

Skill-Biased Technological Change: Distributional and Political Implications

Emil Bustos (22817) and Jesper Vinge (22720)

Abstract

In this paper we synthesize theories on skill-biased technological change and political economy in order to understand the relationship between the widespread diffusion of information and communications technologies, the changes in the structure of the income distribution and the reduced levels of redistributive policies, witnessed since the 1970s. We construct a heuristic model where changes in relative supply and demand for skilled and unskilled labour, induced by skill-biased technological change, affect the distribution of income, the incentives and opportunities to organize politically and thus the relative power between different groups in society. Our model is able to explain a development where a more unequal society chooses to redistribute less, thus moving against the conventional idea that more unequal societies ought to redistribute more. We test the implications of the model using Fixed Effects-estimation on a panel data set of 10 OECD countries for the years 1980–2010. We find robust results that there exist relationships between technological change, relative incomes, political organization and policy outcomes. Our results imply that more research should be conducted in order to understand the complex relationship between technological development, income inequality and political power.

Keywords: Income Distribution, Interest Groups, Lobbying, Skill, Skill Biased, Technological Change

JEL Classification: D72, H50, I24, J24, J31, O15, O33

Supervisor:	Anders Olofsgård
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Discussants:	Åsa Ahlgren and Erik Rockborn
Examiner:	Johanna Wallenius

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1 Introduction

Civil government, so far as it is instituted for the security of property, is in reality instituted for the defence of the rich against the poor, or of those who have some property against those who have none at all.

Adam Smith, *The Wealth of Nations* (1776)

One of the most marked changes in the macroeconomy over the last decades is the rapid diffusion of information and communication technologies. This period of revolutions in the fields of information sharing, unified communications and computer science has been labelled the ‘Third Industrial Revolution’. The commencement of this era can be dated back to the release of the first microprocessor, the ‘Intel 4004’, in 1971, and today, most electrical appliances have been infused with this awesome innovation. In the wake of these new technologies, the means of organizing work and production and how firms and other agents communicate have changed (for an interesting analysis, see (Schön, 2010); (Jovanovic and Rousseau, 2005)).

Another important development is the rapid change of the structure of the income distribution witnessed in the Western world. Following decades of compressed income distributions after the Second World War, we have witnessed a change of trend in recent decades. Inequality has increased in several dimensions. The income distribution came to be more and more skewed to the right in the 1970s and has continued ever since (Katz et al., 1999) (OECD, 2011). Moreover, other scholars find that the incomes of the top 1 % increased substantially over the last decennia (Förster et al., 2014). On the other end of the scale, things look strikingly different. Saez finds that the bottom 99 % in the US has seen a real income growth of 6.6 % over the period 1993–2012, when the average real income rose by 17.9 % (Saez, 2013).

New technologies are not the only defining feature of the modern economy, we have also witnessed changes in policies conducted by governments. Liberalization of trade and financial markets in conjunction with deregulation and reduced social safety nets have been described as the consequences of a ‘neoliberal’ régime (Cornia, 2003) (Glaeser et al., 2004).

Given that these three developments are complex on their own, most research has been devoted to the study of each phenomena. However, it is equally important to understand their interrelationships. Our contribution is to present a unified framework for understanding the links between technological development, changes in the income distribution, political organization and policy outcomes. Our basic approach is to merge the logics of different theories into each other in order to present a comprehensive logic spanning from the economy of firms to the politics of organizations and parties.

Beginning with inequality, researchers are attempting to find factors explaining the witnessed increases. Commonly proposed causes include globalization, weakened labour market institutions and skill-biased technological change. The embodiment of new technologies in new capital has changed the relative demand for workers with various skill levels (Jaumotte et al., 2013) (Cornia, 1999). Relative demand for skilled labour has increased dramatically. At the same time, relative supply has increased as well, as higher education becomes more widespread. We still witness a substantial increase in the relative wages, indicating an increase in the skill premium. One way of explaining this increased skill premium is that new technologies are skill-biased, in that they increase the marginal product of skilled labour relative to unskilled labour (a phenomenon known as skill-biased technological change) (Violante, 2008).

On the other side, research in political economy has advanced theories on the relationship between the structure of the economy and the policies adopted. The role of inequality and redistribution have been given special attention. A surge of new approaches in understanding political life resulted following the apparent failure of the Median Voter Theorem (Zakharov, 2008) (Lupu and Pontusson, 2011). On the other side, researchers working in the intersection of economics and political science have found more complex ways of looking at these relationships (Korpi, 1989) (Quadagno, 1987).

In order to acquire a richer understanding on the workings of the political economy, the historical relationship between technology, inequality and politics needs to be better understood. Research on this topic is still fertile grounds. This paper will enter as a mediator between the earlier research on the connections between technological change and changes in the structure of the income distribution and the research on the structure of inequality and its relationship with political organization. To accomplish this end, we construct a simple model of the political economy linking new ways of production, via its impact on wage differentials, to the changes in power relationships and ultimately to the policies adopted. We test the hypotheses generated by the model against panel data sets of various policy measures.

In the light of these changes in the macroeconomy and the political economy, the purpose of this paper is to understand the impact of technological change on inequality and the workings of the political economy in general and the selection of economic policies in particular. *Per consequens* our research question is:

Do the beneficiaries of the new economic conditions, induced by skill-biased technological change, improve their economic well-being additionally via an increase in political power?

In order to answer this question we first describe how the observed changes in technology have impacted the structure of the economy and the distribution of income, in

order to then analyze the impact of these changes on the political power of different societal groups. We construct a heuristic model and then test the implications of the model on a panel data set of 10 OECD countries. We find that skill-biased technological change is positively associated with increased inequality and a larger share of people having higher education. A larger share of people having higher education is negatively associated with the rate of unionization. Finally, unionizations is positively associated with redistribution, while a higher share of people having higher education is negatively so.

The paper is organized as follows. In section 2 we provide a literature review on the topics of information and communication technologies, skill-biased technological change, inequality and theories of the welfare state. In section 3 we introduce our model of the political economy. We present our data set in section 4. Section 5 contains a description of our method. Section 6 shows the results from our econometrical analyses. Our discussion of the results is presented in section 7. Section 8 concludes.

2 Literature Review

Following the introduction, in this section we discuss previous research. On account of our paper combining several related fields, it would not be conducive to provide an exhaustive review of all fields, instead we briefly present the major ideas relevant for the further study at hand. We first present the development of modern information and communications technologies, then present research on inequality and its causes, then we go into detail on the research on skill-biased technological change (henceforth SBTC) and its implications, then provide an overview of the development of the welfare state and finally describe theories of inequality and politics.

