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Chapter 1

Introduction

In times of rising unemployment, the idea of a shorter working week is often articulated to fight unemployment. In that context, a shorter working week reduces the threshold above which firms have to pay an overtime premium, thus making overtime more costly. In public debates, a redistribution of employment between those employed and unemployed is often proclaimed as the principal aim of a shorter working week. In Europe, the last attempts to move towards a 35-hour-week at federal level have taken place in France and Germany more than ten years ago. In the recent financial and economic crisis, however, some parties and unions seem to have re-discovered the claim of a shorter working week.¹

Shorter working weeks might have significant effects on various aspects of economic interest, such as productivity, health, non-market work, labour supply, labour demand, wages, labour organization etc. The focus of the current public debate is, however, on the possible employment effects. The variety of channels of a shorter working week left the empirical literature inconclusive. Several studies - especially those focussing on microeconomic effects - find that shorter working weeks do not create new positions or even destroy existing ones through diminishing labour demand, especially because of higher hourly wages and fixed costs of employment. Other studies, especially those focussing on macroeconomic effects, find that shorter working hours may create employment.

This thesis contributes to the empirical literature in extending empirical macroeconomic analysis to novel data and estimation techniques. The structure is as follows: Chapter 2 discusses theoretical literature of the effects of work-sharing on several variables of interest. Chapter 3 gives an overview over empirical insights gained so far in economic literature. Chapter 4 presents the empirical analysis. The remainder of the introduction clarifies the definitions of the concepts used in the thesis, highlights the long-run evolution of working time, and discusses recent attempts to reduce working time in Europe.

¹An example being the ÖGB (Austrian Trade Union Federation) demanding a shorter working week (ÖGB 2009).

1.1 Concepts and Definitions

When talking about *work-sharing* or *reducing working time*, many different things can be referred to: more vacation days, more flexibility in arranging work-weeks, the increase of part-time work, reducing the amount of work over the whole lifespan through early retirement, etc. In this paper, however, *reduction of working time* will refer to the reduction of the *standard working week*. This *standard working week* threshold - whether set up by federal legislation, collective agreements, or both - marks the point above which employers have to pay employees more than the usual hourly wage, and/or have to pay overtime taxes. While, in theory, lowering this threshold does not necessarily mean that the actual working time is being reduced, the empirical literature shows abundant evidence of a nearly one-to-one movement of the standard working week and actual hours worked. This limitation in the definition of reducing working time has two reasons: first, including other forms of reducing working time, like part-time work or the increasingly common labour contracts limited in time for relatively low hours, has several caveats in data structure, as persons with multiple employment contracts are difficult to grasp in most data sets. Second, regarding the case of part-time work, the change from full-time to part-time work may be involuntary. Additionally, when people enter employment (either from being unemployed or coming from outside the labour force) and accept a part-time job, the average working time will decrease. This type of decrease in the average working time is typically overlooked. On a political level, the aim is usually to decrease the average hours of those working 40 hours or more. To sum up, in this paper working hours will refer to those employed full-time, and reducing working hours will refer to reducing the standard work week, if not explicitly specified otherwise.

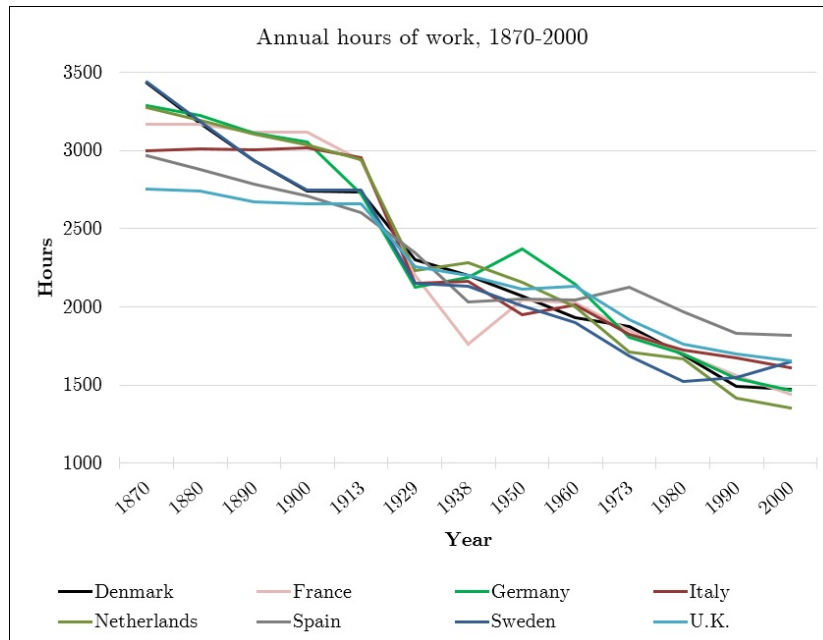
1.2 The Evolution of Working Time in Europe

Across Europe (and more generally, the industrialised world), annual working hours of those employed full-time have been declining since the end of the 19th century.² Figure 1.1 shows this trend for some European countries (data from Huberman and Minns 2007). The convergence is striking, and is quite similar when looking at weekly working hours in Figure 1.2.³ From the mid-1970s onward, average hours began to level out, but the variation of working hours increased at both ends of the working hours distribution (Green 2001).

²The data on both annual hours and weekly hours are for those full-time employed in production.

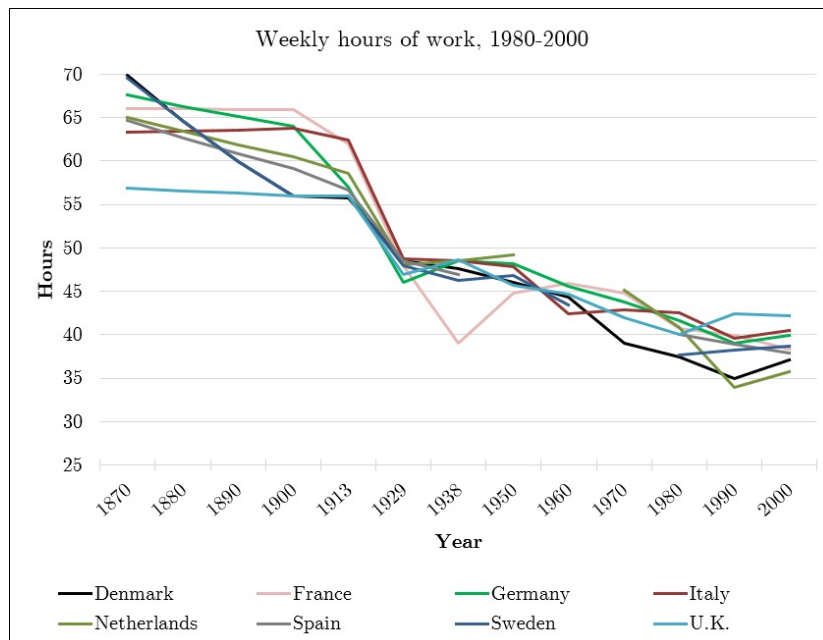
³This trend holds for other European and OECD countries as well.

Figure 1.1: Annual working hours



Source: data from Hubermann and Minns (2007)

Figure 1.2: Weekly working hours



Source: data from Hubermann and Minns (2007)

In recent decades, there is a trend towards longer and more flexible working hours in Europe. In the following, I will highlight some more recent examples of countries that reduced working time. The focus is on federal level while measurements to reduce working time can also be implemented at sectoral or firm level.

In France, the years 1998 and 2000 marked two steps in the plan of the federal government to reduce the working week from 39 to 35 hours. The first step in 1998 was to grant social security payment exceptions to firms that voluntarily reduced working time (by at least 10%) for their employees while increasing the numbers of employed people (by at least 6%). In 2000, this agreement became obligatory for firms with more than 20 employees. The plan to further extend shorter working weeks to all firms could not be pursued, as the coalition of social democrats and greens was not re-elected in 2002. The new conservative administration cancelled virtually all measures of their predecessors. The opposite path was taken and incentives for a longer working week were put into place: new laws granted social security exemptions for the firms that did not reduce working time, and taxes and social security contributions for overtime decreased. This rapid reversal made answering the question whether the shorter hours created employment in France challenging (Bosch and Lehndorff 2001, Askenazy et al. 2004, Flecker et al. 2010).

In Belgium, a law introduced the 39-hour-week in 1999. In collective agreements however, 36 to 38 hours per week were standard, with only few cases of 39 hours (Flecker et al. 2001). In 2002, an overall collective agreement reduced weekly hours from 39 to 38 without wage loss. The measure was, however, softened in 2007, as multiple sector collective agreements allowed for more overtime hours. In the 1980s, Belgium adopted a series of voluntary working time reductions accompanied by wage reduction and employment increase. The incentives for firms where too small, and only a small number of contracts reducing working time were closed. Belgium has a tradition of allowing individual working time reduction, such as benefits for voluntary reduction to part-time employment, early retirement etc. For employees of federal government institutions, a 4-day-week can be chosen with 20% less wage, but a lump-sum support from the government. 10% of the employees took advantage of the agreement, the vast majority of them women. Evidence suggests that productivity increased substantially through this option (Flecker et al. 2001).

Denmark has a relatively high employment rate, due to a high employment rate of women and a high share of part-time workers. In 1994, a set of reforms was introduced to allow for various forms of sabbaticals or other forms of a break from employment, mostly for childcare and educational leave. The aim was to reduce unemployment by filling temporary open positions of employees on leave with unemployed workers. However, the proposals were often accessed in sectors where there was no unemployment. Women were overrepresented in all forms of leaves, not only child care leaves. This had the effect that only very few (long-time) unemployed entered the labour market, and finally led to a partial reversal of the reform. Hence, the average working hours stayed relatively constant until 2008, where the recent economic led to the support of short-time work, like in many other European countries (Flecker et al. 2001, 2010).

In the Netherlands, the rise of the employment rate of women has been even faster than in Denmark. As in most countries, the standard working time agreed upon on the collective bargaining level is lower than the one defined at federal legislative level. Most of the collective agreements are on a sectoral level, with a tendency towards firm and individual level. Pushing part-time work as a means to increase employment was a strategy of the federal government since the 1980s, with disputable success: Delsen (2000, cf. Flecker et al. 2001) attributes an employment effect of 30.000 positions to changes from full- to part-time work between 1983 and 1990. The 40-hours-week was introduced in the 1970s, in the 1980s 38 hours were agreed upon, and in the 1990s 36 hours. Since the 1998, there is a slight increase in working hours.

This fragmentary review of reforms shows the broad spectrum of possible policies aiming at reducing the working week, from subsidies for firms that reduce working weeks and increase employment to increasing part-time work. Most measurements are subject to change with newly elected governments.

Chapter 2

Work-Sharing: Theoretical Considerations

This chapter reviews theoretical contributions dealing with working time reductions and is structured as follows: Section 2.1 discusses theoretical considerations regarding the effects of wage movements along with work-sharing. Section 2.2 reviews the effects on productivity. Section 2.3 discusses the possible effects of work-sharing on labour supply. Section 2.4 discusses the employment effect of reducing working time: subsection 2.4.1 reviews labour demand models, with a focus on the expected effect of work-sharing on employment; subsection 2.4.2 looks at the predictions of general equilibrium models discussing work-sharing.

2.1 Wages

One of the first questions for policymakers, firms and employees is: will a reduction in working time result in a monthly wage loss (through constant hourly wages) or is the reduction accompanied by a (full or a partial) wage compensation? Most federal policies state explicitly which of the two options is the aim, and sometimes implement it via subventions, laws etc. (e.g. Belgium, France). However, there are various ways in which wage bargaining is affected through work-sharing policies that can not be controlled directly, for example by influencing stances and strategies of employer or employee unions. As wages have a considerable effect on employment, the interaction between wages and hours is of interest for the macroeconomic evaluation of working time.

If the reduction of working time does not simultaneously trigger proportional falls in monthly wages, or, if hourly wages rise with reductions in working time, an often articulated concern is the following: If employers are forced to pay higher wages, a firm's labour cost will rise. However, as Bosch and Lehndorff (2001) emphasize, the decisive factor for firms is unit costs, not labour costs. Taking that into account, unit costs can be influenced by working time reduc-

tions as well, mostly by productivity effects and changes in operating hours.¹ A reduction in working time can be an independent source of productivity gains, through changing work organisation and using labour more intensively. In that sense, the productivity effects could be a source of "internal financing" for the cut in working time when wages rise with the cut. Unit costs can also be affected through redesigns of working practices over the channel of capital operating times (and thus capital unit costs).

Theoretical models focussing on the wage effects of shorter working hours point towards a negative effect on wages. De Regt (2002, Chapter 5) sets up an labour market model and concludes that a reduction of working time is likely to lead to wage moderation (in any specification of union bargaining), moderation is stronger if the working time is longer. Calmfors (1985) establishes a model with a monopoly union and finds that if there is perfect substitution between employment and working time - the case most favorable for work-sharing - and initial working time is less than optimal for the union, the hourly wage will increase. If the initial working time is larger than optimal for the union, the wage movement cannot be signed - an increase is as possible as a decrease.

