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The transition to the knowledge economy, labour market institutions, and income inequality in advanced democracies

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Abstract

The transition from Fordism to the knowledge economy in the advanced democracies was underpinned by the ICT revolution. The introduction and rapid diffusion of ICT pushed up wages for college-educated workers with complementary skills and allowed top managers and CEOs to reap greater rewards for their talents. Despite these common pressures, income inequality did not rise to the same extent everywhere; the Anglo-Saxon countries stand out as being particularly unequal. To shed new light on this puzzle, we carry out a panel data analysis of 18 OECD countries between 1970 and 2007. The analysis stands apart from the existing empirical literature by taking a comparative perspective. We look at the extent to which the relationship between the knowledge economy and income inequality is influenced by national labour market institutions. We find that the expansion of knowledge employment is positively associated with both the 90–10 wage ratio and the income share of the top 1%, but that these effects are mitigated by the presence of strong labour market institutions, such as coordinated wage bargaining, strict employment protection legislation and high bargaining coverage. The study provides robust evidence against the argument that industrial relations systems are no longer important safeguards of wage solidarity in the knowledge economy.

Keywords: knowledge economy, income inequality, labour market institutions, industrial relations systems

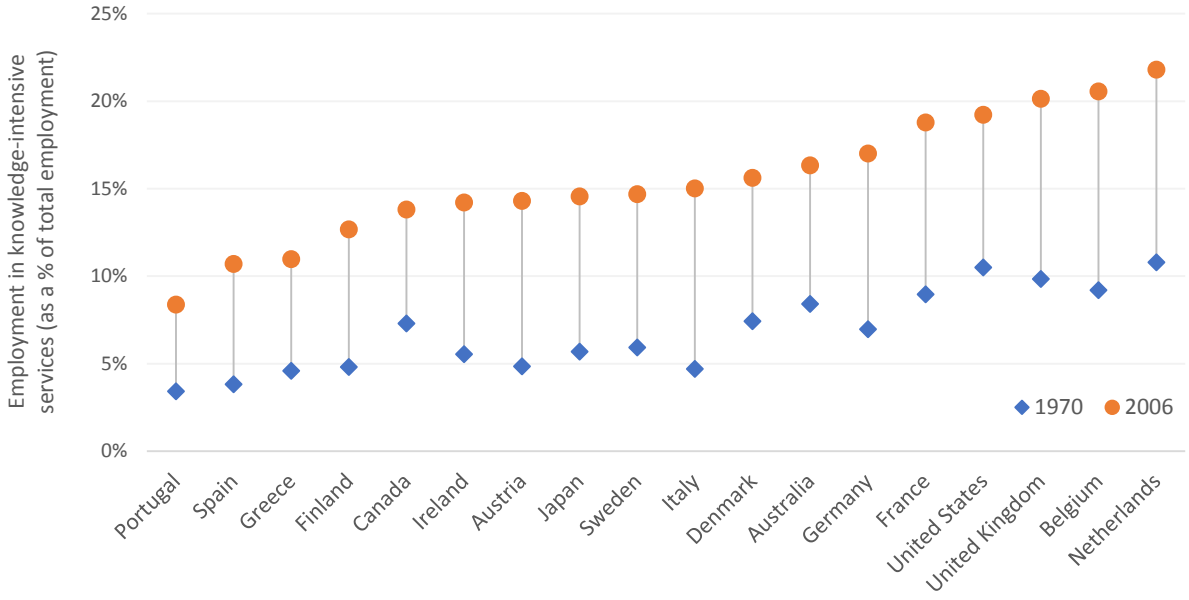
1. Introduction

The last forty years has seen a pervasive rise in income inequality across the advanced democracies of Western Europe, North America and the Asia–Pacific region (Kenworthy and Pontusson 2005; OECD 2011, 2015), especially at the very top of the income distribution (Alvaredo et al. 2013; Atkinson, Piketty, and Saez 2011; Piketty 2014). This has occurred alongside major structural change, which has seen these economies transition from Fordism—an economic system built around the mass production and mass consumption of standardized consumer goods—to the knowledge economy, where the service sectors dominate economic activity and human capital is central to economic prosperity (Iversen and Soskice 2015; Wren 2013b).

The two phenomena are intimately linked. The information and communications technology (ICT) revolution that underpinned the transition to the knowledge economy increased the demand for college-educated workers with complementary skills, which led to a rise in the wage premia for more educated workers (Acemoglu and Autor 2011; Goldin and Katz 2008; Katz and Autor 1999). The ICT revolution and globalization also allowed highly-talented managers, CEOs and entrepreneurs to apply their talent to a much wider pool of resources and to reach a substantially larger audience than possible in previous generations. The rapidly rising compensation of the top 1% in the knowledge economy therefore reflects both the increasing complexity of their work and their enhanced ability to reap the rewards of their talents (Brynjolfsson and McAfee 2014; Kaplan and Rauh 2013; Mankiw 2013).

The transition to the knowledge economy began in earnest after the crisis of Fordism in the 1970s. Figure 1 shows the employment expansion in knowledge-intensive service sectors between 1970 and 2006. Knowledge-intensive services include finance, insurance, business services and telecommunications. These ‘dynamic service sectors’ have been selected by Wren (2013a, 13) as they are ICT intensive, high productivity and increasingly traded internationally. The expansion of knowledge-intensive services since 1970 is ubiquitous across the advanced democracies and represents a substantial shift in economic structure.

Figure 1. The expansion of employment in knowledge-intensive services in advanced democracies between 1970 and 2006



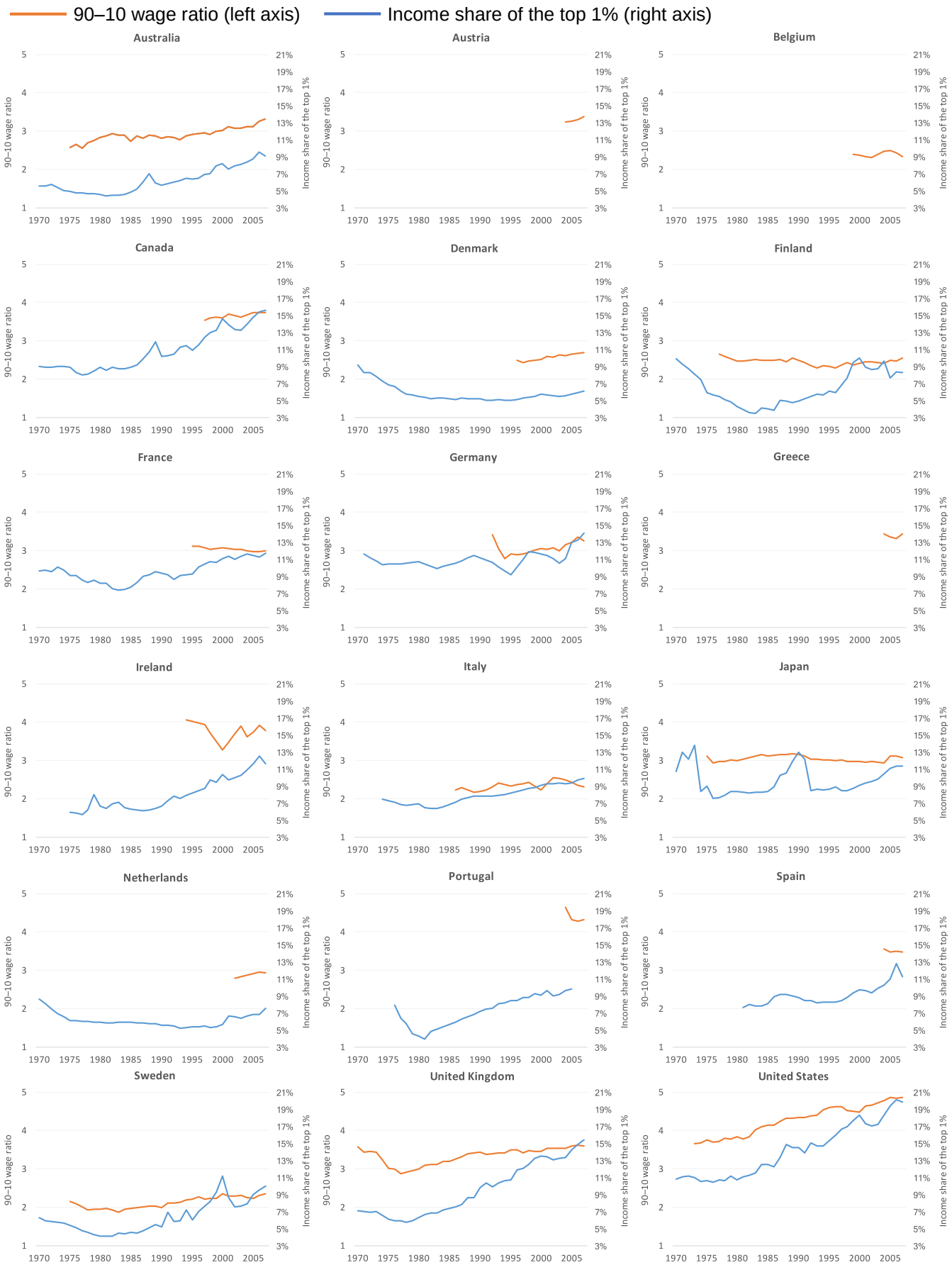
Note: Knowledge-intensive services comprise three sectors: post and telecommunications; financial intermediation; and renting of machinery and equipment and other business activities.