2.1 Information and Communications Technologies

Before presenting the implications of technological change on inequality we begin with a condensed synopsis of the technological development witnessed since the introduction of the first ever microprocessor in the early 1970s. The American company Intel released its ‘Intel 4004’ in 1971, paving the way for several decades of innovative activity. This was mainly within the field of electronics, but its implications have been far more widespread and in many ways changed the way we think of communication and information sharing in our modern society (for a more exhaustive overview, see (Jovanovic and Rousseau, 2005) and (Schön, 2010)). Investments in Information and communications technologies (ICT) have increased across OECD countries, reaching above 20 % of investments already in 1995 in countries such as the US, Denmark and Sweden. This trend continued in many OECD countries during the late 20th century and early 21st century (OECD, 2013).

Jovanovic and Rousseau define the invention of the microprocessor and its follow-up inventions as a general purpose technology (henceforth GPT) meaning that it exhibits properties of being innovation spawning, pervasive and improving over time. They show that the share of ICT equipment and software in the capital stock increases rapidly from the 1980s and onwards. Moreover, we see that the relative price of equipment to consumption goods tends to fall over time as the GPT develops, which is also the case for the ICT era. It is also notable that the price of computers have fallen much more rapidly than other GPTs, such as electricity. The authors argue that the eras of new GPTs are associated with higher wages for skilled labour and higher interest rates. Higher wages for skilled labour stems from increased relative demand for labour having the skills in handling these new technologies. Interest rates raise both in order to dampen aggregate demand and in response to a higher perception of risk levels, the authors show that the average real interest rate is about 3 % higher during the adoption period of ICT than the period up to the 1970s. In conclusion, the authors find that ICT is a powerful set of technologies that have had a large impact on the economy (Jovanovic and Rousseau, 2005).

2.2 The Societal Distribution of Income: Evidence and Explanations

The structure of the income distribution has changed dramatically since the early 1970s in most Western countries. Following a rapid compression of incomes during the decades following World War II, the distribution again became increasingly skewed towards the right in the decades after 1970. Goldin and Katz compare the income growth for households in different income percentiles in two periods, the first being 1947-1973 and the second being 1973-2005. The data reveal that the income growth of the different income groups have changed significantly, where income growth were equal across groups in the first period, while it accelerated for the richest and slowed down for the poorest in the second time period (Goldin and Katz, 2007). It is important to notice that this analysis is also coherent with both (Förster et al., 2014) and (Katz et al., 1999), whose findings indicate that the income growth increased for the top 1 % while it slowed down for the bottom 99 %. In their major work on top incomes, Piketty et al. find support for these claims, they find a dramatic increase in the share of incomes accruing to the top earners since the 1970s (Piketty et al., 2011). There are several proposed explanations for the recent increases in inequality, with globalization, changed labour market institutions and SBTC being among the more prominent ones.

The effects of globalization have been widely studied and is associated with increased within-country income inequality. The basic insight of the Stolper-Samuelson effect is that countries that are abundant with skilled labour should see their wages increase relative to those of unskilled labour, see (Stolper and Samuelson, 1941). Jaumotte finds that globalization has two opposing effects on inequality: while trade liberalization tends to decrease inequality, financial globalization in general and foreign direct investment in

particular, tend to worsen income inequality. The explanation why financial globalization increases inequality is traced to the fact that FDI tends to be directed towards skill intensive sectors and thus increase the relative demand of skilled labour (Jaumotte et al., 2013). However, Epifani and Gancia find that increased trade can indeed increase the skill premium, on both theoretical and empirical grounds (Epifani and Gancia, 2008).

Another competing theory is that changes in labour market institutions have affected inequality. Emmenegger et al. reason that the deindustrialization (i.e. countries moving towards more service-based industries) of Western countries during the last decades lead to reduced levels of unionization (Emmenegger, 2012). Combined with results presented by Freeman who shows that a reduced level of unionization is found to have a causal effect on increased inequality, as the bargaining power of blue-collar workers declined (Freeman, 1991), this reasoning might partly provide an understanding of the witnessed development. Alderson and Nielsen also find empirical support for the hypothesis that deunionization contributes to increased earnings inequality (Alderson and Nielsen, 2002).

Some scholars argue that changes in migration patterns have affected within-country inequality. The main thrust is that movements of workers with lower skills, facilitated by increased globalization, leads to a wider dispersion of wages in Western countries. Katz et al. provide some empirical support for this partial explanation (Katz et al., 1999), whilst other authors argue that immigration has a trivial or non-existent impact on within-country inequality (Card, 2009) (Korpi, 2008).

The theory that has have gained the most support among researchers is based on changes in the relative supply of educated workers driven by the race between education and technology. Historically, technological change has been rapid but so has the supply of skilled workers, however, in recent decades this trend has changed: the technological development has continued to be strong whilst an educational slowdown has been witnessed.¹ The immediate consequence of this is that the demand for educated workers increases more rapidly than the supply leading to an increase in the skill premium (Mankiw, 2010) (Goldin and Katz, 2009). Moreover, Jaumotte finds that the impact of technological change on inequality is more important than the total effects of globalization (Jaumotte et al., 2013). There are also research finding more complex relationships between globalization and technology, where increased globalization induces more widespread adoption of new technologies, causing changes in relative demand, see for example (Ethier, 2005).

In summary, there are several plausible explanations for the changes in inequality witnessed over the last decades, with varying degrees of empirical support. SBTC appears to be the theory which has consistently been shown to be empirically relevant, consequently, we will focus more on this theory in the next section. Another benefit of the

¹The growth rate of educational attainment has slowed down whilst the growth rate of technology has been stable and positive, thus there is a relative slowdown in growth of educational attainment in relation to the growth of technology and not a decrease in years of schooling.

theory is that it yields clear predictions of what changes in technology are and how it ought to affect inequality.