Hence, theoretical models have no concluding consensus on wage movements with shorter working hours, and authors stress that the question has to be answered empirically.

Additionally, the effects of wages considered above have the focus on the microeconomic effects of labour demand and supply. There is, however, a macroeconomic effect of rising wages. Especially in times when the economy is not in equilibrium, positive shocks in the aggregate demand can have positive employment effects. This effects will most likely spread across the economy if only one or several sectors reduce their statutory working week. The possibility of such an effect hinders microeconomic research discussing the employment effect of a lower working week, as we will see in subsection 3.5.1.

2.2 Productivity

The study of the effects of shorter working hours on productivity has a long tradition: Sidney Chapman published his paper "Hours of work" in 1909, where he focuses on the optimal working hours for businesses. His observation is that shorter working hours in British industries did not lead to reductions in output, they rather increased output in some cases. He speculates that the health effects of long working hours could be severe - a statement now supported by a vast amount of medical research.² Longer working hours might result in more output in the short run, but decrease productivity on the long run. Generally, he formulates the notion of decreasing marginal productivity of long working hours due to lack of concentration, exhaustion etc. His argumentation leads to the question why firms do not use shorter working hours to preserve their

¹Greater flexibility in operating / working hours is a policy often put in place simultaneously with reductions in the working week.

²Kivimäki et al. (2015), for example, provide a meta-analysis of studies focusing on coronary diseases. Golden et al. 2011, Caruso et al. 2004 focus on health and productivity.

workers health and productivity. Chapman argues that firms fear that, if their workers change working place, the productivity of the workers could be utilized by other firms.

Bosch and Lehndorff (2001, 212) argue that a reduction in working time might also be an independent source of productivity gain. This argument is important, as it can mitigate the negative effects on labour costs of a reduction in working time. From a firms perspective, unit costs can be influenced through working time reductions by influencing productivity of labour, but also productivity of capital. The productivity of labour can be increased by the incentive of re-organizing the use of the factor labour due to a shorter working week, but empirically it is often the case that cuts in the working-time are accompanied by the possibilities of greater flexibility in operating and working hours. Unit costs can also be affected by redesigns of working practices over the channel of capital operating times (and thus capital unit costs).

2.3 Labour Supply

A somewhat neglected topic is the effect of a reduction in working time on the level and distribution of intra-household labour-supply. A reduction in working time can affect the partner's labour supply in several ways: If the reduction occurs in a household where one person works full-time and the other part-time or not at all, then a work-sharing reduction affecting full-time employees could result in an increase in the labour supply of the partner. This would be the case if the reduction is not accompanied by a full compensation of wages, and the household has a preference for keeping household-income constant. Even if a full compensation is achieved, a reduction in working time could lead to an increase in labour supply if the distribution of reproductive work is distributed more evenly. The hope of a more evenly distribution of both market and reproductive labour between genders is often an argument brought forward by proponents of shorter working times. On the other hand, a decrease in labour supply of the second person in the household is theoretically also possible if the preference for more leisure time together is strong.

A pitfall for work-sharing initiatives linked to labour supply might be the lack of sufficiently high-skilled workers available on the labour market. If working time is reduced and no substitutes for skilled workers can be found in the labour market, firms will have to reduce employment or pay the overtime premium for more hours. Working time reductions may, on the other hand, have positive effects on (skilled) labour supply: In particular, if female labour supply rises as response to a reduction in working time (by allowing more women to switch to full-time), employers will have access to hitherto underutilised sources of human capital.

In terms of explicit models, research linking the reduction of working time to labour supply is scarce. Martin-Roman (2014) evaluates the labour-supply effects of work-sharing measures in the context of a model with search transaction costs. As in the demand side evaluations, a basic relationship between a reduction in regulated working time and an increase in labour market participation

is far from evident. The starting point of the analysis is a simple static neo-classical model that states an inverse relationship between working time and labour force participation. In other words: reducing working hours has an encouraging effect on the labour force. When job-seeking involves transaction costs, the effect becomes ambiguous depending on workers' preferences. In a numerical example - which the authors states is sensitive to parameter values and should be viewed as an example only - a scenario is outlined where high unemployment reduces the encouraging effect on labour participation (because of the costs for job-searching) until, at a certain point, the basic (neoclassical) relationship reappears again.

2.4 Employment

The most important variable of interest for policy-makers concerning work sharing is typically the effect on employment. The aim of this section is to give an overview of the theoretical predictions of this employment effect of both labour-demand and general equilibrium models.

2.4.1 Labour Demand Models

As Hunt (1996, 1999) demonstrates in a simple static labour demand model, labour demand theory is ambiguous regarding the question of employment effects of shorter working hours.

A firm considers the output function g , standard hours h_s , the hourly wages w , fixed costs of employment f , an overtime premium p as well as the rental rate of capital r as given, and chooses actual hours per worker h , employment N , and capital K . The profit maximizing function $\Pi(h, N, K)$ is thus given by:

$$\max_{h, N, K} \Pi(h, N, K) = \max_{h, N, K} g(h, N, K) - whN - fN - pw(h - h_s)N - rK \quad (2.1)$$

Assume that the firm chooses overtime hours ($h^* > h_s$) due to a high fixed cost of employment f . A decrease in standard hours h_s increases labour costs through the overtime premium. A substitution effect will lead to a shift from labour to capital. A scale effect tending to reduce employment and hours per week adds to those effects leading to a fall in worker-hours. First differentiating with respect to the chosen hours h , employment N , and capita K , respectively, yields:

$$\frac{\partial \Pi}{\partial h} = \frac{\partial g(h, N, K)}{\partial h} - wN - pwN \quad (2.2)$$

$$\frac{\partial \Pi}{\partial N} = \frac{\partial g(h, N, K)}{\partial N} - wh - f - pw(h - h_s) \quad (2.3)$$

$$\frac{\partial \Pi}{\partial K} = \frac{\partial g(h, N, K)}{\partial K} - r \quad (2.4)$$

To get a clearer picture of the substitution between hours per workers and workers, a look on the marginal cost of hiring a worker MC_N and the marginal cost of h^* additional hours of work by already employed workers MC_h in equilibrium³ shows:

$$MC_N = wh^* + f + pw(h^* - h_s) \quad (2.5)$$

$$MC_h = (1 + p)wN \quad (2.6)$$

The marginal cost of additional overtime is unaffected by a change in standard hours. The marginal cost of additional employment is increased by a fall in standard hours. The firm will therefore shift from workers to hours, reducing employment. However, the effect depends heavily on the original optimal hours. If the optimal hours for a firm are lower than the standard hours, a reduction will lead to an increase in employment. Relaxing assumptions such as the exogenously fixed costs of employment f to endogenous costs, allowing for unions, wage endogeneity, heterogeneity of firms and workers, the results become even more fragmented.

Calmfors and Hoel (1988) also consider the production function of a firm with three factors of production in a similar fashion: The number of employees N , the number of hours worked h , and the capital stock K . Labour input L is taken to be a function of h and N , i.e. $L = G(h)N$. A special case where the productivity of workers is not affected by the numbers of hours worked would be $L = hN$. It is reasonable to assume that G is an increasing function of h (if h is not extremely big), i.e. the more hours spent on the job, the bigger the labour input. Other assumptions include that for small h , G will be small (start-up time needed), then the hours become more productive as h increase until at some point, decreasing marginal productivity prevails. Introducing simple wage-costs-schedules, a first result is that, if the h considered is in the area of decreasing marginal productivity, a reduction in h will lead to a fall in employment. The reason for this result is that the price of an extra worker rises, but the price of an additional hour is unaffected. This prediction only holds if, before the implementation of shorter hours, workers are employed above standard hours, i.e. work overtime. If all workers work exactly standard hours, an a priori statement about the effect is not possible and depends on what the optimal solution after the fall in hours will be. If the optimum remains a corner solution, then hours will fall and employment will rise. If it is optimal that the firm now requires workers to work overtime, the employment effects remain

³i.e. $\frac{\partial \Pi}{\partial K} = \frac{\partial \Pi}{\partial N} \stackrel{!}{=} 0$

unclear. Also, in a case where the actual hours are smaller than standard hours, the effects are not clear.

Up to now, no influence of working hours on capital has been assumed. De Regt (2002) builds a labour demand model that takes into account the possibility of hours influencing not only the factor labour, but capital services as well. In the absence of shift work, the operating times of capital and the working time of workers are clearly linked. The magnitude of the impact of hours worked on capital usage reduces the positive impact of work-sharing policies on employment, as productivity is adversely affected. Generally, the study finds that there is a critical working time above which work-sharing policies tend to increase employment. Calmfors (1985) establishes a model containing a union with monopoly power to set wages. The effect of shorter hours on employment is decomposed into a direct effect and an induced effect. Both parts cannot be signed without more assumptions. As mentioned in section 3.2, this model predicts wage increases under the assumption of perfect employment-hours substitution and smaller actual hours than optimal for the union. Booth and Schiantarelli (1987) use a similar model with more specific assumptions about the production function and the utility function of workers and conclude that the employment effect is more likely to be negative than positive.

The labour demand theory presented up to this point is partial in the sense that labour supply forces and price effects are not taken into account. The following subsection will therefore present conclusions drawn from general equilibrium models.

2.4.2 General Equilibrium Models

FitzRoy et al. (2002) develop a basic general equilibrium framework featuring a Cobb-Douglas production function, non-productive set-up time, and employers' social security contributions. Two extreme specifications regarding the wage-setting process are considered: monopoly union and perfect competition. A simple fiscal framework and government budget constraint is introduced. The evaluation of the effect of hours worked on employment under a monopolistic union (employers have no bargaining power) results in employment being an inverse U-shaped function of hours. The intuitive explanation for this solution is as follows: with hours being low, an extension of hours comes at little utility costs to workers and unions. The utility costs increase rapidly, however, generating compensating wage demands that offset the productivity gains and lead to a decline in demand for employment. Hence, a reduction in hours is expected to be most likely to produce employment gains in situations where a relatively high level of hours is present, and less likely to do so when hours are relatively low and union representation is strong. Taking into account general equilibrium effects of taxes and benefits suggest that a reduction in working hours is more likely to reduce employment in countries with high taxes and benefits. The other wage-setting extreme where employers choose hours under exogenous taxes and a utility constraint in perfect competition (no union power) results in an increase in employment when hours are set by the government. The authors proceed to simulate numerically for some parameter ranges, and conclude that profit and wages losses following a small cut in working time are likely to be negligible, and

even find cases where both profit and employment can be increased when hours are cut. Hence, the General Equilibrium framework proposed here yields more optimistic evaluations than the partial equilibrium (labour demand) models.

A decisive factor for the employment results is the modelling strategy for wage setting. Fitzroy et al. (2002) use a model with monopoly union as well as one with a perfect competition set up. Marimon and Zilibotti (2000) develop a similar general equilibrium model and take a midway through modelling free negotiation of wages between firms and workers. Another difference to the model of Fitzroy et al. (2002) is that the maximum working time is restricted exogenously (i.e. through legislation). Hiring costs are fixed, and a search-matching model is conducted. The model is characterized by the interaction of opposite forces which make an a priori statement about the employment and distribution effects not possible. On the one hand, decreasing returns to labour are imposed by the aggregate technology, and new workers are perfect substitutes for hours worked by those already employed, both of which stimulates job creation. On the other hand, hiring costs (which correspond to the fixed costs in the labour demand models in Subsection 2.4.1) and wage adaptations do not favour job creation via the reduction of working time. Different preferences for working time are taken into account. Small reductions in working time always result in a small increase in the equilibrium employment, while large reductions result in employment losses. The welfare analysis shows that maximum working time regulation benefits both unemployed and employed workers, even in the cases of wage reductions and falling employment, while output and profits decrease.

Another way to model wage setting is via a moral hazard or efficiency wage framework. The internal logic of those models state that employers pay a wage above equilibrium level to motivate employees. Moselle (1996) uses a moral hazard efficiency wage framework also taking into account set-up costs, increasing marginal disutility of work, and also finds a U-shaped curve being the appropriate unemployment function of hours. Deriving from the free-market equilibrium (where hours and wages are both set endogenously), an exogenous reduction in hours leads to a reduction in unemployment. In contrast to Marimon and Zilibotti's analysis, employed workers are always worse off when hours are reduced in this scenario. Another model of this type is set up by Rocheteau (2002), who combines an equilibrium-matching approach with moral hazard, and finds that if unemployment is high, a work-sharing policy increases aggregate employment, but the opposite is the case for low unemployment situations. The origin of this result lies in the wage formation process assumed, where efficiency wage considerations are taken into account. The effectiveness of working time regulation depends on the bindingness of the no-shirking condition: If the condition is binding, each employer does not internalize the effects of a change in working hours on the efficiency wages paid by other firms. In a shirking-time efficiency wage model linking workers' effort directly to working hours, Huang, Chang, Lai and Lin (2002) also find, not surprisingly, ambiguous results. If a decrease in standard working hours reduces the effort, then it is not optimal for firms to keep employment constant, but to reduce employment and raise wages to tackle lower effort. However, if working time reductions boost work effort, the equilibrium unemployment rate will fall. They also find that this relationship between shorter working hours and worker effort is especially important in the

long run.