Source: EU KLEMS Growth and Productivity Accounts: November 2009 Release, updated March 2011; O'Mahony and Timmer (2009).

While the transition to the knowledge economy has put upward pressure on inequality in all the advanced democracies, we have observed striking differences in the inequality trajectories of different economies. Figure 2 shows the evolution of two widely-used measures of income inequality: the income share of the top 1% and the 90–10 wage ratio. It is clear that inequality has grown more rapidly in the English-speaking countries than in the continental and northern European economies (see also, Alvaredo et al. 2013; Atkinson and Piketty 2007).

The UK and the US particularly stand out, and as we might expect, they have also seen a large employment expansion in knowledge-intensive services. The two countries that saw the biggest movement into knowledge-intensive services, however, were the Netherlands and Belgium, where the growth of inequality has been much more subdued. On top of this, the other continental and northern Europe economies saw equivalent or greater expansions in knowledge-intensive services than the other English-speaking countries (Australia, Canada and Ireland), but experienced substantially smaller rises in inequality. This leaves us with a clear puzzle: given the common pressures from the transition to the knowledge economy, why has income inequality not risen to the same extent across the advanced democracies?

Figure 2. Dependent variables: the income share of the top 1 % and the 90–10 wage ratio



Note: No top 1% income share data is available for Austria, Belgium or Greece.

Source: World Wealth & Income Database (data accessed September 2017); Brady, Huber and Stephens (2014); OECD, Labour Force Statistics (accessed 14 Jan 2013).

Despite the wealth of theoretical and empirical evidence on how labour markets and inequality have been affected by technological progress, there are only a few cross-country empirical analyses that estimate the effects of the transition to the knowledge economy on income inequality in the advanced democracies (Huber, Huo, and Stephens 2017; Kwon and Roberts 2015; Kwon 2014; Rohrbach 2009). These studies use a range of different measures of the knowledge economy and income inequality, but typically find that the expansion of employment in knowledge-intensive sectors is positively associated with income inequality.[1] This emerging empirical literature has advanced our understanding of the relationship between technological and structural change and income inequality, but cannot account for why some advanced democracies have managed to simultaneously expand employment in knowledge-intensive services and maintain relatively high wage solidarity across the workforce, while others have not.

The analysis in this paper aims to shed new light on this puzzle by taking a comparative perspective. There is a large body of empirical work in comparative political economy that finds that labour market institutions, such as coordinated wage bargaining, trade unions and employment protection legislation, help restrain dispersion in the distribution of income (Bradley et al. 2003; Checchi and Garcia 2010; Martelli 2017; Pontusson 2005; Pontusson, Rueda, and Way 2002; Roberts and Kwon 2017; Rueda and Pontusson 2000; Wallerstein 1999). There has yet to be a cross-country empirical study, however, that investigates whether labour market institutions can diminish the effects of the transition to the knowledge economy on income inequality.

We fill this gap in the literature by carrying out a panel data econometric analysis using an unbalanced dataset that covers 18 OECD countries from 1970 to 2007. We investigate whether the effect of the knowledge economy on inequality varies across countries with different labour market institutions. The results show that the expansion of dynamic services increases income inequality, but that this effect is mitigated by the presence of coordinated wage setting, strict employment protection legislation, and high bargaining coverage. In contrast, trade union density does not significantly affect the relationship between knowledge employment and income inequality.

Our results show that industrial relations systems have played a significant part in keeping income inequality in check in continental and northern Europe during the transition to the knowledge economy. This stands in contrast to the recent comparative political economy literature that argues that industrial relations systems have been superseded by redistribution and education spending as the key safeguards against income inequality in the knowledge economy (Iversen and Soskice 2015; Martin and Thelen 2007; Thelen 2014).

[1] The exception to this is Huber, Huo, and Stephens (2017), who find a significant negative effect of knowledge-intensive services on top incomes. This finding and the issues around the measurement of the knowledge economy will be discussed further in Section 3.

2. The knowledge economy, labour market institutions, and income inequality

The post-industrial era has been marked by a dramatic increase in income inequality within the advanced democracies. The richest households in society have typically pulled away from the rest (Alvaredo et al. 2013; Atkinson, Piketty, and Saez 2011; Piketty 2014) and incomes have become more dispersed across the spectrum (Kenworthy and Pontusson 2005; OECD 2011, 2015). Identifying the factors driving income inequality has therefore been at the top of the agenda for many scholars and policy makers, especially in the wake of the global financial crisis. A large theoretical and empirical literature has identified many potential explanations for the changes observed in inequality in the advanced democracies.

Goldin and Katz (2007, 2008) suggest that educational investment (i.e. the supply of skills) has not kept pace with technological advancement (i.e. the demand for skills) in the US, which has put upward pressure on the wages of skilled workers. Huber and Stephens (2014) find evidence supporting the Goldin–Katz hypothesis in a wider panel data analysis of OECD economies. The supply and demand of skills is likely to be less important for explaining the diverging income of the top 1%, however, where tax policy, changes in the bargaining power of managers and employees, the greater individualisation of pay, and capital income are found to be more salient (Alvaredo et al. 2013).

Other scholars have highlighted the rise in international trade liberalizations (Milanovic and Squire 2005), finding that trade tariffs reductions led to increased inequality. Cross-country studies on inequality and globalization have found that measures of trade and capital account integration, such as southern import penetration and outward investment flows, have significant positive effects on within-country inequality, but are less pertinent to explaining cross-country differences (Alderson and Nielsen 2002). Although, Lee, Nielsen, and Alderson (2007) find that these globalization effects are mitigated in countries with larger public sectors.

The growth in financial sectors and the financial labour force has been identified as another important driver of greater wage disparities and the concentration of income in the most affluent households (Flaherty 2015; Godechot 2016; Jacob Assa 2012; Kus 2012). Summarising this literature, Kwon and Roberts (2017) argue that the financialization of the advanced democracies shifted economic resources away from rank-and-file production workers to financial workers and the households at the top of the income distribution.

Despite the wide-ranging explanations put forward for changes in income inequality, technological change and labour market institutions remain the two dominant factors in the political economy literature (Autor, Levy, and Murnane 2003; Iversen and Soskice 2015; Katz and Autor 1999; Pontusson, Rueda, and Way 2002; Rueda and Pontusson 2000; Wallerstein 1999). These two factors are the focus of our

paper. In the remainder of the literature review, we look at the direct effects of technological change and labour market institutions on income inequality, before turning to the potential interaction effect between the two factors that is at the heart of the empirical analysis in this paper.

2.1. *The knowledge economy and inequality*

The advanced democracies have undergone a major technologically-driven structural transformation since the 1970s. The Fordist system of the post-WWII era was built on the dual pillars of mass production and mass consumption, and was supported by collective bargaining, a generous welfare state, and Keynesian demand management policies. This system collapsed under the weight of short-term factors, such as industrial conflict and oil price shocks, and longer term factors, such as globalization, de-unionization and technological change (Hope and Soskice 2016). The knowledge economy that arose in its place is distinct from what went before in a number of ways. Manufacturing has receded in importance and service sectors now dominate economic activity. Complementarities in production between skilled and semi-skilled workers have been replaced by complementarities between skilled workers and new information and communications technologies. These changes have brought about a huge increase in skill and education levels of big segments of the labour force, facilitated through the rapid expansion of higher education (Iversen and Soskice 2015). The welfare state, collective bargaining and labour unions have generally declined in importance over time, but there are still salient and theoretically interesting differences in political–economic institutions among the advanced democracies in the knowledge economy (Iversen and Soskice 2012; Pontusson 2005; Schneider and Paunescu 2012).