2.3 Skill-Biased Technological Change

There exists a vast literature detailing the topic of skill-biased technological change. A simple definition of the phenomenon is given by Giovanni L. Violante in his 2008 survey:

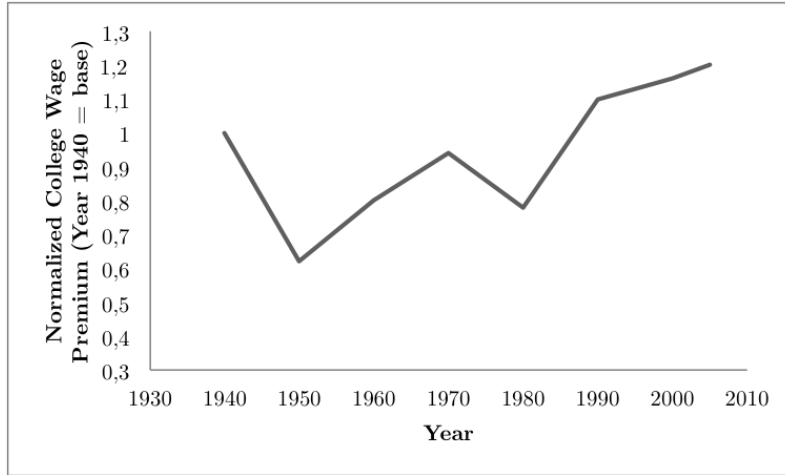
Skill-Biased Technical Change (. . .) is a shift in the production technology that favors skilled (e.g., more educated, more able, more experienced) labor over unskilled labor by increasing its relative productivity and, therefore, its relative demand. (Violante, 2008, page 2)

One of the early influential empirical works on the topic is the 1992 study by Katz and Murphy on relative wages in the US labour market during 1963-1987. They find that the demand for more educated, women, and more skilled workers increased substantially and that inequality between groups rose during the same period. They conclude that one important explanation for this change in relative demand comes from the adoption of new technologies that are skill-biased (Katz and Murphy, 1992). Murphy et al. follow up on the 1992 study and find that relative demand for skilled labour in both the US and Canada has increased as a consequence of technological change, however, they also find that the effect is sensitive to changes in relative supply, i.e. to the number of highly educated people in the workforce (Murphy et al., 1998). In a similar spirit, Berman et al. find international evidence based on 1980-1990 data for the effects of SBTC in developed countries, noticing that wages and relative employment both increased over the period (Berman et al., 1998).

As described above, SBTC is prevalent in macroeconomic data, however, there are also studies showing its presence on the firm level. In an early study on the subject, Bartel and Lichtenberg find that relative demand for skilled workers is higher the more modern the capital stock is (Bartel and Lichtenberg, 1985). Katz et al. find in their classic study from 1999, that there is a positive association between the uses of computers in various industries and the share of college graduates (Katz et al., 1999).

One weakness with the traditional statistical analyses of SBTC is that they generally do not present a theoretical reason why recent changes have been skill-biased. The literature provides three major explanations. The first theory, developed by Nelson and Phelps, starts out from the idea that the adoption of new technologies is costly and that skilled labour can learn to handle these quicker (Nelson and Phelps, 1966) (Greenwood and Yorukoglu, 1997) (Violante, 2008). A contrasting view is presented by Krusell et al.: They argue that new types of capital equipment affect the ways production can be organized. Specifically, they hold that capital equipment can more easily substitute unskilled labour than skilled labour, meaning that the elasticity of substitution is higher for unskilled labour (Krusell et al., 2000). A third way of looking at technology-skill

Figure 1: College Wage Premium



Evolution of the college wage premium in the US.

Calculations based on data from the OECD for the years from 1940 to 2005.

complementarity is presented by Milgrom and Roberts in their 1990 paper. They focus on the fact that ICT has reduced the costs of data storage and communication that pave the way for new organizations of work. More specifically the technological enhancements of ICT have led to more flat organizations based on cross-functional teams that demands more general skills of employees. Thus the introduction of new technologies have led to a skill-bias in organizations of work leading to an increase in the skill premium of highly educated workers (Milgrom and Roberts, 1990) (Violante, 2008).

To summarize, there is now substantive evidence in favour of technological change impacting the relative wages of skilled and unskilled labour, and the debate nowadays concerns why, not if, this is happening. There are various theories with differing analytical *foci*: the Nelson-Phelps view stresses the relative ease with which skilled labour can adopt new technologies giving them a comparative advantage, Krusell et al. focus on the substitutability of unskilled labour and capital equipment and the complementarity of skilled labour and equipment, whilst Milgrom and Roberts look at how the new technologies open up new ways of organizing work and production. Evidence show that all these explanations have some analytical power, see (Violante, 2008).

2.4 Politics and Inequality

This section focuses on the role of the political sphere with regards to the structure of inequality. The first subsection presents a brief historical overview of the development of the post-war welfare states in the Western world. The second subsection discusses different theories attempting to explain the determinants of political outcomes.

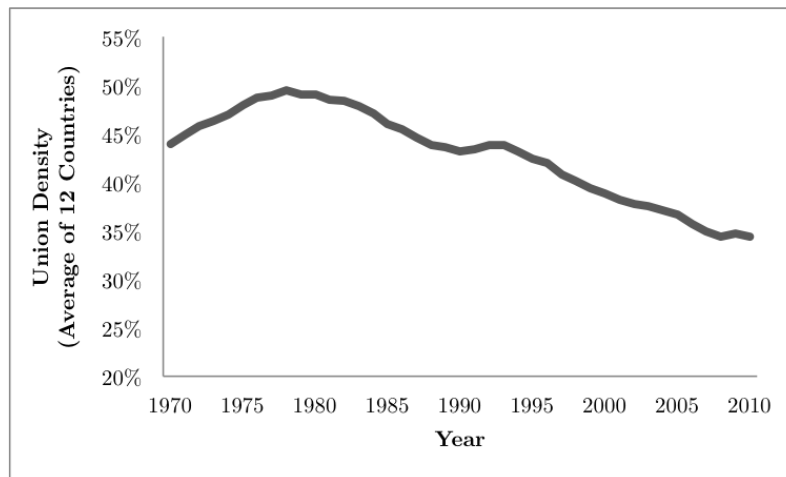
2.4.1 Political Development in the Late 20th Century

This subsection provides a general overview of the political development of the Western world during the latter half of the 20th century, namely the rise of the welfare state after the Second World War and the liberalization of markets and the reduction of the public sector witnessed since the 1970s.

Parallel to the growth of output around the world, driven to some extent by the adoption of new technologies, we have witnessed political changes as well. Following World War II, the Western capitalist societies constructed welfare states built on a foundation of a large public sector put in use to promote economic and social well-being. These policies and the rising social expenditures were associated with widespread dominance of Social Democratic parties or parties conducting progressive politics (Berman, 2006) (Esping-Andersen, 1996).

However, things have changed since the beginning of the 1970s. Policies were associated with weakened welfare states and a general disillusionment in the potency of politics in controlling the macroeconomy (Quadagno, 1987). The 1970s also witnessed changes in labour market regulations and social policies. Deregulations of the labour market in conjunction with increased flexibility have adversely impacted on income inequality. Social policy, which is potent to milden these adverse effects, has not been used in that manner (Emmenegger, 2012). Also, a general trend among western countries has been a rapid deunionization among workers (see Figure 3) and an increased activity among lobbyists and special interest groups, see (Thomas, 2014) and (Smith, 1995).

Figure 2: Union Density



Share of salaried workforce with trade union membership, average value for 12 OECD countries.
Calculations based on data from the OECD for the years from 1970 to 2010.

