the differences in desired hours between large and small firms should evolve similarly for part-time and full-time workers, and temporary and permanent workers, respectively. For both part-time and temporary workers, the identifying assumption does not hold. The bottom row plots the coefficient γ_t which measures the effect of overtime tax on desired hours for part-time (3.12b) and temporary workers (3.12c). As a response to the overtime tax in 2013, part-time workers increase their labour supply by $0.66 \cdot 60$ minutes $= 39.6$ minutes, compared to the pre-treatment period 2011. This effect for temporary workers is positive, however statistically insignificant.

Overall, there is weak evidence that labour supply responses changed in the same direction, as the equilibrium hours worked, measured by actual hours worked. This indicates that on average, overtime tax caused a substitution effect for all workers, but income effect for part-time workers. The magnitude of the effect of overtime tax on desired hours is smaller than the effect on actual hours, indicating that labour demand amplified the labour supply responses. More specifically, the decrease in labour supply for all employees was further decreased by firms reducing hours on average. On the other hand, an increase in labour supply for part-time workers was further increased by the firms increasing actual hours for part-time workers.

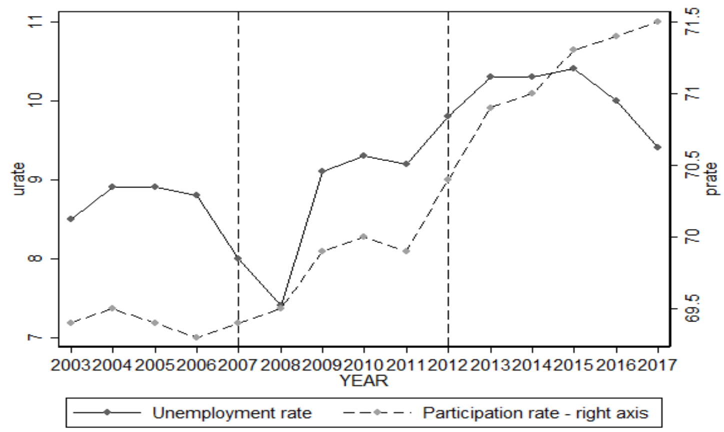
3.10 Conclusion

The aim of this paper was to estimate the effects of overtime tax on hours worked. The goal of the policy in 2012 was to potentially reduce unemployment and increase income tax revenue. I find that overtime tax in the equilibrium, on average, reduced actual hours worked and increased fiscal responsibility of the firms through more diligent reporting of overtime hours. Using LFS variable desired hours, I am able to estimate the effects on labour supply. In large firms, which were treated in 2012, labour supply decreases, confirming that for an increase in overtime tax, workers substitute income for leisure. The effect on labour supply is lower than on actual hours worked. This suggests that the general equilibrium result could be driven by the demand side, rather than primarily the supply side.

However, this result does not hold for part-time and temporary workers. These two groups of workers who are generally more vulnerable on the labour market, do not report more overtime hours, but do work more hours. As a consequence of the overtime tax, part-time workers' labour supply increases, although the estimate is biased. However, this implies that for part-time workers, income effect is likely to hold (rather than the substitution effect), especially in recessions when outside options are even more limited. On the other hand, firms faced higher domestic demand and high levels of uncertainty about the future business cycle. With high cost of overtime (usually used to adjust to economic booms) and high cost of hiring new workers, firms had to find the least costly way of satisfying the higher production demand: standard (non-overtime) hours of part-time and temporary workers.

From the policy maker's perspective, it seems that the policy partly succeeded: it increased reporting of overtime hours and fiscal responsibility, while decreasing hours worked of an average employer. However, instead of decreasing unemployment, the reform affected the hours of part-time and temporary workers. This unintended consequence of the overtime tax reform could be viewed in two ways. One is that the reform increased the demand for hours from workers with very limited outside options and forced them to accept higher hours worked as the only option to retain their jobs. Two, there is some weak evidence that those groups increased their labour supply at the same time. Although the estimates of labour supply are unreliable, if this is true, the overtime tax reform potentially served as the equaliser on the labour market, by increasing hours worked by those affected by the Great Recession the most. The answer to this lies in reducing the bias from labour supply estimates, which is left for future work.

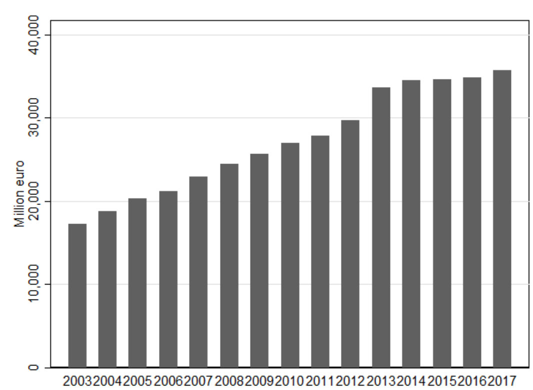
Figure 3.2: Unemployment and participation rate in France



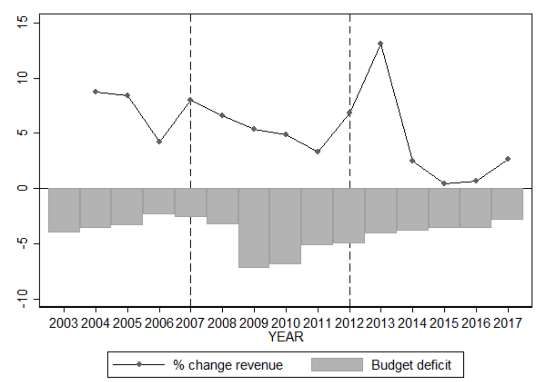
Notes: Sourced from Eurostat Database, European Labour Force Survey

Figure 3.1: Government revenue from payroll and government deficit in France

(a) Government revenue from payroll and workforce

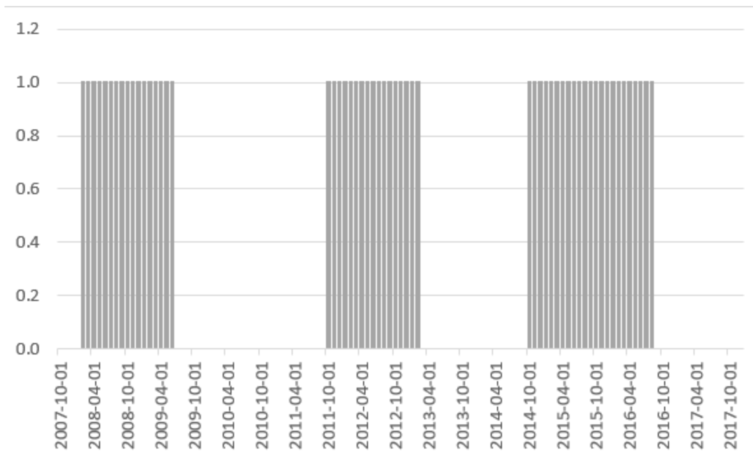


(b) Revenue from payroll and government deficit



Notes: This figure plots revenue from payroll and workforce on the left-hand side and the budget deficit with the percentage change in the payroll deficit on the right-hand side. Source: OECD Statistics

Figure 3.3: Monthly OECD recession indicator for France

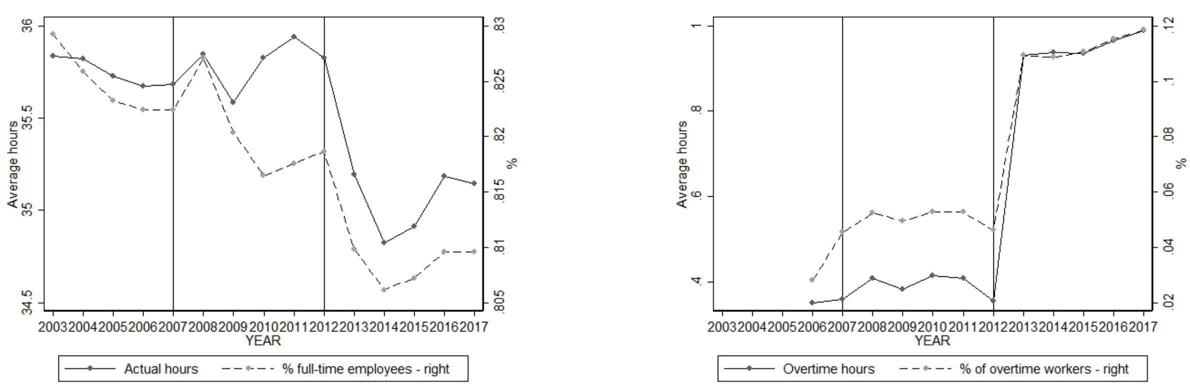


Notes: Sourced from Federal Reserve Economic Data – FRED (July 2020), on July 27, 2020. Grey areas are the recession periods.

Figure 3.4: Average actual and overtime hours worked

(a) Actual hours per employed

(b) Overtime hours per employed



Notes: Actual and overtime hours are average hours worked per employed in the reference week, for all employed individuals who reported the size of the firm they are employed in.

Table 3.1: Calibration of the labour supply model

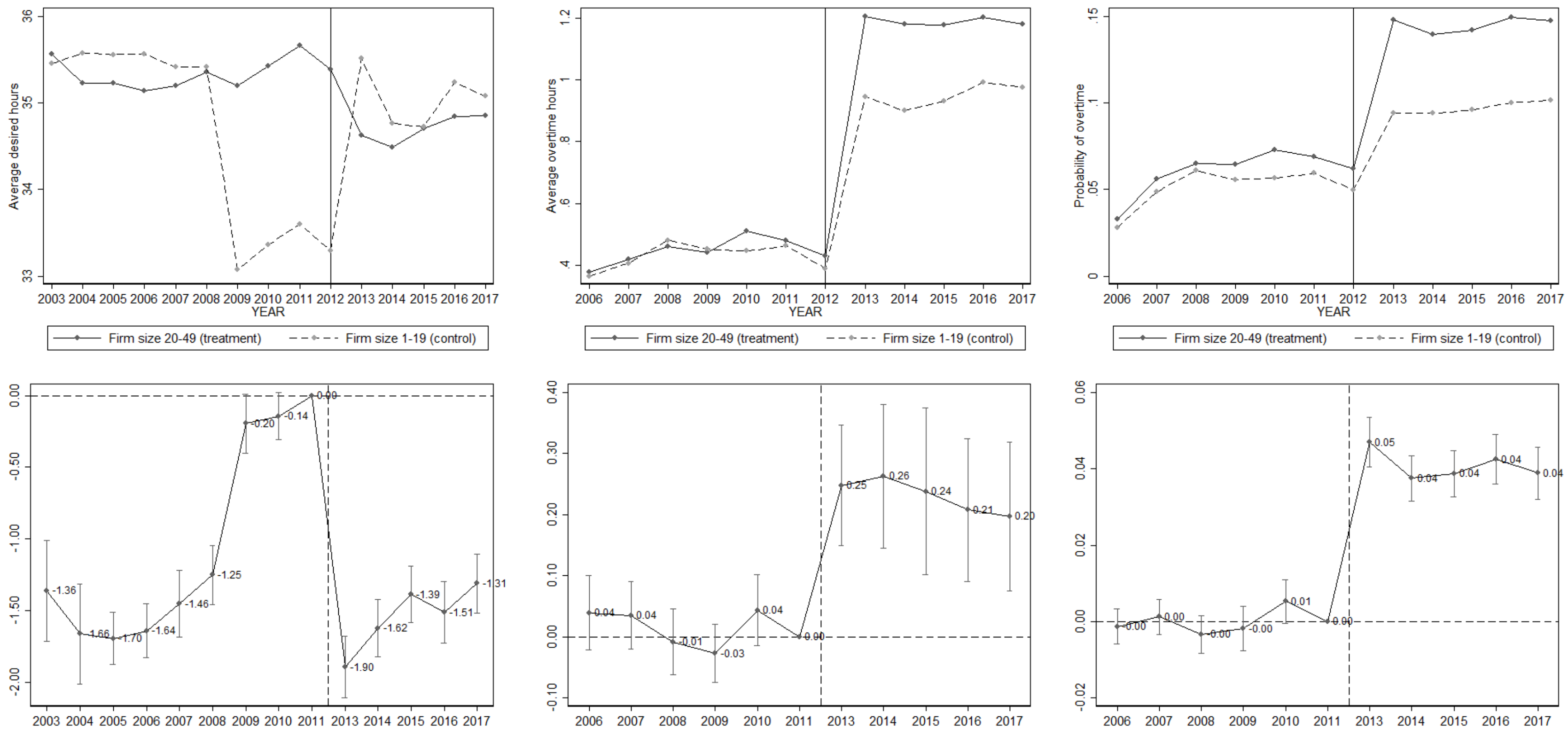
	(1)	(2)	(3)
α	0.3	0.5	0.6
$\overline{H}$	35	35	35
L_0	80	80	80
b	1.25	1.25	1.25
w	21	21	21
σ	0	0	0
t	0.3	0.3	0.3
$\frac{\partial H_s^*}{\partial \sigma}$	<0	>0	>0

Table 3.2: Descriptive statistics for DD analysis

	Firm size			Differences	
	(1)	(2)	(3)	(4)	(5)
	1-19	20-49	>50	(1)-(2)	(1)-(3)
Overtime hours	0.73	0.79	0.64	-0.05	0.10
	(4.37)	(4.47)	(4.01)	(0.01)	(0.01)
Actual hours	34.85	35.12	35.63	-0.27	-0.79
	(13.69)	(10.14)	(10.05)	(0.03)	(0.02)
Desired hours	36.81	37.89	38.37	-1.08	-1.56
	(9.86)	(8.28)	(8.34)	(0.02)	(0.02)
% overtime	0.07	0.09	0.07	-0.02	-0.00
	(0.25)	(0.28)	(0.26)	(0.00)	(0.00)
Years in firm	9.86	11.06	13.83	-1.21	-3.97
	(9.78)	(10.46)	(11.29)	(0.03)	(0.02)
% <= 5 years	0.45	0.41	0.31	0.04	0.14
	(0.50)	(0.49)	(0.46)	(0.00)	(0.00)
Age	41.76	40.90	41.88	0.86	-0.12
	(12.01)	(11.42)	(11.01)	(0.03)	(0.02)
% female	0.54	0.46	0.46	0.08	0.08
	(0.50)	(0.50)	(0.50)	(0.00)	(0.00)
% medium skilled	0.48	0.46	0.43	0.01	0.05
	(0.50)	(0.50)	(0.50)	(0.00)	(0.00)
% high skilled	0.26	0.32	0.37	-0.05	-0.11
	(0.44)	(0.46)	(0.48)	(0.00)	(0.00)
% low skilled	0.26	0.22	0.19	0.04	0.07
	(0.44)	(0.42)	(0.40)	(0.00)	(0.00)
% part-time	0.25	0.17	0.14	0.08	0.12
	(0.43)	(0.38)	(0.34)	(0.00)	(0.00)
% temporary	0.14	0.14	0.13	0.01	0.02
	(0.35)	(0.35)	(0.33)	(0.00)	(0.00)
N	428823	245337	800588	674160	1229411

Notes: This table summarises descriptive statistics for employed individuals 2003–2017 and who answered the question on the firm size they are employed in. Average hours are calculated as unconditional mean of employed individuals. Standard deviations in brackets in columns (1)-(3) and standard errors of the differences of means in columns (4) and (5).

Figure 3.5: The effect of overtime tax on hours worked



(a) Outcome variable: actual hours (b) Outcome variable: overtime hours (c) Outcome variable: probability of overtime

Notes: This figure shows parallel trends for hours worked in the first row. Average hours are calculated for treatment and control group per employed individual, who reported the variable firm size. In the second row, I plot coefficients β_t from equation (3.12) and the corresponding 95% confidence intervals, calculated with bootstrapped standard errors. The coefficients are the marginal effect of the introduction of overtime tax for large companies (interactions $Year_t \cdot Treat_{it}$) on actual and overtime hours worked, and the probability of overtime. The coefficients should be interpreted compared to the pre-treatment year - 2011. The regression includes time and treatment dummies and control variables: second-order polynomial of age, education, gender, temporary contract and part-time dummies, and a variable indicating the time in the company.

Table 3.3: Placebo effect of 2012 overtime tax

	# of individuals in the hh	# of employed in the hh
Treat x 2003	-0.000693	-0.0169
	(0.0311)	(0.0224)
Treat x 2004	0.0452	-0.00645
	(0.0324)	(0.0204)
Treat x 2005	0.0177	-0.0196
	(0.0267)	(0.0174)
Treat x 2006	0.0326	0.00205
	(0.0329)	(0.0280)
Treat x 2007	0.0322	0.0146
	(0.0381)	(0.0261)
Treat x 2008	0.0175	-0.0201
	(0.0368)	(0.0271)
Treat x 2009	0.00335	0.0296
	(0.0379)	(0.0268)
Treat x 2010	-0.0159	0.00210
	(0.0334)	(0.0275)
Treat x 2011	0	0
	(0)	(0)
Treat x 2013	-0.0118	-0.0190
	(0.0253)	(0.0170)
Treat x 2014	0.00803	-0.0243
	(0.0268)	(0.0167)
Treat x 2015	0.0200	-0.00399
	(0.0257)	(0.0155)
Treat x 2016	0.0327	-0.0134
	(0.0240)	(0.0153)
Treat x 2017	-0.0110	-0.00718
	(0.0256)	(0.0151)
N	674160	674160
adj. R^2	0.032	0.006

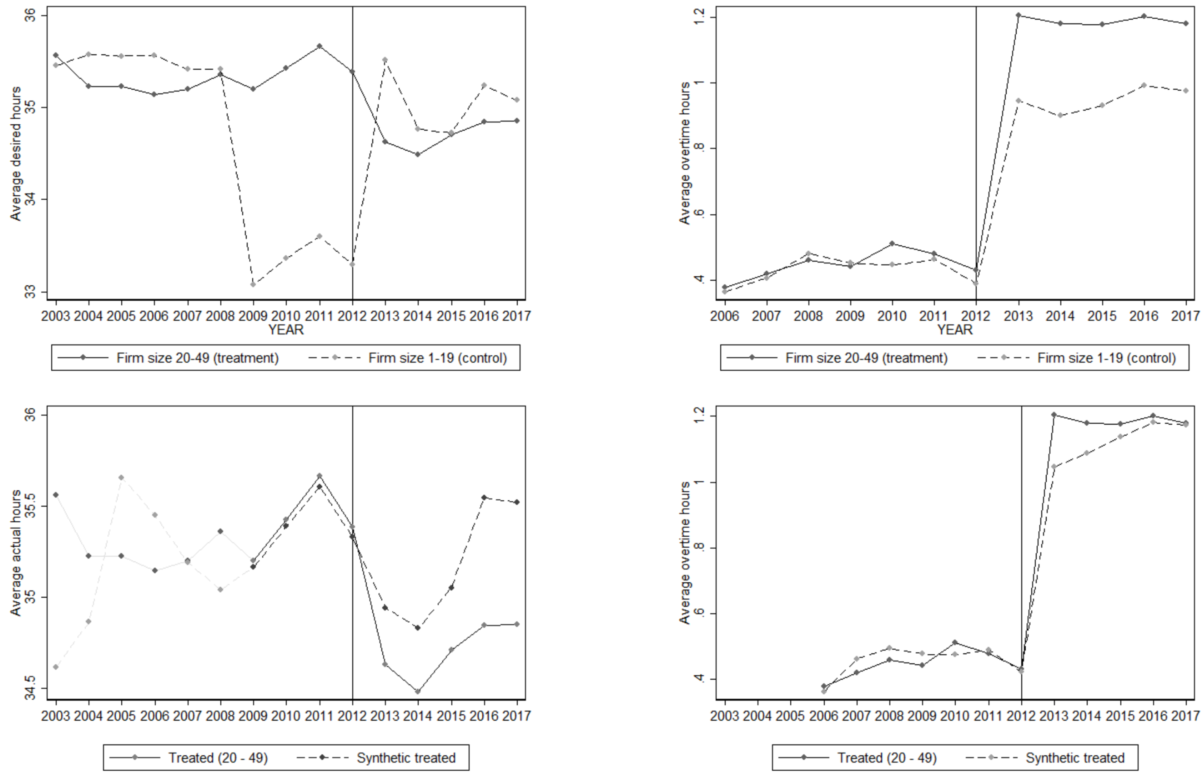
Notes: The table shows coefficients β_t from equation (3.12), with bootstrapped standard errors in the brackets. Outcome variables in the two regressions is the number of individuals in the household and number of employed individuals in the household. The coefficients should be interpreted compared to the pre-treatment period, 2011. Regressions include time and treatment dummies and control variables: second-order polynomial of age, education, gender, temporary contract and part-time dummies, and a variable indicating the time in the company.