The information and communication technology (ICT) revolution that underpinned the transition to the knowledge economy has been found to be one a key driver behind the upward trend of earnings inequality. Chen, Förster, and Llena-nozal (2013) carry out a cross-national study into the drivers of inequality in OECD countries and find that technological change (measured by ICT intensity, R&D expenditure and patents) significantly widens wage dispersion and accounts for more of the within-country variation in inequality than trade or financial factors.

The diffusion of ICT throughout the advanced democracies created a sharp upturn in demand for college-educated workers, because their high-level, general skills are complements in production to ICT. The additional demand for skilled workers that came with these new technologies led to a rise in the relative wages of more educated workers (Acemoglu and Autor 2011; Goldin and Katz 2008; Katz and Autor 1999). The losers from technological change have typically been those workers in the middle of the skill distribution, whose jobs focus on routine tasks that can be easily be replicated by computers or machines (Autor and Dorn 2013; Autor, Katz, and Kearney 2006; Autor, Levy, and Murnane 2003; Goos and Manning 2007; Goos, Manning, and Salomons 2009, 2014; Michaels, Natraj, and Van Reenen 2014).

The knowledge economy also contributed to the rapid rise in the income of the top 1% during the post-industrial era. Murphy and Zábojník (2004) provide a market-based explanation for the explosion of CEO pay in the knowledge economy, arguing that the skills needed to manage a modern corporation are much more focused on general, transferable skills (e.g. management, economics, accounting, computing etc.) than the firm-specific knowledge that was important in the pre-digital era, and this has created a highly competitive global market for the best CEOs. The integration of capital and goods markets that came with ICT and globalization also allows highly-talented managers, CEOs and entrepreneurs to operate in more markets and reach more customers. The rapidly rising compensation of the top 1% in the knowledge economy therefore reflects both their superior ability to reap the rewards of their talents and the greater complexity of their roles (Brynjolfsson and McAfee 2014; Kaplan and Rauh 2013; Mankiw 2013). An aspect of the knowledge economy, particularly in new digital technologies, that reinforces this dynamic is the existence of large networks effects, whereby the value of a product rises the greater number of users it has (e.g. social media platforms). Network effects often lead to the creation of winner-take-all or winner-take-most markets, where the first mover gets a disproportionate amount of the returns in an industry (Brynjolfsson and McAfee 2014).

2.2. *Labour market institutions and inequality*

Institutional factors such as de-commodification, trade union density, wage coordination, and collective bargaining have been found to shape the patterns of inequality in the advanced democracies, particularly cross-national variation (Brady, Baker, and Finnigan 2013; Brady and Leicht 2008; Kenworthy and Pontusson 2005; Pontusson, Rueda, and Way 2002; Wallerstein 1999).

In an empirical study of OECD countries, Wallerstein (1999, 676) finds that “the more wage and salaries are set in a centralized manner, the more egalitarian the distribution of wages and salaries”. The three theoretical channels that Wallerstein (1999) identifies as explaining this relationship are the economic explanation (i.e. wage differentials in decentralized wage-setting systems are inefficient), political (i.e. compressed wages in centralized wage-setting systems reflect the preferences of the median wage-earner), and the norms explanation (i.e. centralized bargaining influences norms around fairness).

There is substantial evidence that labour unions, in their roles as both wage bargainers and political actors, influence class-based inequity in politics and public policy, and therefore reduce economic disparities (Ahlquist 2017). The top 1% are not typically union members or covered by collective bargaining agreements, but these institutions can still provide a brake on the incomes of top executives. Huber, Huo, and Stephens (2017) argue that union strength reduces the proportion of the firm surplus that goes to executives, and greater worker discretion and performance in unionized workplaces can lessen the need for highly paid managers and supervisors. The

authors' panel data analysis finds that policy and political variables, such as union density, are closely associated with the incomes of the most affluent households.

As well as industrial relations systems, there is evidence that employment protection legislation (EPL) can influence the distribution of income. Checchi and García-Peñalosa (2008) find that OECD countries with stricter employment protection legislation, where workers are much harder to fire, typically have lower levels of household income inequality.

2.3. *The interaction of labour market institutions and the knowledge economy*

The previous two subsections have highlighted the vast literature on the direct effects of the transition to the knowledge economy and labour market institutions on income inequality in advanced democracies. However, the literature looking at whether the relationship between the expansion of knowledge-intensive services and income inequality depends on national labour market institutions is much less developed. To the best of our knowledge, there have been no cross-national empirical studies that investigate whether labour market institutions mitigate the inequality-enhancing effects of the transition to the knowledge economy. Despite the lack of panel data analyses into the relationship, the literature has identified several theoretical channels that provide clear motivation for focusing our study on the interaction between labour market institutions and the knowledge economy.

Oesch and Menés (2011) set out three explanations of occupational change in advanced economies in the 1990s and 2000s. The institutional explanation suggests that the effects of technological change on the occupation structure and wage inequality vary depending on national wage-setting institutions. Acemoglu (2001) uses a model of non-competitive labour markets in which high-paid and low-paid jobs coexist to develop this argument. He shows that the incentive for firms to invest in the productivity of low-skilled workers is higher when labour market institutions have created a high wage floor for low-skilled workers.

The upgrading of the employment structure in countries with more coordinated industrial relations systems and more generous welfare states occurs through greater training and technology adoption. This leads to improvements in productivity that push low-skilled wages closer to the national median, and hence reduces economy-wide wage dispersion (Oesch 2015). Lloyd, Weinkopf, and Batt (2010) find evidence of these effects in a multi-country case study of call centre workers in Europe. Through a series of in-depth interviews and workplace observations, they discover that call centre employees in the United Kingdom, which has few labour market protections and little collective representation, are less skilled, have less complex and diverse roles, and are paid less relative to the median, than call centre employees in Denmark and France.

EPL protects labour market insiders, those with secure employment often working in core sectors of the economy (Rueda 2005). Martelli (2017) argues that EPL insulates workers in the middle of the income distribution from the routinization associated with technological change and finds evidence that EPL contains the wage effects associated with job polarization.

Labour market institutions can also restrain the incomes of the most affluent households in the knowledge economy. In liberal market economies, such as the Anglo-Saxon economies, labour markets are largely deregulated, bargaining takes place at the firm level, and managers have full discretion over hiring and firing. These highly fluid labour markets provide employers with little incentive to make long-run investments in training or employment (Hall and Soskice 2001). As liberal market economies shifted further toward shareholder value maximization strategies with the transition to the knowledge economy and the associated expansion of the financial sector, this gave management a clear motivation to reduce costs and push up short-term profitability through mass layoffs, outsourcing and cuts in the wages of rank-and-file employees (Fligstein and Shin 2007; Lin and Tomaskovic-Devey 2013). This dramatically changed the bargaining power between management and workers in these economies, shifting compensation towards top managers and CEOs, whose incomes were often tied into the value of corporate shares (Goldstein 2012). In contrast, the more coordinated economies of continental Europe and Scandinavia did not have labour market institutions or corporate governance structures conducive to firm strategies centred on short-term profits, so were better able to rein in the incomes of the richest in society (Roberts and Kwon 2017).

3. Data and measures

Our empirical analysis uses an unbalanced panel dataset covering 18 OECD countries from 1970 to 2007. The countries included in the sample—Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Portugal, Spain, Sweden, the UK and the US—vary markedly in their industrial relations systems (Pontusson 2005), and more broadly, in the organization of their political economies (Hall and Soskice 2001; Schneider and Paunescu 2012; Thelen 2014).

3.1. *Dependent variable*

We use two measures of income inequality as our dependent variables. The first is the income share of the top 1% from the World Wealth and Income Database (Alvaredo et al. 2016). The second is the 90–10 wage ratio, which is the ratio of gross earnings received by a worker at the 90th earnings percentile to that received by a worker at the 10th percentile. This is taken from the OECD Labour Force Statistics (Brady, Huber, and Stephens 2014). Both our income inequality measures are before taxes and transfers (i.e. prior to government redistribution), which is appropriate for a

study looking at the effects of the knowledge economy and labour market institutions on wage dispersion.