2.4.2 Theories of Politics and Inequality

This subsection discusses major theories of political economy. It will take off in the canonical Downsian model, discuss its empirical support, and present more successful modern theories.

One of the most influential theories on political competition is the Downsian model (Downs, 1957). The main idea of the theory is that the policies chosen in a democracy will be determined by the median voter. Taking the example with taxes and redistribution, the level of redistribution will be set according to the preferences of the citizen earning the median level of income – if that person earns more than the average level of income, then that person will prefer less redistribution, see (Meltzer and Richard, 1981), (Romer, 1975) and (Roberts, 1977). This hypothesis has been subject to extensive empirical scrutiny, and scholars have repeatedly failed to find substantial empirical support for the theory, see for instance (Gouveia and Masia, 1998), (Rodríguez, 1999), (Larcinese, 2007) and (Pecoraro, 2014). Contrary to earlier predications, more unequal societies do not redistribute more, quite the opposite: more equal societies redistribute more. This phenomenon, dubbed the ‘Robin Hood paradox’ is one of the major problems of the simple Downs–Meltzer–Richards model (Iversen and Soskice, 2009).

As a consequence of the apparent failure of the simple Downsian model on empirical grounds, there are more complex models that attempt to capture the realities of political-decision making. Some models introduce uncertainty either on the side of voters or politicians, others look at the personal characteristics of the candidates and even others analysing the role of political parties. For a good overview, see (Zakharov, 2008).

Lupu and Pontusson provide an alternative way of looking at the societal income distribution and preferences for redistribution. They argue that it is the structure of inequality and not the level of inequality that matters for redistribution, meaning that the focus is on the ratio of middle income earners to low income earners in relation to the ratio of high income earners to middle income earners, rather than the median-to-mean ratio. A rightward shift in the income distribution causing the dispersion of earnings in the upper half of the distribution to increase in relation to the dispersion of earnings in the lower half of the distribution would induce increased preferences for redistributive activities (Lupu and Pontusson, 2011).

There are several mechanisms at work, which is hardly surprising giving the highly complex the nature of political systems. Since the main focus of this paper is the impact of technological change and the structure of the income distribution, we want to work with a framework that captures the changed incentives as a result of changed relative incomes, which can successfully overcome the ‘Robin Hood paradox’. In order to do so, we work with two frameworks focusing on the role of organization, namely theories on power resources and special interest groups. We believe that these two theories are sui-

table for analysing the impacts of large events affecting collectives in society.

The power resource theory (PRT) is based upon the idea that political power is gained from organization and that the resulting political power is different from bargaining power in the market. Collectives that have little market power, e.g. the working class, can mobilize in order to gain political influence and change market outcomes in order to favour itself. This has been used by the working class to organize social democratic parties in order to erect the institutions of the welfare state. It is also important to notice that all groups can organize in order to promote their own interests. For a pedagogical overview, see (Korpi, 1989).

The general view in the literature is that the PRT is the most successful theory in explaining variation in welfare systems between economically developed states (Rothstein et al., 2010) (Iversen and Soskice, 2009). PRT appears to have larger explanatory power than other theories of the development of the welfare state, such as those discussing the importance of economic growth and constitutional structures (Quadagno, 1987). For example (Huber et al., 1993) finds that the strength of Social Democratic parties, seen as a result of working class organization, has substantial explanatory power in explaining the extent of social expenditures and the size of the public sector. (Korpi, 1989) also finds that left governments have a positive impact on the extension of the welfare state.

Another group of theories concerning the impact of organized actions are theories of special interest groups and lobbying. The general idea is that small groups, individuals or organizations, with resources have incentives to organize and attempt to influence either voters or politicians to support policies in their favour. As of today, there exists no general framework for understanding these actions, even though there are many interesting models (Van Winden, 1999). Becker presents a model where different lobby groups compete in buying political power in order to acquire policies benefitting them (Becker, 2008). A later development by Coughlin instead focuses on the incentives of politicians in supporting groups whose electoral support is more uncertain (Coughlin et al., 1990). Other theories focus on the impact of lobby groups on the perceptions of the voters rather than the politicians (Bardhan and Mookherjee, 2000) (Sobbrio, 2011). Thus, even if there is little consensus around the exact nature of the workings of lobby groups, there is little controversy around their impact. As Mulcahy writes for Transparency International:

[A] select number of voices with better resourcing and contacts can come to dominate political decision-making. At the very least, this can skew individual decisions, and at the worst, it can lead to wide-scale institutional and state capture. (Mulcahy, 2015, page 6)

Authors agree on the fact that special interest groups have a widespread influence on political decision-making, but there have been no success in creating a unified framework

in order to understand the mechanisms and the impact of lobbying. However, there are substantial problems associated with empirical testing. In general, it is difficult to operationalize the activities of lobby groups, which has resulted in the usage of different proxy variables. However, they have been criticized for being inadequate (Heckelman, 2000). Studies do show however that lobbying has an impact on the policies conducted and that these activities have increased substantially over the last decades in both the US and the EU (Smith, 1995) (Thomas, 2014).

Thus far, we have not explicitly discussed the role of political parties in the process of political competition. The basic logic of democratic societies is that aggregate preferences will be reflected in the parties or candidates elected into office, motivating parties to adopt policy proposals that are supported by the population. What mainly differs is to what extent other factors affect parties, such as demands from lobby groups, core voters or ideological preferences of party leaders, see (Zakharov, 2008), (Iversen and Soskice, 2006), (Roemer, 1997), (Coughlin et al., 1990) to name a few. Similar to the literature on lobbying, there is no unified framework on account of the topic being too complex. However, the overarching conclusion is that the will of the majority is the most important determinant of public policy.

In conclusion, there are three major macroeconomic changes witnessed since the beginning of the 1970s: the rapid technological enhancement within the field of information sharing technologies, the increased within-country income inequality, where high income earners have attained a larger share of total income, and finally the shift in politics from the ‘welfare state’ associated with a large public sector to a more liberal approach with widespread market deregulations and less public spending. We show that there are several theories attempting to explain these different events. The literature on SBTC develops clear logics of why the adoption of new technologies ought to change the structure of the income distribution. The Median Voter Theorem is a way of explaining policy preferences: while the political mechanism receives weak empirical support, the basic idea that preferences are determined by the distribution of income still appears sound. Power resource theory and theories of lobbying attempt to explain how political organization affects the development of public policy. Ultimately, our task is to combine these different theories into a unified framework that can explain chronologically the developments witnessed over the last decades.