Table 3.4: The effect of 2012 overtime tax on hours worked - alternative treatment groups

	Treatment: 50 or more		Treatment: 20 or more	
	Overtime	Actual	Overtime	Actual
Treat x 2003	0	-1.798***	0	-1.720***
	(0)	(0.158)	(0)	(0.145)
Treat x 2004	0	-1.904***	0	-1.878***
	(0)	(0.140)	(0)	(0.144)
Treat x 2005	0	-2.008***	0	-1.961***
	(0)	(0.0953)	(0)	(0.0902)
Treat x 2006	0.0859***	-1.892***	0.0722**	-1.867***
	(0.0241)	(0.0868)	(0.0248)	(0.0872)
Treat x 2007	0.0296	-1.542***	0.0295	-1.556***
	(0.0200)	(0.0840)	(0.0212)	(0.0811)
Treat x 2008	0.00424	-1.317***	-0.000453	-1.336***
	(0.0215)	(0.0862)	(0.0216)	(0.0895)
Treat x 2009	-0.0217	-0.179*	-0.0233	-0.177*
	(0.0237)	(0.0854)	(0.0221)	(0.0825)
Treat x 2010	0.0123	-0.224**	0.0200	-0.201*
	(0.0210)	(0.0849)	(0.0211)	(0.0789)
Treat x 2011	0	0	0	0
	(0)	(0)	(0)	(0)
Treat x 2013	0.0490	-1.739***	0.0754*	-1.816***
	(0.0350)	(0.0903)	(0.0328)	(0.0883)
Treat x 2014	0.0974*	-1.596***	0.129**	-1.643***
	(0.0400)	(0.0758)	(0.0401)	(0.0850)
Treat x 2015	0.0763*	-1.370***	0.106**	-1.414***
	(0.0309)	(0.0860)	(0.0355)	(0.0737)
Treat x 2016	0.0175	-1.546***	0.0509	-1.589***
	(0.0340)	(0.0759)	(0.0376)	(0.0795)
Treat x 2017	0.0925*	-1.337***	0.109**	-1.382***
	(0.0405)	(0.0840)	(0.0390)	(0.0711)
N	933233	1229411	1124446	1474748
adj. R^2	0.009	0.304	0.009	0.302

Notes: The table shows coefficients β_t from equation (3.12), with bootstrapped standard errors in the brackets. The treatment groups are individuals in firms with over 50 employees and with over 20 employees. As a comparison, baseline specification included individuals working in firms with 20–49 employees. The coefficients should be interpreted compared to the pre-treatment period 2011. Regressions include time and treatment dummies and control variables: second-order polynomial of age, education, gender, temporary contract and part-time dummies, and a variable indicating the time in the company.

Figure 3.6: Synthetic control estimates for actual and overtime hours worked

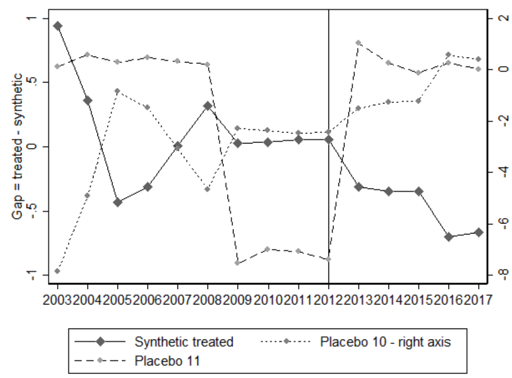


(a) Outcome variable: actual hours

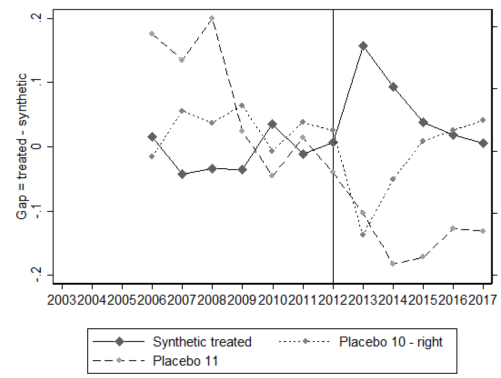
(b) Outcome variable: overtime hours

Notes: In the first row, this figure shows average hours worked per employee for the treated and control groups. In the second row, the figures plot average hours worked for the treated (firm size 20–49) and the synthetic control estimates from equation (3.14), using the two untreated groups: firm size 1–10 and 11–19.

Figure 3.7: Placebo for synthetic control estimates



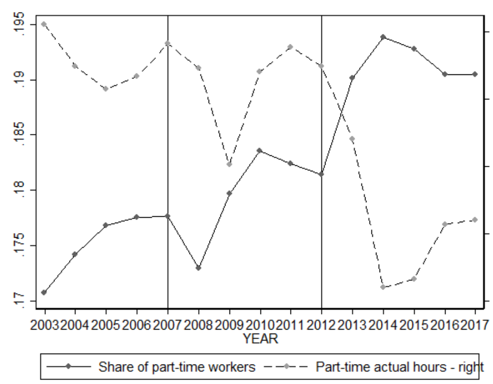
(a) Outcome variable: actual hours



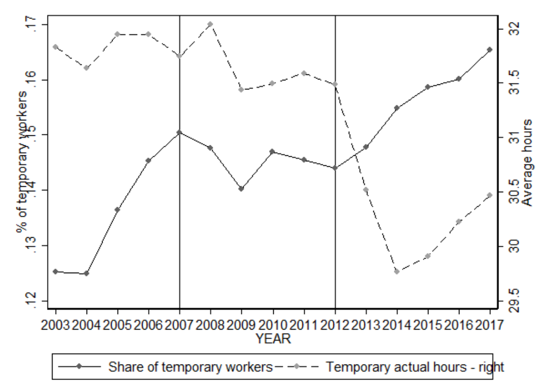
(b) Outcome variable: overtime hours

Notes: the figures plot differences in average hours worked between treated (firm size 20–49) and the synthetic treated estimates from equation (3.14), using the two untreated groups: firm size 1–10 and 11–19. The placebo are differences in hours between the untreated group and the synthetic untreated group.

Figure 3.8: Part-time and temporary workers over time



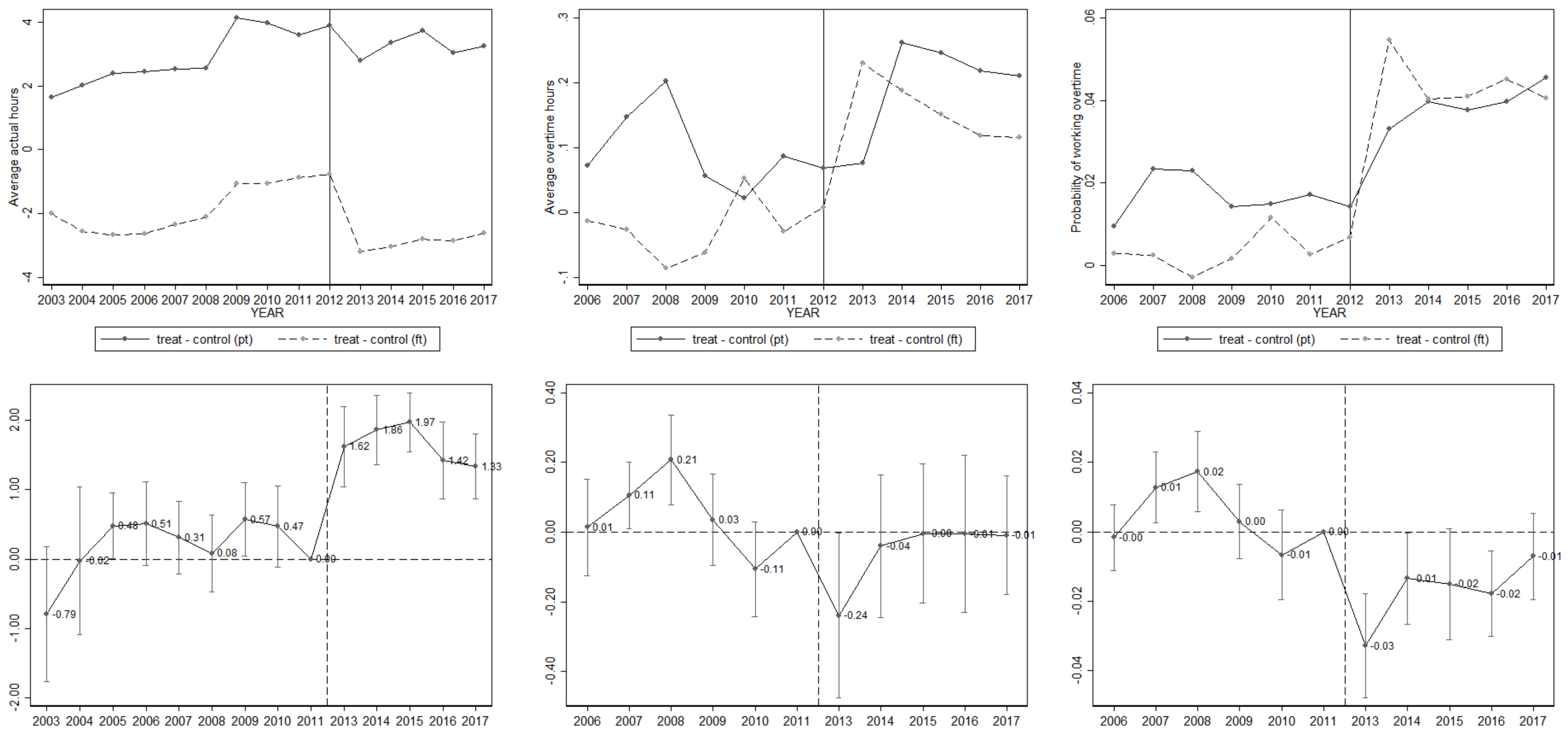
(a) Part-time workers



(b) Temporary workers

Notes: This figure shows the share of part-time and temporary workers and their corresponding average actual hours worked. The sample consists of employed individuals who reported the variable firm size.

Figure 3.9: Part-time workers: The effect of overtime tax on hours worked



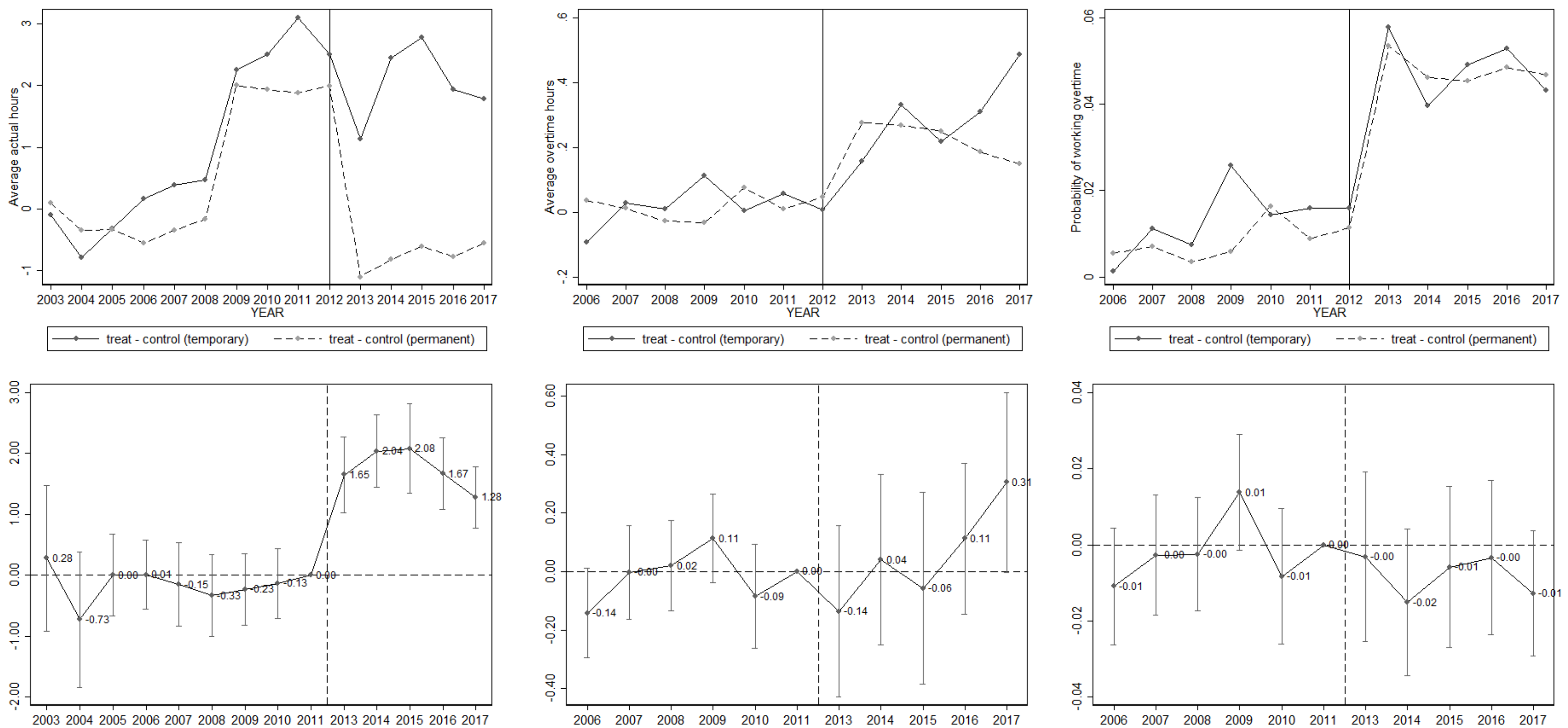
(a) Outcome variable: actual hours

(b) Outcome variable: overtime hours

(c) Outcome variable: probability of overtime

Notes: This figure shows the identifying assumption for DDD estimates in the first row. Average hours are calculated for treatment and control group per employed part-time/full-time individual, who reported the variable firm size. The differences are calculated as average treated hours minus average control hours for part-time and full-time workers. In the second row, I plot coefficients γ_t from the equation (3.15) and the corresponding 95% confidence intervals, calculated with bootstrapped standard errors. The coefficients are the marginal effect of the introduction of overtime tax for part-time workers in large companies (interactions $Year_t \cdot Treat_{ijt} \cdot Group_{ijt}$, where Group is part-time) on actual and overtime hours worked, and the probability of overtime. The coefficients should be interpreted compared to the pre-treatment year 2011. The regression includes time, treatment and part-time dummies and interactions between them and the control variables: second-order polynomial of age, education, gender, temporary contract and a variable indicating the time employed in the company.

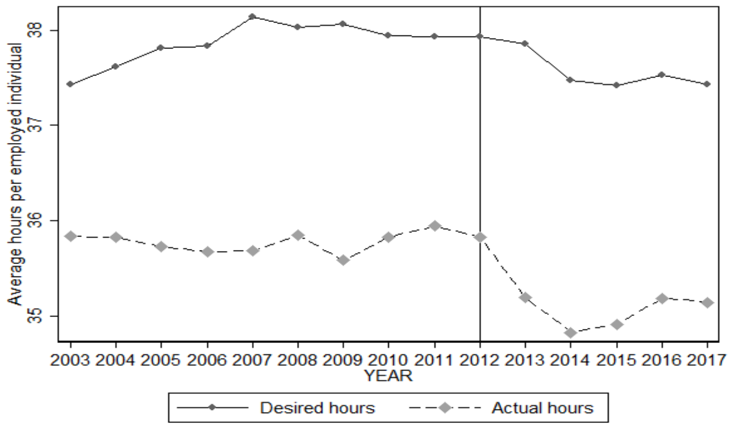
Figure 3.10: Temporary workers: The effect of overtime tax on hours worked



(a) Outcome variable: actual hours (b) Outcome variable: overtime hours (c) Outcome variable: probability of overtime

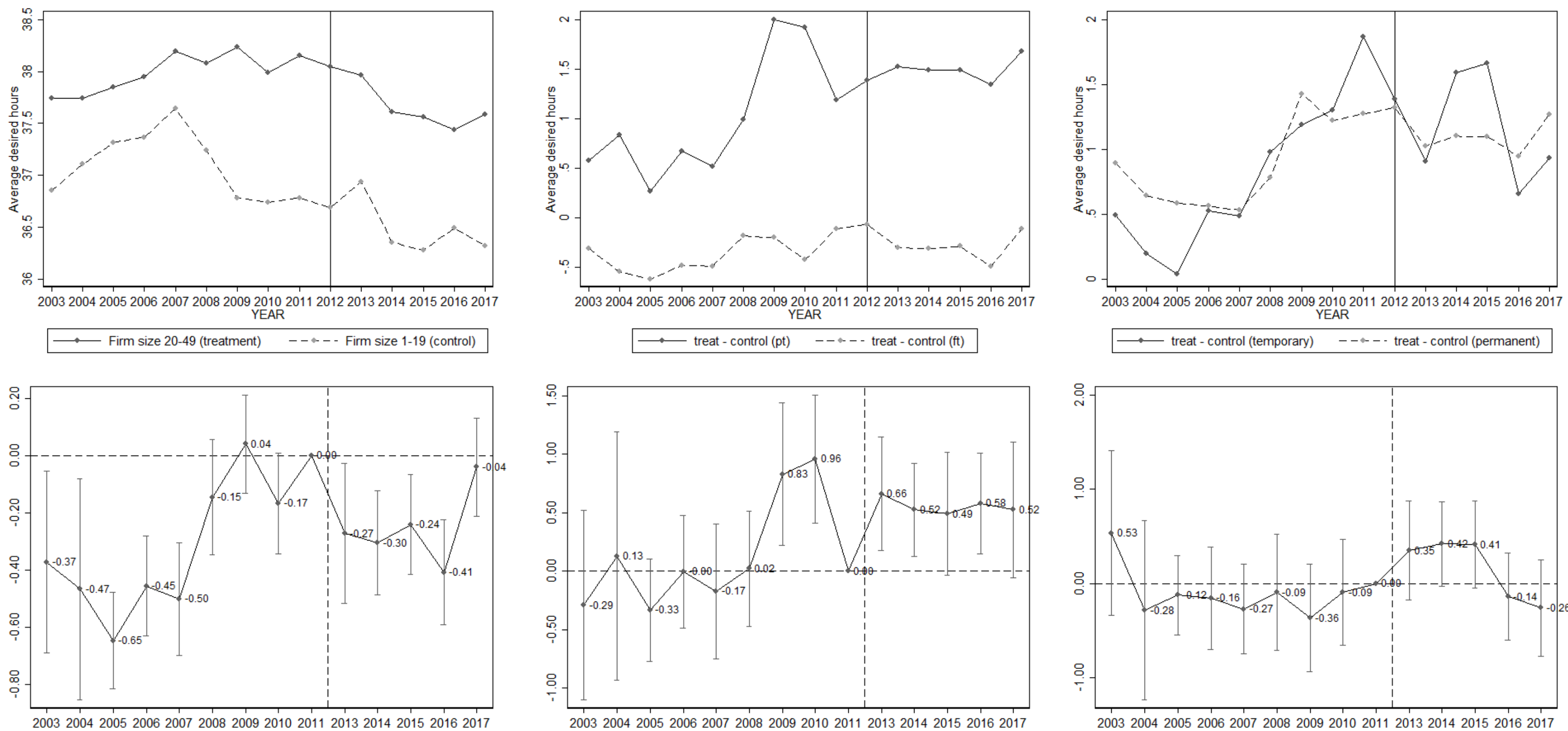
Notes: This figure shows the identifying assumption for DDD estimates in the first row. Average hours are calculated for treatment and control group per employed temporary/permanent individual, who reported the variable firm size. The differences are calculated as average treated hours minus average control hours for part-time and full-time workers. In the second row, I plot coefficients γ_t from the equation (3.15) and the corresponding 95% confidence intervals, calculated with bootstrapped standard errors. The coefficients are the marginal effect of the introduction of overtime tax for temporary workers in large companies (interactions $Year_t \cdot Treat_{ijt} \cdot Group_{ijt}$, where Group is temporary) on actual and overtime hours worked, and the probability of overtime. The coefficients should be interpreted compared to the pre-treatment year 2011. The regression includes time, treatment and temporary dummies and interactions between them and the control variables: second-order polynomial of age, education, gender, part-time contract and a variable indicating the time employed in the company.