The income share of the top 1% and the 90–10 wage ratio have been used in many previous cross-national studies on the determinants of income inequality (e.g. Huber, Huo, and Stephens 2017; Roberts and Kwon 2017; Rueda and Pontusson 2000; Wallerstein 1999). We chose these measures as our dependent variables for two reasons. First, they have superior data availability over other measures of income inequality, especially over time, which is crucial for panel data analysis; and second, they allow us to test the effects of our key independent variables on different parts of the income distribution. The top 1% income share looks solely at the most affluent people in society. It is calculated using tax returns, and because it avoids top coding, it captures income growth at the very top of the income distribution much better than traditional measures based on household surveys (Atkinson, Piketty, and Saez 2011). In contrast, the 90–10 wage ratio better captures income inequality across the whole workforce and is fairly closely correlated with other widely-used measures of inequality, such as the Gini coefficient (Gottschalk and Smeeding 1997; Rueda and Pontusson 2000). It has clear advantages over the Gini coefficient for our study, however, as it is less liable to measurement error, because it does not incorporate the hard to measure tails of the income distribution, and it is insensitive to "wage differentials among observationally equivalent workers", which is essential to accurately estimate the effect of labour market institutions on income inequality (Wallerstein 1999).

The data availability, and therefore the samples, vary slightly for the two measures. The sample for the regression models using the top 1% income share covers 15 countries (no data is available from the World Wealth and Income Database for Austria, Belgium or Greece) and 541 country-year observations. The sample for the regression models using the 90–10 wage ratio covers all 18 countries, but as this measure typically has shorter time series, the sample only has 322 country-year observations.

3.2. *Key independent variables*

The previous studies that estimate the effects of the knowledge economy on income inequality have used a range of different measures. Kwon and Roberts (2015) utilize the International Labour Organization's measure of knowledge employment (as a percentage of the total labour force), which categorises workers based on their occupations. Knowledge employees are the combination of managers, professionals, technicians and associate professionals. In contrast, Rohrbach (2009) and Huber, Huo, and Stephens (2017) construct measures of employment in knowledge sectors (using OECD STAN and EUKLEMS data respectively) by adding up employment in sectors they deem to be knowledge-intensive. The definitions chosen by these authors differ. Rohrbach (2009) includes high-tech manufacturing industries in her definition, whereas Huber, Huo, and Stephens (2017) focus solely on services. Huber, Huo, and

Stephens (2017) definition includes sectors that are traditionally dominated by government provision, such as public administration, health and education.[2]

The measure of the knowledge economy used in our study follows Wren's (2013a) definition of dynamic services, which combines the sectors that have seen the greatest diffusion of new information and communications technologies. Table 1 shows the average contribution to value added growth of ICT capital services across sectors for 12 advanced democracies between 1983 and 2006. Three sectors stand out as having significantly higher ICT contributions: post and telecommunications, financial intermediation (covering finance and insurance), and renting of machinery and equipment and other business activities (which is dominated by business services such as legal, technical, computer, and advertising services). Our measure of knowledge-intensive services adds up employment in these three sectors and expresses it as a percentage of total employment.

Our knowledge-intensive service sectors have other characteristics that set them apart from the other service sectors. Wren (2013a) finds that they typically have higher productivity growth and are more likely to be traded internationally. This is no coincidence. The ICT revolution has drastically reduced the cost of performing routine programmable tasks (Nordhaus 2007), which has pushed up productivity in ICT-intensive sectors (Dahl, Kongsted, and Sørensen 2011; Spiezia 2012; Stiroh 2002). It has also lowered many of the technical barriers to trade in services, because digitized information can be almost costlessly stored and transported across the globe (Choi 2010; Freund and Weinhold 2002).

We believe Wren's (2013a) measure of the knowledge employment is superior to the measures used in the previous panel data studies on the determinants of income inequality for three main reasons. First, these sectors have seen dramatic employment expansion across the advanced democracies since the collapse of the Fordist system (see Figure 1). Second, the knowledge-intensive sectors are selected through a transparent data-driven procedure (see Table 1). Lastly, the theoretical and empirical literature summarised in the previous section identifies ICT as the central mechanism that connects the transition to the knowledge economy to changes in the income distribution (e.g. Acemoglu and Autor 2011; Goos, Manning, and Salomons 2014; Michaels, Natraj, and Van Reenen 2014).

[2] This is likely why Huber, Huo, and Stephens (2017) find a negative effect of knowledge employment on income inequality, which contrasts with the other studies (Kwon and Roberts 2015; Roy Kwon 2016; Rohrbach 2009), because the empirical literature suggests that greater public sector employment can reduce income inequality, especially in coordinated market economies (Pontusson 2005; Pontusson, Rueda, and Way 2002; Rueda and Pontusson 2000).

Table 1. The contribution of ICT capital services to value added growth across sectors in 12 advanced democracies, 1983 – 2006

Sector	Average contribution of ICT capital services to value added growth (percentage points)
Agriculture, hunting, forestry and fishing	0.074
Mining and quarrying	0.205
Manufacturing	0.411
Electricity, gas and water supply	0.401
Construction	0.169
Wholesale and retail trade	0.558
Hotels and restaurants	0.269
Transport and storage	0.487
Post and telecommunications	**1.739**
Financial intermediation	**1.512**
Real estate activities	0.126
Renting of machinery and equipment and other business activities	**1.173**
Public administration and defence; compulsory social security	0.427
Education	0.237
Health and social work	0.226
Other community, social and personal services	0.569

Note: The advanced democracies included are Australia, Austria, Belgium, Denmark, Spain, Finland, France, Italy, Japan, the Netherlands, the United Kingdom and the United States.

Source: EU KLEMS Growth and Productivity Accounts: November 2009 Release, updated March 2011; O'Mahony and Timmer (2009).

The other key independent variables are the four measures of labour market institutions. We take the coordination of wage-setting and the adjusted bargaining (or union) coverage rate from the ICTWSS database (Visser 2016). The former measures the degree of coordination of wage setting on a five-point scale running from firm-level bargaining through to formal or informal centralised bargaining that sets explicit minimum or maximum rates of wage growth. The latter measures the proportion of all employees with the right to bargaining that are covered by collective (wage) bargaining agreements. We collect data on trade union membership from joint database compiled by the OECD and Jelle Visser (2013). Trade union density measures the proportion of employees that are members of trade unions. Finally, we use the OECD Labour Force Statistics measure of employment protection legislation for workers on permanent contracts, which is expressed on a 0-6 scale with higher values indicating that workers

are harder to dismiss. Previous cross-country comparative studies have found that these labour market institutions reduce wage dispersion in the advanced democracies, both below the 90th percentile (Checchi and García-Peñalosa 2008; Kwon and Roberts forthcoming; Martelli 2017; Pontusson, Rueda, and Way 2002; Roberts and Kwon 2017; Wallerstein 1999) and between the top 1% and the rest (Flaherty 2015; Huber, Huo, and Stephens 2017; Roberts and Kwon 2017).

3.3. *Control variables*

In our models with controls, we include a selection of additional variables that have been found to be drivers of income inequality in the theoretical and empirical literature. The variables cover the broad areas of education, partisanship, financialization, globalization and the economy.

Goldin and Katz (2007, 2008) argue that the post-industrial era in the United States has been marked by both a rise in the demand for higher education and a slowdown in educational expansion. The excess demand for educated labour created by education losing the race against technology creates upward pressure on the wages of more educated workers. The Goldin–Katz hypothesis has been found to hold across the advanced democracies (Huber and Stephens 2014). We include two measures of education in our analysis to account for both the expenditure on education and the human capital of the workforce. The first is education expenditure as a percentage of gross national income from the World Bank Development Indicators, and the second is the human capital index from the Penn World Tables (Feenstra, Inklaar, and Timmer 2015).

The partisanship variable we use is the share of parliamentary seats of secular parties of the centre and right as a proportional of all seats of the governing parties. The measure is cumulative since 1946 until the year of observation, and hence, higher values indicate the prolonged incumbency of these parties. Huber, Huo, and Stephens (2017) and Brady and Leicht (2008) find that right party power drives up income inequality.

Many panel data studies find that higher levels of financialization are associated with greater income inequality in the advanced democracies (Flaherty 2015; Godechot 2016; Kus 2012; Roberts and Kwon 2017). Finance is one of the sub-sectors within our measure of knowledge-intensive services (see Section 3.2). To ensure that financialization is not driving our main results, we therefore control for stock market capitalisation as a percentage of GDP (from Roine, Vlachos, and Waldenström 2009) and private credit as a percentage of GDP (from the Financial Development and Structure Dataset; Beck, Demirgüç-Kunt, and Levine 2000, 2009; Čihák et al. 2012). These measures control for aspects of the growth of the financial sector over the post-Fordist era that affect inequality through different channels to those hypothesised for the broader knowledge-intensive services sector (as set out in the literature review),

such as the increased use of stock options in the compensation packages of top managers and CEOs and the dramatic rise in household borrowing.