3 Heuristic Model

In this section, we present a heuristic model capturing the effects of technological change on the incentives of various groups to organize politically and their impact on various policy outcomes. The aim of the model is to synthesize the literature described previously in order to explain the chain of events from skill-biased technological change, via changes in the income distribution, to changes in political organization and a shift in

policy outcomes within one framework. Our intended contribution to the literature is to combine the logics of SBTC and political organization in order to overcome the Robin Hood paradox. Section 3.1 presents the premises of the model, based upon the theories presented in the literature review. Section 3.2 then evaluates the effects of SBTC within this model, and concludes with hypotheses. Section 3.3 discusses the assumptions and the boundaries of the model.

3.1 Outline and Premises

We describe the basics of our model in this section. The model is centred around three building blocks::

Development of the Skill Premium: The race between technology and education determines the relative price for skilled and unskilled labour, and thus the structure of the income distribution.

Economic Determinants of Policy Preferences: The structure of the income distribution conditions the distribution of preferences among groups in society.

Political Organization and Policy Outcomes: Changes in the income distribution and the relative sizes of groups give the opportunities to organize and acquire political power as well as the incentives to do so.

3.1.1 Development of the Skill Premium: Technology and Education

The purpose of this building block is to link the adoption of new technologies to the structure of the income distribution in society. We base our model on the theories of SBTC as developed by Katz, Murphy, Krusell et al., Nelson and Phelps, and Milgrom and Roberts.

Firms constitute the central actors in this part, as they choose to upgrade their capital stocks to benefit from new technologies and hire people with differing skill levels to produce goods and services. Here we follow the literature and assume that the adoption of ICT in businesses results in an increase of the relative demand for skilled labour versus unskilled labour. A higher relative demand of skilled labour implies, holding everything else constant, that the relative wage for skilled labour, that is, the skill premium, increases. However, this is not the only consequence of the ICT-revolution, as argued by Jovanovic and Rosseau (2005), we should also see higher interest rates. This increases the income of the capitalists.

This view of the economy implies that we have three broad groups active on the labour market. We follow Teixeira and Abramowitz (2009) and assume that educational level is a suitable proxy for skill level, which is a powerful explanatory variable for occupational

and general socio-economic characteristics (Teixeira and Abramowitz, 2009). Thus the group without higher education, unskilled labour, represents the broad ‘working class’, the educated, skilled labour, are the ‘middle class’, and finally, the capital-owning class are henceforth referred to as the ‘capitalists’.² Still, we assume that the capitalists also have a higher education.

However, while the adoption of ICT represents the demand-side in this project, the supply-side is given by the attainment of higher education among the population. As more and more acquire higher education, we see an increase in the middle class (to be discussed in the next section) and a reduction of the skill premium. In other words, the skill premium, which constitutes the main determinant of the structure of inequality in our model, is jointly determined by the adoption of ICT capital and the rate of graduation from universities. An increased skill premium increases inequality between the working class and the other groups.

3.1.2 Economic Determinants of Policy Preferences

The function of this second building block is to describe the determination of policy preferences among broad groups in society, based upon the structure of the distribution of income. We follow the conventional approach to preferences and assume that they are conditioned by the distribution of income, analysed already in the Downsian model. However, we depart from the political logic of the Downsian model with regards to how inequality affects preferences. In the Downsian sense, the main determinant of policy preferences is the median-to-mean ratio. We choose instead to follow the logic of Lupu and Pontusson (2011) and look at the complete distribution, rather than only the median-to-mean ratio. The determinants of policy preferences are thus the income ratios of the top and the middle, the middle and the bottom and the top and the bottom.

We continue in the tradition of political economy and view voters as essentially rational beings, aiming to maximize their material conditions. This implies that they choose such policies that improve their well-being. However, this should not be interpreted as voters being perfectly informed at all times, on the contrary, lobbying and political advertisements can affect people to vote for the alternative they find to benefit them most.³

Since this paper is focusing on policy outcomes at large, we need to understand the determination of aggregate preferences, or more strictly, the distribution of preferences

²As of today, there is no universally accepted way of measuring socio-economic strata. Still, this proxy based upon educational attainment is sufficient on account of theoretical reasons, as described in Teixeira and Abramowitz (2009), and for empirical reasons, since education data is relatively widely available.

³This paper will not present any sophisticated theory of how voters acquire information, on account of it significantly making the analysis more complex without necessarily giving additional explanatory power.

Figure 3: Two Hypothetical Income Distributions.



within society, rather than the determination of such preferences on the micro level. In general, the capitalists and the working class will be polar opposites with regards to policy preferences for redistribution and the size of government, etc. The middle class, on the other hand, is not such a simple case. The preferences of the middle class is determined by the relative distance between the capitalists and the middle class and the middle class and the working class with regards to income. Moreover, the preference for redistribution of the middle class is not binary, but instead in-between the other two groups. Changes in the preferences of the middle class are generally modest in the direction of one of the two other groups.

If increased inequality increases (decreases) the distance between the middle class and the working class but reduces (increases) the distance between the capitalists and the middle class, then the preference of the middle class for redistribution moves in the direction towards the capitalists (working class) and decreases (increases) somewhat.

To change perspective, policy preferences are determined by changes in the skewness of the income distribution. A change in market outcomes that shifts the income distribution towards the right would then tilt the distribution of aggregate policy preferences as well. Looking at Figure 4, the middle class has become better off compared to the working class, but the capitalists have seen their incomes increase even more. This scenario would lead to the preferences of the middle class moving somewhat towards the working class, thus inducing an increase in preferences for redistribution among the middle class.

It is worth noticing that these are the preferences given by the marking outcomes. However, before voting actually takes place, there are room for organized interests, such as lobby groups and unions, to influence individual behaviour and thus distort policy preferences in any direction. This is further developed in the next section.

3.1.3 Political Organization and Policy Outcomes

To summarize the model so far: The first building block discusses the race between education and technology in determining the structure of the distribution of income, whilst the second building block presents a way to assess how the structure of the income distribution affects the distribution of preferences among groups in society. Finally, this third building block describes how economic outcomes and preferences interact to give incentives and opportunities for people to organize politically, and how this translates into policy choices by political parties and candidates.

In our model, we assume that people seek to improve their welfare both on the market, as workers, and in politics, as voters. On the market, their position is determined by their skill level, whilst it is determined by the party in power in the political sphere. The workings of the economy is described above, here we will focus how and why people try to influence politics. Their incentives to organize come both from the potential gains of organizing and from the extent of free-riding problems.

We are inspired by authors such as Korpi, van Winden and Coughlin in that politics is the conflict between organized interests attempting to persuade politicians and the public to support policies favoured by the organized interests. In theory, this can take forms in various ways. Lobbyists might attempt to influence both parties and voters to support their interests. Meanwhile, workers might organize in trade unions, and create parties promoting the cause of the working class. Our focus will be on the relative organizational power between the three groups that we identify in section 3.1.1.