Figure 3.11: Desired and actual hours in France



Notes: This figure plots average actual and desired hours, per employed individual in France.

Figure 3.12: Labour supply: the effect of overtime tax on desired hours



(a) DD: all employed

(b) DDD: part-time workers

(c) DDD: temporary workers

Notes: This figure shows the identifying assumptions for DD (all employed) and DDD (part-time and temporary workers) estimation in the first row. Average hours are calculated for treatment and control group per employed individual, who reported the variable firm size. In the second row, for DD estimates, I plot coefficients β_t from equation (3.12) and the corresponding 95% confidence intervals, calculated with bootstrapped standard errors. For DDD estimates, I plot coefficients γ_t, from equation (3.15). The coefficients are the marginal effect of the introduction of overtime tax for large companies. The coefficients should be interpreted compared to the pre-treatment year 2011. DD regressions include time and treatment dummies and control variables: second-order polynomial of age, education, gender, temporary contract and part-time dummies, and a variable indicating the time in the company. DDD regressions add interactions between treatment and group, year and group dummies.

3.A Descriptive statistics for synthetic control

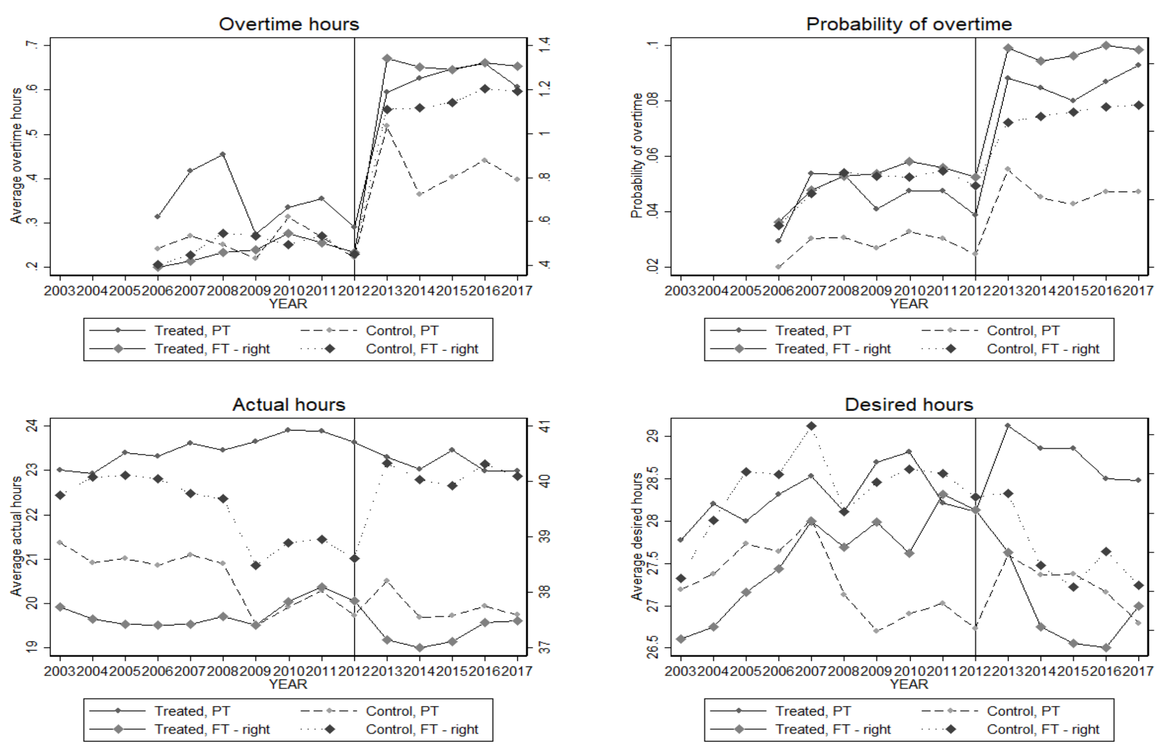
Table 3.5: Descriptive statistics by firm size

	Firm size		
	(1)	(2)	(3)
	1-10	11-19	20-49
Overtime hours	0.70	0.78	0.79
	(4.40)	(4.32)	(4.47)
Actual hours	34.55	35.36	35.12
	(15.17)	(10.65)	(10.14)
Desired hours	36.01	37.86	37.89
	(10.78)	(8.39)	(8.28)
% overtime	0.06	0.09	0.09
	(0.23)	(0.28)	(0.28)
Years in firm	9.41	10.62	11.06
	(9.46)	(10.26)	(10.46)
% <= 5 years	0.46	0.43	0.41
	(0.50)	(0.50)	(0.49)
Age	42.50	40.48	40.90
	(12.21)	(11.54)	(11.42)
% female	0.58	0.48	0.46
	(0.49)	(0.50)	(0.50)
% medium skilled	0.49	0.46	0.46
	(0.50)	(0.50)	(0.50)
% high skilled	0.22	0.33	0.32
	(0.42)	(0.47)	(0.46)
% low skilled	0.29	0.21	0.22
	(0.45)	(0.41)	(0.42)
% part-time	0.30	0.18	0.17
	(0.46)	(0.38)	(0.38)
% temporary	0.15	0.14	0.14
	(0.35)	(0.35)	(0.35)
N	271487	157336	245337

Notes: This table shows descriptive statistics for employed individuals from 2003-2017 and who answered the question on the firm size they are employed in. Overtime hours are available from 2006. Average hours are calculated as unconditional mean of employed individuals. Standard errors are in brackets.

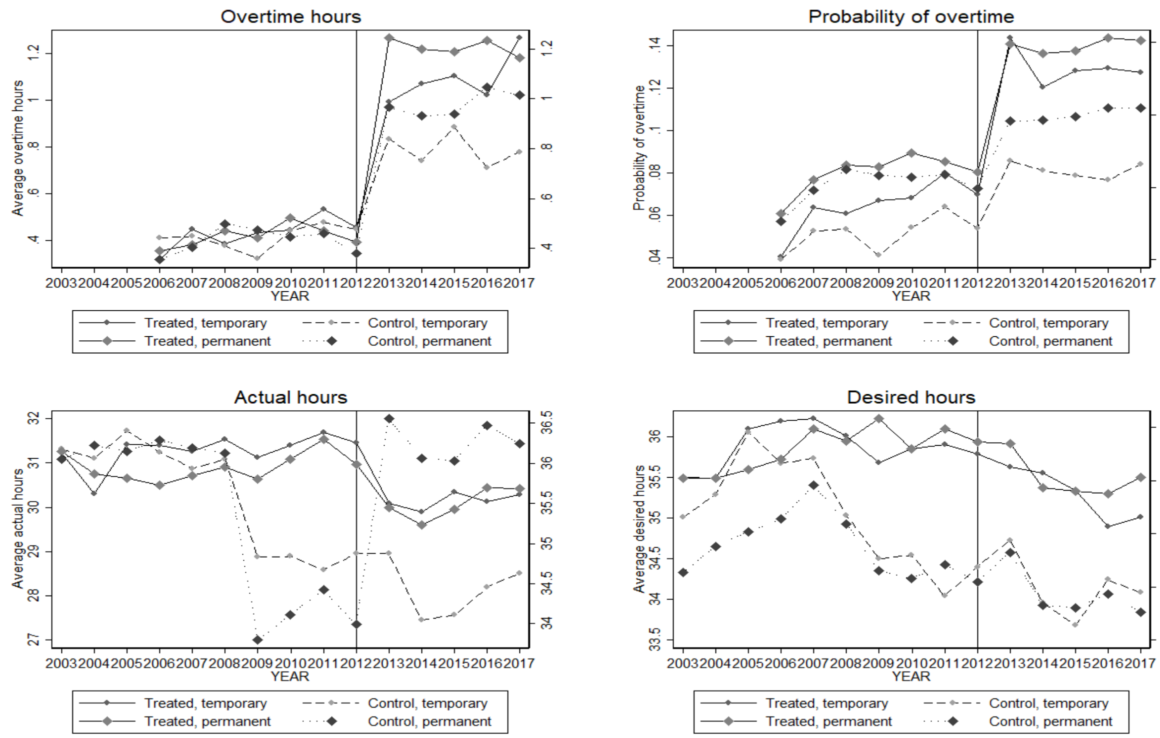
3.B Descriptive statistics for heterogeneous effects analysis

Figure 3.13: Average hours for heterogeneous effects analysis – part-time workers



Notes: This figure shows average hours for treatment and control groups per employed part-time/full-time individual, who reported the variable firm size.

Figure 3.14: Average hours for heterogeneous effects analysis – temporary workers



Notes: This figure shows average hours for treatment and control groups per employed temporary/permanent individual, who reported the variable firm size.

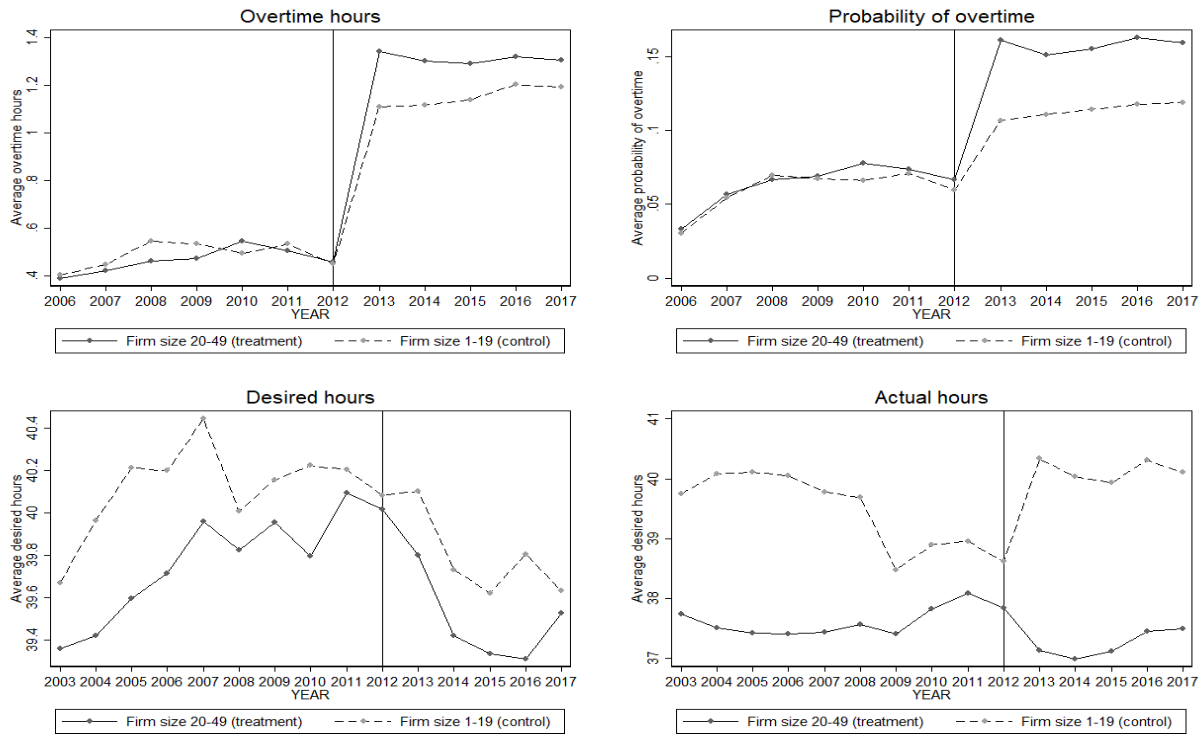
3.C Full-time workers

The main result discussed in Section 3.6.1 is an average effect for all employed individuals. However, in Section 3.8 I discuss how the reform of overtime tax had the opposite effect for part-time workers - they work less overtime but supply more hours worked and work more hours in total. To confirm that the main result from Section 3.6.1 holds for full-time workers, I exclude part-time workers from the sample and re-estimate equation (3.12):

$$Y_{it} = \alpha_0 + \sum_{t \neq 2011} \beta_t \cdot Year_t \cdot Treat_{it} + Treat_{it} + \delta^{'} X_{it} + \alpha_t + \epsilon_{it}$$

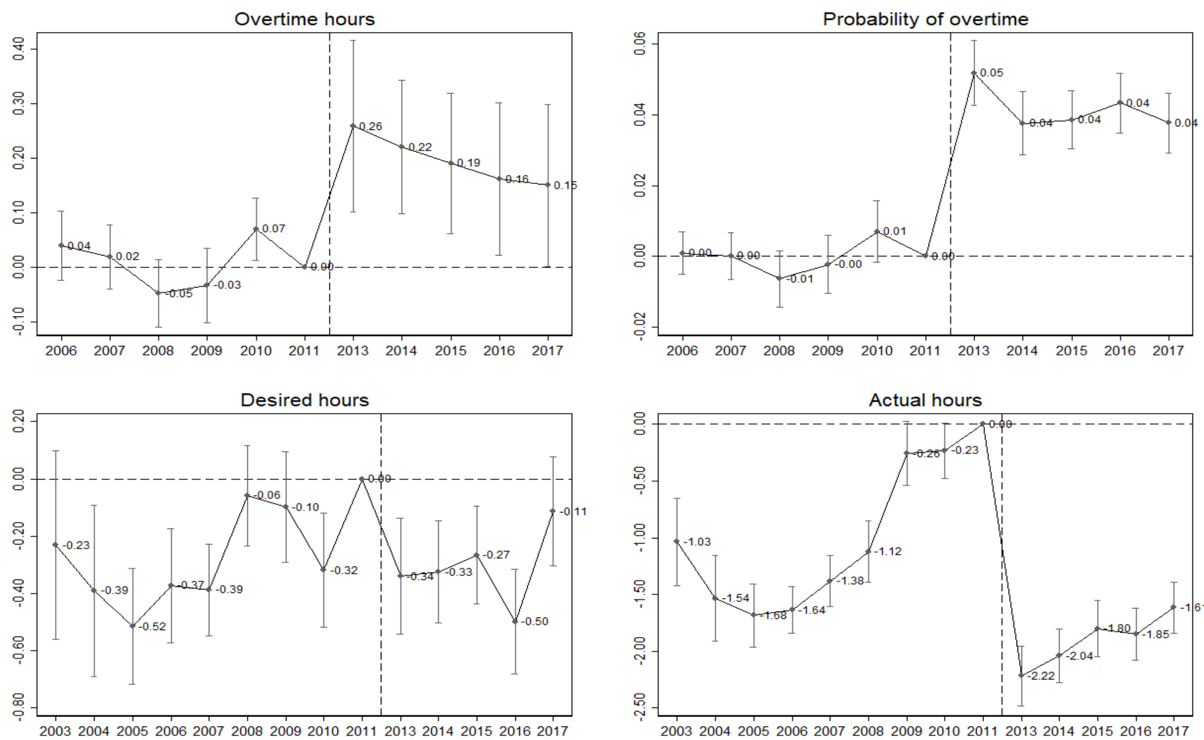
Figure 3.15 shows the parallel trends assumption for full-time workers. Figure 3.16 shows the marginal effect of the treatment for individuals in large companies, interacted by year dummies.

Figure 3.15: Parallel trends for full-time workers in small and larger companies



Notes: Notes: This figure shows parallel trends for hours worked. Average hours are calculated for treatment and control group per *full-time* employed individual, who reported the variable firm size.

Figure 3.16: The effect of overtime tax for full-time workers



Notes: This figure shows coefficients β_t from equation (3.12) and the corresponding 95% confidence intervals, calculated with bootstrapped standard errors. The sample consists of full-time employees, who reported the variable firm-size. The coefficients are the marginal effect of the introduction of overtime tax for large companies (interactions $Year_t \cdot Treat_{it}$) on actual and overtime hours worked, and the probability of overtime. The coefficients should be interpreted compared to the pre-treatment year 2011. The regression includes time and treatment dummies and control variables: second-order polynomial of age, education, gender, temporary contract and part-time dummies, and a variable indicating the time in the company.

From Figure 3.16, full-time workers in large companies increase their overtime hours after 2012 by 0.26 hours per week, but also increase the probability of working (reporting) overtime by 5 percentage points. Desired hours decrease post-reform, however the parallel trends assumption does not hold for desired hours. On the other hand, actual hours decrease by 2.25 hours post-reform, which is more than for all employed workers from Section 3.6.1. Since parallel trends assumption holds for actual hours from 2009 until the reform, and the result is consistent with both the average effect for all employed workers and heterogeneous effects analysis, there is evidence that the overtime tax reform in France increased the reporting of overtime hours, but decreased hours worked.

Chapter 4

Does higher unemployment increase income inequality? Evidence from European labour markets using a discrete choice labour supply model

4.1 Introduction

Unemployment rates in European countries increased in the midst of the Great Recession in 2009. In countries like Germany, the unemployment rate increased at the beginning of the crisis and decreased in the subsequent years. In others like Spain, the unemployment rate has soared for a longer period of time, peaking in 2012 at well above 20 percent.[1] During the recession years, the most prominent inequality academics have written papers and books arguing what could drive different types of inequality. Some recent and popular examples of summarised drivers of economic inequalities are Deaton (2013) or Atkinson (2015). Labour markets, among other drivers, seem to play a role in economic inequality. Work by Checchi and Garcia-Penalosa (2010) and Jaumote and Osorio Buitron (2015) studies labour market institutions and income inequality in advanced economies, using aggregate data. The authors investigate the effects of unionisation and wage-bargaining power on income inequality, and show ambiguous effects on income inequality due to multiple channels through which labour market institutions affect income inequality. However, using aggregate macroeconomic data does not allow for disaggregation of individuals' behavioural response to shocks on the labour market.

To contribute to the macroeconomic discussion of the link between labour markets and income inequality, this paper examines the role of unemployment shock and unemployment benefit reform on income inequality in European countries. The main contribution to the macroeconomic literature is that it takes into account individual behavioural responses to macroeconomic shocks. It is expected that higher unemployment in a country would increase income inequality by extending the bottom tail of the distribution. On the other hand, higher unemployment benefits increase the labour income at the bottom of the income distribution, therefore decreasing income inequality, but could also disincentivise employment and increase unemployment, therefore increasing income inequality. There is little evidence on how the employed individuals would react to such macroeconomic changes. Recent evidence from Tuda (2020) and Bell and Blanchflower (2018) indicate that recessions increase labour supply of the employed individuals in European countries and that individuals in high unemployment areas tend to work harder, as shown by Lazear, Shaw, and Stanton (2016). These findings have important implications for *labour supply* responses and income distributions. If employed individuals in a recession can increase their hours worked and incomes, they could further amplify income inequality changes which resulted from the unemployment shock.

This paper bridges two literature strands: macroeconomic literature which examines the link between labour markets and income inequality (for example, Checchi and Garcia-Penalosa, 2010) and the labour supply literature, pioneered by Soest (1995), which is able to model the behavioural response to a shock on the labour market.

[1] Statistic retrieved from Eurostat, Labour Force Survey, March 2017.