To sum up this subsection, general equilibrium models tend to be more optimistic regarding the employment effects of reductions in working time. The prediction of most of these models on employment and working hours is a U-shaped curve. That is, in situations of high unemployment and/or high hours, reducing working time may lead to employment gains, but if unemployment and/or hours are low, the opposite is likely. However, the case is far from clear-cut and depends heavily on assumptions on wage setting and preferences. Additionally, while general equilibrium can take labour supply responses into account, the analysis is still limited in the presence of macroeconomic spill-overs.

Chapter 3

Work-Sharing: Empirical insights

The review of the theoretical literature has shown to be rather inconclusive in answering questions about basic relationships between a reduction in working hours and important economic variables, most notably employment. The reason for these results are simple: For a meaningful and explicit evaluation of the effects of a reduction in working time, assumptions such as the degree of substitution between hours and employed workers have to be used, which simply have to be investigated empirically. Accordingly, the following section will highlight insights on empirical research aiming to shed light on the relationships in question. Section 3.1 will provide insights of whether a cut in the standard work week will empirically result in a drop in actual hours worked. Section 3.2 summarizes assessments of the movement of wages along reductions in working hours. Section 3.3 focusses on the changes in productivity if hours are reduced. Section 3.4 discusses the effect of work-sharing on labour supply. Section 3.5 discusses the empirical evidence of the employment effects of work-sharing. The last section includes the structural differences as well as advantages and disadvantages of microeconomic and macroeconomic studies.

3.1 The Relationship Between Standard Hours and Actual Hours

The first question that is worth asking when evaluating the effects of work-sharing is: does a reduction in the standard working week through legislation or collective agreement reduce actual hours worked? Theoretically, it is possible that firms do not change the actual hours worked and accept to pay more overtime premium, or even that they even increase the number of hours worked. The theoretical labour demand model of DeRegt (2002) however finds that actual hours, if overtime is worked, respond in the same direction to a change in standard hours, although less than proportionally.

In her discussion of the German work-sharing reform, Hunt (1999) uses data from the German Socio-Economic Panel. The reduction of one hour of standard

hours is found to lead to a decrease between 0.88 and 1 hour in actual hours worked. Overall, there is no statistically significant difference between gender, but the reaction is higher for women in the manufacturing and service sectors. Skuterud (2007) confirms the results of Hunt (1999) using a logit model. He finds that the probability of reducing working time one hour as the standard working week lowered by one hour is increasing for every year of the reform.¹ Hart (1987) uses data for 25 German industries from 1969-81 and finds that a 1% reduction in standard hours leads to a disproportionately bigger response of actual hours, namely 1.2%.

Hence, empirical research suggests that (i) actual hours worked respond to changes in standard hours in the same direction and (ii) that the response is close to a one-to-one reaction, at least if standard hours are close to 40 hours per week. The results are important for empirical analysis, because data on actual hours worked is often more accessible than data for standard hours.

3.2 Wages

Microeconomic research has taken increasing interest in the question whether a reduction in hours leads to "full compensation", i.e. the monthly wages move in a similar way in industries where a reduction in hours is achieved and in comparable industries.² While movements in wages heavily depend on the structure of bargaining in the respective countries and industries, some cases of work-sharing that allowed the wage effect was studied are the following: Skuterud (2007) finds for the Quebec work-sharing initiative decreasing wages of those working more than 44 hours (the old standard working week) and increases in wages for those working between 40 and 44 hours, although no "full compensation" was previously agreed upon. For Germany, where no agreement was set up legislatively either, empirical research is inconclusive in determining whether there was full compensation in affected industries or not. Hunt (1999) finds almost full wage compensation, similar to Steiner and Peters (2000). Schank (2006) finds full compensation in plants with a bargaining agreement, and smaller compensations in those without. Franz and Smolny (1994) find wage compensation for some industries, and none in others. For Portugal, where the working week was reduced in 1996 from 44 to 40 hours, Raposo and Van Ours (2009) find partial wage compensation. A similar result is found by Sanchez (2010) for Chile's 2005 reform reducing weekly working hours from 49 to 45 hours. For France, on the other hand, Kramarz et al. (2008) find that wages decreased, whereas Logeay and Schreiber (2008) find no effect of reducing hours on wages.

To summarize, two points can be made: It is not trivial to determine the wage movements, with the effect that there are dispersing empirical results regarding wage movements with work-sharing, even if the same region and sectors are studied. For most of the work-sharing agreements, it seems that employer and

¹From 1997 to 2000, the standard work-week for non-unionized workers in Quebec was set from 44 to 40 hours, with an hourly reduction every year.

²That is, hourly wages do not remain unchanged, but rise and monthly wages thus does not fall.

employee unions often agree on a partial compensation with a reduction in hours.

3.3 Productivity

The narrative that longer hours lead at some point to diminishing productivity is documented for various countries and industries: Holman et al. (2008) find lower output per hour of work for longer hours in a given industry for the US. Shepard and Clifton (2000) support this finding for the manufacturing industry.³ Cette et al. (2011) find, for a sample of 19 OECD countries, a negative impact of per hour-productivity for an increase in working time, the effect increasing more rapidly for longer working hours. Using a data set from munition workers in the UK during the First World War (where the measurement of hours and output is relatively straightforward compared to other industries), Pencalvel (2014) found a non-linear relationship between hours and output. Output per hours is found to evolve linear with hours below 49 weekly hours, and to decrease if people worked more. Regarding productivity in the long term, the effects of longer hours on worker health through fatigue and work stress are well-documented (e.g. Golden et al. 2011, Caruso et al. 2004).

3.4 Labour Supply

Generally, the nexus between work-sharing and labour supply has not received as much attention as the link with between work-sharing labour demand, both in theoretical and empirical literature. Hunt (1998) is a notable exception. She focusses on spousal labour supply in households, and limits her analysis to the reaction of wives, as "women are much more likely to work part time or not at all" (Hunt 1998, p. 356). Several theoretical considerations can affect the effect of a reduction of working time on the labour supply reaction of wives: If the men that reduce their working time are substitutes in household production, then wives may increase their labour supply. The same is true if there is an income effect (reducing household income). If, on the other hand, complementarity in leisure dominates, then wives will reduce their labour supply. Hunt uses the German Socio-Economic Panel for the period of 1984-94 for a sample of women that are between 20 and 55 years old and have domestic partners or spouses in the same age range. A further selection is that their spouses are wage earners (as opposed to self-employed) and work between 35 and 45 hours. The fixed effects linear probability analysis shows that the response of women reacting to changes of actual hours of their spouses⁴ is relatively small. The significant estimate suggests a one-hour fall in the hours triggers a fall of 0.0017 in the woman's probability of working. This analysis is, of course, only valid for women who do not work. If women do already work, then a one hour reduction of their partners result in an 0.19 to 0.21 reduction in their hours, depending on the specification (statistically significant). The probability of working a second

³Kossek and Lee (2008) find better self-reported performance on the job if hours are reduced.

⁴If this decline is triggered by reduced standard hours.

job is also discussed, but the small sample is a problem and leads to insignificant effects that are not reported. Oliviera and Ulrich (2002) find for the French Aubry-reforms 2000-2002 that the probability of switching from long part-time (20-29 hours) to full time increased with the implementation of the 35 hour week.

3.5 Employment

The section on the existing empirical evaluations will be extensive and provide a literature review explicitly taking into account the methodology used and defining what exactly it is that is or is not measured in the evaluations. There does not exist one single "right" method to measure the employment effect of work-sharing. Instead, different methodologies can be used, and the results obtained have to be (at least partly) accounted for the method used. Some results of the literature review are presented in tables 3.1 and 3.2. .

3.5.1 Microeconomic Studies

Chronologically, aggregated time series analysis that tackled the effect of a reduction in working hours on employment (and mostly found positive effects) have been criticised on the grounds that they capture historical correlations rather than the responses of employers and employees.⁵ Subsequently, empirical research focused on microeconomic analysis in order to deal with direct effects of reductions in working hours. In terms of the narrative in those studies, the focus on labour demand led the authors to regard wage compensation as having a clear negative effect on the employment effect. While this view captures the rising cost for labour for employers, it ignores possible aggregate demand effects. A rise in wages could lead to an economic stimulus mitigating the negative effect of rising labour costs on employment, or even dominating this effect. Additionally, as Bosch and Lehndorff (2001) point out, the decisive factor for firms is unit costs, not absolute wage costs. The following paragraphs will highlight some of the findings and methodologies of microeconomic studies.

⁵In retrospect, the criticism would now tackle that those studies do not take into account the non-stationarity of many time series they are dealing with, therefore rendering the used estimators biased and inconsistent.

Table 3.1: Selected empirical studies (1)

Paper	Region(s), Time	Type	Data	Method	Size of Reduction	Affected	Employment effect	Mandatory compensation
Hunt (1999)	Germany 1985-1995	Partial Equilibrium	Micro	FE, RE, IV	40 to 36 over 1984-1994	Workers (Metalwork, Print)	Not significant, but negative	No
Steiner and Peters (2000)	Germany 1978-1996	Partial Equilibrium	Micro	SUR	40 to 36 over 1984-1994	Dependently employed	Negative (medium/unskilled) insignificant (high-skilled)	No
Simmons et al. (2005)	Germany 1993,1995-1999	Partial Equilibrium	Micro	OLS/GLS	40 to 36 over 1984-1994	Dependently employed non-service workers	Positive for small eastern plants, else no effect	No
Franz and König (1986)	West-Germany 1984-1983	Partial Equilibrium	Aggregated	OLS	-	-	Positive	-
Lehment (1991)	West Germany 1973-1990	Partial Equilibrium	Aggregated	OLS	-	-	Small, not significant	-
Wadwhano (1987)	UK 1962-1981	Partial Equilibrium	Aggregated	OLS IV	-	-	Positive	-
Crepon and Kramarz (2002)	France 1982	Partial Equilibrium	Micro	Logistic Regressions	40 to 39 hours	All	Negative	Yes (full)
Kramarz et al. (2006)	France 1997-2000	Partial Equilibrium	Micro	OLS	39 to 35 hours with subsidies	All	Positive	Somewhat
Estevao and Sa (2008)	France 1997-2000	Partial Equilibrium	Micro	Diff.-in-Diff.	39 to 35 hours with subsidies	All	No effect	Somewhat

Table 3.2: Selected empirical studies (2)

Paper	Region(s), Time	Type	Data	Method	Size of Reduction	Affected	Employment effect	Mandatory compensation
Logeay and Schreiber (2004)	France 2000	Macro	Aggregated	VECM	39 to 35 with subsidies	All	Positive	Somewhat
Passeron (2002)	France 1986-1989	Partial Equilibrium	Micro	OLS	39 to 35	All (voluntary)	Positive	Yes
Raposo and Van Ours (2009)	Portugal 1996-1997	Partial Equilibrium	Micro	Diff.-in-Diff.	44 to 40	All	Positive	No
Sanchez (2010)	Chile 2005	Partial Equilibrium	Micro	Diff.-in-Diff.	48 to 45	All	No effect	No
Skuterud (2007)	Quebec 1997-2000	Partial Equilibrium	Micro	Double/Triple Diff.	44 to 40 hours over 4 years	Nonunionized workers, hourly paid	Negative (men)	No
Brunello (1989)	Japan 1973-1998	Partial Equilibrium	Aggregated	2LS	-	-	Negative	-
Altavilla et. al. (2005)	Germany and US	Macro	Aggregated	SVECM	-	-	Negative	-
Kapteyn, Kalwij, Zaidi (2003)	16 OECD countries 1960-2001	Macro	Aggregated	VAR	-	-	Positive, but not significant	-

In Germany, the unions in the metalworking and printing sectors achieved a reduction in standard hours from 40 to 36 hours between 1984 and 1994. In metalwork, the standard hours even dropped to 35 hours in 1995. The agreement allowed for more flexibility such that every plant could decide on the way of implementing shorter hours (e.g. reducing the daily working time or have shorter working time on Fridays etc.). Hunt (1999) uses data from the Socio-Economic Panel in the time range 1984-94. She finds no significant effects for the whole sample, but the negative signs hint at a decrease in employment as a reaction to the reduced standard hours. Restricting the sample to men, the effect is bigger, but still insignificant. For women, the effect is not significant and either positive or negative, depending on the weights used. The estimation technique is a fixed effects estimation. As discussed in section Section 3.2, Hunt finds that a full compensation took place, but the case does not seem clear-cut, taking other research into account.