The organizational power of a group can be analysed in two components, the opportunities for a group to organize and the incentives to do the same. Opportunities to organize and acquire political power is determined by the relative size and the relative share of resources available. With regards to size, a more numerous base of constituents is a power factor in a popular democracy on account of equality before the voting booth. Moving on to resources, a member base with larger incomes opens the door for more resources being available for the organization to organize activities – campaigns or lobbying efforts.

On the other hand, incentives to organize are determined by relative size and the distribution of income. The size of the group being organized is important on account of free-rider problems, where the incentives for the individual to organize is weaker the larger the group at hand is. Moreover, incentives are also determined by the possible gains or losses. A more unequal society has stronger incentives for the working class to organize and redistribute, while it also gives stronger incentives to the capitalists to defend their interests.

While trade unions and party activities are more common for the working class, the

capitalists more often use smaller, more subtle lobby groups. If the power of the working class is more driven by sheer numbers, the power of these groups are more dependent on the amounts of resources available. As the distance between the capitalists and the middle class and working class increases, the incentives for the capitalists to protect their incomes increases.

With regards to the political parties and candidates, we assume that they are sensitive to the influence of organized interests. This can go through several channels: parties might respond to organized interests on account of them being more sensitive voters (cf (Coughlin et al., 1990)), parties might conform to policy proposals to acquire campaign financing, or parties might be linked to the organization, as with Social Democratic parties and trade unions, such that policy ideas go from one to the other. In sum, we abstract from the internal workings of political parties and assume that on the aggregate, the distribution of power is reflected in the policies enacted.

3.2 Analysis

In this subsection we analyse our heuristic model, applying the large macroeconomic changes that have been witnessed since the 1970s, in order to generate testable hypotheses. We start from the race between education and technology and combine that with the rise of the middle class in order to acquire a chain of events predicting how the structure of inequality should have been affected and how policies ought to have changed.

Starting from skill-biased technological change, we have witnessed a substantial decline in relative prices of ICT and improved processor capacities. This increases the incentives to adopt new capital, thus increasing the relative demand for skilled labour. Simultaneously, we have seen an increase in educational attainment, thus spurring the relative supply of skilled labour. The key detail is that the rate of adoption has been higher than the rate of educational attainment. This implies that the skill premium increases, and induces a rightward shift in the structure of the income distribution, i.e., increases the inequality between the working class and the rest. An increase in ICT-adoption also implies a higher rental rate on capital, further increasing the incomes of capitalists.

These changes in relative incomes have implications for the distributions of preferences in society. Since the working class becomes worst off compared to everybody else, they desire more redistribution. The capitalists become more well off compared to everybody else, and so want less redistribution. The middle class, on the other hand, wants more redistribution, on account of their relative income decreasing more compared to the capitalists than it increases compared to the working class. It is important to take into account that even if the middle class do want some redistribution, they do not desire it to the same extent as the working class. In sum, this implies that a majority of the population have preferences for more redistributive policies to some extent. Thus far, our results do not differ from the Downsian model nor from Lupu and Pontusson, on account of

all theories posing a relationship between higher inequality and increased preferences for redistribution. However, we are yet to introduce the political dynamics into this analysis.

The importance of political organization becomes clear on account of our model positing that the policies that are eventually realized are based upon the preferences of the most powerful group in society, which need not be the most numerous group. If we had only analysed the level of inequality, we would not be able to differentiate changes in the distribution of power between large groups in society. Then we would end up with a result generating the ‘Robin Hood paradox’, leading us to arriving at undesirable conclusions. Moving forward, we look closer at the distribution of power by analysing both resources and numerality. We go through the changes for each group in order.

Working Class: As more and more unskilled workers attain a higher education as a result of increased demand for skilled workers, induced by SBTC, we see a relative decline in the size of the working class. In parallel, we see a relative decline in the share of income accruing to the working class. Thus, we see increased incentives to organize, as the relative size declines whilst inequality increases. However, the opportunities to achieve power is dramatically reduced as the relative size is reduced, while at the same time, the working class controls a relatively smaller share of total resources. All this implies that workers’ organizations, such as trade unions and Social Democratic parties, ought to be less successful, e.g. Social Democratic parties ought to have less political influence.

Capitalists: The capitalists mainly see increased incentives to organize on account of their incomes becoming relatively larger than rest of society, and these newfound resources also pave the way for increased lobbying activities. With regards to size, the middle class grows compared to the capitalist group, whilst the working class becomes relatively smaller. Overall, the general impact of technological change on the capitalists is to increase their relative power.

Middle Class: We have two major developments affecting the middle class, it gets larger in relative size and it becomes relatively richer versus the working class, but poorer compared to the capitalists. With respect to political power, we have two aspects to analyse. The opportunities to acquire political power have increased since the middle class has grown and since it has become more wealthy. On the other hand, the impact on the incentives to organize are somewhat more ambiguous: more inequality increases the incentives for the middle class to protect its wealth, whilst an increased size makes mobilization more difficult on account of free-rider problems. However, the most reasonable net effect is that the power of the middle class has increased.

Our model do predict a relative increase in the power of the middle class, in other words, an increasingly powerful group behind more redistributive policies. However, the relative power of the working class is reduced substantially. At the same time, the relative power of the capitalist group increases. The question is in what direction the net effect

will go. Our claim is that the dramatic increase in the incomes of the capitalists allow them to fund lobby groups to such extents that they can influence both politicians and voters so that the middle class, or only parts of it, becomes against redistribution. This is plausible on account of the middle class only desiring a modest level of redistribution to begin with, compared to the preferences of the working class. Conversely, the working class, cannot muster sufficient organizational power to make their wishes go through. In sum, we see a relative decrease in preferences for redistribution. This does not mean that there are no preferences at all for redistributive activities, but merely that the relative power behind less redistribution have increased on account of a weaker working class and a dramatically stronger capitalist group.

Since we assume that parties pick up changes in preferences among the population in order to conduct politics, a decrease in the preference for redistribution would have this effect on the political parties as well. A more powerful capitalist group can expend more resources on lobbying, thus affecting the policies actually conducted by political actors.

To summarize our analysis:

- 1** Increased SBTC changes the relative incomes such that the relative incomes of capitalists to the middle class increase more than the relative income of the middle class to the working class.
- 2** The changes in the structure of the income distribution causes, *caeteris paribus*, increased support for more redistribution by the working class and for some redistribution by the middle class.
- 3** Higher demand for skilled labour incentivizes more people to acquire a higher education, resulting in a growing relative size of the middle class.
- 4** The incentives to reduce redistribution increases for the capitalists, while their resources to conduct lobbying increases simultaneously. Conversely, the working class has larger incentives to support more redistribution, but worse opportunities to realize the demands.
- 5** Lobbying activities from the capitalists persuade politicians and parts of the middle class to support less redistribution, resulting in a sufficiently powerful alliance behind less redistributive policies.
- 6** Political actors respond to changed preferences and power distributions and implement less redistributive policies.