Another secular trend that has taken place alongside the transition to the knowledge economy is globalization. Goods and capital markets have become considerably more integrated over time, which has had knock on effects for inequality. We control for three different aspects of globalization: exposure to trade, outward investment flows and import competition from China. Exposure to trade is measured by total trade (exports plus imports) as a percentage of GDP and is taken from the OECD Annual National Accounts. It is common to control for trade openness in cross-country studies into the determinants of income inequality (Huber, Huo, and Stephens 2017; Huber and Stephens 2014). Investment outflows are measured by outward foreign direct investment as a percentage of GDP. Alderson and Nielsen (2002) and Lee, Nielsen, and Alderson (2007) find that higher outward investment flows lead to greater income inequality. The rise of China as a global exporting powerhouse has been one of the major features of the post-industrial era. Empirical studies have found that Chinese import competition has adverse consequences on labour markets and is positively associated with income inequality in the advanced democracies (Autor, Dorn, and Hanson 2013; Van Reenen 2011; Thewissen and van Vliet 2017). We measure Chinese import penetration by the value of manufactured goods (SITC Rev 1. 5-8) imports from China as a percentage of GDP (calculated using data from the UN COMTRADE database and the OECD National Accounts).

Lastly, we control for conditions in the labour market using the unemployment rate as a percentage of the civilian labour force (from the OECD Labour Force Statistics) and for the level of economic development using GDP per head at current prices and current PPPs (from the OECD Annual National Accounts). The summary statistics for the two dependent variables, the key independent variables and the control variables are shown in Table 2 (for a complete list of variable definitions and sources, see Table A1 in the Appendix). The small amount of missing values across the dataset have been linearly interpolated.

Table 2. Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Top 1% income share	541	0.09	0.03	0.04	0.20
90–10 wage ratio	322	3.04	0.67	1.88	4.86
Dynamic services employment (% of total employment)	682	0.11	0.04	0.03	0.22
Wage coordination (1 – 5 scale)	669	3.25	1.40	1.00	5.00
Union density (%)	659	40.41	19.71	7.55	83.86
EPL (0 – 6 scale)	414	2.20	0.99	0.26	5.00
Bargaining coverage (0 - 100)	614	70.62	24.38	12.61	98.00
Education expenditure (% of GNI)	684	4.63	1.32	1.00	8.29
Human capital index	684	2.89	0.44	1.40	3.66
Secular centre and right government (%)	655	20.40	16.22	0.07	62.00
Stock market capitalization (% of GDP)	525	0.49	0.41	0.00	2.70
Private credit (% of GDP)	682	74.80	38.22	16.93	192.82
Trade openness (% of GDP)	684	0.59	0.30	0.11	1.75
Outward FDI (% of GDP)	628	2.16	3.98	-4.70	47.01
Chinese import competition (% of GDP)	631	0.00	0.01	0.00	0.04
Unemployment rate	684	6.92	3.88	0.57	24.17
GDP per capita ($US, current prices, PPP)	684	17,170	10,090	2,080	47,987

4. Empirical strategy

The data for our analysis is unbalanced time series cross-sectional (TSCS) data covering 18 OECD countries. We employ Prais–Winsten regressions as our empirical strategy, which have been widely used in the empirical literature investigating the determinants of inequality in advanced democracies (Huber, Huo, and Stephens 2017; Kwon and Roberts 2015, forthcoming; Volscho and Kelly 2012). Prais–Winsten regressions are estimated using ordinary least squares (OLS) and include both panel corrected standard errors (PCSEs) and a correction for first-order auto-regression. The approach helps mitigate the problems of serial correlation, group-wise heteroscedasticity and contemporaneous cross-sectional correlation that are common in regression analyses using TSCS data (Beck and Katz 1995, 2011; Plümper, Troeger, and Manow 2005).

Our empirical strategy has clear advantages over other widely used approaches. Beck and Katz (1995) use Monte Carlo experiments to show that for the types of TSCS data used in comparative politics, OLS models with panel corrected standard errors

provide more accurate estimates of standard errors than feasible generalized least squares estimation, and entail little loss of efficiency. We deal with serial correlation by including a correction for first-order autocorrelation, which is preferable to the alternative approach of adding a lagged dependent variable, which would absorb much of substantively interesting variation in our TSCS data and risk biasing the coefficient estimates on our main independent variables (Huber, Huo, and Stephens 2017; Plümper, Troeger, and Manow 2005).

Given that our unit of analysis in our TSCS data is countries, we also include country fixed effects in our regressions, which control for unobserved, time-invariant, country-specific factors that influence inequality. Country fixed effects help guard against omitted variable bias and are commonly employed in Prais–Winsten regression models (Huber, Huo, and Stephens 2017; Kwon and Roberts forthcoming). For the reasons outlined, we believe our empirical strategy is the most appropriate for our TSCS data, but as a robustness check, alternative specifications are also tested. Tables A2 to A4 in the Appendix shows the results of Prais-Winsten regressions with country fixed effects and decade dummies, as well as fixed and random effects estimators.

The equations estimated in the empirical analysis are:

(1) $$y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 W_{it} + \beta_3 X_{it} * W_{it} + \delta_i + \varepsilon_{it}$$

(2) $$y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 W_{it} + \beta_3 X_{it} * W_{it} + \sum \beta_k Z_{itk} + \delta_i + \varepsilon_{it}.$$

In both sets of models, y_{it} refers to our measures in income inequality: the income share of the top 1% and the 90–10 wage ratio. The main independent variables in the analysis are X_{it}, the share of total employment in knowledge-intensive services, and W_{it}, our measures of labour market institutions. The interaction of our main independent variables, $X_{it} * W_{it}$, is crucial for testing the main hypotheses of the paper. Our four labour market institutions are tested in separate regression models; all of which also include country-fixed effects, δ_i, and an intercept term, β_0. The second set of models also include a vector of k control variables, represented by Z_{itk}.

5. Results

The results for the top 1% income share are shown in Table 3. Models 1 to 4 show the results from the baseline regressions, which simply include our main independent variables and an interaction term, as well as country-fixed effects. In all four models, knowledge employment is positively associated with the income share of the top 1% and significant at the 99% level. The interaction effects between knowledge employment and the four labour market institutions are all negative, but the effects are only statistically significant for wage coordination, employment protection legislation and bargaining coverage (but not union density). The baseline results tentatively

support the hypothesis that the presence of strong labour market institutions reduces the effect of the transition to the knowledge economy on top incomes shares.

Models 5 to 8 in Table 3 introduce a full set of control variables. These models take account of other important drivers of inequality, covering human capital, government partisanship, financialization, globalization, and the state of the economy. The results show that the effects of the expansion of knowledge employment on the income share of the top 1% is conditional on the strength of labour market institutions. The interaction effects for all the labour market institutions aside from union density are significant, negative, and of a similar magnitude to the baseline regressions. Only two of the control variables are statistically significant across three or more of the models: stock market capitalization and Chinese import competition.

The results in Table 4 show the same eight regression models, but with the 90–10 wage ratio as the dependent variable. The same patterns emerge for the main independent variables. In all eight regression models, knowledge employment is positively associated with the 90–10 wage ratio and highly statistically significant. The interaction effects are also negative and significant in the baseline models and the models with controls for wage coordination, employment protection legislation and bargaining coverage. Table 4 therefore provides evidence that the presence of strong labour market institutions helps mitigate the wage dispersion across the labour force that comes with the transition to the knowledge economy.

From Models 5 to 8 in Table 4, we can see that different control variables exert consistent, statistically significant effects on the 90–10 wage ratio than did on the income share of the top 1%. Human capital and trade openness are both consistently negatively associated with the 90–10 wage ratio.

Table 3. Knowledge employment, labour market institutions, and the income share of the top 1% (Prais–Winsten regressions)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Knowledge employment	0.525***	0.271***	1.063***	0.607***	0.240**	-0.064	0.212	0.495***
Wage coordination	0.005***				0.007***			
Union density		-0.001***				-0.001***		
EPL			0.015***				0.014***	
Bargaining coverage				0.000				0.001**
Wage coordination * Knowledge employment	-0.059***				-0.078***			
Union density * Knowledge employment		-0.002				0.001		
EPL * Knowledge employment			-0.207***				-0.112***	
Bargaining coverage * Knowledge employment				-0.004**				-0.007***
Education expenditure					0.000	0.000	0.002*	0.001
Human capital					-0.004	-0.015	0.029**	0.009
Secular centre and right government					0.001*	0.001***	0.001	-0.000
Stock market capitalization					0.015***	0.015***	0.018***	0.015***
Private credit					-0.000	-0.000	-0.000**	-0.000**
Trade openness					-0.014	-0.016*	-0.009	-0.018*
Outward FDI					-0.000	0.000	-0.000	0.000
Chinese import competition					0.558**	0.446*	-0.005	0.536*
Unemployment					-0.001***	0.000	0.000	0.000**
GDP per capita					0.000	0.000	0.000*	0.000
Constant	0.039***	0.125***	0.001	0.041	0.097**	0.181***	-0.044	0.025
ρ	0.84	0.86	0.77	0.87	0.72	0.78	0.60	0.77
R^2	0.57	0.57	0.69	0.55	0.75	0.71	0.87	0.72
Observations	538	538	342	503	456	456	299	441

Note: Prais–Winsten regressions (panel-corrected standard errors and ar(1) corrections) with country fixed effects in all models. Unbalanced panel using data from 1970-2007. Pairwise option used to compute the covariance matrix. Knowledge employment comprises three sectors: post and telecommunications; financial intermediation; and renting of machinery and equipment and other business activities. * P < 0.1, ** P < 0.05 and *** P < 0.01.