The effects of labour market shocks on income inequality are identified using a static, discrete choice labour supply model in four European countries: Belgium, Germany, Spain and Italy. Labour supply is country specific and differs by the probability of receiving a job offer, which takes into account differences in the macroeconomic environment. In this scenario, an individual from Germany, with the same skill set and preferences, will have a higher probability of receiving a job offer than an individual from Spain. Therefore, in this set-up, the number of hours supplied is a choice, restricted by the probability of receiving a job offer, which accounts for involuntary unemployment. The model also allows for heterogeneous preferences and unobserved preference heterogeneity.

Advantages of this methodological approach are as follows: First, using a structural approach circumvents a possible endogeneity issue between labour market variables and income inequality. Labour market outcomes could be driving income inequality; at the same time, income inequality could be driving labour market outcomes. In the model below, exogenous shock effects are estimated at the same time with the labour supply effects on income inequality. This approach reduces possible endogenous estimations. Second, the model allows for simultaneous estimation of the labour supply and exogenous shocks that individuals face on the labour market. In this way, both the extensive (participation on the labour market) and intensive (hours worked) margins are estimated at once. Third, discrete choice models allow for choice restrictions which can be implemented directly in the model. The choice restriction is a probability of receiving a job offer, implemented for any positive number of chosen hours worked. Finally, in order to compare results across countries, it is required to estimate the same model, in all countries, without any methodological differences. Discrete choice labour supply models are usually easier to estimate than continuous models, which makes cross-country comparisons easier.

The paper uses *ex ante* harmonised data – from the Household Finance and Consumption Survey (HFCS), which has not been used before in income microsimulation models with behavioural response. HFCS was published by the European Central Bank in two waves. This paper uses the panel component of the first wave, with data collected around 2010. Using harmonised data in discrete choice models provides consistent estimation of the model and cross-country comparison of the results, as stressed by Blundell (2016) or Bargain, Orsini, and Peichl (2014). Another important reason to use HFCS in inequality analysis is that HFCS oversamples the top of the income and wealth distribution. It is a common issue in income surveys to under-represent the top of the income distribution, due to respondents' confidentiality concerns or simply lower response rates at the top of the distribution. By oversampling the top of the distribution, HFCS overcomes this issue, at least to some extent, and potentially offers a better measure of inequality.

In order to answer the question how does higher unemployment rate affect income inequality, I implement an exogenous shock of 6.6% increase in unemployment rate. I find that in Italy and Spain, inequality measures decrease by a negligible amount, and that inequality in Belgium and Germany increases. While in Spain inequality decreased by at most 3%, Theil in Belgium increased by over 13%. Although, in all four countries, the main drivers of inequality changes are the tails of the income distribution, the biggest changes in income inequality are surprisingly found in the upper tail of the distribution. This result indicates a large behavioural response from the employed individuals. Furthermore, I investigate whether an unemployment benefit change can cushion the effect of unemployment shock and diminish the effect on income inequality.

Implementing an increase in unemployment benefit replacement rate of 15 percentage points (as implemented in Italy in 2012), I find that that income inequality decreases in all countries, with an exception in Spain. The biggest decrease in German inequality is observed in the Mean Log Deviation (-12%). Similarly, Callan, Doorley, and Savage (2018) find that discretionary policy (e.g. unemployment benefit) changes also contributed to reductions in inequality, but to a much lesser extent. The changes in Belgium and Italy are small and statistically insignificant. In Spain, unemployment benefits increase income inequality – Theil increases by around 2%. A similar result is found by Dolls et al. (2020), where the stabilisation effect was even negative in some years of the crisis, implying that the tax and transfer system exacerbated income shocks.

The results of this paper contribute to several strands of literature. The first one is the literature on estimating the distributional effects of the Great Recession. Bargain et al. (2011) find that the effect of labour demand shocks during 2008 and 2009 in Germany had lower distributional effects due to labour demand adjustments on the intensive, rather than extensive margins. Dolls, Fuest, and Peichl (2012) implement an income and an unemployment shock to US and European households, simulating the recession environment. The authors report considerable heterogeneity and various degrees of stabilisation of disposable income, especially in Europe. More recently, Dolls et al. (2020) analyse the combined effect of automatic stabilisers and discretionary changes in tax-benefit systems on cushioning of income shocks in the Eurozone. The authors find that the stabilisation effect was even negative in some years of the crisis, implying that the tax and transfer system exacerbated income shocks. Matsaganis and Leventi (2014) use EUROMOD microsimulation model to simulate the Great Recession and austerity measures, and estimate the effect on inequality in seven European countries. They find that income inequality increased in Greece, Spain, Latvia, Lithuania and Romania, during the 2009–2013 period. Income inequality decreased in Italy and Spain.

Furthermore, there is a large literature on discrete choice labour supply models, which coupled with simulated tax-benefit systems allow for a simultaneous estimation of labour supply and individuals' responses to various exogenous shocks, observed as a change in hours worked. Some examples are Aaberge, Colombino, and Strom (1999), Dagsvik and Strom (2006), Callan, Soest, and Walsh (2009), Bargain et al. (2013), Bargain, Orsini, and Peichl (2014). Furthermore, there is a growing need for modelling hours restrictions (see for example Kornstad and Thoresen, 2005, Bloemen, 2008, Beffy et al., 2016). Modelling choice restrictions comes from overprediction of part-time workers when estimating models of labour supply without hours restrictions. Most data examined so far show low choice predictions for part-time workers and peaks at 0 and 40 hours worked, which is usually not predicted in the basic labour supply model. By incorporating hours restrictions, the fit of the model seems to improve, as it mimics the lack of part-time job offers on the labour market.

A separate strand of discrete choice models literature incorporates job offers distribution in the discrete choice models. The underlying explanation is that some individuals choose unemployment because they did not receive any job offers and are involuntarily unemployed. Part of the literature uses data from surveys where respondents were asked to report desired hours worked. The difference from the chosen and desired hours worked is regarded as involuntary and can be incorporated in the basic discrete choice labour supply model. Examples can be found in Euwals and Soest (1999), Bloemen (2008) or Callan, Soest, and Walsh (2009). However, surveys with a question on desired hours and the corresponding labour income are rare, and the data tends to be difficult to obtain, especially in cross-country comparisons. The literature modelling job offers, without the data on desired hours worked, usually generates a random job offer distribution which replaces the stochastic term in the baseline model (e.g. Soest, Woitiez, and Kapteyn, 1990, Tummers and Woitiez, 1990). I add to these papers by estimating involuntary unemployment using actual hours worked, conditional on individual characteristics and macroeconomic environment.

Section 4.2 outlines the theoretical framework and empirical approach of the labour supply model. Section 4.3 describes the data used in the estimations, presented in Section 4.5. Section 4.4 presents the main institutional framework, and Section 4.6 discusses inequality measures used in the subsequent sections. Section 4.7 implements labour market shocks and estimates effects on income inequality. Section 4.8 concludes.

4.2 The model

The main goal of this paper is to examine effects of labour market shocks on income inequality in the South and North of Europe. In order to answer this question, I first estimate a static discrete choice labour supply model, which accounts for involuntary unemployment. The model builds on the long strand of literature on discrete labour supply models, introduced by Soest (1995). Involuntary unemployment is accounted for by estimating the probability of receiving a number of job offers (see Soest, Woitiez, and Kapteyn, 1990, Tummers and Woitiez, 1990). This model adds to the literature by making the probability of receiving a job offer dependent on individual- and country-specific characteristics.

There are several reasons for this methodological approach. First, using a structural approach circumvents a possible endogeneity issue between labour market variables and income inequality. Labour market outcomes could be driving income inequality; at the same time, income inequality could be driving labour market outcomes. In the model below, exogenous shocks effects are estimated at the same time with the labour supply effects on income inequality. This approach reduces possible endogenous estimations.[2] Second, the model allows for simultaneous estimate of the labour supply and exogenous shocks that individuals face on the labour market. In this way, both the extensive (participation on the labour market) and intensive (hours worked) margin are estimated at once. Third, discrete choice models allow for choice restrictions which can be implemented directly in the model. The choice restriction is a probability of receiving a job offer, implemented for any positive number of chosen hours worked. Finally, in order to compare results across countries, it is required to estimate the same model, in all countries, without any methodological differences. Discrete choice labour supply models are usually easier to estimate than continuous models, which makes cross-country comparisons easier.

Individuals choose to supply a number of hours worked in order to maximise their static utility function. The choice of supplied hours is conditional on the known alternative characteristics: leisure and income. Additionally, individuals face a restriction from a probability of receiving a job offer, dependent on individual- and country-specific characteristics. As a result, two individuals from two different countries, but with the same skill set, age and preferences, would be predicted to choose two different levels of hours worked, because of different labour market opportunities.

The main source of variation are individual characteristics, and nonlinearities and discontinuities in the tax-benefit system of each country. Some variation also comes from spatial variation, due to tax-benefit system and macroeconomic environment cross-country differences. A more detailed description of sources of variation is discussed in Section 4.4.

The model builds on a discrete choice labour supply model, developed by Soest (1995).[3] An individual (i) in a country (k) is choosing from a set of alternatives $j = 1, ..., J$ of leisure, weighed against the corresponding net income in order to maximise her utility. Income and leisure preferences are specified using a random quadratic utility function (similar to e.g. Bargain, Orsini, and Peichl, 2014):

$$U^*_{ijk} = \beta_{ik1} y_{ijk} + \beta_{i2} le_{ij} + \beta_3 y^2_{ij} + \beta_4 le^2_{ij} + \beta_5 le_{ij} y_{ij} + \epsilon_{ijk}, \tag{4.1}$$

[2] In the model below, wages and the probability of receiving a job offer are estimated separately and can cause endogeneity in the model. Therefore, I keep those two variables constant. Additionally, preference variables in the job offer probability differ from preference variables in the utility function.

[3] For a detailed guide on modelling and estimations of discrete choice models, see Creedy and Kalb (2005).

where y_{ij} is net income, l_{ij} is leisure time. ϵ_{ijk} are assumed to be extreme value type I distribution and independent of explanatory variables in the model. ϵ_{ijk} can be interpreted as individuals' optimisation errors or errors in individuals' perception of the alternatives' utilities. Parameters on income and leisure are defined as follows:

$$\beta_{ik1} = \alpha_0^y + \alpha_1^y \hat{d}_{ik} + \epsilon_{ik}^{rp} \tag{4.2}$$

$$\beta_{i2} = \alpha_0^{le} + \alpha_1^{le} T_i \tag{4.3}$$

The parameter on income from equation (4.2) includes unobserved preference heterogeneity into our labour supply model. ϵ_{ik}^{rp} are normally distributed and independent of explanatory variables and ϵ_{ijk} from (4.1). Income varies with the probability of receiving a job offer ($\hat{d}_{ik}$). With higher probability of receiving a job offer, there is a higher probability of choosing positive hours worked. With lower probability of receiving a job offer, the marginal utility of income is lower and individuals are restricted in choosing positive hours worked. Leisure varies with individual characteristics (T_i), specifically age and dependent children.

Since individuals are choosing the alternative for which U_{ijk}^* is the largest, the probability of alternative j being chosen is:

$$P[U_{ijk}^* \geq U_{ilk}^*, \forall l] = \frac{e^{\beta_{ik1} y_{ij} + \beta_{i2} le_{ij} + \beta_3 le_{ij}^2 + \beta_4 y_{ij}^2 + \beta_5 le_{ij} y_{ij} + \beta_6 \hat{d}_{ik}}}{\sum_{l=1}^{M} e^{\beta_{ik1} y_{il} + \beta_{i2} le_{il} + \beta_3 le_{il}^2 + \beta_4 y_{il}^2 + \beta_5 le_{il} y_{il} + \beta_6 \hat{d}_{ik}}} \tag{4.4}$$

Alternatives are characterised by leisure hours and net income.[4] It is assumed that individuals have a total of 80 hours per week to allocate between hours worked and leisure hours. Therefore, $TE = 80$ and the leisure variable is constructed as $TE - h_j$, where $j = 1, ..., 8$. Net income is defined as a function of labour and non-labour income and individual characteristics:

$$y_{ijk} = f(w_i k h_{ij}, y_{ik}^{nl}, H_i k) \tag{4.5}$$

Gross labour income ($w_i h_{ij}$) is determined at each hours-worked level (h_{ij}), for individual wage (w_i). Individual and household characteristics H_i determine which tax-benefit system rule applies to an individual and generate net income (y_{ij}). In the tax-benefit system I simulate social contributions, income and capital taxes and unemployment benefits. Social contributions and taxes are applied on observed individual characteristics and income. Hourly wages (w_i) are observed for majority of workers, but are not observable for non-workers. Gross hourly wage is estimated as:

[4]Net income is assumed to be equal to individual consumption in our static model.

$$w_i = \rho^{'} X_i + \epsilon_i^w, \tag{4.6}$$

where X_i are individual characteristics and ϵ_i^w are normally distributed and independent from explanatory variables and other error terms in the model. Wage equation is estimated separately, following Heckman (1979), and estimated are included in the labour supply model. Heckman's model accounts for selection bias, where the first step is the participation equation. Presence of dependent children is used as the exclusion restriction. Estimation details and results can be found in Appendix 4.A.

Without the probability of receiving an offer as a choice restriction, all unemployed individuals would willingly choose unemployment. In other words, if an individual chooses unemployment, the underlying assumption would be that it is voluntary. The probability of receiving an offer is implemented so that there is a positive marginal utility from higher employment opportunities in equation (4.1), for strictly positive hours worked. Additionally, the probability of receiving a job offer affects marginal utility of income through equation (4.2): the lower the probability of an offer, the lower the marginal utility of income, and individuals are more likely to choose 0 hours worked. The choice restriction or the involuntary unemployment in this model is estimated based on individual characteristics and the macroeconomic environment in a country, providing the cross-country source of variation:

$$d_{ik} = \gamma^{'} X_i + \delta^{'} Z_k + \mu_k + \epsilon_{ik}^d \tag{4.7}$$

d_{ik} is a dummy equal to 1 if the individual works a number of positive hours, and 0 otherwise.[5] ϵ_{ik}^d are logistically distributed and assumed independent from explanatory variables and other error terms. X_i are individual characteristics, Z_k are country-specific characteristics and μ_k are country-fixed effects. The probability of receiving a job offer is estimated using the logit model, on the sample of all countries pooled together and $0 < \hat{d}_{ik} < 1, \forall i, k$. The reason for pooling observations is to obtain probabilities of receiving a job offer which vary across both individuals and countries. Therefore, two individuals with the same set of individual characteristics in different countries will have different probabilities of receiving job offers, due to country-specific characteristics – GDP per capita and unemployment rates. Obviously, there will be other labour market variables which could affect this probability. Labour market tightness, minimum wage, active labour market policies and other labour market institutions could play a role in determining the probability of receiving a job offer. These variables are not included for either data non-availability or simply difficulties in measurement of some labour market institutions. However,

[5]For concerns of correlation with the wage equation, d_{ik} is not the same left-hand side variable as in the participation equation from equation (4.6), where the observed dependent variable is 1 for a non-missing wage and 0 otherwise. As explained above, some individuals in our sample have positive hours worked, but a missing wage.

the omitted variable bias is minimised by including country-fixed effects explicitly in equation (4.7).

The model includes four error terms in total. Without the probability of receiving a job offer and random preferences, the model could be estimated using the maximum likelihood. In that case, unobserved wages would be integrated out using equation (4.6). By including random preferences and the probability of receiving a job offer, two additional error terms are added, which have to be integrated out. The integral is approximated by a simulated mean, in order to avoid multidimensional integration. For each individual, there are S draws from the distribution of error terms[6] and I calculate the average of these likelihood values. If number of draws and number of observations tend to infinity, the estimation is consistent and parameters in (4.1) can be estimated using a simulated maximum likelihood. By specifying β_i as a vector containing random parameters from equations (4.1), (4.2), (4.7), the unconditional probability is:

$$P_{ij} = \int \frac{e^{\beta_{ik1}y_{ij}+\beta_{i2}le_{ij}+\beta_3 le_{ij}^2+\beta_4 y_{ij}^2+\beta_5 le_{ij}y_{ij}+\beta_6\hat{d}_{ik}}}{\sum_{l=1}^{M} e^{\beta_{ik1}y_{il}+\beta_{i2}le_{il}+\beta_3 le_{il}^2+\beta_4 y_{il}^2+\beta_5 le_{il}y_{il}+\beta_6\hat{d}_{ik}}}\phi(\beta_i|\beta,\Sigma_\beta)d\beta_i \tag{4.8}$$

where $\phi(\boldsymbol{\beta_i}|\boldsymbol{\beta},\Sigma_{\boldsymbol{\beta}})$ denotes the multivariate normal density for β_i, with mean β and variance Σ_β. The simulated maximum likelihood maximises the log-likelihood:

$$ln\hat{L}_N(\beta,\Sigma_\beta) = \sum_{i}^{N}\sum_{j}^{m} P_{ij}\ln\Big[\frac{1}{S}\sum_{s=1}^{S}\frac{e^{\beta_{ik1}^{(s)}y_{ij}+\beta_{i2}le_{ij}+\beta_3 le_{ij}^2+\beta_4 y_{ij}^2+\beta_5 le_{ij}y_{ij}+\beta_6^{(s)}\hat{d}_{ik}}}{\sum_{l=1}^{M} e^{\beta_{ik1}^{(s)}y_{il}+\beta_{i2}le_{il}+\beta_3 le_{il}^2+\beta_4 y_{il}^2+\beta_5 le_{il}y_{il}+\beta_6^{(s)}\hat{d}_{ik}}}\Big] \tag{4.9}$$

where $s = 1, ..., S$ is number of draws from the error term distribution and superscript (s) denotes the value of each draw for the random parameter.

The static nature of the model has several important implications that require attention. First, receiving a job offer in a static framework, without the demand side, implies that individuals automatically accept any received offer. There is no wage bargaining or transaction costs. Second, wages and the probability of receiving a job offer are exogenous and constant. As a result, there is no reverse causality between wages or the probability of receiving an offer and preferences. Third, without the time dimension, effects of any shocks implemented in the model can be estimated only as a morning-after effect.

The rest of the paper discusses the data used to estimate the model, presents model results and then shows how labour market shocks affect income inequality, using the labour supply model.

[6] I use S=100 Halton draws, by using a default option in Stata's mixlogit command.

4.3 Data

The data set used in this paper is from the Household Finance and Consumption Survey (HFCS), published by the European Central Bank. HFCS is a repeated cross-sectional survey for European countries. The first wave of the data was published in 2013, with the survey years 2009/2010, depending on the country (HFCN, 2013). The second wave of the data was released in 2016, with reference years 2013/2014 (HFCN, 2016).[7]

There are two main reasons why use HFCS data in this paper. First reason is the *ex ante* harmonisation of survey questions. All countries collect the core questions with the same definition that is agreed before data collection. This allows for a clear comparison of the results in a cross-country set-up. Second is that HFCS oversamples the top of the income and wealth distribution. It is a common issue in income surveys to under-represent the top of the income distribution, due to respondents' confidentiality concerns or simply lower response rates at the top of the distribution. By oversampling the top of the distribution, HFCS overcomes this issue at least to some extent and potentially offers a better measure of inequality.[8]

I use a sub-sample of employed and unemployed panel individuals in Belgium, Germany, Italy and Spain, who are aged 16–65 and are not self-employed. Sample means are reported in Table 4.1. Belgium, Germany and Italy recorded their first wave in 2010, while Spain conducted the survey in 2008. Regarding age and education information, the countries are relatively similar. Spain and Italy surveyed slightly younger respondents, Belgium has the highest share of tertiary-educated respondents and Italy the smallest.

Average hours worked are fairly similar across countries, ranging from 35 in Belgium to 39 in Spain. For the model estimation, hours worked are discretised, according to Table 4.2. There are obvious peaks at the hours level 0 and 40. Individuals observed at 0 hours worked are treated as unemployed. Peaks at 40 hours worked are common to observe, due to restrictions in the European labour markets, where most job offers are made at 40 hours per week.