Steiner and Peters (2000) analyse the same reduction in Germany. He distinguishes between unskilled, skilled and high-skilled workers to investigate potential differences in the effects due to qualification. They also find a negative employment effect which is particularly strong for unskilled workers. No significant employment effect is found for the group of high-skilled employers, and the elasticities for unskilled and skilled workers are estimated to be -0.25 and -0.11, meaning that a one-hour reduction will lead to a reduction in employment for unskilled by about 0.4% and a reduction by 0.24% for skilled workers. This conclusion is only reached when indirect employment effects (through wage movements) are taken into account. Therefore, only high-skilled workers gain, as no employment is lost and wages rise when working time is reduced.

Another empirical investigation for Germany is conducted by Simmons et al. (2005). They use the Establishment panel provided by the IAB⁶ for the years 1993-1999, taking into account firm heterogeneity. They find no evidence of work-sharing affecting employment, with the exception of small non-service-sector plants in Eastern Germany, where employment gains are found.

France has experienced two rounds of reductions in working time. In 1982, the standard working week was reduced from 40 to 39 hours. In 1998-2000, the work week was reduced to 35 hours, first for large firms, then for small ones. The second reduction was flanked by subsidies for social security payments from the employees. Crepón and Kramarz (2002) study the employment effects of the 1982 reform and take advantage of the non-anticipated reform, which can be viewed as quasi-experiment. They find that persons who worked 40 or more hours before the reform (and therefore were affected by the cut in standard hours) have a higher probability to lose employment than the control group (those who worked 36-39 hours before the reform). However, the analysis does not control for wages and takes actual hours into account, which is likely to cause short-term noise (as opposed to usual hours over a year). This data is not available before the reform, but afterwards. Controlling for the information post-policy, the result that there is a higher probability for unemployment for those employed 40 hours before the reform remains significant.

⁶Institut für Arbeitsmarkt- und Berufsforschung, Institute for Employment research

The second reform is more difficult to evaluate, as it was anticipated two years before and subsidies may distort inference. Crepón et al. (2005), Bunel (2004) and Gubian (2000) conclude that there was positive employment effect between 6% and 9% following the first step of the reform 2000, and a smaller effect of 3% for the 2002 reform. Kramarz et al. (2006) estimate that between 1997 and 2000, 3.4% of employment growth can be attributed to work-sharing. Estevao and Sa (2008) analyse the reform step of 2000 (where only large firms were affected). They use a difference-in-difference approach, the treatment group being large firms and the control group small ones. They find that wages increased more for men than for women, and hours worked decreased faster in large firms. Although they find that large firms hired more people from unemployment after the law, the total level of employment does not seem to be affected. Dual job-holdings increased for men in 2000, reflecting the desire to work more.

Raposo and Van Ours (2009) analyze the case of Portugal, where the standard workweek was reduced from 44 to 40 hours in 1996, while also allowing for more flexibility for firms. Using a data set that matches employee and firm data, they find that overall employment was positively affected through the reduction in working time.

Moving away from European cases, Sánchez (2010) discusses the Chilean case of the reduction of the standard working week from 48 to 45 hours in 2005. This policy was not accompanied by subsidies, greater flexibility etc., hence making it more likely to capture the pure effect of work-sharing in employment. He finds no significant effect on job transitions.

In Quebec, the standard hours for employees paid on hourly basis not covered by a union contract were reduced from 44 to 40 hours over beginning in 1997. Skuterud (2007) argues that this limited sample provides better grounds for estimating the employment effect as there was no wage compensation agreed upon, and the workers affected are very likely to be substituted quite easily. He uses a triple-difference approach, using neighbouring jurisdictions as well as similar groups in the same jurisdiction as control groups. The data is taken from the Labour Force Survey in the time range of 1996-2002. The estimation strategy is not straight forward. As the sample of workers affected is relatively small, the employment effect may be too small to be estimated. Therefore, a comparison between industries with larger and smaller shares of workers that are affected by the cut in working time are compared. Those who hold a larger share should be affected more. Estimation suggests a 0.5% decrease in employment for men if standard hours drop by one hour. For women, employment gains are suggested, but this result is not significant.

This microeconomic research, based mostly on neoclassical labour-market theory, is limited by the partial equilibrium nature of its models. The focus on direct effects in effected sectors or firms – which arguably should amount for the main effects of a cut in standard hours – leaves out the possibility of other channels that could affect employment. Among those channels are: aggregate demand, the impact on intra-household (market and domestic) work distribution, as well as the effects on health and productivity, as noted above.

Additionally, the time span of most of the microeconomic studies is relatively small, so if long-run effects differ from short-run effects, a concluding evaluation of even the direct effects is not possible.

Another problem that arises, specifically in cases where only certain firms or industries reduce hours, is the existence of spillovers. If, like in Germany case, other industries are the control group when assessing the employment effect of work-sharing in certain industries, the following problem arises: especially in cases where there is partial or full wage compensation, the additional aggregate demand may trigger employment impulses in other industries, thus leading to an under-estimation of the employment effect in the treatment industries. In other words, if the wages of the workers in metalwork and print sectors rise, employment in other industries might rise, as the extra wage is not exclusively (or at all) spent in the metalwork and print sector. If this effect lets employment in other industries rise, then comparing the effects in the treatment groups with the control groups, employment effects in treatment groups will be underestimated.

3.5.2 Macroeconometric Studies

Some research has been dedicated to capturing the effects of reductions in working hours neglected by microeconomic assessment. The caveats and blind spots mentioned in the last section can be accounted for when using a macroeconomic framework.

Logeay and Schreiber (2006) analyse the impact of the French work-sharing reform of 2000 during which a reduction in standard hours was flanked by wage subsidies (lower social security contributions for employers). A vector error correction model for labour market variables as well as inflation and output is used to produce out-of-sample forecasts. Significant positive employment effects of the policy mix are found, whereas output, productivity, hourly labor costs and inflation are only affected transitorily or not at all.

Altavilla et al. (2005) estimate structural vector error correction models for Germany and the US. They find that shorter hours have negative effects on wages, GDP and employment. However, the error-variance decomposition shows that employment movements are not driven by working hours.

Kapteyn et. al. (2003) use a panel of 16 OECD countries to estimate the long-run effects of working hours on employment. They find significant and positive direct effects, but taking into account indirect effects, the long-run effect becomes small and insignificant.

Macroeconometric research on this topics clearly has blind spots too: specifically identifying the channels through which a reduction in working time affect employment remains difficult in a macroeconomic context. Hence, the difference between the slightly more positive evaluation of shorter working times for employment of macroeconomic research compared to the more negative results found by labour demand research might indicate that there are other channels

through which employment is affected (e.g. labour supply, productivity), but cannot identify them.

Chapter 4

Empirical Analysis

In the empirical part of the thesis, the aim is to expand macroeconometric research in two aspects: first, more accurate data not available to previous researchers is used. Second, new estimators accounting for cross-country dependencies in panel data are applied. The empirical part of the project begins by a discussion of the data used, including some graphic analyses to get an overview of the behaviour of the time series data.

4.1 Data

As for the selection of variables for the empirical evaluation, the two obvious variables employment and working hours have to enter naturally to answer the research question whether shorter hours have employment effects. The employment rate is used to measure employment. Another way would be to take the unemployment rate as measure. However, if we want to take into account labour supply responses, the unemployment rate will not be as informative as the employment rate, as it does not take into account those outside of the labour force. As seen in the literature review, both theoretical and empirical research deliver strong arguments why the wage rate should be included as well. For these three variables, separate equations are estimated to acknowledge the interdependencies. The ARDL (Autoregressive Distributed Lag) model, as opposed to standard VAR (Vector Autoregressive) procedures, gives the freedom to include variables that are not determined endogenously in the system. Kapteyn et al. (2003) take into account real GDP and the share of individuals aged 15-64. GDP is, in the long-run, an important determinant of employment. The share of persons in the working age is included mainly because the employment rate is, as opposed to the unemployment rate, influenced by the total population.

The choice of variables is, of course, not indisputable. Logeay and Schreiber (2004), for example, use GDP as a dependent variable in their VECM, but find no significant influence of hours on output. This would concede the case for not including GDP as a dependent variable. Altavilla et al. (2005), on the other hand, find that output decreases with shorter working hours. However, they argue with error-variance decompositions, that hours account for a fairly small proportion of output dynamics. Hence, the choice of including GDP only as

independent variable is mainly motivated by the existing empirical evidence.

Logeay and Schreiber (2004) include productivity, labour costs and inflation as well, but find no or only transitory effects of working hours on those variables.

In the empirical literature with aggregate time series, the definition of working hours is usually the mean of hours worked of all employees in the economy. Of course, an increase in part-time work (or other types of non-full-time-work regimes) will affect the data heavily. If, as in most studies, the effect of a reduction of the full-time working week is in the center of attention, the use of this data has potentially large effects on the outcome. The employment effects of more people working part-time are not straightforward. Most empirical research acknowledges this short-coming, but hints at data limitations. However, since 1998, a unified data set that allows for considering the actual working hours of those working full-time exists in form of the Labour-Force-Survey (LFS) conducted in all European countries. The micro-dataset allows for differencing between part-time and full-time employees. The time dimension of the data set is therefore quite short ($T=16$), but a panel of countries is used to increase the numbers of observations. Originally, the data was gathered for 24 European countries, however, missing data points for 6 countries¹ led to the conclusion of including only the remaining 18 countries in the empirical analysis, as a further reduction of the time span would potentially result in quality of inference. Hence, the final data set consists of 288 observations ($N=18$, $T=16$).

The wage rate, defined as average annual wages in constant prices is taken from the OECD labour force databank. The share of individuals in the age group 15-64, thus potentially in the workforce, is taken from the World Bank World Development Indicators data set. The employment rate is obtained from Eurostat. Per capita GDP at constant prices, made comparable through the application of Purchasing Power Parities, is taken from the Groeningen Growth and Development Center.

Figure 4.1 depicts the evolution of the average working hours for those fully employed for the three countries with the highest values in 1998, the beginning of the time series. The Czech Republic, Greece and the United Kingdom all had average working hours of 44-45 hours per week. In 2013, in all of those countries the hours decreased remarkably, most notable in the Czech Republic, where the decrease reached almost 4 hours.

Figure 4.2 shows the evolution of the average working hours of those fully employed for countries with values of 43 to 41 hours in 1998. All countries display falling hours, Switzerland being the exception.

Figure 4.3 shows the evolution of the average working hours of those fully employed for countries with values of 41 to 38 hours in 1998. Finland, Sweden, France and Denmark display falling working hours over the time period, while the average hours Luxembourg, Netherlands and Belgium remain relatively stable with slight increases.