Table 4. Knowledge employment, labour market institutions, and the 90–10 wage ratio (Prais–Winsten regressions)

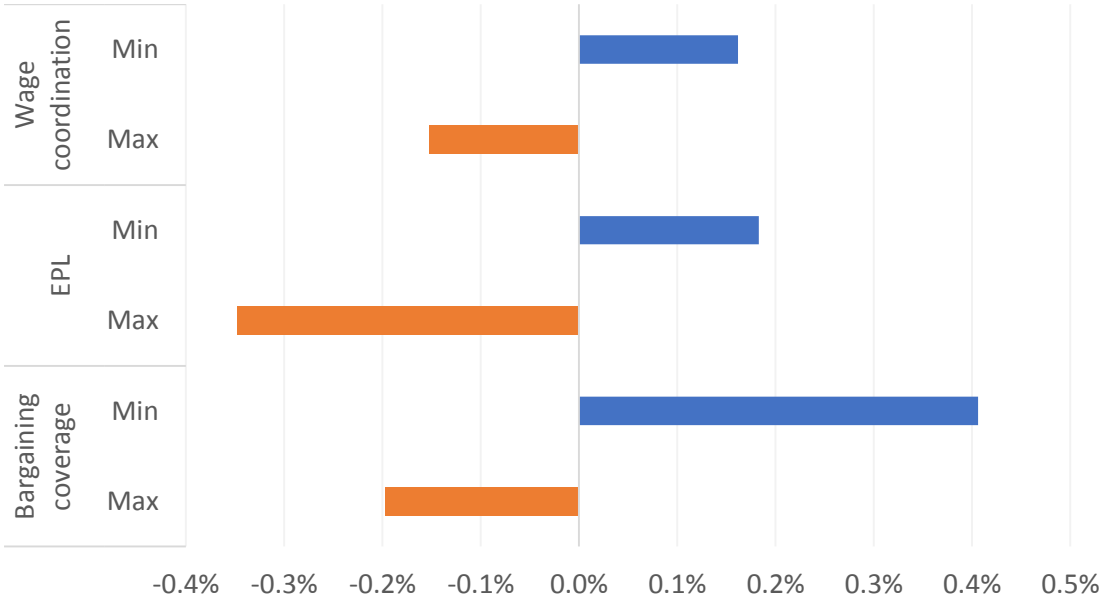
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Knowledge employment	7.935***	4.671***	8.465***	7.694***	9.590***	6.350**	8.554**	5.640**
Wage coordination	0.165***				0.196***			
Union density		-0.001				0.006		
EPL			0.263**				0.204	
Bargaining coverage				0.007*				0.003
Wage coordination * Knowledge employment	-1.576***				-1.822***			
Union density * Knowledge employment		-0.058***				-0.043		
EPL * Knowledge employment			-2.675***				-2.319**	
Bargaining coverage * Knowledge employment				-0.070***				-0.054**
Education expenditure					0.006	0.001	0.039***	0.002
Human capital					-1.050***	-0.810***	-0.244	-0.975***
Secular centre and right government					0.004	0.005	-0.011**	-0.002
Stock market capitalization					0.046*	0.057*	0.052*	0.021
Private credit					-0.001	-0.000	-0.000	-0.000
Trade openness					-0.550***	-0.619***	-0.672***	-0.293
Outward FDI					0.001	0.001	0.001	0.001
Chinese import competition					2.687	1.124	7.713*	-2.424
Unemployment					0.003	-0.000	-0.002	-0.006
GDP per capita					0.000**	0.000	0.000	0.000***
Constant	2.668***	2.554***	3.076***	1.860***	4.866***	4.355***	(omitted)	5.336***
ρ	0.70	0.72	0.64	0.71	0.60	0.61	0.43	0.63
R^2	0.96	0.95	0.97	0.96	0.97	0.96	0.98	0.97
Observations	320	320	255	314	275	275	216	270

Note: Prais–Winsten regressions (panel-corrected standard errors and ar(1) corrections) with country fixed effects in all models. Unbalanced panel using data from 1970-2007. Pairwise option used to compute the covariance matrix. Knowledge employment comprises three sectors: post and telecommunications; financial intermediation; and renting of machinery and equipment and other business activities. * P < 0.1, ** P < 0.05 and *** P < 0.01.

Figures 3 and 4 show the estimated effects of a 1 percentage point increase in employment in knowledge intensive services as a percentage of total employment on our two measures of inequality when our three statistically significant labour market institutions are at the maximum and minimum values observed in the sample (see Table 2). We can see that for the income share of the top 1%, an increase in knowledge employment is associated with an increase in inequality when labour market institutions are very weak and a reduction in inequality when labour market institutions are very strong (see Figure 3). The effects are largest when employment protection legislation is extremely strict, but the maximum value pertains only to Portugal between 1985 and 1989. Outside of Portugal, EPL is rarely above 3 in our sample.

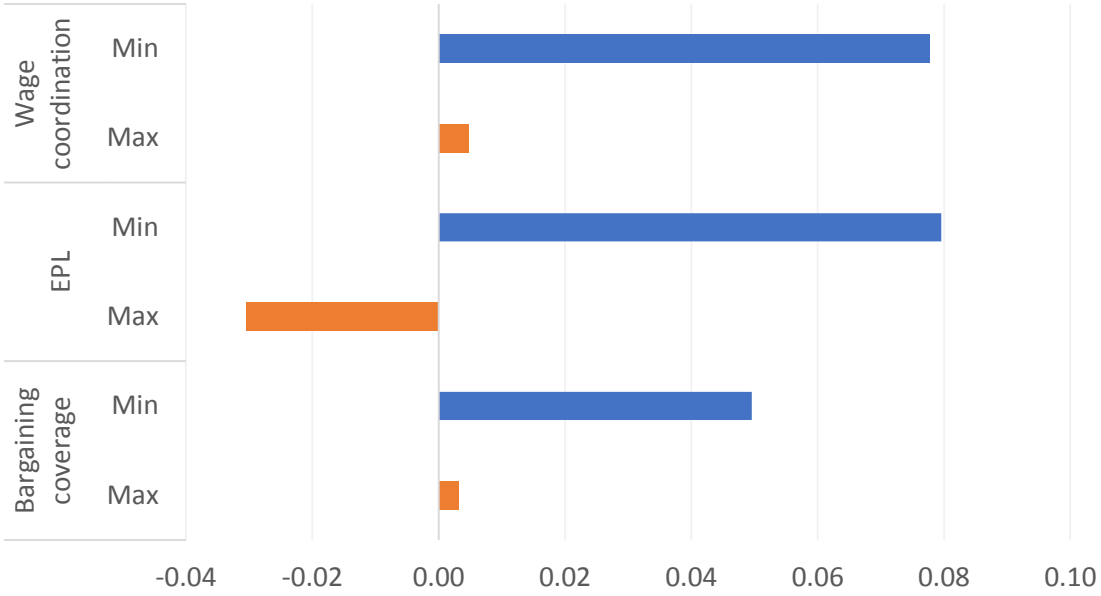
Similar patterns emerge for the 90–10 wage ratio, but in this case, even the maximum values of wage coordination and bargaining coverage are not sufficient to reverse the positive association between expansion of knowledge employment and wage inequality (as they were with the top 1% income share). The figures show that the effects of the expansion of knowledge employment on the top 1% income share are greatest when bargaining coverage is at its lowest value, whereas the effects are greatest for the 90–10 wage ratio when wage coordination and EPL are at their lowest values. Overall, these marginal effects figures highlight the role that strong labour market institutions can have in mitigating the inequality associated with the transition to the knowledge economy.

Figure 3. Estimated effect on the income share of the top 1% of a one percentage point increase in the share of knowledge employment



Source: Author's calculations; for data sources for underlying regression analysis, see Table A2 in the appendix.