Gross earnings in Table 4.1 are calculated using both predicted and observed hourly wage rate. Predicted wage rate was estimated using the Heckman sample selection model (Heckman, 1979) separately for each country. The selection equation includes individuals with a non-missing wage on the left-hand side, and I use the dummy for dependent children as the exclusion restriction.

[7]Participating countries in the first wave are Austria, Belgium, Germany, Greece, Spain, France, Italy, Cyprus, Luxembourg, Malta, the Netherlands, Portugal, Slovenia, Slovakia and Finland. In addition to the 15 countries in the first wave, Estonia, Ireland, Latvia, Hungary and Poland joined the survey in the second wave.

[8]Ideally, there would be a dataset with detailed labour market information, including desired and actual hours worked (for example, EU Labour Force Survey), income (for example, EU Survey of Income and Living Conditions) and wealth (HFCS). I am not aware of such dataset which is comparable across countries; therefore, I chose HFCS, with respect to the nature of the research question.

The model and the econometric specification can be found in Appendix 4.A. Average gross earnings show large cross-country differences and large standard deviation of the mean, both driven by the data. Figure 4.1 shows confidence intervals of mean wage rate found in the data and the predicted wage from equation (4.6). Wage rate from the data has the least deviation from the mean if hours worked are 40 per week. Individuals working part-time (10 or 20 hours) report the widest range of their wage rate. Predicted wage rate is estimated lower than the observed wage, with lower standard deviation and less variation across hours worked.

Gross income is provided in the HFCS dataset, where I add the simulated unemployment benefit. Net income is obtained by subtracting social contributions and total taxes from gross income. Social contributions and total taxes are calculated through simulated tax-benefit systems for each country. Details on each tax-benefit system can be found in Appendix 4.B. Germany's gross earnings are estimated lower than observed wage rate. However, this is in line with gross income, which is found in the data – Germany recorded the lowest gross income and unemployment benefits out of all 4 countries in the sample. It is important to keep this in mind when interpreting results in the paper.

4.4 Institutional setting and tax-benefit systems assumptions

Sources of variation in our model presented in Section 4.2 come mainly from individual characteristics. Net income for each individual is calculated as gross income combined with unemployment benefit if taxable, from which I subtract social contributions, income tax and capital tax. The tax-benefit system, in addition to determining different net incomes within a country, is a source of the cross-country variation. Social contributions vary from 9.49% in Italy to 20.475% in Germany, whereas in Spain the rate depends on the International Standard Classification of Occupations (ISCO) and educational attainment. Income tax is progressive in all 4 countries in our sample, whereas capital tax is applied as a flat tax. Unemployment benefit is contributory benefit in Spain and partially in Germany. The replacement rate is 60% in all countries apart from Spain, where it is 70%. More details on the order of simulation within the tax-benefit system and exact rates used in the simulation can be found in Appendix 4.B.

Unemployment benefit is a variable of special interest in our model. It is as a labour market institution that could potentially cushion the effect of higher unemployment rate on income inequality. Eligibility for unemployment benefit in our samples depends on the time an individual has spent working and paying for social contributions. It is not possible to simulate eligibility depending on the employment duration, due to the data restrictions. There is no variable in the data that asks how long the individual has been working. Therefore, I simulate the eligibility on other eligibility conditions, for example, age. In addition, I assume that the individual is eligible for unemployment benefit if the model predicts positive hours worked for an individual.

For example, assume a 23-year-old individual in Belgium, for which the model predicts to work 40 hours per week. If she loses her job due to the unemployment shock, she will not be eligible for ordinary unemployment benefit due to her age. She will be eligible for youth unemployment benefit, because the model predicted employment in the first instance. Therefore, the number of eligible recipients of unemployment benefit will be overpredicted.

The amount of unemployment benefit in all our countries depends on the duration of unemployment spells, and is decreasing with time. I do not observe how long an individual will remain unemployed; I simulate the amount as if the individual is unemployed in one period only. In addition, unemployment benefit can interact with other welfare payments (for example, non-contributory employment assistance or single-parent welfare payments), which are not modelled here. This assumptions will underestimate the total net income. With overpredicting eligible recipients of the unemployment benefit, but underpredicting net income at the bottom of the income distribution, the modelling assumptions should not affect the total net income and its distribution to a great extent.

4.5 Results and the model fit

The model from Section 4.2 is estimated as a two-step procedure. The first step is to estimate wages and job offer probabilities. These estimates of wages (discussed in the data section 4.3) and the the probability of employment are then included in the estimation of the utility function.

Job offer probabilities are estimated from equation (4.7), using a logit model. The sample for this estimation includes all four countries pooled together. The left-hand side variable is a dummy equal to 1 if an individual is observed as employed and 0 otherwise. Right-hand variables are individual characteristics (age, education, gender and occupation), country-specific characteristics (GDP per capita and unemployment share) and country-fixed effects. Table 4.3 shows marginal effects at the mean of individual characteristics and macroeconomic variables on the latent variable which indicates whether an individual has received a job offer or not. An increase in the number of unemployed decreases the probability of receiving a job offer, which is consistent with our expectation. For example, if an individual lives in a country where unemployment increased from 40.8% to 41.8%, her probability of receiving a job offer will decrease by almost 20 percentage points. The marginal effects of education are increasing with higher levels of education, as expected. Marginal effects of occupations appears to be similar in magnitude because the excluded dummy is equal to 1 for individuals without ISCO classification. Country-fixed effects are included in order to control for omitted variable bias.

The estimated probability of receiving a job offer is then assigned to each individual for strictly positive levels of discrete hours worked. The estimated probability ($\hat{d}$) is included as the choice restriction in equation (4.1). It is important to evaluate the estimated probabilities over the income distribution, as it might bias the distributional analysis of the unemployment shock at a later stage. Figure 4.2 plots confidence intervals of estimated probabilities of receiving a job offer. As expected, in Belgium, Spain and Germany the probability of employment increases with income. However, the differences in the average offer probability between the first and fourth quartile are 3–5 percentage points, which is not great enough to bias the initial estimation of income inequality.

Utility function is estimated for each country, using a simulated maximum likelihood model. As discussed in Section 4.2, the labour supply model is estimated on the individual level, mainly because the choice of hours worked is constrained by the probability of receiving a job offer which does not depend on a partner's choices, income or dependent children.

The utility estimations are presented in Table 4.4, which presents coefficients from equation (4.1) in utility terms, for each country separately. Parameters on leisure and variables interacted with leisure, if positive, have a positive effect on marginal utility of leisure and a negative on labour supply. For example, the parameter on the interaction term of age and leisure is positive in Belgium. In other words, there is a positive effect of increasing age on marginal utility of leisure and a negative effect on labour supply. The opposite is true for Spain and Italy. A positive parameter on net income or interaction term with net income will positively affect the marginal utility of income and labour supply. For example, positive parameter on interaction term net income and offer has a positive effect on marginal utility of income in all 4 countries. It is important to note that the parameter on the interaction term between net income and the offer probability is much higher in Germany than other countries. This is driven mainly by net income in Germany, which is lower than in other countries, as discussed in Section 4.3. Probability of receiving an offer could be driving the result if there were large observable differences between countries. However, Figure 4.2 showed that the probability of receiving an offer and the number of employed individuals is roughly similar to other countries in the sample.

McFadden's pseudo R^2 ranges from 1.5% in Italy to 12% in Spain. Comparing the fit of the model to, for example results found by Bargain, Orsini, and Peichl (2014), the choice of hours worked is not captured by the covariates well. One of the reasons why this could be the case is the fixed cost of work, which is included in the utility in Bargain, Orsini, and Peichl (2014) and is not included here, because of data unavailability.

The model fit can be checked by comparing hours worked and mean incomes in the data, with the model predictions. Figure 4.3 shows the share of individuals per each discrete hour alternative available to them. The model predicts peaks at 0 and 40 hours worked, as in the model. However, the model does not have the power to predict other levels of hours worked. Table 4.11 in Appendix

4.A details these results and shows that, on average, the model predicts the mean with the gap ranging from 6% in Belgium to 9% in Germany.

Income means fit is presented in Table 4.5, which compares gross and net incomes in the data and the model. The gap for the gross income ranges from 0.89% in Spain to 9% in Germany. The highest gap for net income, also in Germany, is estimated lower than gross income: 7.08%. Furthermore, the model slightly overpredicts gross and net income in Belgium, Germany and Spain, and slightly underpredicts gross and net income in Italy. These deviations from the data could possibly be explained by predicted hours worked. More predicted employed individuals will yield higher mean income and vice versa, more unemployed individuals is likely to yield lower predicted incomes. By comparing Figure 4.3 with Table 4.5, we can exactly see that: In Belgium and Germany, the model predicts more individuals working full-time and higher income means; in Italy, the model predicts more unemployed than is found in the data and underpredicts income means.

4.6 Income inequality measurement

Individual net income predictions from the previous section will be used to measure income inequality and the effects of the unemployment shock on income inequality. To capture changes across the entire income distribution, income inequality is measured using three measures: Gini index, Theil index and Mean Log Deviation.

The Gini index is the most standard inequality measure and is calculated from the area between the Lorenz curve and a 45-degree line:

$$Gini = 1 + \frac{1}{N} - \frac{2}{\bar{y}N^2} \sum (N - 1 + i) y_i, \tag{4.10}$$

where y is income, $\bar{y}_i$ is the mean income and N is sample size, for individual (i). Because of the Lorenz curve, the distance from the 45-degree line will be the largest in the middle of the distribution. Therefore, any change in individual income in the middle of the distribution will affect Gini the most. On the other hand, generalised entropy measures allow us to examine effects of changes in other parts of the distribution:

$$GE(\alpha) = \begin{cases} \dfrac{1}{N\alpha(\alpha-1)} \sum_{i=1}^{N} [(\dfrac{y_i}{\bar{y}})^{\alpha} - 1], & \alpha \neq 0, 1 \\ \dfrac{1}{N} \sum_{i=1}^{N} \dfrac{y_i}{\bar{y}} ln \dfrac{y_i}{\bar{y}}, & \alpha = 1 \\ -\dfrac{1}{N} \sum_{i=1}^{N} ln \dfrac{y_i}{\bar{y}}, & \alpha = 0 \end{cases} \tag{4.11}$$

where y is income, $\bar{y}_i$ is the mean income and N is sample size. α is weight given to distances between incomes at different parts of the distribution. For $\alpha = 1$, generalised entropy measure is equal to the Theil index. From equation (4.11), the Theil index measures the distance between incomes from above. Therefore, Theil will be more sensitive to changes in the upper part of the distribution. If $\alpha = 0$, generalised entropy measure is called Mean Log Deviation, where the distance between incomes becomes negative (see equation 4.11). Therefore, the Mean Log Deviation will be most sensitive to changes in the lower part of the distribution.

In the next section, I examine the effects of unemployment shock and unemployment benefit reform on income inequality, using the model from Section 4.2 and the inequality measures discussed above.

4.7 Labour market reform and unemployment shock

Tuda (2020) shows that in recessions, employed individuals increase their labour supply, as a response to a higher unemployment rate. There are several reasons which could be driving the this result: wealth effect, precautionary labour supply, an individual's partner losing their job, or an income effect. The author suggests that an income effect is driving the increase in labour supply, as workers at the bottom of the income distribution, part-time and temporary workers respond to the unemployment rate change the most. This result is consistent with Lazear, Shaw, and Stanton (2016), who show that recessions increase workers' effort as their outside options decrease. However, Tuda (2020) provides descriptive evidence that full-time employees increase labour supply, due to changes in labour market preferences during recessions.

This section recreates a recession environment, similar to the empirical findings from Tuda (2020), and investigates the effects of an exogenous unemployment rate shock on income inequality. The unemployment shock is implemented by imposing a higher unemployment rate in each country, and it affects labour supply on the intensive and extensive margin. At the extensive margin, hours worked of the newly unemployed individuals falls to zero, reducing the labour income as well. Individuals working positive hours before the shock and not suffer from the unemployment shock will choose the level of hours worked according to their preferences and individual characteristics, as determined by equation (4.1). This will determine the intensive margin of the labour supply.

In recession times, the largest safety net for the unemployed is the unemployment benefit, which cushions the effect of an increase in unemployment rate. In subsection 4.7.2, by increasing the unemployment benefit rate, the goal is to estimate the extent to which a bigger safety net would affect income inequality. Instead of directly affecting hours worked by individuals, higher unemployment benefit changes the relative price of income and leisure, by increasing the price of leisure for those eligible for unemployment benefit. In this case, both intensive and extensive margin are determined from preferences in equation (4.1). Each level of hours worked chosen by an individual will determine the corresponding income. Therefore, income and hours worked jointly determine the new income distribution in each country.

Income distribution is determined simultaneously by two effects. The shock and the reform will cause a behavioural, labour supply response at the extensive and the intensive margin. Changes in the labour supply cannot be driven by changes in wages or probability of receiving a job offer, as they are constant in the model. Therefore, labour supply is driven by an income or a substitution effect on the aggregate level, as a consequence of changed preferences after a shock in the economy. These mechanisms are discussed in more detail for each exogenous shock in the subsections below.

4.7.1 Unemployment shock

The Spanish unemployment rate rose by 6.6 percentage points from 2008 to 2009. I exploit this change in the unemployment rate and implement it to our data by changing the choice of employment for individuals in each country. More specifically, unemployment is directly imposed to 6.6 percentage points more individuals, compared to what the model predicts. The choice of these individuals is based on the probability of receiving a job offer, estimated using equation (4.7). Individuals affected by this shock are chosen based on the lowest estimated probability of receiving an offer within each country and in each net income quartile. More specifically, 33 individuals in Belgium, 81 in Germany, 138 in Spain and 132 in Italy become unemployed with the unemployment shock. For these individuals, hours worked and labour income are therefore set to zero.

There are two main transmission mechanisms from the unemployment shock to income inequality: a change in incomes at the bottom of the income distribution and a behavioural change in individuals' labour supply. Newly unemployed individuals would see their incomes reduced, thereby decreasing aggregate incomes at the bottom of the income distribution. The effect of the unemployment shock without the behavioural response is graphed in Appendix 4.C, showing a small and insignificant change in income inequality. Employed individuals could change their labour supply as a behavioural response to the recession. The behavioural response is determined from the parameters in the labour supply model. Table 4.6 shows the estimation of the labour supply model after the unemployment shock.

The biggest coefficients in all four countries are the ones on leisure, net income and the interaction between net income and the probability of receiving an offer, which will determine individuals' labour supply. By adding up the coefficients on net income, marginal utility of income is higher in Belgium and Germany, whereas marginal utility of leisure is the highest in Italy (adding up coefficients on leisure). Spain is somewhat of an outlier as the marginal utility of both income and leisure is negative. Under these coefficients, individuals choose hours worked, as shown in

Figure 4.4. Since the aggregate income in an economy falls, if individuals choose higher hours worked, the income effect dominates the substitution effect. On the other hand, if workers choose lower hours worked, workers substitute income for leisure.

In Spain and Germany, there is a clear drop in the number of employed, where the unemployment shock affected the unemployed but did not change hours of the employed. In Italy, regardless of the unemployment shock, the number of unemployed remained the same, suggesting that some previously unemployed chose employment. In addition, a small number of full-time employees chose to decrease their hours worked to 30. This is driven by the large marginal utility of leisure from Table 4.6. In Belgium, there is a decrease in the number of unemployed, as some unemployed individuals choose higher hours worked. However, there is a large decrease in the number of full-time workers, who now choose mostly part-time work. A small number of individuals chooses 50 hours worked per week. On average, the substitution effect dominates in all countries, with a few exceptions in Belgium.

These new incomes and hours worked determine income distribution. In the left column of Figure 4.5 are levels of the Gini index, Theil index and Mean Log Deviation, with their confidence intervals. These measures, the differences between model and unemployment shock inequality measures and their standard errors are shown in Table 4.7. Although differences are instructive to compare the model and shock measures, they are not mutually comparable as Gini, Theil and MLD do not fall on the same scale. To be able to compare them and discuss which parts of the income distribution drive the change in inequality, the right-hand side of the Figure 4.5 plots the percentage change between model predictions and unemployment shock.

In Belgium, all three measures of income inequality increase. The differences are statistically significant. However, the biggest percentage change is found in Theil (13%), which is most sensitive to changes at the top of the distribution. This is in line with Figure 4.4, which suggested that full-time employees choose part-time or overtime work after the unemployment shock. Similar is true for Germany, where all three measures increase. However, the increase in income inequality is driven mostly at the bottom and the top of the distribution: Theil and MLD increase by around 5%.

In Spain, unemployment shock decreases income inequality. The differences are statistically significant, although very small. The biggest decrease is found at the top of the income distribution (Theil), suggesting that the richest individuals have decreased their hours worked. In Italy, income inequality changes sightly and the differences are not statistically significant.

4.7.2 Adding the unemployment benefit reform

In 2013, Italy changed their unemployment benefit system from ordinary unemployment benefit to ASPI. The benefit replacement rate changed in 2012 from 60% to 75% in 2013. I implement the same replacement rate percentage change to other countries in our sample, without changing the eligibility conditions. Therefore, this reform affects individuals already unemployed and eligible for the unemployment benefit, as well as individuals unemployed because of the unemployment shock. For Belgium and Germany, the replacement rate is increased from 60% to 75%. In Spain, the replacement rate is changed from 70% to 87.5%, a 15 percentage point increase.

Table 4.8 shows the labour supply estimated after the unemployment benefit reform. Since the net income change from the reform is not large, most coefficients in the labour supply model did not change substantially. However, the biggest change, compared to Table 4.6 is the parameter on the interaction between net income and probability of receiving an offer in Germany. Before, this coefficient was around 3, whereas now it is negative. This suggests that the marginal utility of income in Germany is now much smaller, if not negative, for some individuals. Although this is surprising, it can be explained by very low unemployment benefit levels in the German data.

Income distribution is determined simultaneously by two effects. The unemployment benefit reform increases incomes of the unemployed and eligible for unemployment benefit. However, it also changes the relative price of income and leisure, by changing the price of leisure for those eligible for unemployment benefit. Employed individuals could be incentivised to choose unemployment, if the change in unemployment benefit is large enough. Therefore, income and hours worked jointly determine the new income distribution in each country.

Hours worked after the unemployment benefit reform are plotted in Figure 4.6. In Belgium and Italy hours worked do not change, which is not surprising as the parameters in the labour supply model do not change either. In Spain, a few individuals who worked 10 hours now choose to work full-time. This change is however very small. The biggest behavioural response is visible in Germany, where individuals choose to exit unemployment and work full-time. This change is driven by the big change in the marginal utility of income. It can be expected that more people working full-time will have a large effect on income distribution as well.

Figure 4.7 shows income inequality measures after the unemployment shock and after the unemployment benefit reform. In Belgium and Italy, changes in income inequality are statistically insignificant. In Spain, inequality increases, mostly at the top of the income distribution, as Theil index increases the most. As expected, this is driven by individuals who decided to increase their hours worked from 10 to 40. The biggest change in income inequality is visible in Germany, where all measures decrease. The biggest decrease can be seen in MLD, over 10%. Opposite of what one would expect, individuals choose to work full-time, even though the unemployment benefit became more generous, suggesting a dominating income effect in the economy.

4.8 Conclusion

Discrete choice labour supply literature uses actual hours as a proxy for supplied hours, even though actual hours are constrained by the labour demand. Therefore, the literature on labour supply modelling has greatly dealt with implementing restrictions to the actual hours worked in order to capture the labour demand effects. This paper adds to the labour supply literature which accounts for involuntary unemployment. Without involuntary unemployment, the model would not simulate the number of unemployed correctly and all unemployed would have to be assumed to be voluntarily unemployed. The model in this paper implements a probability of receiving an offer, which allows the simulation of unemployment choices well in all 4 countries in the sample. However, the model does not capture part-time choices well, as fixed costs of work are not included in the model.

The first chapter of this thesis suggests that labour supply increases during recessions, driving underemployment from the supply, rather than demand side of the labour market. However, using the labour supply model, with choice restrictions on actual hours worked, and simulating a recession environment, the model predicts a change in preferences in only one country - Belgium. Therefore this model is not able to capture the same change in labour supply, as shown by Tuda (2020).