¹Estonia, Latvia, Romania, Slovenia, Iceland, Norway

Figure 4.1: Working Hours 1

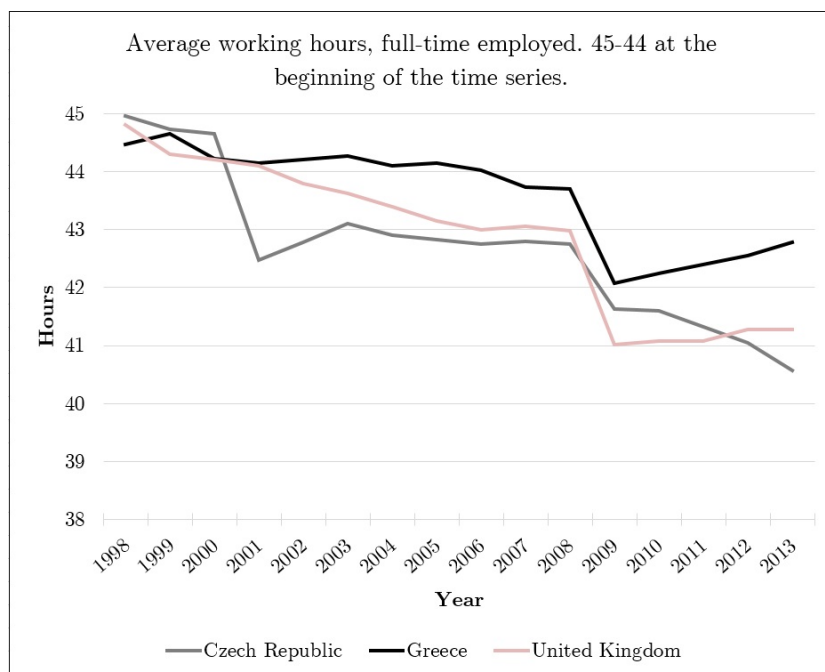


Figure 4.2: Working Hours 2

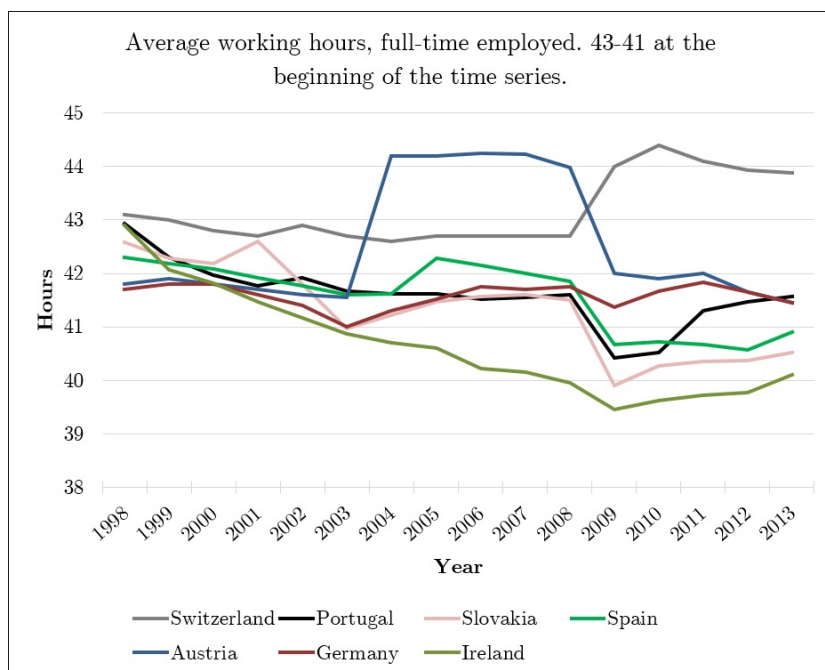


Figure 4.3: Working Hours 3

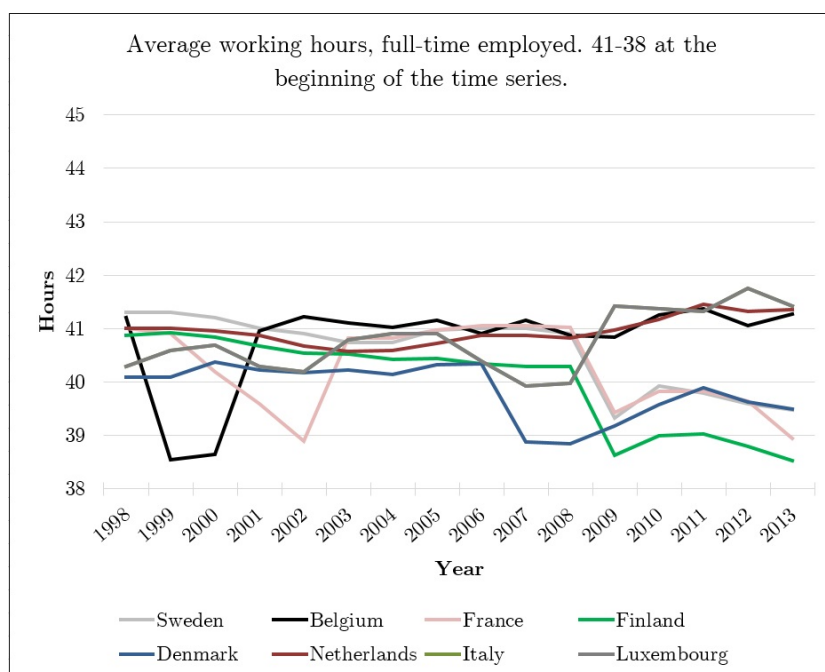


Figure 4.4 depicts the employment rates of the countries in the dataset. From 1998 to 2007, there is a tendency of increasing employment rates, most notably in Spain, Greece and Ireland. Those countries are also those most affected by the crisis, with falls in employment rates. After 2007, there is a general tendency towards falling employment rates, with some exceptions, most notably Germany, Switzerland and Austria.

Figure 4.4: Employment Rates

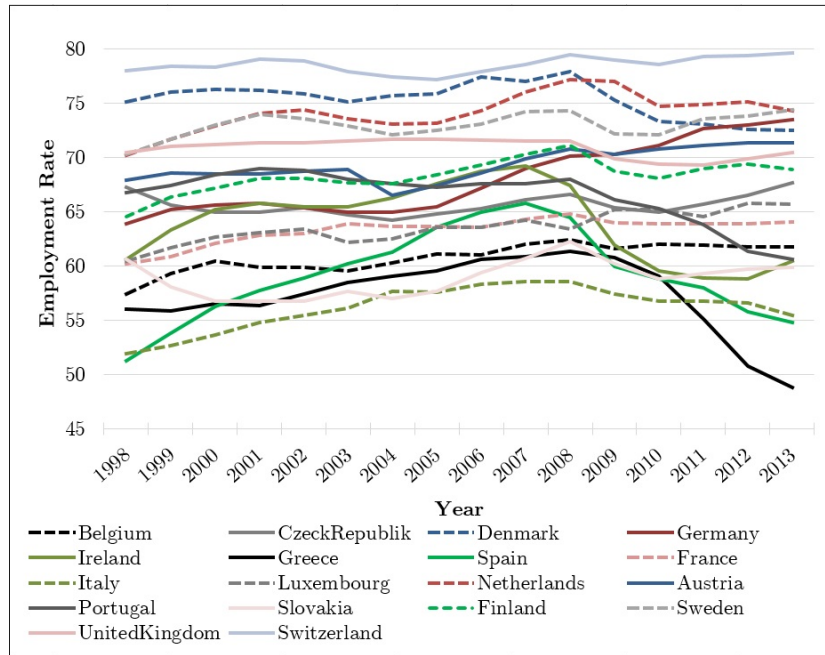


Figure 4.5 shows the evolution of the wage rate.² In most countries, a slow increase or stagnation of the wage rate can be observed, with the exception of Switzerland with a faster increase. Ireland, Greece and the UK experienced the most notable falls in wage rate since the crisis. Overall, the wage rate is relatively stable in most countries, with less variance than GDP and employment.

Figure 4.6 depicts the evolution of per-capita GDP (adjusted by PPP) since 1998. The different effects of the crisis on different countries can be seen as in most countries, after a slump in 2008-2010, per-capita GDP started to increase again. In other countries, such as Spain, Greece, and Italy, there is a downward tendency lasting until 2013.

²Denmark, Sweden and the Czech Republic are not depicted. A moderate wage growth since 1998 can be observed in those countries.

Figure 4.5: Wage Rate

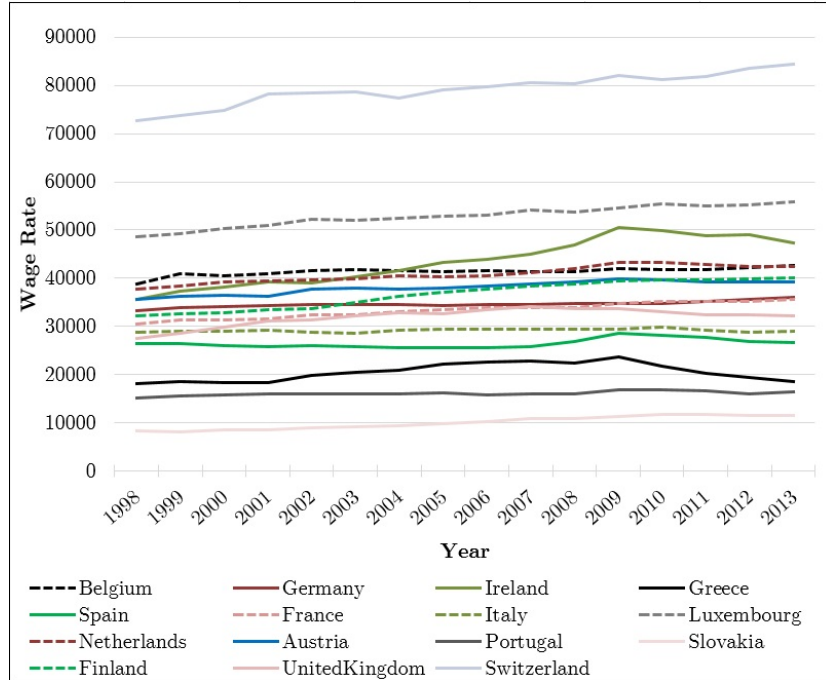
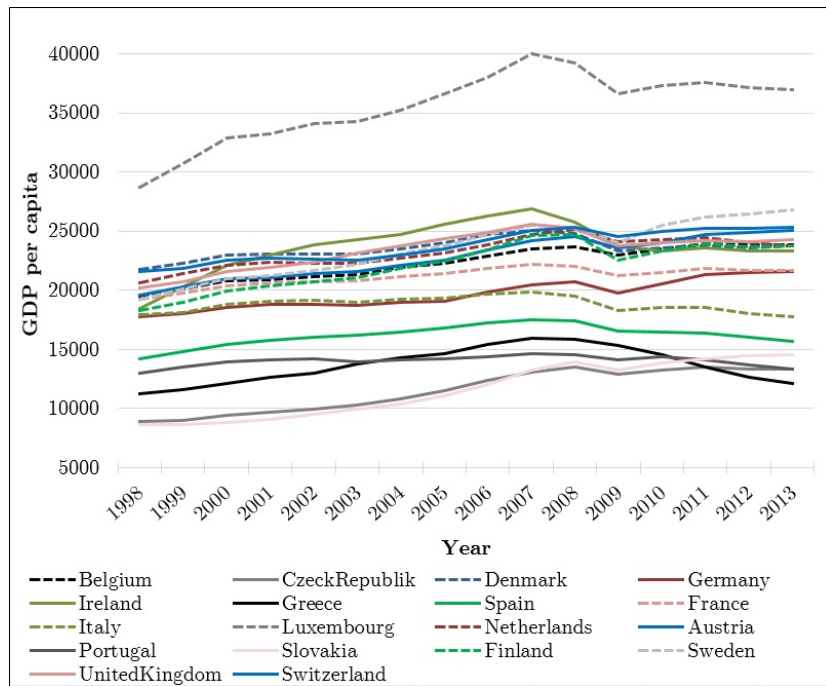
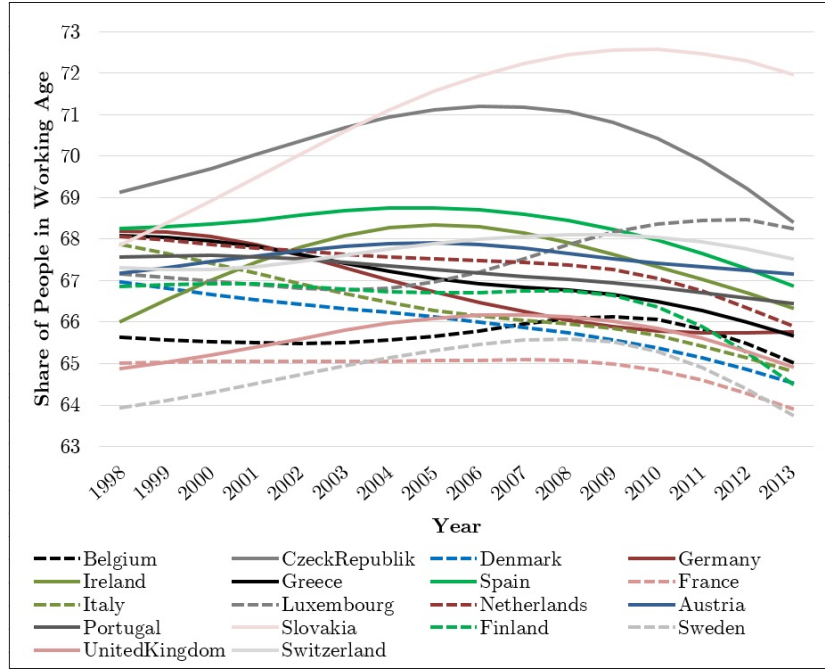


Figure 4.6: GDP per capita



The last variable used in the empirical analysis in this paper is the share of individuals in the working age (15-64), depicted in figure 4.7. This variable controls for effects of ageing, birth rates, migration etc. on the employment rate. In most European countries, a slow decline of the share of individuals in the working age can be observed, most changes in the last ten years however only amount to one or two percentage points.

Figure 4.7: Share of Persons aged 15-64, relative to total population



4.2 Theoretical Considerations

Macroeconometric research taking into account the non-stationarity of the time series relevant for the issue of the employment-effect of work-sharing is scarce. Notable exceptions are Logeay and Schreiber (2003), who use a Vector Error Correction Model (VECM) to analyse the macroeconomic impact of the French work-sharing reform of 2000; Altavilla et al. (2005), who use a structural VECM to evaluate work-sharing effects in Germany and the US; and Kapteyn et al. (2003), who use a Panel of 16 OECD countries to estimate a ARDL model. The empirical part of the master thesis will build on the latter study, using a panel of 18 European countries.

The reason for using Panel data is that the quality of statistic inference can be increased by taking into account more observations that can not be obtained if the time series dimension can not be extended. This is exactly the case in the data chosen, as discussed above.

Theoretically, the cointegrating relationship obtained in panel data can be as-

sessed via Panel VECMs and Panel ARDLs. The concepts are closely related, however ARDL-models don't require all variables to be integrated of the same order. Additionally, in ARDL specifications, exogenous variables can be taken into account, whereas in VECM specifications, all variables need to be endogenously determined (i.e. in the system of equations).