Figure 4. Estimated effect on the 90–10 wage ratio of a one percentage point increase in the share of knowledge employment



Source: Author's calculations; for data sources for underlying regression analysis, see Table A2 in the appendix.

The results of the robustness tests are shown in Table A2 to A4 in the Appendix. We can see that the main results of the analysis are unaffected by the empirical strategy chosen. The variables of theoretical interest exhibit the same relationships when we include decade dummies to our Prais–Winsten regressions (Table A2) or when we use fixed effects (Table A3) and random effects (Table A4) estimation. Most importantly, for both dependent variables, the interaction effects between knowledge employment and wage coordination, employment protection legislation and bargaining coverage are all negative and statistically significant at (at least) the 95% level.

The control variables that are found to influence the two measures of inequality differ only slightly from our preferred empirical specification of Prais–Winsten regressions with country dummies. The finding that Chinese import competition is positively associated with top incomes is not robust to alternative specifications, whereas a negative effect of private credit on top incomes is consistently found in the robustness checks. Stock market capitalization is found to exert a consistent positive effect on the top 1% income share, just as in the main results, but unlike the main results, it is also positively associated with the 90–10 wage ratio across the alternative specifications. The negative relationships between human capital and trade openness and the 90–10 wage ratio are also robust to alternative estimation techniques. In addition, the GDP per capita is consistently positively associated with the 90–10 wage ratio in the alternative specifications.

6. Discussion and conclusion

The ICT revolution and the transition to the knowledge economy in the advanced democracies has created winners and losers. Workers with university education and the most affluent households have reaped much of the gains, often at the expense of those workers lower down the income distribution with jobs that can be easily substituted by machines and computers. The dominant narrative in the emerging comparative political economy literature on the knowledge economy is that the complementarities between skilled and semi-skilled workers that underpinned industrial relations systems in the Fordist era have been so undermined by the ICT revolution that strong labour market institutions are no longer the main guarantor of wage solidarity across the labour force (Iversen and Soskice 2015; Martin and Thelen 2007; Thelen 2014).

Our empirical analysis of 18 advanced democracies between 1970 and 2007 challenges that argument by showing that the presence of strong labour market institutions played an important role in mitigating the upward pressure on income inequality from the transition to the knowledge economy. We find that the effects of expanding knowledge employment on both the income share of the top 1% and the 90–10 wage ratio are moderated by more coordinated wage bargaining, stricter employment protection legislation and higher bargaining coverage. Our results complement the wider empirical literature that finds that industrial relations systems and the power of organized labour can limit wage dispersion across the workforce (Pontusson, Rueda, and Way 2002; Wallerstein 1999) and constrain the income growth of the most affluent households in society (Huber, Huo, and Stephens 2017). However, we go beyond the previous literature by showing that labour market institutions effects in the post-industrial era operated through their capacity to counteract the pressures on wage solidarity arising from the rapid expansion of knowledge-intensive service sectors.

While the results for the main independent variables were consistent across the two measures of inequality, the control variables that exhibited consistent, statistically significant effects across specifications varied markedly between the two measures. The capitalization of the stock market was positively associated with rising top incomes, which supports the voluminous empirical literature on the effects of financialization on income inequality (Flaherty 2015; Godechot 2016; Kus 2012; Roberts and Kwon 2017), and reflects the increasing use of stock options as CEO compensation over the post-Fordist period in both liberal and coordinated market economies (Huber, Huo, and Stephens 2017). The finding that Chinese import competition pushes up the incomes of the top 1% is striking and warrants further investigation, as the focus of most of the previous empirical studies have been on the adverse effects on the bottom and middle of the income distribution (Autor, Dorn, and Hanson 2013; Thewissen and van Vliet 2017). Turning to the results for the 90–10 wage ratio, we see that trade openness and human capital are negatively associated

with wage dispersion. The trade openness finding suggests that different aspects of globalization have different effects on wage inequality, and that exposure to international trade actually reduces wage inequality across the bottom 90% of the income distribution. The human capital finding supports the Goldin–Katz (2007, 2008) hypothesis and the theory of skills-biased technological change (Acemoglu and Autor 2011; Katz and Autor 1999).

The analysis presented in this paper has several important limitations that point to fruitful avenues for future work. The Prais–Winsten regression models pin down the importance of labour market institutions for mitigating the inequality effects of the transition to the knowledge economy, but have a limited amount to say about the underlying mechanisms. Our cross-country comparative analysis would therefore be nicely complemented by micro-level empirical analyses or qualitative case study analyses into how labour market institutions have interacted with the expansion of knowledge employment to ensure greater wage solidarity in Scandinavia and some parts of continental Europe than elsewhere. The extent to which producer groups have adapted their strategies and forms of coordination in the knowledge economy is also hard to ascertain from the high-level, national measures of labour market institutions used in this study, and requires further investigation. Lastly, the empirical analysis is constrained by the time series availability of the income inequality measures and the unavailability of comparable data on knowledge employment past 2007. If and when this data becomes available, an updated empirical analysis should be carried out.

This paper makes an important contribution to the growing body of comparative work that looks at how national institutions can condition the effects of structural changes in the economy on income inequality in advanced democracies (Iversen and Soskice 2015; Kwon and Roberts forthcoming; Roberts and Kwon 2017; Thelen 2014). We provide evidence against the argument that labour market institutions are redundant in the knowledge economy; in fact, we find that they can alleviate the upward pressure on income inequality arising from the continued shift of workers in advanced democracies into high-value added, ICT intensive, service sectors.

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Appendix

Table A1. Variable descriptions and sources

Variable	Variable description	Source
Top 1% income share	Top 1% income share, based on pre-tax incomes	World Wealth & Income Database (data accessed September 2017)
90–10 wage ratio	Ratio of gross earnings received by a worker at the 90th earnings percentile to that received by a worker at the 10th percentile	Brady, Huber and Stephens (2014); OECD Labour Force Statistics (accessed 14 Jan 2013)
Knowledge employment (% of total employment)	Employment in dynamic services as a share of total employment (using Wren's (2013a) definition of dynamic services)	EU KLEMS Growth and Productivity Accounts: November 2009 Release, updated March 2011; O'Mahony and Timmer (2009)
Wage coordination (1 – 5 scale)	Coordination of wage-setting (1-5 scale) — a measure of the degree of coordination, ranging from firm-level bargaining (1) to fully centralized bargaining (5)	J. Visser, ICTWSS Data base. version 5.1. Amsterdam: Amsterdam Institute for Advanced Labour Studies (AIAS), University of Amsterdam. September 2016
Union density (%)	The ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners	OECD and J. Visser, ICTWSS database (Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, 1960-2010), version 3.0
EPL (0 – 6 scale)	Strictness of employment protection: individual and collective dismissals (regular contracts) (0-6 scale) — higher values denote stricter regulation	OECD Labour Force Statistics (data accessed June 2017)
Bargaining coverage (0 - 100)	Employees covered by collective (wage) bargaining agreements as a proportion of all wage and salary earners in employment with the right to bargaining, expressed as a %, adjusted for the possibility that some sectors or occupations don't have the right to bargain	J. Visser, ICTWSS Data base. version 5.1. Amsterdam: Amsterdam Institute for Advanced Labour Studies (AIAS), University of Amsterdam. September 2016.
Education expenditure (% of GNI)	Adjusted savings: education expenditure (% of GNI)	World Development Indicators, The World Bank (data accessed September 2017)
Human capital index	Human capital index, based on years of schooling and returns to education	Feenstra, Inklaar, and Timmer (2015)
Secular centre and right government (%)	Cumulative share of parliamentary seats of secular center and right parties as a proportion of the seats of all governing parties	Brady, Huber and Stephens (2014); Mackie and Rose (1991), annual election reports and issues of the Political Data Yearbook published by the European Journal of Political Research since 1986, IDEA Voter Turnout Database
Stock market capitalization (% of GDP)	Stock market capitalization: market value of publicly listed stocks divided by GDP	Roine, Vlachos, and Waldenström (2009)
Private credit (% of GDP)	Private credit by deposit money banks and other financial institutions (as a % of GDP)	Financial Development and Structure Dataset (June 2017 version); Beck, Demirgüç-Kunt, and Levine (2000, 2009); Čihák et al. (2012)
Trade openness (% of GDP)	Total trade (exports plus import) (as a % of GDP)	OECD Annual National Accounts (data accessed June 2017)
Outward FDI (% of GDP)	Outward foreign direct investment (as a % of GDP)	United Nations Conference on Trade and Development (UNCTAD) FDI Database (data accessed September 2017)
Chinese import competition (% of GDP)	Chinese import penetration: value of manufacturing imports from China (SITC REV 1. 5-8) as a % of GDP	United Nations COMTRADE Database (data accessed September 2017)
Unemployment rate	Rate of unemployment as a % of the civilian labour force	OECD Labour Force Statistics (data accessed September 2017)
GDP per capita ($US, current prices, PPP)	GDP per head, current prices, current PPPs	OECD Annual National Accounts (data accessed September 2017)