When Belgium, Germany, Spain and Italy are exposed to the exogenous unemployment shock of the same magnitude, the effects on hours worked and income inequality are substantially different. In Italy and Spain, inequality measures slightly decrease, and inequality in Belgium and Germany increases. The changes in the South of Europe are smaller in magnitude, compared to changes in the North. Although the Great Recession was an asymmetric shock in Europe, affecting the South more than the North, imposing an unemployment shock of the same magnitude caused substantially different effects on income inequality. To further simulate the Great Recession environment in Europe, I implement an unemployment benefit reform of the same magnitude as in Italy in 2012. Italy increased the unemployment benefit replacement rate, to strengthen the safety net for the large number of newly unemployed individuals in the early 2010s. The model in this paper predicts very small changes in hours worked and income inequality in Belgium, Spain and Italy. In Germany, there is a large decrease in income inequality. This result is driven by comparably low unemployment benefit levels in Germany and a stark change in German labour market preferences.

The model predictions have important implications for preference estimations under large exogenous shocks on the labour market and labour market policies in tackling income inequality.

However, the results differ greatly and should be interpreted with caution. Due to data restrictions, the model does not include costs of working, which might improve the model fit and consequently its predictions. Additionally, the model used in this paper is static, therefore the effects on income inequality are a consequence of only the exogenous shocks imposed, and are fairly small. Other dynamic effects, for example, wealth effects, precautionary savings or consumption smoothing, are not included in the model. Including the dynamic effects of exogenous shocks on individuals would allow for an estimation of longer-term effects on income inequality. This is left for further research.

Table 4.1: Descriptive statistics

	(1) BE	(2) DE	(3) ES	(4) IT
Reference year	2010	2010	2008	2010
Age	44.74	44.91	43.58	44.32
	(14.18)	(13.84)	(14.70)	(14.30)
16-29, %	0.17	0.18	0.22	0.21
	(0.38)	(0.38)	(0.41)	(0.40)
30-49, %	0.39	0.38	0.37	0.36
	(0.49)	(0.49)	(0.48)	(0.48)
50-65, %	0.43	0.44	0.41	0.43
	(0.50)	(0.50)	(0.49)	(0.50)
Primary edu, %	0.05	0.02	0.22	0.11
	(0.22)	(0.15)	(0.41)	(0.31)
Lower secondary edu, %	0.13	0.06	0.19	0.33
	(0.34)	(0.23)	(0.39)	(0.47)
Upper secondary edu, %	0.32	0.55	0.22	0.42
	(0.47)	(0.50)	(0.41)	(0.49)
Tertiary edu, %	0.47	0.34	0.34	0.11
	(0.50)	(0.47)	(0.47)	(0.32)
% employed	0.64	0.65	0.51	0.57
	(0.48)	(0.48)	(0.50)	(0.49)
Hours worked	35.79	37.51	38.72	36.85
	(10.53)	(12.05)	(8.13)	(8.62)
Unemployment benefits	11185.80	3862.37	9374.30	10715.52
	(2959.90)	(272.79)	(2632.35)	(0.00)
Gross earnings	21790.26	15706.57	14556.78	22746.34
	(32044.24)	(31809.60)	(11730.03)	(11386.21)
Gross income	22027.89	17538.43	19895.12	20370.86
	(33526.23)	(32251.70)	(51350.99)	(15328.16)
Net income	18482.41	12304.56	16201.35	15028.76
	(20003.44)	(16468.80)	(36016.49)	(8366.69)
N	1427	2884	5274	4183

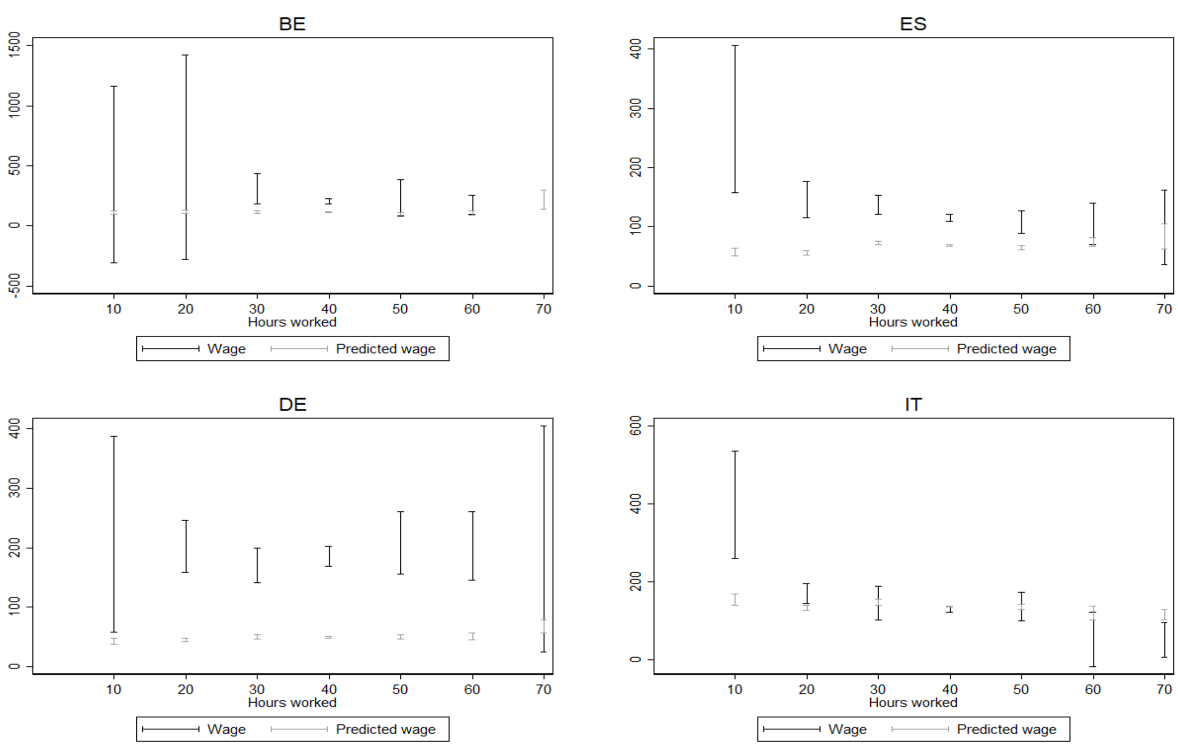
Notes: This table shows descriptive statistics for individuals of age 16–65, who are either employed or unemployed and not self-employed. Standard deviations of the mean are in parentheses. Average hours worked are calculated as conditional on employment. Individual wage is predicted for unemployed, using the Heckman model discussed in Section 4.3, and is used to calculate gross earnings. Net income is calculated on the individual level using tax-benefit systems for each country.

Table 4.2: Observed and discrete hours worked, %

Observed hours worked	Discrete hours worked	BE	DE	ES	IT
0 - 5	0	35.88	35.85	49.91	42.82
6 - 15	10	2.17	3.43	0.72	1.48
16 - 25	20	8.97	8.36	2.64	5.69
26 - 35	30	10.02	7.63	6.9	5.04
36 - 45	40	36.44	34.02	34.74	41.12
46 - 55	50	3.99	7.25	3.74	3.16
56 - 65	60	2.17	2.7	1.14	0.45
> 66	70	0.35	0.76	0.23	0.24

Notes: This table shows observed and discretised hours worked for the 4 samples, alongside the shares for each hours bracket.

Figure 4.1: Predicted wages per hours worked bracket



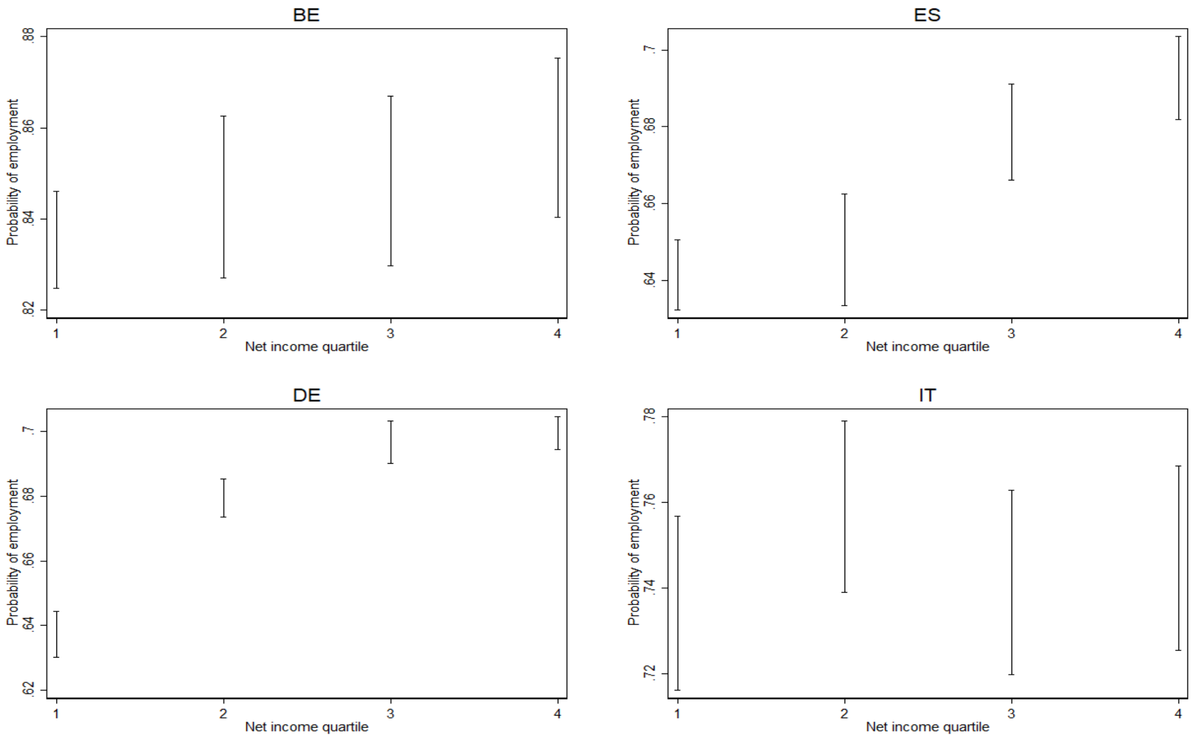
Notes: This figure shows the standard deviation of the mean for observed and predicted wage means, per dicrete hours worked. Predicted wage is slightly underpredicted, compared to the observed wage, with narrower standard deviations.

Table 4.3: Estimation of the probability of receiving a job offer

Received job offer		
Age	0.022***	(0.002)
Age2	-0.00025***	(0.000028)
Primary education	0.0338	(0.038)
Lower secondary education	0.0781*	(0.037)
Upper secondary education	0.1007**	(0.036)
Tertiary education	0.1379***	(.036)
Gender	-0.0708***	(0.01)
ISCO 10	0.6287***	(0.017)
ISCO 20	0.6313***	(0.013)
ISCO 30	0.6601***	(0.013)
ISCO 40	0.6516***	(0.012)
ISCO 50	0.6511***	(0.014)
ISCO 60	0.5983***	(0.026)
ISCO 70	0.6494***	(0.015)
ISCO 80	0.665***	(0.018)
ISCO 90	0.6476***	(0.014)
GDPpc growth rate	-0.5847***	(0.03)
% of unemployed	-0.1992***	(0.01)
Country FE	YES	
N	13768	
pseudo R^2	0.274	

Notes: This table shows logit regression results for the probability of receiving a job offer. Coefficients are marginal effects at the mean. Bootstrapped standard errors are in parentheses. Dependent variable is a dummy equal to 1 if the individual is observed as employed, and 0 otherwise. The sample pools all 4 countries.

Figure 4.2: Probability of employment per income quartile



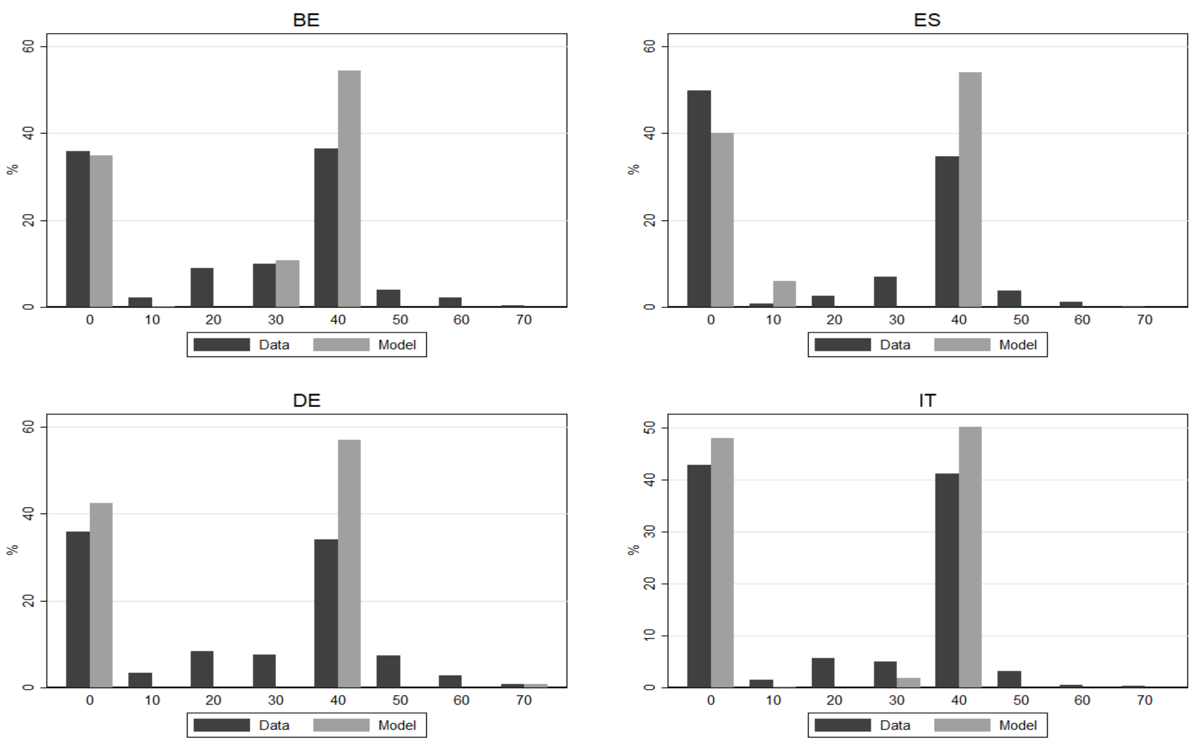
Notes: This figure shows the standard deviation of the mean for probability of receiving a job offer. The probability of receiving a job offer is estimated using equation (4.7).

Table 4.4: Labour supply estimations in utility terms

	BE	DE	ES	IT
Leisure	0.121***	0.0194	0.111***	0.318***
	(0.0231)	(0.0110)	(0.0131)	(0.0285)
Leisure x Age	0.00421***	0.00166**	-0.00667***	-0.00534***
	(0.00121)	(0.000543)	(0.000593)	(0.000853)
Leisure x Age2	-0.0000334*	-0.00000800	0.0000773***	0.0000874***
	(0.0000144)	(0.00000663)	(0.00000737)	(0.0000114)
Leisure x Dep Children	-0.00359	0.00982***	-0.000614	0.00776*
	(0.00634)	(0.00274)	(0.00315)	(0.00348)
Leisure2	-0.00176***	-0.000217***	0.000303***	-0.00189***
	(0.000171)	(0.0000632)	(0.0000682)	(0.000168)
Net Income2	-0.00565***	-0.000000186***	0.00000113	-0.00000149
	(0.000845)	(4.53e-08)	(0.00000168)	(0.00000161)
Net Income x Leisure	0.00189***	-0.0000419***	0.000133	0.00127***
	(0.000263)	(0.00000873)	(0.0000810)	(0.000371)
Net Income	-0.146***	1.478***	-3.903***	-0.0117
	(0.0225)	(0.160)	(0.199)	(0.0278)
Net income x Offer	0.399***	2.953***	1.733***	0.315***
	(0.0205)	(0.185)	(0.180)	(0.0169)
N	11416	23072	42192	33464
adj. R^2	0.0208	0.0591	0.1289	0.0151

Notes: This table shows estimated equation (4.2), in utility terms. Bootstrapped standard errors are in brackets. Adjusted R^2 is the so-called McFadden's pseudo-R^2, taking into account the maximised likelihood of the fitted model and the value of the model with no covariates.

Figure 4.3: Model predictions of hours worked



Notes: This figure shows the shares of individuals working each level of discrete hours worked in the data and model predictions.

Table 4.5: Model fit - income means

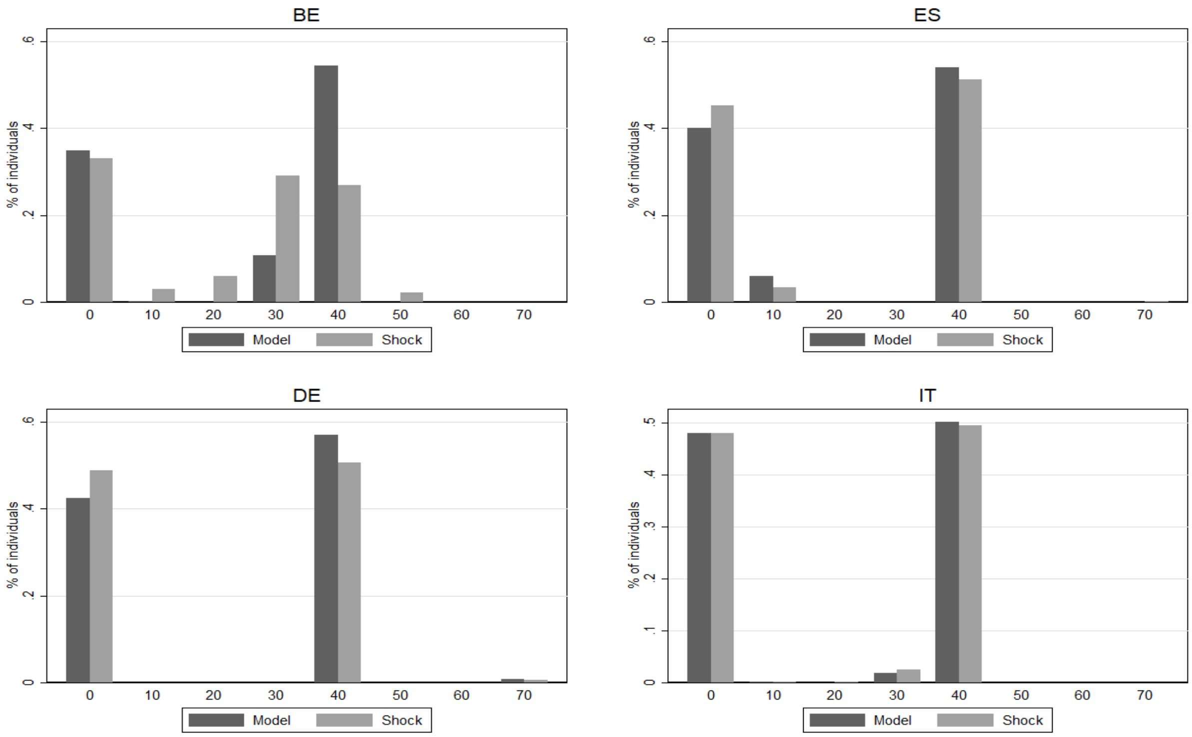
	BE	DE	ES	IT
Mean gross income				
Data	21811.78	17538.43	15873.84	18237.84
Model	22411.41	19312.07	16016.72	17899.82
Gap(%)	2.66	9.18	0.89	1.89
Mean net income				
Data	18301.09	12304.56	12923.6	13455.11
Model	18866.12	13241.6	13227.54	13214.52
Gap(%)	2.99	7.08	2.3	1.82