4.2.1 A short Introduction to Autoregressive Distributed Lag Models

ARDL models have shown to provide reliable results for the testing of long-run relationships. For dynamic single-equation regressions, this approach is considered as the workhorse model (Hassler and Wolters 2006), and it gained increasing popularity since an error-correction representation as developed by Engle and Granger (1987) can capture cointegrating relationships.

Cointegration vectors determine $I(0)$ relations that hold between variables that are individually non-stationary. Variables are cointegrated when a long-run linear relationship is obtained from a set of variables that share the same non-stationary properties. Intuitively, cointegration analysis searches for stationary linear combinations of nonstationary variables. If such a stationary combination exists, then the variables are cointegrated, i.e. bound by an equilibrium relationship. Thus the advantage of cointegration analysis is a direct test of economic theories of long-run relationships. However, cointegrating relationships might exist between variables that are $I(0)$ and $I(1)$.

If all series are $I(0)$, then simple estimation techniques using levels, like OLS, can be used. If it is certain that the underlying series are all integrated of order one ($I(1)$) as well as cointegrated, then the Johansen cointegration technique, a system-based reduced rank regression approach can be used as well as two-step residual-based procedures testing the null of no cointegration (Pesaran, Shin, Smith 2001). OLS for the Levels will provide long-run equilibrium relationships between variables, where an error-correction model estimated by OLS will represent the short-run dynamics between the variables. If all variables are $I(1)$, but not cointegrated, then differencing the data and estimating standard regressions with OLS is appropriate. However, if the order of integrations of the corresponding variables is mixed or if the true order of integration is uncertain, then the ARDL model should be preferred. The reasons why the true order of integration may be difficult to obtain are manifold, but one or many structural breaks are a common problem.

Pesaran et al. (2001) introduce the ARDL bounds testing procedure as a tool for investigating the existence of a long-run relationship between several variables. Dependent and independent variables can be introduced in the model with lags. Hence, "Autoregressive" refers to lags of the dependent variable and "Distributed" refers to the lags of explanatory variables. Intuitively, this feature states that the effect of a change of the independent variables may or may not be instantaneous. Given the presence of lagged values of the dependent variable, OLS estimation yields biased estimates. If the error term is autocorrelated, OLS is inconsistent - Instrumental Variables estimation is therefore

often used. Not all regressors need to have the same lag order, as the time span in which a past change in a variable affects another variable can arguably vary. This is feature of the ARDL models that allows for more flexibility than the cointegrated VAR approaches that do not allow for different lags for different variables. It also follows that the choice of lag order for the ARDL model is crucial for long-run analysis. Lag orders have to be selected based on diagnostic tests for residual serial correlation, functional form misspecification, non-normality and heteroscedasticity (several information criteria are available for this purpose, such as the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (SBC), the Hannan-Quinn Criterion (HQC) and the R2 criterion³). Pesaran et al. (2001) show that the ARDL model yields consistent estimates of long-run coefficients under asymptotic normality. This result holds for regressors that are purely I(0), I(1) or mixed. Pesaran and Shin (1999) show that the small sample properties of the bounds testing approach are better than that of the traditional Johansen cointegration approach (a large sample size is normally required for the results to be valid). This is another reason why, besides the inclusion of a possibly stationary variable and the better options to control for cross-section dependencies, the ARDL approach is chosen in the present thesis.

To illustrate, consider a general ARDL(p, q) model for a scalar variable y_t :

$$y_t = \sum_{j=1}^p \lambda_j y_{t-j} + \sum_{j=0}^q \delta'_j x_{t-j} + \epsilon_t \quad (4.1)$$

where ϵ_t is a scalar zero mean error term, x_t is a k -dimensional vector of explanatory variables. Typically, a constant and a time trend is included, which is for now neglected for the sake of simplicity. λ is a coefficient scalar for each j ,⁴ and δ' is a row vector for each j . δ_0 is the vector that describes the immediate effects of changes in the explanatory variable vector x_t , i.e. the vector of impact multipliers. The long-run effect over all future periods is $\sum_{j=0}^q \delta'_j$, sometimes denoted as the vector of equilibrium multipliers. Heading towards a more compact notation, a lag polynomial $\lambda(L)$ and a vector polynomial $\delta(L)$ are introduced:

$$\lambda(L) = 1 - \lambda_1 L - \dots - \lambda_p L^p \quad (4.2)$$

$$\delta(L) = \delta_0 + \delta_1 L + \dots + \delta_q L^q \quad (4.3)$$

Now equation 4.1 can be written as:

$$\lambda(L)y_t = \delta'(L)x_t + \epsilon_t \quad (4.4)$$

An infinite number of λ coefficients cannot be estimated (which would be the case here if p and q are ∞). Practical methods to solve this problem are to truncate the lags to finite lengths, which is appropriate if the lag distribution

³Pesaran and Shin (1999) show that the SBC criterion performs better than the AIC criterion, reflecting the fact that the SBC is a consistent model selection criterion while the AIC is not.

⁴Sometimes referred to as lag weights which collectively form the lag distribution.

is effectively zero beyond the point of truncation (p or q). This is the approach chosen here as in most economic applications. Another approach would be to allow the lag distribution to gradually decay to zero using a functional form.

The first-order autoregressive lag model, with a single explanatory variable (with no lags of the explanatory variable and one lag of the dependent variable) is often called the Koyck lag, referring to Koyck (1954) and his seminal application of the model to the macroeconomic investment function.

To ensure dynamic stability, the roots of the characteristic polynomial of λ must lie outside the unit circle, that is:

$$\lambda(z) = 0 \rightarrow |z| > 1 \quad \text{for} \quad z \in \mathbb{C} \quad (4.5)$$

This condition ensures that there exists an absolutely summable infinite expansion of the inverted polynomial $\lambda^{-1}(L)$:

$$\lambda^{-1}(L) = \frac{1}{\lambda(L)} = \sum_{i=0}^{\infty} \lambda_i^* L^i, \quad \sum_{i=0}^{\infty} |\lambda_i^*| < \infty \quad (4.6)$$

Equation 4.1 is suitable for estimation, but to obtain an economic interpretation, transformations are required (Wickens and Breusch 1988). One possible transformation as suggested by Pesaran and Shin (1998) and Hassler and Wolters (2005) is the following:

Invertability of $\lambda(L)$ yields the following representation:

$$y_t = \frac{\delta'(L)}{\lambda(L)} x_t + \epsilon_t, \quad \epsilon_t = \lambda(L) \epsilon_t \quad (4.7)$$

Rearranging the x 's one obtains:

$$y_t = \sum_{j=1}^p \lambda_j y_{t-j} + \lambda(1) \beta' x_t - \sum_{j=0}^{n-1} \left(\sum_{m=j+1}^n \delta_m \right)' (1-L) x_{t-j} + \epsilon_t \quad (4.8)$$

$$\text{with } \beta = \frac{\delta(1)}{\lambda(1)} = \sum_{j=0}^{\infty} b_j.$$

Now, the dependent variable y_t is related to its own past, contemporaneous x_t and differences $(1-L)x_{t-j}$. This specification is suggested for cointegration analysis by Pesaran and Shin (1998).

Further subtracting $(\sum_{i=1}^p \lambda_i) y_t$ and re-normalizing yields:

$$y_t = \frac{-1}{\lambda(1)} \sum_{j=0}^{p-1} \left(\sum_{m=j+1}^p \lambda_m \right) \Delta y_{t-j} + \beta' x_t - \frac{1}{\lambda(1)} \sum_{i=0}^{n-1} \left(\sum_{m=j+1}^n \delta_m \right) \Delta x_{t-j} + \epsilon_t \quad (4.9)$$

The advantage of this representation is that the long-run multipliers β are the coefficients of x_t . The contemporaneous value of Δy_t now enters the equation, the correlation with ϵ_t is rendering OLS invalid. Using the past values of y and the present and past values of x as instruments, a consistent instrumental variable estimation is possible.

A final transformation, suggested by Hassler and Wolters (2005) uses the equation:

$$\sum_{j=1}^p \lambda_j y_{t-1} - y_{t-1} = -\lambda(1)y_{t-1} - \sum_{j=1}^{p-1} \left(\sum_{m=j+1}^p \lambda_m \right) \Delta y_{t-j} \quad (4.10)$$

Using this result and $x_t = x_{t-1} + \Delta x_t$, equation 4.8 yields:

$$\begin{aligned} \Delta y_t = & -\lambda(1)(y_{t-1} - \beta' x_{t-1}) - \sum_{j=1}^{p-1} \left(\sum_{m=j+1}^p \lambda_j \right) \Delta y_{t-j} + \\ & (\lambda(1)\beta - \sum_{m=1}^n \delta_m)' \Delta x_t - \sum_{j=1}^{n-1} \left(\sum_{m=j+1}^n \delta_m \right)' \Delta x_{t-j} + \epsilon_t \end{aligned} \quad (4.11)$$

This representation relies on a long-run equilibrium relation $y = \beta' x$, if there exists such a linear combination with $\beta \neq 0$. The error-correction mechanism is the adjustment of y_t via $\lambda(1)$ to equilibrium deviations in the previous periods $y_{t-1} - \beta' x_{t-1}$.

Having discussed suitable representations, the following assumptions (Pesaran and Shin 1998, Hassler and Wolter 2005) have to be made (respectively be assured by the choice of lags in the empirical application):

- (i) The errors ϵ_t are serially independent with variance $\sigma^2, \epsilon_t \sim iid(0, \sigma^2)$
- (ii) The errors are uncorrelated with Δx_{t+h} , for all $h \in \mathbb{Z}$

$$y_t = \mu + \gamma_t + \sum_{j=1}^p \lambda_j y_{t-j} + \beta' x_t + \sum_{j=0}^q \delta_j' \Delta x_{t-j} + \epsilon_t \quad t = 0, \dots, T \quad (4.12)$$

$$\Delta x_t = P_1 \Delta x_{t-1} + P_2 \Delta x_{t-2} + \dots + P_s \Delta x_{t-s} + u_t \quad (4.13)$$

where x_t is the k -dimensional vector of $I(1)$ variables, u_t and ϵ_t are serially uncorrelated disturbances with zero means and constant variance-covariances, and P_i are $k \times k$ coefficient matrices s.t. the autoregressive process in Δx_t is stable.

4.2.2 Considerations on the Panel Structure of the Data

The literature on cointegrated panels is growing and recently received a lot of attention. Effort has been put into the possibility of dropping the assumption of cross-section independence, which is fairly strong. Specifically, cross-section dependence can be an issue when a variable in country i is non-spuriously correlated with a variable in country j or if there are unobserved factors common to all countries. The cross correlation can be due to omitted common effects, spatial effects, among others. Conventional panel estimators as fixed or random effects can give misleading inference, and if the cross-sectional dependence is large enough, even inconsistent estimates (when the source generating the cross-sectional dependence is correlated with the regressors). As shown in the

empirical results, cross-section independence is powerfully rejected for all variables used.

Pooling panels can be done in different ways. One extreme is the use of fixed or random effects, which allow only the intercepts to differ across groups, while the other parameters are assumed to remain constant. This is often an inappropriate assumption. Taking nonstationarity in Panels into account, Pesaran, Shin and Smith (1997, 1999) introduce two techniques to estimate dynamic panels with parameter heterogeneity across groups: The Mean-Group (MG) and Pooled Mean Group (PMG) estimator. The MG estimator relies on estimating the time series regression for each country separately, and then averaging the coefficients. The PMG estimator relies on a combination of pooling and averaging. Both estimators can be augmented by means of the dependent as well as independent variables. This captures common effects that influence all cross-sections, such surely is the case with the recent global financial crisis starting in 2008 in the data set used here. A similar approach is taken by recent research such as the CCEMG (Common Correlated Effects Mean Group) estimator (Pesaran 2006) as well as the AMG (Augmented Mean Group) estimator (Eberhardt and Teal 2010), however those estimators cannot (yet) be used in a cointegration / ARDL setting.

4.3 The Econometric Model

The starting point is assuming a long-run relationship between the vector of dependent variables Y_{it} and the vector of explanatory variables Z_{it} :

$$Y_{it} = \Theta_{0,i} + \Theta_i Z_{it} + \Phi_i Y_{i,t-1} + U_{it}, \quad i = 1, \dots, N \quad t = t_i^0, \dots, t_i^T \quad \Longleftrightarrow \quad (4.14)$$

$$(I - \Phi_i)Y_{it} = \Theta_{0,i} + \Theta_i Z_{it} + U_{it} \quad (4.15)$$

All variables are expressed in logs, such that the changes in parameters can be interpreted as elasticities. Y_{it} is a vector containing the employment rate, the wage rate and the working hours in period t of country i . Z_{it} is a vector containing GDP per capita, the Consumer Price index (CPI) and the share of persons aged 15-64 in period t of country i . Φ_i is a (3x3) matrix with zeros on the diagonal, $\Theta_{0,i}$ is a (3x1) vector of intercepts and Θ_i is a (3x3) matrix.