It is worth noticing that it is the political mechanism that is the key in our resolution of the ‘Robin Hood paradox’. Since we argue that the relative ascension of the middle class is insufficient to balance out both the increasingly powerful capitalist group and the weakened working class, the changes in the income distribution need not result in changes in the policies actually conducted.

This analysis contains some logical steps which can be tested empirically. We can divide the chain into three main steps, stated below as three hypothesis. In the ideal case, we would have tested the effects of a changed structure of the income distribution of the actual policy preferences. However, this is not feasible for a large time scale and across countries; we can only test the implications of said policy preferences.

H1 Increased SBTC induces a relatively richer middle class and capitalist group, while at the same time resulting in a growing middle class.

H2 A rightward shift in the structure of the distribution of income and a growing middle class weakens the relative power of the working class.

H3 Less relative power with the working class results in less redistributive policies.

These hypotheses are further operationalized in the sections on Method and Data.

3.3 Limitations and Discussion

In this section we analyse the assumptions of the model and their implications for the robustness. Section 3.3.1 presents the most important assumption, while 3.3.2 problematizes the predictive powers of the model.

3.3.1 Major Assumptions

In this section we discuss those assumptions that we find to be restrictive for our model.

Beginning with political preferences, our model is based upon a harsh categorization of the entire population into three broad groups based upon educational attainment. There are two broad problems with this method, firstly that there are variations within each group, parts of the lower middle class are likely to have more in common with the upper working class than the upper middle class, according to the logic of our framework; secondly, there are other ways of dividing people into politically relevant groups, e.g. urban or rural dweller and religious affiliation. A more fine-grained analysis would no doubt improve the analysis. Still, we do believe that our simple model is sufficient in explaining the larger trends witnessed in the Western world over the last decades.

In addition, we assume that voting behaviour is strictly determined by economic interests, and specifically the material self-interest. Consequently, we disregard from any social preferences for equality or community responsibility, moreover, we also disregard from people's opinions on value-based issues, such as minority rights and environmental issues. These other factors also have an impact on voting outcomes. However, we do believe that this economic view of politics can have explanatory power with regards to broad macroeconomic changes over time. We also disregard any dynamic aspects of the model, in the sense that preferences are formed around the current state of the economy.

Another central assumption is that preferences can be affected by the activities of lobby groups. The qualitative aspect of this assumption is quite reasonable, the part open for the discussion is to what extent lobby groups can impact preferences. However, since the necessary condition for our analysis is that lobby groups can persuade parts of the middle class to change their opinions about redistribution to a small degree, we still find our analysis to be robust to variations in this assumption.

A major point in our framework is that political power is mainly determined by relative organizational power between groups in society. This view is motivated on account of models assuming a smooth link between economic interests and policy outcomes having failed to generate empirical support. Two major drawbacks with this approach are that we do not take into account other organizations in society that also affects policy, such as employer's associations or that we do not allow for cross-class cooperation. Both these drawbacks imply that our model is necessarily confrontational and focused on conflict. A more nuanced approach would recognize the possibilities for cooperation in politics. However, we believe that such a confrontational view is motivated on account of SBTC being a process about polarizing the labour market and changing the distribution of income.

Parties do not receive much attention in our model, we mostly consider parties, candidates and the state itself as passive in the political process. A large amount of literature shows that this is indeed not the case. Candidates and bureaucrats have their own interest to promote, and simply imagining them to be loyal agents to the people is too much to ask. Still, introducing such mechanisms would complicate the model substantially, and we argue that it is still reasonable to assume that changes over longer periods of time are substantially determined by organizational features of the population. In addition, by looking empirically within individual countries, we can reduce the effects of bureaucratic structures and political cultures.

3.3.2 Modelling Boundaries

One of the major drawbacks with this modelling setup is the lack of dynamic effects, in the sense that innovations today and subsequent policy implementations do not have any implications for new innovations, which is important in real life. However, this lack of dynamism does not make the model less powerful in understanding the developments that we have actually witnessed.

The scope of this model is mainly limited to the societies of the Western world, since it is implicitly modelled on countries with democratic governments and such labour institutions that are prevalent in these countries. It can thus be argued that the model has weaker explanatory power with regards to societies with other kinds of institutions. This is not a problem per se, but rather limits the conclusions we are able to draw.

Moreover, since the model is based upon the diffusion of ICT, it is also questionable how satisfactory the model's predictions are with regards to earlier and later technologies, if they do not have similar impacts on economic and political life. In other words, the model is theoretically limited in both space and time to the industrialized world and the decades from 1970 and onwards. Nevertheless, it does not appear implausible to believe that some general ideas can be found about the relationship between technology, inequality and political power.

To summarize, we are well aware of the limitations of our modelling framework, where our behavioural assumptions of voters and political parties are especially restrictive. Nonetheless, we believe that the assumptions are reasonable and that they allow us to conduct plausible empirical tests within the scope of this paper.

4 Data

We use a panel data set on 10 OECD countries using data from the years 1980-2012 in order to conduct our main analysis. The first subsection discusses the scope of our data collection, while the second one details the variables and their sources, the third one provide some descriptive statistics, and, finally, the fourth subsection handles the problems associated with our data set.

4.1 Scope

This subsection discusses the scope of our empirical analysis: what we look at, and what limits our approach. When determining which countries and years to look at that, we believe that there are three main factors which are important to be able to conduct a fruitful analysis. The three factors are economic development, political structure and data availability.

Data Availability: Since the regressions heavily relies upon long time-series, we are only able to use data from the countries with largely available data. It is the case that the measurement of ICT capital is the most difficult variable to acquire data on. We have excluded countries with insufficiently extensive ICT records. We believe that it is important to have long time-series, otherwise our results might not be representative on account of us only having observations from a few years, especially since we expect the policy effects to be lagged compared to the introduction of ICT.

Economic Development: Only countries with developed economies are included in the data set. We choose this criterion on account of SBTC being most prominent in rich countries, and it being in these countries where we expect to see the effects of wage polarization. However, this criterion does imply that we lose out the effects of the adoption

of the new technologies in developing countries. However this falls outside the scope of this essay, even if it opens up new areas of research.

Political Structure: We choose to only work with countries that have been stable democracies for several decades. This is motivated on account of our model requiring preferences being transmitted into policy via electoral politics, which is exclusive to democratic societies. Consequently, countries that are dictatorships are excluded from the sample.