Table 4.6: Labour supply estimations after the unemployment shock

	BE	DE	ES	IT
Leisure	0.101***	0.0490***	-0.0649***	0.966***
	(0.0251)	(0.0118)	(0.0106)	(0.0728)
Leisure x Age	0.00569***	-0.000572	-0.00340***	-0.00302
	(0.00134)	(0.000551)	(0.000461)	(0.00183)
Leisure X Age2	-0.0000496**	0.0000175**	0.0000358***	0.0000294
	(0.0000160)	(0.00000673)	(0.00000556)	(0.0000227)
Leisure x Dep Children	0.000349	0.0109***	0.00316	-0.00168
	(0.00711)	(0.00272)	(0.00234)	(0.00829)
Leisure2	-0.00175***	-0.0000692	0.00174***	-0.0108***
	(0.000184)	(0.0000628)	(0.0000565)	(0.000668)
Net Income2	-0.00666***	-0.000000152***	0.00000165*	-0.0000300*
	(0.00130)	(4.37e-08)	(0.000000729)	(0.0000122)
Net Income x Leisure	0.00237***	-0.0000335***	0.00000553	0.0000572
	(0.000307)	(0.00000839)	(0.0000303)	(0.00101)
Net Income	-0.193***	1.299***	-1.143***	0.105
	(0.0265)	(0.155)	(0.0930)	(0.106)
Net income x Offer	0.493***	3.016***	-0.648***	-0.0820
	(0.0270)	(0.179)	(0.103)	(0.0478)
N	11416	23072	42192	33464
adj. R^2	0.0270	0.0580	0.0660	0.2637

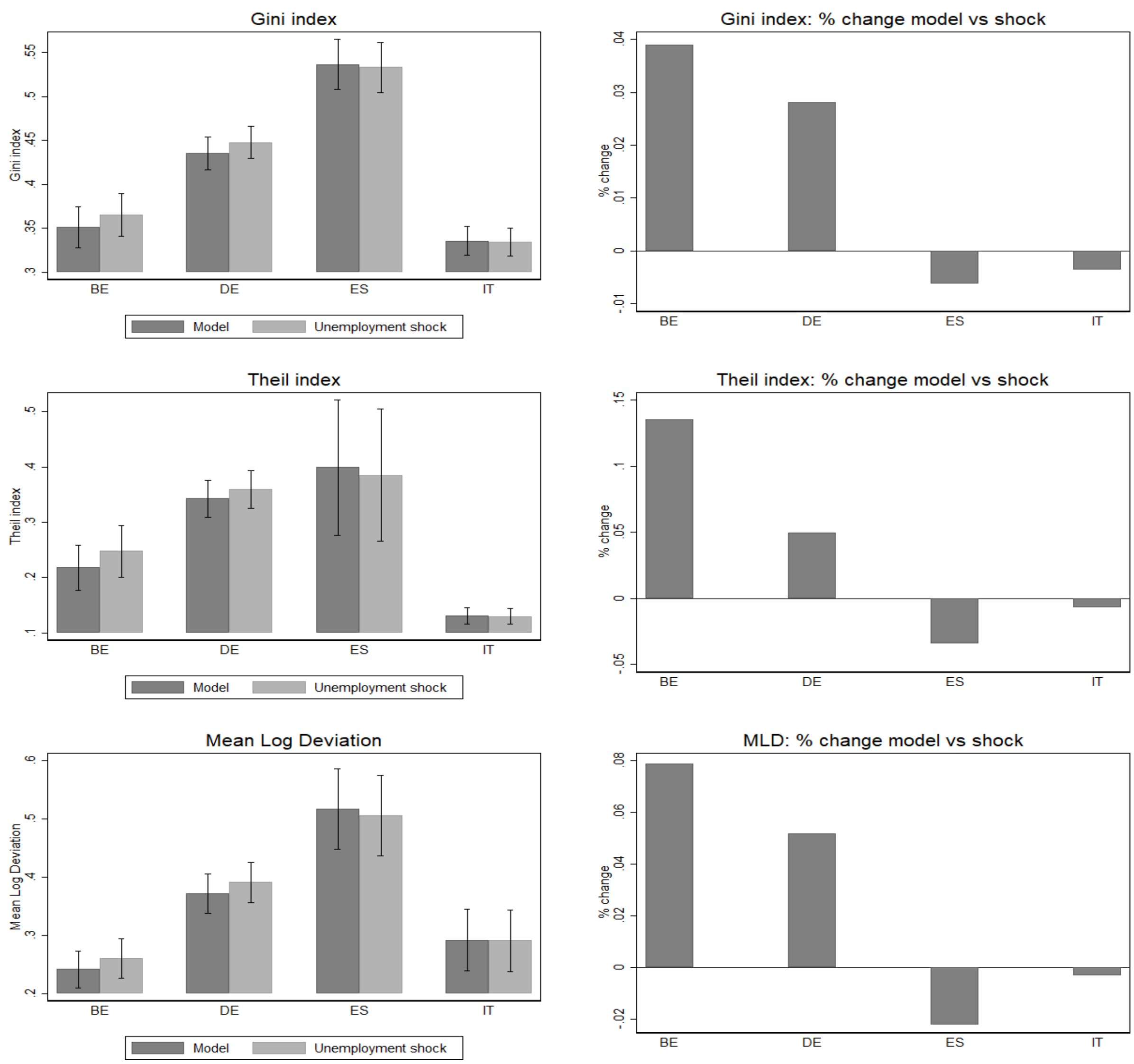
Notes: This table shows estimated equation (4.2), after implementing the unemployment shock. Bootstrapped standard errors are in brackets. Adjusted R^2 is the so-called McFadden's pseudo-R^2, taking into account the maximised likelihood of the fitted model and the value of the model with no covariates.

Figure 4.4: The effect of unemployment shock on hours worked



Notes: This figure shows the shares of individuals working each level of discrete hours worked. It compares model predictions with the hours worked after the unemployment shock.

Figure 4.5: The effect of unemployment shock on income inequality



Notes: The left-hand side column of this figure compares model predictions of income inequality and the effect of unemployment shock, with the corresponding confidence intervals. The right-hand side shows the % change between the unemployment shock and model predictions, for cross-country and inequality measures comparison.

Table 4.7: The effect of unemployment shock on income inequality measures: model vs unemployment shock

	BE	DE	ES	IT
Gini index				
Model	0.3510	0.4353	0.5361	0.3356
	(0.0118)	(0.0094)	(0.0146)	(0.0082)
Shock	0.3647	0.4475	0.5327	0.3344
	(0.0125)	(0.0093)	(0.0146)	(0.0082)
Difference	0.0137	0.0122	-0.0033	-0.0012
	(0.0048)	(0.0013)	(0.0026)	(0.0003)
% change	0.0389	0.0281	-0.0062	-0.0036
Theil index				
Model	0.2179	0.3424	0.3989	0.1307
	(0.0208)	(0.0170)	(0.0623)	(0.0075)
Shock	0.2474	0.3594	0.3852	0.1298
	(0.0239)	(0.0173)	(0.0609)	(0.0075)
Difference	0.0295	0.0170	-0.0138	-0.0009
	(0.0079)	(0.0019)	(0.0041)	(0.0002)
% change	0.1353	0.0495	-0.0345	-0.0070
Mean Log Deviation				
Model	0.2415	0.3720	0.5171	0.2917
	(0.0163)	(0.0172)	(0.0355)	(0.0269)
Shock	0.2605	0.3912	0.5055	0.2908
	(0.0173)	(0.0177)	(0.0354)	(0.0268)
Difference	0.0191	0.0193	-0.0115	-0.0009
	(0.0093)	(0.0030)	(0.0059)	(0.0002)
% change	0.0790	0.0518	-0.0223	-0.0031

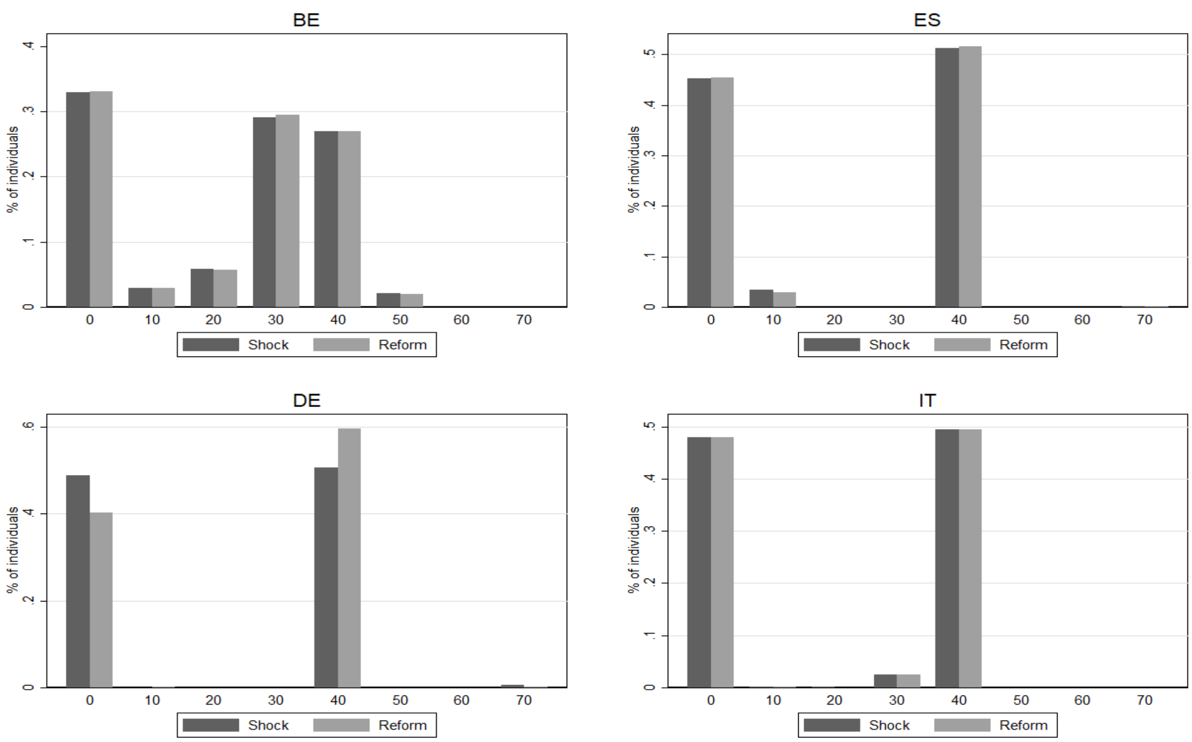
Notes: This table shows income inequality measures for model predictions and after the unemployment shock. Standard errors are in parentheses. The difference between the model and the shock can be used to compare the effect cross-country, while the % change can be used to compare the effect across inequality measures.

Table 4.8: Labour supply estimations after the unemployment benefit reform

	BE	DE	ES	IT
Leisure	0.0991***	0.00283	-0.0665***	0.955***
	(0.0250)	(0.0115)	(0.0105)	(0.0738)
Leisure x Age	0.00551***	-0.000833	-0.00303***	-0.00323
	(0.00133)	(0.000519)	(0.000453)	(0.00183)
Leisure X Age2	-0.0000480**	0.0000153*	0.0000338***	0.0000310
	(0.0000160)	(0.00000624)	(0.00000553)	(0.0000228)
Leisure x Dep Children	0.000314	0.0101***	0.00327	-0.000997
	(0.00711)	(0.00249)	(0.00230)	(0.00825)
Leisure2	-0.00171***	0.000469***	0.00168***	-0.0108***
	(0.000183)	(0.0000646)	(0.0000566)	(0.000688)
Net Income2	-0.00607***	-0.00000143**	-0.000000624	-0.0000231*
	(0.00108)	(0.000000516)	(0.000000964)	(0.0000108)
Net Income x Leisure	0.00247***	-0.000244***	-0.0000866*	0.000618
	(0.000303)	(0.0000707)	(0.0000383)	(0.000964)
Net Income	-0.202***	0.0749***	-0.0734***	0.0354
	(0.0257)	(0.0117)	(0.00923)	(0.0995)
Net income x Offer	0.493***	-0.0269*	-0.0743***	-0.0768
	(0.0271)	(0.0118)	(0.0125)	(0.0477)
N	11416	23072	42192	33464
adj. R^2				

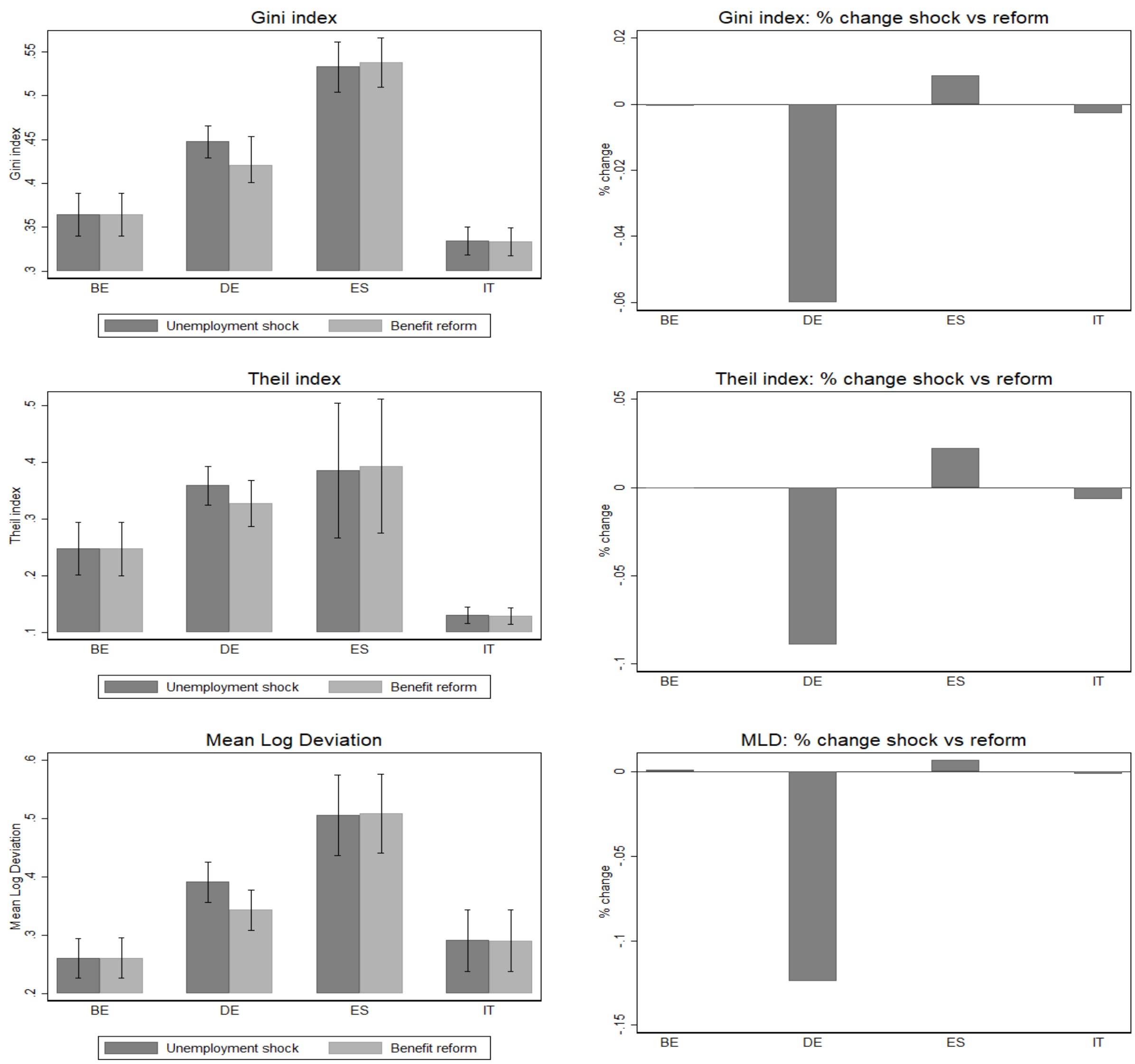
Notes: This table shows estimated equation (4.2), after implementing the unemployment benefit reform. Bootstrapped standard errors are in brackets. Adjusted R^2 is the so-called McFadden's pseudo-R^2, taking into account the maximised likelihood of the fitted model and the value of the model with no covariates.

Figure 4.6: The effect of unemployment shock and unemployment benefit reform on hours worked



Notes: This figure shows the shares of individuals working each level of discrete hours worked. It compares hours worked after the unemployment shock and after the unemployment benefit reform.

Figure 4.7: The effect of unemployment shock and unemployment benefit reform on income inequality



Notes: The left-hand side column of this figure compares income inequality after the unemployment shock and after the unemployment benefit reform, with the corresponding confidence intervals. The right-hand side shows the % change between the unemployment benefit reform and the unemployment shock, for cross-country and inequality measures comparison.

Table 4.9: The effect of unemployment benefit reform on income inequality measures: unemployment shock vs unemployment benefit reform

	BE	DE	ES	IT
Gini index				
Shock	0.3647	0.4475	0.5328	0.3344
	(0.0125)	(0.0093)	(0.0146)	(0.0082)
Reform	0.3645	0.4206	0.5374	0.3334
	(0.0125)	(0.0103)	(0.0144)	(0.0082)
Difference	-0.0002	-0.0270	0.0047	-0.0010
	(0.0003)	(0.0040)	(0.0023)	(0.0003)
% change	-0.0007	-0.0601	0.0087	-0.0029
Theil index				
Shock	0.2474	0.3594	0.3852	0.1298
	(0.0239)	(0.0173)	(0.0609)	(0.0075)
Reform	0.2472	0.3274	0.3937	0.1289
	(0.0239)	(0.0208)	(0.0603)	(0.0075)
Difference	-0.0002	-0.0321	0.0085	-0.0009
	(0.0005)	(0.0094)	(0.0029)	(0.0003)
% change	-0.0008	-0.0893	0.0221	-0.0068
Mean Log Deviation				
Shock	0.2605	0.3912	0.5055	0.2908
	(0.0173)	(0.0177)	(0.0354)	(0.0269)
Reform	0.2608	0.3428	0.5090	0.2904
	(0.0173)	(0.0176)	(0.0348)	(0.0270)
Difference	0.0002	-0.0485	0.0034	-0.0003
	(0.0009)	(0.0105)	(0.0041)	(0.0002)
% change	0.0009	-0.1239	0.0068	-0.0012

Notes: This table shows income inequality measures after the unemployment shock and after the unemployment benefit reform. Standard errors are in parentheses. The difference between the shock and the reform can be used to compare the effect cross-country, while the % change can be used to compare the effect across inequality measures.