The long-run relationship of a single endogenous variable y_{it} with the remaining variables X_{it} (that is, one of the three equations of the latter vector representation) is denoted as follows:

$$y_{it} = \theta_{0,1} + X'_{it}\theta_i + u_{it} \quad i = 1, \dots, N \quad t = t_i^0, \dots, t_i^T \quad (4.16)$$

The variables included may be non-stationary, and are assumed to be cointegrated, hence the error term u_{it} is stationary. The data generating process is assumed to be an ARDL(p,q) model:

$$y_{it} = \mu_i + \gamma_i t + \sum_{j=1}^p \lambda_{ij} y_{it-j} + \sum_{j=0}^q \delta'_{ij} X_{it-j} + \epsilon_{it} \quad (4.17)$$

The error terms have to be serially uncorrelated, this can be done by choosing the distributed lag orders on y_{it} and X_{it} , p and q . Writing equation 4.3 in an error-correction form, we can identify both long-run and short-run effects:

$$\Delta y_{it} = \mu_i + \gamma_i t + \phi_i (y_{it-1} - \theta'_i X_{it}) + \sum_{j=1}^{p-1} \lambda_{it}^* \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta X_{it-j} + \epsilon_{it} \quad (4.18)$$

with:

$$\phi_i = -(1 - \sum_{j=1}^p \lambda_{ij}); \quad \theta_i = \sum_{j=0}^q \delta_{ij} / \theta_i; \quad \lambda_{ij}^* = - \sum_{m=j+1}^p \lambda_{im}; \quad \delta_{ij}^* = - \sum_{m=j+1}^q \delta_{im}$$

For every dependent variable - employment, hours, and wages - equation (4.18) is estimated simultaneously.

4.4 Empirical Results

First, one has to test the assumption of cross-section dependence and the order of integration of the time series will be established. To ensure the rank and order conditions to be satisfied, the set of restrictions is chosen. The last preparation step before the regressions can be conducted is to choose the appropriate lag length for each equation based on selection criteria and to avoid serial correlation. Then, the regression results are presented and discussed.

As table 4.1 shows, there is overwhelming evidence for rejecting cross-section independence, which is the null of Pesarans (2004) test performed here. For each variable, the rejection of the null hypothesis of cross-country independence is rejected at a high significance level as indicated by the p-values. The absolute correlation coefficients reported here are fairly high, adding evidence to the rejection of the null of Pesaran's test.

The next step is to investigate whether the time series are stationary or not, and if not, the order of integration is of importance, as in the ARDL model, no I(2) is allowed. Pesaran (2007) proposes a unit root test for cross-sectionally dependent data. The null hypothesis is nonstationarity.

The results displayed in table 4.2 suggest that for each of the time series, the null hypothesis of nonstationarity is rejected for levels, suggesting none of the series being integrated of order 0. However, not rejecting the null hypothesis of nonstationarity does not yet tell us if the data is I(1) or I(2) or even integrated

Table 4.1: Pesaran’s (2004) test for cross-sectional dependence

Variable	CD-test	pvalue	abs(corr)
loghours	9.86	0.00	0.570
logemploy	12.52	0.00	0.458
logwage	36.28	0.00	0.739
logshare	17.08	0.00	0.584
loggdp	37.98	0.00	0.757
loghcpi	49.10	0.00	0.960

Note: *abs(corr)* refers to the absolute correlation coefficient.

of higher order. Everything beyond $I(1)$ means the ARDL model is not suitable. To that end, Pesaran’s (2007) panel unit roots test is performed on the first differences for each cross-section. In no case is the null of trend stationarity rejected, so we can conclude that all time series are $I(1)$. Hence, we can safely work with ARDL specifications. All series integrated of the same order means that we could in principle also work with a VECM specification. Freedom in lag selection, the possibility to include exogenous variables and more ways to control for cross-section dependency make the ARDL model the preferred specification.

To ensure that estimation of the three equations is possible, the rank and order conditions have to be satisfied. Hence, the following restrictions are imposed on the model: The share of persons aged 15-64 is excluded from the wage rate equation and from the working hours equation. The system is thus over-identified, but adding a fourth equation would violate some equations rank conditions (e.g. Lütkepohl 2006).

After establishing that the data is cross-sectionally dependent and integrated of order $I(1)$, the next step is to find the appropriate lag lengths for each equation. Additional to conventional selection criteria as the Akaike Information Criterion AIC and the Schwarz Information Criterion SIC, the error terms have to be chosen such that they are serially uncorrelated. For the the working hours equation, a ARDL(2,2,2) model is chosen, that is, two lags are included for the dependent variable working hours as well as the independent variables employment. The reparametrization into error-correction form, which is needed for performing the test on long-run cointegrating relationships, results in estimating equation 4.18 with one lag of each variable. In both the MG and PMG estimation, cross-country means⁵ of the dependent and independent variables are included manually to control for cross-section dependence. It would be ideal to include means of all variables, however this would not be feasible for the PMG estimator (there are not enough observations to estimate all included coefficients). The cross-section means of employment, wages and working hours show to have the

⁵As the estimation is in error-correction form, the means enter in first differences.

Table 4.2: Pesaran's (2007) panel unit root test in presence of cross section dependence in levels and first differences

Variable	trend	Levels p-value	First Diff. p-value	Conclusion
loghours	yes	0.292	0.000	I(1)
logemploy	yes	0.951	0.000	I(1)
logwage	yes	0.899	0.000	I(1)
logshare	yes	1.000	0.000	I(1)
loggdp	yes	0.871	0.030	I(1)
loghcpi	yes	0.113	0.020	I(1)

Note: To obtain the appropriate lag lengths for unit root testing, the STATA *varsoc* routine was used. Various information criteria such as AIC, SIC, HQIC and the final prediction error FPE are computed for each cross-section. Most of the criteria and countries show similar test statistics, the lag order that shows the best result in most countries is chosen.

most explanatory power, so they are included. To provide comparability, only these three means are included in the MG estimation as well, even if the additional variable GDP could be included without problems for the MG estimation.

Table 4.3 shows the long-run elasticities estimates (the values entering the cointegrating vector) for the estimation of the equation with working hours being the dependent variable.⁶ The PMG estimator results suggest that higher wages result in a drop in working hours. This result reflects the desire to increase leisure time if a certain level of income is achieved (e.g. through union bargaining). Higher employment rates result in higher working hours. Both coefficient estimates are significant at a 1% level. The MG estimator points at an opposite direction regarding wages and the same direction regarding employment, however both estimates are not significant.

Table 4.3: Long-run elasticities: MG and PMG estimators for dependent variable loghours

Variable	MG		PMG	
	Coef.	p	Coef.	p
logwage	0.373	0.587	-0.119	0.000
logemploy	1.074	0.457	0.549	0.000

The next equation estimated is the employment equation. The lag selection cri-

⁶Detailed regression results including short-run coefficient estimates as well as technical details on used statistical programs and codes can be found in the annex.

teria suggest an ARDL (2,2,2) model, hence the error-correction will have a lag order of ARDL(1,1,1). As exogenous variables, GDP and the share of people in the working age are included. The (first differences of the) cross-country means of employment and hours are included. Again, the reason for this is that the inclusion of more variables renders the PMG estimation infeasible. The PMG results are significant at an 1% level, and suggest that a 1% decrease in working hours results in a 0.66% increase in the employment rate. Hence the long-run effect of reducing the working time of those employed full time seems to create employment. This adds to the notion that "work-sharing" in the sense of sharing work between those employed (full time) and those unemployed or out of the labour force can work. For wages, the PMG estimator finds a coefficient of 0.194 which is highly significant, associating a 1% increase in wages with a 0.19% increase in the employment rate. The MG results are opposing those of the PMG estimator, but are not significant. It is worth stressing again that the data used is the employment rate, so the increase in the employment rate associated with shorter hours and higher wages can stem from either people in the labour force finding jobs as well as people entering the labour market.

Table 4.4: Long-run elasticities: MG and PMG estimators for dependent variable logemployment

Variable	MG		PMG	
	Coef.	p	Coef.	p
loghours	0.845	0.792	-0.663	0.000
logwage	-0.070	0.906	0.194	0.000

The last equation is the wage equation. Again, a ARDL(2,2,2) model is selected in levels, resulting in one lag for each endogenous variable in error correction form. GDP is included as exogenous variable, the means of wages, employment and working hours correct for cross-country dependencies. The PMG estimator finds that longer hours are associated with lower wages, a 1% increase in hours decreasing wages by 1.5%. The MG estimator finds a positive relationship, but the estimated coefficient is not significant. Regarding the influence of employment on wages, the results of the two estimators are opposite. The PMG estimator finds that an increase in employment by 1% leads to 0.142% lower wages (at a 5% significance level), where the same increase leads to 5.376% higher wages according to the MG estimator (at a 5% significance level).

4.5 Conclusion

Since the recent crisis resulted in high unemployment rates in most European countries, there is rising discussion whether shorter working hours can be a policy instrument to generate employment. This thesis presents the findings of the most important theoretical literature, where no clear-cut relationships between shorter hours and economic variables of interest such as employment, wages and labour supply can be obtained. Empirical studies are less ambiguous

Table 4.5: Long-run elasticities: MG and PMG estimators for dependent variable logwages

Variable	MG		PMG	
	Coef.	p	Coef.	p
loghours	0.604	0.804	-1.505	0.000
logemploy	5.376	0.028	-0.142	0.017

and mostly find shorter working hours to cause higher hourly wages and higher productivity. In the question of the employment creation potential of shorter hours, however, the empirical literature is divided. Of the 17 reviewed studies, seven studies find positive or partly positive employment effects, six studies find negative effects and four studies find no or no significant effect. The thesis aims to add to the existing macroeconometric literature in two ways: The first is to use not average hours of everyone employed, but of those fully employed. The second is to control for cross-section dependence in the econometric set-up. The empirical analysis uses a three-equation ARDL model including the variables working hours, employment, wages, GDP per capita and the share of persons in working age. The long-run elasticities show the following results: working hours fall with rising wages (reflecting the desire to work less if a certain level of income is achieved) and falling employment. As for wages, longer average hours of those fully employed result in lower wages. The results for employment are ambiguous and depend on the form of pooling. Finally, the estimates for the employment equation suggest that a fall of working hours of those fully employed leads to a (under-proportional) rise in employment. Rising wages are also found to result in a rising employment rate.

Hence, the empirical research presented in this paper suggests that reducing working hours is a viable way to increase employment in Europe. There are, however, still blind spots in the understanding of the effects of reduced working hours. One of them is the effect on labour supply and the distribution of non-market work. Another line of research that deserves attention is the modelling of cross-section dependencies in the presence of cointegration.

Chapter 5

Literature

- Altavilla, Carlos; Garofalo, Antonio; Vinci, Concetto Paolo. 2005. Evaluating the effects of working hours on employment and wages. *Journal of Policy Modelling* 2005, no. 27: 647-644.
- Askenazy, Philippe; Bloch-London, Catherine, Roger, Muriel. 2004. La réduction du temps de travail 1997-2003: dynamique de construction des lois Aubry et premières évaluations. *Économie et Statistique, Programme National Persée*, no. 376/1: 153-171.
- Bond, Stephen and Eberhardt, Markus. 2013. Accounting for unobserved heterogeneity in panel time series models.
- Bosch, Gerhard and Lehndorff, Steffen. 2001. Working-time reduction and employment: experiences in Europe and economic policy recommendations. *Cambridge Journal of Economics* 2001, no 25: 209-243.
- Bunel, Mathieu. 2004. Aides incitatives et déterminants des embauches des établissements passés à 35 heures. *Économie et Statistique*, no. 376-377.
- Calmfors, Lars and Hoel, Michael. 1989. Work Sharing, Employment and Shiftwork. *Oxford Economic Papers*, New Series, 41, no 4:758-773.
- Caruso, Claire.; Hitchcock, Edward; Dick, Robert; Russo, John; Schmitt, Jennifer 2004. Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries, and Health Behaviors (Cincinnati, OH, National Institute for Occupational Safety and Health).
- Crépon, Bruno; Leclair Marie; Roux Sébastien. 2005. RTT, productivité et emploi : nouvelles estimations sur données d'entreprises. *Économie et Statistique* no. 376-377.
- De Regt, Erik Ronald. 2002. Employment, wages and working time. *Doctoral dissertation*, Maastricht University).
- Denison, Edward F. 1962. The Sources of Economic Growth in the United States and the Alternatives Before Us. *Committee for Economic Development*, New York, 1962.
- Eberhardt, Markus and Teal, Francis. 2010. Productivity Analysis in Global Manufacturing Production. *Economics Series Working Papers* 515, Department of Economics, University of Oxford.
- FitzRoy, Felix R., Funke, Michael and Nolan, Michael A. 2002. Working Time, Taxation and unemployment in general equilibrium. *European Journal of Political Economy* 2002, no. 18: 333-344.
- Flecker, Jörg; Schönauer, Annika; Hermann, Christoph; Allinger, Bernadette.