Table A2. Robustness tests: Determinants of the income share of the top 1% and the 90–10 wage ratio (Prais–Winsten regressions with decade dummies)

	Income share of the top 1%				90-10 wage ratio			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Knowledge employment	0.255***	-0.109	0.218	0.476***	9.955***	6.852***	8.466**	6.866**
Wage coordination	0.008***				0.199***			
Union density		-0.001***				0.007		
EPL			0.014***				0.190	
Bargaining coverage				0.001***				0.005
Wage coordination * Knowledge employment	-0.087***				-1.822***			
Union density * Knowledge employment		0.001				-0.047		
EPL * Knowledge employment			-0.114***				-2.208**	
Bargaining coverage * Knowledge employment				-0.007***				-0.062**
Education expenditure	0.000	-0.001	0.002*	0.000	0.008	0.004	0.039***	0.004
Human capital	0.004	-0.000	0.032***	0.020	-1.120***	-0.857***	-0.272	-1.008***
Secular centre and right government	0.001**	0.001***	0.001	-0.000	0.002	0.003	-0.011**	-0.005
Stock market capitalization	0.015***	0.015***	0.018***	0.016***	0.052*	0.060**	0.052*	0.027
Private credit	-0.000*	-0.000*	-0.000**	-0.000**	-0.001	-0.000	-0.000	-0.000
Trade openness	-0.014	-0.016*	-0.012	-0.016*	-0.495**	-0.562**	-0.649***	-0.236
Outward FDI	-0.000	-0.000	-0.000	-0.000	0.001	0.001	0.001	0.001
Chinese import competition	0.366	0.217	-0.072	0.360	5.207	4.248	8.473*	0.253
Unemployment	-0.001**	-0.000	0.000	-0.000	0.001	-0.003	-0.003	-0.008*
GDP per capita	0.000	0.000	0.000	0.000	0.000**	0.000	0.000	0.000***
1980s	-0.004*	-0.005***	-0.000	-0.004**	0.053*	0.056**	0.007	0.052*
1990s	-0.004	-0.005	-0.002	-0.004	0.059	0.063	0.014	0.040
2000s	-0.001	-0.001	omitted	-0.001	0.022	0.022	omitted	-0.004
Constant	0.076**	omitted	omitted	-0.001	omitted	4.243***	4.573***	4.748***
ρ	0.68	0.68	0.59	0.72	0.58	0.61	0.43	0.61
R^2	0.78	0.77	0.88	0.76	0.97	0.96	0.98	0.97
Observations	456	456	299	441	275	275	216	270

Note: Prais–Winsten regressions (panel-corrected standard errors and ar(1) corrections) with country fixed effects in all models. Unbalanced panel using data from 1970-2007. Pairwise option used to compute the covariance matrix. Knowledge employment comprises Post and Telecommunications; Financial Intermediation; and Renting of Machinery & Equipment and Other Business Activities. * P < 0.1, ** P < 0.05 and *** P < 0.01.

Table A3. Robustness tests: Determinants of the income share of the top 1% and the 90–10 wage ratio (random effects models)

	Income share of the top 1%				90-10 wage ratio			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Knowledge employment	0.388***	-0.056	0.054	0.343***	12.768***	10.334***	8.333***	8.847***
Wage coordination	0.016***				0.232***			
Union density		-0.000**				0.006		
EPL			0.013***				0.071	
Bargaining coverage				-0.000				0.003
Wage coordination * Knowledge employment	-0.170***				-1.992***			
Union density * Knowledge employment		-0.003**				-0.056**		
EPL * Knowledge employment			-0.066**				-1.428	
Bargaining coverage * Knowledge employment				-0.003***				-0.059***
Education expenditure	-0.001	0.001	0.002*	-0.002**	0.008	0.000	0.068***	0.006
Human capital	0.005	0.005	0.025***	-0.010**	-1.384***	-1.206***	-0.700***	-1.220***
Secular centre and right government	0.000**	0.000***	0.001***	-0.000	0.002	0.004	0.004	-0.002
Stock market capitalization	0.021***	0.020***	0.023***	0.016***	0.100***	0.124***	0.085***	0.075***
Private credit	-0.000*	0.000	-0.000**	-0.000	-0.000	0.000	0.000	-0.000
Trade openness	-0.004	-0.011**	-0.013*	-0.017***	-0.641***	-0.639***	-0.635***	-0.281*
Outward FDI	-0.000	-0.000	-0.000*	0.000	-0.003	-0.004	-0.001	-0.002
Chinese import competition	0.353	-1.307***	-0.159	-0.240	-3.576	-7.046*	4.812	-10.33***
Unemployment	-0.000*	-0.000	0.000	0.000	0.006	0.001	-0.009*	-0.007
GDP per capita	0.000**	0.000***	0.000***	0.000***	0.000***	0.000*	0.000	0.000***
Constant	0.017	0.062***	-0.048*	0.106***	5.592***	5.472***	4.250***	5.678***
R^2 (within)	0.69	0.50	0.74	0.58	0.67	0.57	0.37	0.65
R^2 (between)	0.35	0.76	0.31	0.70	0.09	0.09	0.23	0.19
R^2 (overall)	0.53	0.66	0.40	0.67	0.07	0.14	0.39	0.09
Observations	456	456	299	441	275	275	216	270

Note: Unbalanced panel using data from 1970-2007. Knowledge employment comprises Post and Telecommunications; Financial Intermediation; and Renting of Machinery & Equipment and Other Business Activities. * P < 0.1, ** P < 0.05 and *** P < 0.01.

Table A4. Robustness tests: Determinants of the income share of the top 1% and the 90–10 wage ratio (fixed effects models)

	Income share of the top 1%				90-10 wage ratio			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Knowledge employment	0.374***	-0.231**	-0.049	0.577***	13.009***	12.684***	10.095***	12.431***
Wage coordination	0.017***				0.234***			
Union density		-0.001***				0.012**		
EPL			0.014***				0.140	
Bargaining coverage				0.001***				0.010***
Wage coordination * Knowledge employment	-0.170***				-2.008***			
Union density * Knowledge employment		0.002**				-0.085***		
EPL * Knowledge employment			-0.053				-1.994**	
Bargaining coverage * Knowledge employment				-0.008***				-0.096***
Education expenditure	-0.001	-0.004***	0.002*	-0.001	0.007	0.001	0.066***	0.005
Human capital	0.021**	0.027**	0.042***	0.044***	-1.408***	-1.237***	-0.492**	-1.211***
Secular centre and right government	0.000	0.001***	0.001*	-0.000	0.000	-0.003	-0.011*	-0.013**
Stock market capitalization	0.022***	0.022***	0.023***	0.023***	0.100***	0.129***	0.089***	0.075***
Private credit	-0.000***	-0.000**	-0.000**	-0.000**	-0.001	0.000	0.000	-0.000
Trade openness	-0.005	-0.011	-0.009	0.004	-0.680***	-0.763***	-0.837***	-0.345**
Outward FDI	-0.000	-0.000	-0.000**	-0.000	-0.002	-0.003	-0.000	-0.002
Chinese import competition	0.508**	0.488*	-0.061	0.383	-3.495	-6.727	7.243*	-9.579***
Unemployment	-0.001**	-0.000	0.000	-0.001**	0.007	0.002	-0.004	-0.003
GDP per capita	0.000	-0.000	0.000**	-0.000	0.000***	0.000**	0.000	0.000***
Constant	-0.024	0.053*	-0.090***	-0.089***	5.644***	5.284***	3.663***	5.294***
R^2 (within)	0.69	0.59	0.74	0.63	0.67	0.58	0.39	0.65
R^2 (between)	0.26	0.49	0.17	0.18	0.08	0.00	0.00	0.02
R^2 (overall)	0.43	0.51	0.27	0.28	0.05	0.01	0.05	0.00
Observations	456	456	299	441	275	275	216	270

Note: Unbalanced panel using data from 1970-2007. Knowledge employment comprises Post and Telecommunications; Financial Intermediation; and Renting of Machinery & Equipment and Other Business Activities. * P < 0.1, ** P < 0.05 and *** P < 0.01.