4.A Additional tables

Table 4.10: Heckman selection model - predicted wages for non-workers

	BE	DE	ES	IT
Log wage				
ISCO 10	-0.671	0.432	0.23*	0.095
	(0.70)	(0.36)	(0.10)	(0.11)
ISCO 20	-0.463	0.539	0.308**	-0.061
	(0.56)	(0.29)	(0.94)	(0.09)
ISCO 30	-0.161	0.541	0.0240	0.0323
	(0.44)	(0.29)	(0.09)	(0.81)
ISCO 40	0.0395	0.444	-0.137	-0.173
	(0.44)	(0.28)	(0.09)	(0.11)
ISCO 50	-0.243	0.176	-0.388***	0.0644
	(0.48)	(0.31)	(0.08)	(0.10)
ISCO 60		-0.239	-0.756***	0.104
		(0.4)	(0.21)	(0.1)
ISCO 70	-0.199	0.169	-0.275**	0.138
	(0.48)	(0.31)	(0.09)	(0.11)
ISCO 80	-0.138	-0.0266	-0.171	-0.0146
	(0.51)	(0.29)	(0.09)	(0.09)
ISCO 90	0.0755	-0.157	-0.362***	0.0437
	(0.63)	(0.31)	(0.09)	(0.11)
Age	0.228	0.207***	0.0736**	0.00230
	(0.21)	(0.04)	(0.025)	(0.04)
Age2	-0.00219	-0.00207***	-0.000654*	0.000199
	(0.002)	(0.0004)	(0.0003)	(0.0004)
Primary education		-0.314	-0.320**	-0.386***
		(0.56)	(0.11)	(0.11)
Lower secondary education	0.909	0.236	-0.136	-0.109

	(0.55)	(0.44)	(0.11)	(0.08)
Upper secondary education	0.493	0.334	-0.0144	0.0734
	(0.55)	(0.41)	(0.103)	(0.09)
Tertiary education	0.605	0.428	0.0669	0.372***
	(0.59)	(0.41)	(0.1)	(0.11)
Gender	-0.307	-0.549***	-0.273***	-0.140
	(0.45)	(0.09)	(0.07)	(0.07)
Constant	-1.113	-1.444	2.622***	4.395***
	(6.55)	(1.3)	(0.73)	(0.94)
1st stage				
Age	0.211***	0.100***	0.189***	0.252***
	(0.03)	(0.01)	(0.01)	(0.01)
Age2	-0.00238***	-0.00116***	-0.00217***	-0.00295***
	(0.0003)	(0.002)	(0.0001)	(0.0002)
Gender	-0.171	-0.106	-0.327***	-0.443***
	(0.09)	(0.06)	(0.05)	(0.05)
Dependent children	-0.362**	-0.325***	-0.378***	-0.415***
	(0.12)	(0.07)	(0.05)	(0.06)
Constant	-5.336***	-2.757***	-4.518***	-5.620***
	(0.57)	(0.3)	(0.24)	(0.34)
mills	0.253	0.868*	0.276	-0.0582
lambda	(1.33)	(0.38)	(0.17)	(0.17)
N	1427	2884	5274	4183
pseudo R^2				

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.11: Model fit - hours worked

Frequencies(%)	BE	DE	ES	IT
Data				
0	35.88	35.85	49.90	42.82
10	2.17	3.43	0.72	1.48
20	8.97	8.36	2.64	5.69
30	10.02	7.63	6.9	5.04
40	36.44	34.02	34.74	41.12
50	3.99	7.25	3.74	3.15
60	2.17	2.71	1.14	0.45
70	0.35	0.77	0.23	0.24
Model				
0	34.9	42.4	40.1	47.96
10	0.14	0	5.88	0.05
30	10.65	0	0	1.86
40	54.31	56.9	54.02	50.13
70	0	0.69	0	0
Means				
Data	36.09	36.93	38.47	37.19
Model	38.3	40.36	37.06	39.61
Gap(%)	6.13	9.29	3.69	6.53

4.B Tax-benefit systems simulation

HFCS data set contains individual and household level variables which I am able to use in the tax-benefit system simulation for each country. The definitions of the variables are *ex ante* harmonised across all countries in the sample. I construct total gross income by summarising household-level variables: social transfers, regular private transfers, rental, financial and other income. These variables are not available on the individual level, and I use an income equivalisation variable to equivalise household level incomes. The equivalised income is then added to all individual level variables: earnings, unemployment benefits, public and private pensions income. Self-employment income is left out of the equation, as I do not include self-employed in our sample. To gross income on the individual level, I apply social contributions all employed individuals pay, possible unemployment benefits for the eligible unemployed individuals and income and savings taxes, in order to obtain individual net income. Each of the components in the tax-benefit system vary across European countries. Therefore, I construct the systems separately. I simulate employee social contributions, unemployment benefits and income and savings taxes in each country. Other parts of the tax-benefit systems are not of interest in this paper. For example, employers' social contributions would be important to simulate if I were interested in the government budget effects, self-employed contributions would be important if I were not interested in labour supply, etc.

4.B.1 Belgium

As noted in EUROMOD, 2014a, the order of simulation in Belgium is: (i) employee social contributions, (ii) unemployment benefits and (iii) income and savings taxes.

Social contributions are paid by all employed individuals, and in 2010 it amounted to 13.7% of gross earnings. For now, I do not simulate Belgian social deductions (workbonus).

Unemployment benefits are paid to eligible unemployed individuals. I simulate only the ordinary (after) employment unemployment benefit and youth unemployment benefit, due to lack of information in order to simulate other unemployment benefits. An individual is eligible for ordinary unemployment benefit if she lost employment and is actively seeking employment. I simulate eligibility for people who are employed in the data or are already recipients of the benefit. In 2010, the unemployment benefit replacement rate was 60% of the average lost daily wage, for individuals with dependent members. Single unemployed are entitled to 50 percent of their average lost daily wage. Youth unemployment benefit depends on the age of individuals and possible dependent family members. Single individuals younger than 18 are entitled to €10.94 per day; age bracket 18-21, €17.20 per day; and those older than 21 €28.49 per day. Youth with dependent family are eligible to receive 38.52 per day.

A tax unit in Belgium can be an individual or a married couple. I simulate the tax system as individual system. Tax exemptions include social benefits, which are equivalised in our data set and unemployment benefits. Tax deductions consist of employee social contributions, paid alimony, professional expenses and mortgage repayments. HFCS data set allows for simulation of professional expenses and mortgage repayments. Professional expenses apply for employed workers, depend on the individuals' gross taxable income and cannot exceed €3460 per year. Deduction of mortgage repayments in Belgium depends on whether the mortgage was taken out before or after 2005. I simulate the deduction only in the case of mortgage after 2005. If the mortgage is for the individual's own, self-occupied and only dwelling, with a term of at least 10 years, the deduction is €1500. Additional €500 can be deducted during the first 10 years of the mortgage. Tax base is then calculated after tax exemptions, and deductions are deducted from gross income. Income from assets, interest from bonds and other fixed income securities are taxed through withholding tax, and I simulate it as a savings tax, separately.

After calculating income tax using tax brackets and progressive tax rates, tax credits are applied. In 2010, each taxpayer could apply a yearly tax credit of €6430. Additionally, the first child increases the tax credit by €1370, second €2150, third €4360 and from fourth child onward €4870. Lone parent with dependent children could add €1370. Other tax credits are not simulated. Income tax is calculated by deducting tax credits. Witholding tax on investment incomes ranges from 15-25 percent. EUROMOD, 2014a assumes a 15 percent tax rate and I apply the same rate. Total tax is then obtained by summing income and savings tax. Net income is calculated by deducting social contributions and total taxes from gross income.

4.B.2 Germany

The order of simulation in Germany is: (i) unemployment benefit I, (ii) employee social contributions, (iii) unemployment benefit II and (iv) income and savings taxes (EUROMOD, 2014b).

Unemployment benefits I are contributory benefits, and are therefore simulated before social contributions. Individuals eligible for unemployment benefit I are younger than 65, able to work at least 15 hours a week and have paid social contributions prior to becoming unemployed. The replacement rate was 60% in 2010, and it is applied on net earnings, therefore gross earnings minus paid social contributions.

Social contributions are paid by all employed individuals. In 2010, the total social contribution rate was 20.475% applied to gross earnings and unemployment benefit I.

Unemployment benefits II are paid to unemployed individuals, able to work at least 3 hours per week, not in receipt of unemployment benefits I and have no financial wealth in the household. The amount paid to those individuals was €359 per month in 2010. There are some differences applied to the basic amount in case of more than one adult in the household in receipt of the benefit, as there are with respect to the recipient's age. I do not simulate these differences.

Taxes in Germany are simulated on the individual level. The income-tax base consists of employment, self-employment, property and other sources. I simulate employment, property and other sources of income. Simulated tax allowances for 2010 are:

- a lump sum employment allowance – €3068 – 16% of employee income up to employee income of €19175; if employee income is greater than €19175, the allowance is €2001,
- single parent allowance (€1308),
- allowance for children (€3504 per child) and
- alimony allowance (up to €13805 yearly)

Other allowances are applied for elderly persons, which I do not have in the sample, therefore are not simulated. Taxable income is calculated as gross income, without social benefits and tax allowances, however including unemployment benefits. As in EUROMOD, 2014b, I apply progressive tax schedule for 2010 in order to obtain income tax. There are no explicit tax credits applied in Germany. Savings tax is calculated as a lump sum tax of 25 percent on equivalised household financial income. Total tax is obtained by summing up income and savings tax. Net income is calculated by deducting social contributions and total taxes from gross income.

4.B.3 Spain

The order of simulation in Spain is: (i) employee social contributions, (ii) unemployment benefit and (iii) income and savings taxes (EUROMOD, 2012).

Social contributions in Spain are the most complex out of the four countries in our sample. For simplicity, I describe the way I calculate social contributions; for detailed rates, minimum and maximum amounts, please see the official government guide.[9] There are three main schemes I am simulating in this paper: General, Agricultural and part-time. Employees in Spain are divided in 11 social contribution groups, based on their occupation, educational attainment and type of work they do. Each group defines a specific minimum and maximum social contribution base, which is used to calculate social contributions. Finally, social contributions are calculated based on the thresholds applied to a social contribution base.

Unemployment benefits are contributory benefits. An individual is eligible for unemployment benefits if she loses her job, after paying social contributions for 360 days during 6 years, prior to losing her job. I am able to simulate eligibility as observing positive social contributions or unemployment benefits in the data. The replacement rate of 70% is applied to IPREM, a multiplier for public income index. IPREM in 2008 was €6390.13. Additionally, there are minimum and maximum amounts applied, depending on the household type of the individual and number of dependent children. Unemployment benefit for part-time workers is calculated as a proportion to full-time workers. Income guarantee benefit is simulated for individuals older than 45 years and if their employee income was not higher than €5400. Unemployment assistance benefit is not simulated due to lack of information.

Income tax can be paid based on an individual and joint scheme. I simulate individual scheme only. Tax exemptions are social benefits, unemployment benefits if they are not higher than €12020.24. Tax allowances are employee allowance, determined based on net earnings and private pensions tax allowance, up to €12500 for individuals older than 50 and €10000 for individuals younger than 52.

Tax base is calculated after deducting social contributions, tax exemptions and allowances and financial income from gross income. Financial income is taxed separately. Income tax is determined by applying a progressive tax scheme. Savings tax was a lump sum tax in 2008, with a rate of 18%.

Tax credits are applied to a total tax due. Personal tax credit was €5151. Main residence mortgage tax credit is applied to mortgage payment in a particular fiscal year. If the payments

[9] `http://www.seg-social.es/Internet_6/Trabajadores/CotizacionRecaudaci10777/Basesytiposdecotiza36537/index.htm#36550_6`; accessed April 3, 2017.

were lower than €9015, 15% was eligible for the tax credit. Otherwise, 15% is applied to the maximum of €9015. Maternity tax credits are not simulated. After subtracting total tax credits from the total tax due, I obtain total tax to be paid. Net income is obtained by subtracting social contributions and taxes from gross income.

4.B.4 Italy

The order of simulation in Spain is: (i) employee social contributions, (ii) unemployment benefit and (iii) income and savings taxes (EUROMOD, 2014c).

Employee social contributions in Italy depend on the firm's sector and size. Since I do not have information necessary to simulate social contributions in detail, following EUROMOD (2014c), I assume industrial firms, with more than 50 employees. The total rate in 2010 was 9.49%, applied on gross earnings. I am not able to simulate temporary job contributions.

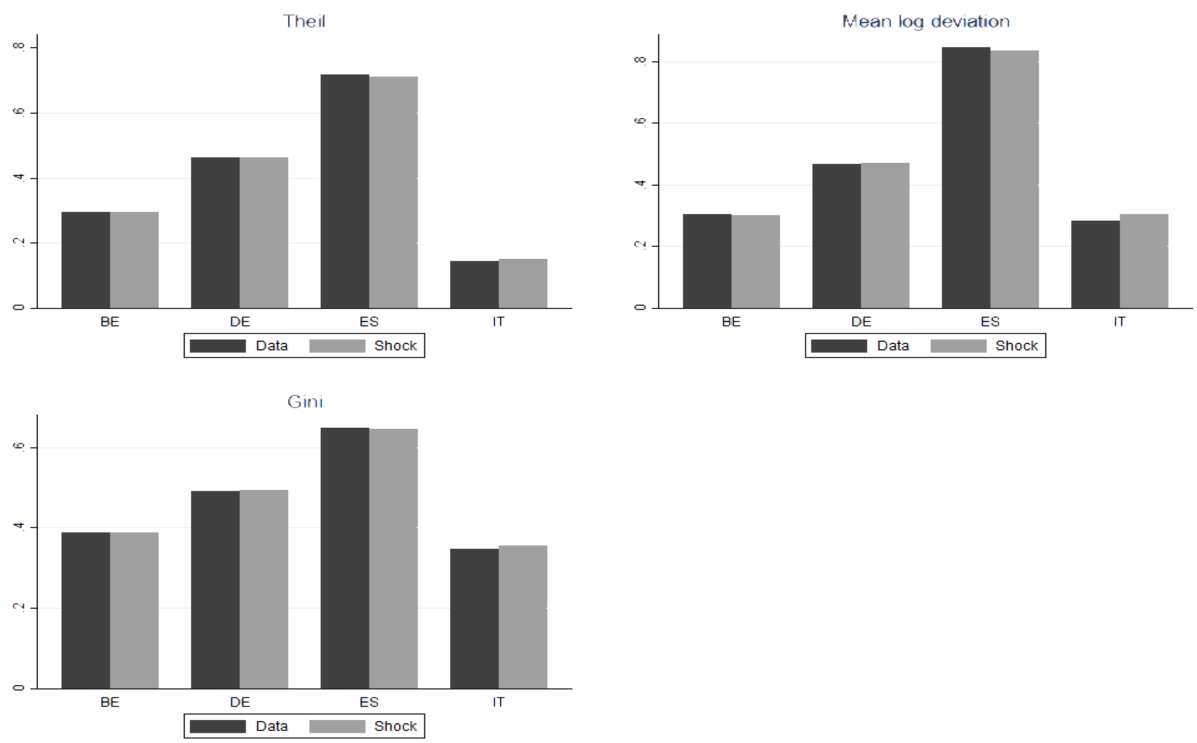
The ordinary unemployment benefit in Italy is paid to individuals after loss of employment, who have paid contribution against unemployment for at least two years or have paid 52 weeks of social contributions in the previous two years. I simulate eligibility for those who have paid social contributions or are already receiving unemployment benefit. The replacement rate is 60% of the average gross wage. Additionally, there is a threshold of €1917 per month, below which, the maximum amount is €893, and above which the maximum amount is €1073. Unemployment benefit in Italy is taxable.

Income tax is paid individually. Tax exemptions are financial income, subject to withholding tax; social contributions; social benefits, except for the unemployment benefit. Tax allowances are simulated for employees with a private pension plan, up to 12% of total individual income, or €5164.54. I am not able to simulate main residence tax deduction, disabled persons' health expenses and grants to religious institutions. Tax base is then obtained as tax allowances and exemptions subtracted from gross income. Applying a progressive tax schedule to the tax base, I obtain income tax, before tax credits. Tax credits simulated interest paid on mortgage loans, up to €4000. Health expenses, educational expenses, and life premiums cannot be simulated. Employment tax credit is simulated according to income brackets. Financial income is taxed according to the source of income. Due to lack of information, I simulate a tax rate of 20% on the total financial income. Net income is obtained by subtracting social contributions and taxes from gross income.

4.C Income inequality after the unemployment shock, without the behavioural response

If the unemployment shock of 6.6 percentage point increase is implemented, without any labour supply responses, there is a very small effect on income inequality. Figure 4.8 shows income inequality changes, post-unemployment shock, without any behavioural responses. Mean Log Deviation shows the biggest changes out of all four inequality measures. As discussed in Section 4.6, mean log deviation is more sensitive to changes in the lower part of the distribution, therefore indicating that the lowest part of the net income distribution was affected by the unemployment shock the most.

Figure 4.8: The effect of unemployment shock on income inequality, without the behavioural response



Notes: This figure shows the effect of the unemployment shock on income inequality, without the behavioural response.

Chapter 5

General conclusion

This thesis investigated the effects of recessions on labour supply (Chapter 2), the effects of overtime tax on hours worked (Chapter 3) and the effect of labour market shocks on income inequality through labour supply (Chapter 4).

In Chapter 2, I show that, in 12 European countries, desired hours worked fall in the boom periods and increase in the recession times, in 12 European countries. The magnitude of the effect is quite large on the yearly level, varying from 2.6 hours in Germany, Czech Republic, and Poland, to almost 8 hours in Spain. These results are biased down because of the possible composition effect, and they represent an average effect over the entire period of booms and busts. This drawback is circumvented using a panel of individuals in the French LFS, where the effect is seven larger – 1.6 hours per quarter at the beginning of the Great Recession (2007q4–2009q1). Out of several possible explanations of this pattern, I focus on the income effect: poorer individuals or individuals could desire more hours during recessions. This is true in all countries, with even larger effects on desired hours, ranging from 6.8 hours on a yearly level in France to 36.4 hours in Ireland. In Ireland, part-time workers account for almost half of the effect in the bottom part of the income distribution. Similarly, in Portugal, where temporary work is among the highest in Europe, temporary workers desire 10 minutes more in the reference week, or 8 hours more on a yearly level, for a higher unemployment rate.

The aim of Chapter 3 was to estimate the effects of overtime tax on hours worked. I find that overtime tax in the equilibrium, on average, reduced actual hours worked and increased fiscal responsibility of the firms through more diligent reporting of overtime hours. However, this result does not hold for part-time and temporary workers. These two groups of workers who are generally more vulnerable on the labour market, do not report more overtime hours, but do work more hours. As a consequence of the overtime tax, part-time workers' labour supply increases, although the estimate is biased. However, this implies that for part-time workers, income effect is likely to hold (rather than the substitution effect), especially in recessions when outside options are even more limited, which is suggested by the result in Chapter 2 as well. On the other hand, firms faced higher domestic demand and high levels of uncertainty about the future business cycle. With high cost of overtime (usually used to adjust to economic booms) and high cost of hiring new workers, firms had to find the least costly way of satisfying the higher production demand: standard (non-overtime) hours of part-time and temporary workers.

The goal of the policy in France, 2012 was to potentially reduce unemployment and increase income tax revenue. From the policy maker's perspective, it seems that the policy partly succeeded: it increased reporting of overtime hours and fiscal responsibility, while decreasing hours worked of an average employer. However, instead of decreasing unemployment, the reform affected the hours of part-time and temporary workers.

A common finding in Chapter 2 and Chapter 3 is that the result which holds on average, in a country, is not the same once we start looking into the most vulnerable subgroups on the labour market. Due to data restrictions and unavailability, we do not know at which income levels marginal utility of income becomes higher. To answer this question, we require better data: detailed labour market information paired with reliable income information. This would allow researchers to inform policy better and shape labour markets to aid workers with limited opportunities for work.

Chapter 4 attempts to recreate the labour supply responses in recessions from Chapter 2, in order to investigate the effects of labour market shocks on income inequality. To do this, I use data which contain income information paired with actual hours. As is common in the discrete choice labour supply literature, actual hours are used as a proxy for supplied hours, while implementing restrictions to the actual hours worked in order to capture the labour demand effects. Therefore, to account for involuntary unemployment, I estimate a labour supply model, restricted by a probability of receiving an offer, which allows the simulation of unemployment choices well in all 4 countries in the sample. However, the model does not capture part-time choices well, as fixed costs of work are not included in the model, due to data limitations. Therefore, this model is not able to capture the same change in labour supply as shown in Chapter 2.

When Belgium, Germany, Spain, and Italy are exposed to the exogenous unemployment shock of the same magnitude, the effects on hours worked and income inequality are substantially different. In Italy and Spain, inequality measures slightly decrease, and inequality in Belgium and Germany increases. The changes in the South of Europe are smaller in magnitude, compared to changes in the North. Although the Great Recession was an asymmetric shock in Europe, affecting the South more than the North, imposing an unemployment shock of the same magnitude caused substantially different effects on income inequality. This result is also driven by several modelling and data limitations, which again serves as a caution for better data availability.

Regardless, I hope that the findings of this thesis serve as a start to new measurement of labour supply and further research into different factors that affect it.

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