2010. Arbeitszeitverkürzung zur Umverteilung von Arbeit - internationale Beispiele. *FORBA-Forschungsbericht 1/2010*.
- Flecker, Jörg; Hermann, Christoph; Mairhuber, Ingrid. 2001. Internationale Beispiele für Arbeitszeitverkürzung, -umverteilung und -flexibilisierung. *FORBA-Forschungsbericht 1/2001*.
- Franz, Wolfgang and Smolny, Werner. 1994. Sectoral Wage and Price Formation and Working Time in Germany: An econometric Analysis. *Zeitschrift für Wirtschafts- und Sozialwissenschaften* 114(4): 507-529.
- Freeman, Richard. 1998. Work-Sharing to Full employment: Serious Option or Populist Fallacy? In: *Generating Jobs: How to Increase Demand for Less-Skilled Workers*. NY: Russell Sage Foundation; 1998. pp. Chapter 6.
- Friesen, Jane. 2002. Overtime pay regulation and weekly hours of work in Canada. *Labour Economics* no 8: 691-720.
- Golden, L.; Lambert, S.; Henly, J.; Wiens-Tuers, B. 2011. "Working Time in the Employment Relationship: Perceived Control and Work-Life Balance", in K. Townsend and A. Wilkinson (eds): *Edward Elgar Handbook on Work and Employment Relations* (Cheltenham, UK, Edward Elgar).
- Gubian, Alain. 2000. Les 35 heures et l'emploi : d'une loi Aubry à l'autre. *Regards sur l'actualité* no 259: 3-26.
- Green, Francis. 2002. It's Been A Hard Day's Night: The Concentration and Intensification of Work in Late Twentieth-Century Britain. *British Journal of Industrial Relations* 2001, no. 39/1: 53-80.
- Hart, Robert. 1987. *Working Time and Employment*. Allen and Unwin, Boston.
- Hart, Robert and Wilson, Nicholas. 1988. The Demand for Workers and Hours: Micro Evidence from the U.K. Metal Working Industry. In Robert Hart ed. *Employment, Unemployment and Labor Utilization*. Unwin Hyman, Boston.
- Hassler, Uwe; Wolters, Jürgen. 2005. Autoregressive distributed lag models and cointegration. *Diskussionsbeiträge des Fachbereichs Wirtschaftswissenschaft der Freien Universität Berlin* no. 2005/22.
- Hubermann, Michael; Minns, Chris. 2007. The times they are not changing': Days and hours of work in Old and New Worlds, 1870-2000. *Explorations in Economic History* 2007, no. 44: 538-567.
- Hunt, Jennifer. 1996. The response of wages and actual hours worked to the reductions of standard hours. *NBER Working Paper Series*, Working Paper 5716.
- Hunt, Jennifer. 1998. Hours Reduction as Work-Sharing. *Brookings Papers on Economic Activity* 1998, no 1: 339-381.
- Hunt, Jennifer. 1999. Has work-sharing worked in Germany? *Quarterly Journal of Economics* 114, no 1: 117-148.
- Kapteyn, Arie; Kalwij, Adriaan and Zaidi, Asghar. 2003. The myth of work-sharing. *Labour Economics* 10(1), no. 11: 293-313.
- Kivimäki, Mika; Jokela, Markus; Nyberg, Solja. 2015. Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603838 individuals. *The Lancet* no. 386: 1739 - 1746.
- Kramarz, Francis; Cahuc, Pierre; Crépon, Bruno; Schank, Thorsten; Skans, Oskar Nordström; van Lomval, Gijsbert; Zylberg, Andre. 2006. Labour market effects of work-sharing arrangements in Europe. In: *Working hours and job sharing in the EU and USA: Are Europeans lazy? Or Americans*

- crazy?* ed. Tito Boeri, Michael Burda, and Francis Kramarz. Oxford: Oxford University Press.
- König, Heinz and Pohlmeier, Winfried. 1998. A Dynamic Model of Labor Utilization. In Robert Hart ed. *Employment, Unemployment and Labor Utilization*. Unwin Hyman, Boston.
- Lehment, Harmen. 1991. Lohnzurückhaltung, Arbeitszeitverkürzung und Beschäftigung. Eine empirische Untersuchung für die Bundesrepublik Deutschland 1973-1990. *Die Weltwirtschaft* 2: 72-85.
- Logeay, Camille and Schreiber, Sven. 2006. Testing the effectiveness of the French work-sharing reform: a forecasting approach. *Applied economics* no.38(17), 2053-68.
- Marimon, Ramon and Zilibotti, Fabrizio. 2000. Employment and distributional effects of restricting working time. *European Economic Review* no. 44: 1291-1326.
- Matthews, Robin; Feinstein, Charles Hilliard and Odling-Smee, John. 1982. British Economic Growth 1856-1972. *Stanford University Press*, California 1982.
- ÖGB (Oesterreichischer Gewerkschaftsbund) 2009. Foglar: Arbeitszeit sinnvoll verändern, Arbeitslosigkeit bekämpfen. OTS0033.
- Pencavel, John. 2014. The Productivity of Working Hours. *IZA Discussion Paper Series* no. 8129.
- Pesaran, M. H. 2004. General diagnostic tests for cross section dependence in panels. *Cambridge Working Papers in Economics* no. 0435.
- Pesaran, Hashem; Shin, Yongcheol and Smith, Ron P. 1999. Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association* no. 94: 621-634.
- Pesaran, Hashem; Shin, Yongcheol and Smith, Richard. 2001. Bounds Testing Approaches to the Analysis of level relationships. *Journal of Applied Econometrics* no. 16: 289-326.
- Pesaran, Hashem and Smith, Richard. 1995. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics* 68, no. 1: 79-113.
- Pesaran, Hashem. 2006. Estimation and Inference in Large Heterogeneous Panels with a multifactor error structure. *Econometrica* 74, no. 4: 967-1012.
- Skuterud, Mikal. 2007. Identifying the Potential of Work-Sharing as a Job-Creation Strategy. *Journal of Labour Economics* 25, no 2: 265-287
- Steiner, Viktor; Peters, Ralf-Henning. 2002. Employment Effects of Work Sharing. An econometric analysis for West Germany. *ZEW Discussion Paper* no. 0020.
- Westerlund, Joakim. 2007. Estimating Cointegrated Panels with Common Factors and the Forward Rate Unbiasedness Hypothesis. *Journal of Financial Econometrics* 5, no 3: 491-522.

Chapter 6

Appendix

6.1 Regression results

The following tables give an overview of the regression results of every equation. The prefix *d* denotes the first difference, the prefix *dmean* denotes the cross-country means in first differences.

The short run estimates are reported here for completeness. However, their interpretation is not straight-forward, as the effect of shocks (permanent or contemporaneous) consist of multiple components: The error-correction term which is the short-run adjustment due to the deviation from the (long-run) equilibrium; the lagged difference of the dependent variable and the delayed direct effect. Given a correct interpretation of those parameter is therefore difficult and are not presented as the focus of this paper are long-run effect.

Table 6.1: Hours equation

dloghours	PMG		MG	
	Coeff.	p-value	Coeff.	p-value
Long run				
logwage	-0.119	0.000	0.374	0.587
logemploy	0.550	0.000	1.074	0.457
Short Run				
ddloghours	0.378	0.000	0.321	0.000
dlogwage	0.009	0.951	-0.283	0.867
ddlogwage	0.054	0.278	0.090	0.250
dlogemploy	0.249	0.003	0.098	0.663
ddlogemploy	-0.061	0.455	0.011	0.951
dloggdg	-0.062	0.386	-0.309	0.325
dmeanloghours	0.485	0.078	1.104	0.111
dmeanlogwage	-0.65	0.694	0.235	0.516
dmeanlogemploy	-0.033	0.792	0.691	0.433
constant	-0.478	0.007	-1.670	0.040

Table 6.2: Employment equation

dlogemploy	PMG		MG	
	Coeff.	p-value	Coeff.	p-value
Long run				
loghours	-0.663	0.000	0.845	0.792
logwage	0.194	0.000	-0.070	0.906
Short Run				
ddlogemploy	0.378	0.000	0.570	0.000
dloghours	0.417	0.143	0.672	0.304
ddloghours	-0.306	0.002	-0.347	0.185
dlogwage	-0.057	0.706	0.068	0.807
ddlogwage	-0.054	0.501	-0.119	0.434
dloggdg	0.127	0.106	0.294	0.031
dlogshare	-0.892	0.456	-1.770	0.554
dmeanlogemploy	-0.578	0.035	0.205	0.592
dmeanlogshare	-0.849	0.001	-1.060	0.000
constant	-0.728	0.043	0.654	0.813

Table 6.3: Wage equation

dlogemploy	PMG		MG	
	Coeff.	p-value	Coeff.	p-value
Long run				
loghours	-1.504	0.000	0.604	0.804
logemploy	-0.142	0.000	5.376	0.028
Short Run				
ddlogwage	0.359	0.000	0.567	0.000
dlogemploy	0.196	0.339	0.201	0.856
ddlogemploy	0.044	0.846	-0.538	0.564
dloghours	-0.893	0.009	0.047	0.963
ddloghours	0.308	0.022	-0.030	0.959
dloggdp	0.407	0.065	-0.455	0.484
dmeanlogwage	0.501	0.172	1.817	0.018
dmeanlogemploy	-0.725	0.209	1.180	0.462
dmeanloghours	-0.153	0.812	2.002	0.193
constant	-1.354	0.043	-0.009	0.998

6.2 Technical Notes

The empirical part of this thesis was largely programmed in STATA. The following user-written programs were used: The `xtcd` command implements Pesarans (2004) test for cross-section independence and was programmed by Markus Eberhardt. The `pescadf` command runs the t-test for unit roots in heterogeneous panels with cross-section dependence as proposed by Pesaran (2003) and was programmed by Piotr Lewandowski. The `ardl` command was used to compute the appropriate lag lengths for the ARDL model and was programmed by Sebastian Kripfganz. The `xtpmg` command facilitates estimation of nonstationary heterogeneous panels and was programmed by Edward Blackburne and Mark Frank. Additionally, the EViews Add-in `ARDLbound` was used for lag selection as well, and was programmed by Yashar Tarverdi.

I would like to express my gratitude towards the authors of those programmes that helped perform the empirical part of the thesis. Last but not least, I would like to thank Christoph Scheuch and Anna Lena Bankel for valuable comments on earlier drafts of this thesis.

6.3 Zusammenfassung

Seit der Finanzkrise 2008 und der daraus resultierenden gestiegenen Arbeitslosigkeit in vielen europäischen Ländern gibt es eine Diskussion über Arbeitszeitverkürzung zur Schaffung von Beschäftigung. Theoretische Modelle können nur unter sehr restriktiven Annahmen Aussagen über das Verhältnis von kürzeren Arbeitswochen und Beschäftigung sowie anderen Variablen von Interesse treffen. Auch die empirische Literatur zeigt vor allem beim Beschäftigungseffekt von Arbeitszeitverkürzungen kein eindeutiges Ergebnis. Die vorliegende Arbeit knüpft an existierende empirische makroökonomische Studien an und bringt an zwei Punkten Weiterentwicklungen an: Erstens werden über 18 europäische Länder vergleichbare Arbeitsstundendaten von Vollzeitbeschäftigten verwendet, auf die ältere Studien noch nicht zugreifen konnten. Zweitens wird für Abhängigkeit der Variablen zwischen den Querschnittsdimensionen der Panels kontrolliert. Die empirische Analyse umfasst ein drei-Gleichungen-ARDL Modell für die Variablen Arbeitsstunden, Beschäftigungsrate und Einkommen mit den Kontrollvariablen BIP sowie Anteil an Personen im beschäftigungsfähigen Alter. Die Langzeitelastizitäten zeigen, dass Arbeitsstunden mit höherem Einkommen und niedrigerer Beschäftigung fallen. Das Einkommen fällt mit längeren Arbeitszeiten. Der Beschäftigungseffekt ist positiv, wenn die Arbeitsstunden fallen, der Effekt ist aber unterproportional. Auch höheres Einkommen lässt die Beschäftigung steigen.

6.4 Abstract

Since the recent financial crisis resulted in high unemployment rates in most European countries, there is rising discussion whether shorter working hours can be a policy instrument to generate employment. In the theoretical literature, no clear-cut relationships between shorter hours and economic variables of interest such as employment, wages and labour supply can be obtained. The empirical literature is divided as well, especially regarding the question of the employment effects of shorter working hours. The thesis aims to add to the existing macroeconometric literature in two ways: The first is to use not average hours of everyone employed, but of those fully employed. The second is to control for cross-section dependence in the econometric set-up. The empirical analysis uses a three-equation ARDL model including the variables working hours, employment, wages, and the control variables GDP per capita and the share of persons in working age. The long-run elasticities show the following results: working hours fall with rising wages and falling employment. As for wages, longer average hours of those fully employed result in lower wages. The estimates for the employment equation suggest that a fall of working hours of those fully employed leads to a (under-proportional) rise in employment. Rising wages are found to result in a rising employment rate.

6.5 CV

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