In the end, it is data availability that is the most important criterion. Within the scope of this paper, the most important variable is ICT development, which is the most difficult variable to acquire extensive panel data on. There are several data sets recording ICT, however, these show radically different measures of ICT development even for the same country the same year, implying that merging data sets would be unsatisfactory. We choose to work with one data set covering 15 countries over the years 1970–2012, the EU KLEMS project.⁴ Out of these fifteen countries, we choose to exclude five countries: the Czech Republic, Germany, Slovenia, Spain and Sweden. The reason for excluding the Czech Republic, Germany, Slovenia and Spain is that they have not been stable democracies for longer periods of time. The Czech Republic became democratic in 1993, Germany was reunited in 1991, a merger that would change the economic conditions of the united Germany, Slovenia became independent from Yugoslavia in 1991, and Spain transitioned to democracy in 1978. Sweden is excluded on account of the short time-series available.

With regards to the temporal dimension, we choose to work with the years 1980–2010. One could argue that the analysis should be extended back to 1971, when the ICT revolution took off. However, there are both theoretical and practical reasons for waiting until 1980. Firstly, we do not expect to see immediate economic or political effects of the ICT revolution, on account of the technologies needing to diffuse in the economy until we expect any effects on hiring practices, wages and politics. Secondly, ICT data, as well as other data, is substantially more exhaustive from 1980 than 1970, implying that we can make more extensive empirical analyses.

It is worth commenting on the consequences of our criterion of data availability, since it might induce bias on account of the countries being chosen. The selection of countries from the EU KLEMS project is beyond our reach. However, it is not implausible to think that richer countries can spend more resources on data records, increasing the probability of them having sufficiently detailed data to be included in the EU KLEMS project. However, since the countries we are interested in are already economically developed, we do not believe that this confounds our results to any greater extent.

⁴As of today, the project has extensive data on capital stocks for Australia, Austria, Canada, the Czech Republic, Denmark, Finland, Germany, Italy, Japan, the Netherlands, Slovenia, Spain, Sweden, the United Kingdom and the United States.

4.2 Variable Description

The following subsection presents our most important variables, their sources and potential data problems.

Our central variable of interest is a measurement of aggregate adoption of ICT by businesses that is comparable across time and space. A simple way to accomplish this is to relate the size of the fixed assets of computing equipment, communications equipment and software to the size of the total capital stock. The purpose of such a measurement is to express the importance of ICT in the economy. This also implies that the proposed ratio could lose explanatory power if the denominator would increase substantially for reasons not related to growth of the real economy. For that reason we choose to exclude residential structure from the total capital stock, since that sector might be subject to speculation. Consequently, our preferred ratio of choice is thus the share of ICT capital of non-residential fixed assets (labelled ‘ICTNRA’).

One project that have aggregated fixed assets is the aforementioned EU KLEMS project, which aims to gather data on growth, capital and employment across European Union member states from the 1970s (O’Mahony and Timmer, 2009). Fortunately, the project also covers Australia, Japan and the United States, which implies that we have access to a data base covering developed countries for a substantial period of time. Our measurement of ICT as a share of total non-residential fixed assets (ICTNRA) is:

$$ICTNRA = \frac{Computing\ Equipment + Communications\ Equipment + Software}{Fixed\ Assets - Residential\ Structures}$$

For inequality we use several variables. Our main two measurements of the structure of the income distribution are two ratios of gross earnings between two percentile groups. We include both the 90/50 ratio and the 50/10 ratio. the ratio of the 90th percentile to the 50th percentile and the ratio of the 50th percentile to the 10th percentile. This measurement comes from the ‘Comparative Welfare States in the 21st Century’ (Brady et al., 2014). The 90/50 ratio is supposed to capture the divide between the highest-earners and the middle class, while the 50/10 ratio is supposed to capture the divide between the middle class and the working class. Since we believe that both ratios are important, we also include a combined measure of the ratio of the P90P/P50 ratio to the P50/P10 ratio. We follow Lupu and Pontusson and call this variable ‘skew’. A level of skewness above one implies that the relative distance between the capitalists to the middle class is larger than the distance between the middle class and the working class.

Moving on, we will also include a set of control variables believed to influence inequality that consists of trade openness and financial openness. For trade openness, we follow the literature and use the sum of imports and exports as a share of GDP as a proxy for trade openness. This is a measure of the *de facto* trade going on and can thus be seen as

reflecting trade policy as well. Since we are only using the within-country variation, we do not need to worry about other factors affecting the propensity to engage in trade with foreign countries; in other words, we find this measurement as a good proxy for trade openness. Moreover, this measurement is widely available and probably suffers trivial measurement errors. We use data on imports, exports and GDP from the OECD data on national accounts, implying that we have little problems with missing values (OECD, 2015)

Financial openness, is not as easy to capture. One proxy is to use the stock of net foreign assets as a share of GDP, which thus attempts to measure the role of foreign holdings for a country. Data on this variable is readily available from the World Bank (World-Bank, 2015)

We also need to complement our measure of ICT with a measure of the relative supply of educated labour. In order to do this, we use an estimate of the share of people aged 25 years and above that have achieved a tertiary education. This data comes from (Barro and Jong-Wha, 2010). The authors do recognise a lack of comprehensive educational data, but still estimates that they can reconstruct actual levels based on the data available. We use this measure as a proxy for the share of the population with a higher skill level, which we also identify with the broad middle class. Since we believe that the capitalist group also is educated, this variable will measure the size of both the middle class and the capitalist group. However, since we believe this latter group is relatively small, we still find this proxy satisfactory.

With regards to organizational power, the ultimate measurement is the policies actually implemented or the parties in power. However, such variables would not make for any fruitful analysis since the policies are the dependent variables of interest. Following Korpi (1989), we are left with measurements of organization, which are relatively scarce. The only widely available data are on unionization and Social Democratic votes (called ‘Left Vote’ in the data set), which would then be a measure of the organizational power of the working class. We use data from the OECD and the ‘Comparative Political Data Set’ (CPDS) to measure this. Unionization is the ratio of wage earners in unions to the total number of wage earners (OECD, 2015);(Armingeon et al., 2014).

We choose to include policy variables that can be readily quantified in order for our hypotheses to be testable; using qualitative variables would risk such low levels of variation that the regressions would be trivial to run. The variables we choose are tax revenues and social expenditures. These variables have been chosen since they can be considered good proxies for the redistributive policies discussed in our model, higher taxes and more social expenditures are usually associated with more redistribution. On account of these variables stemming from government activities and being highly aggregated, we find it unlikely that they should be associated with any extensive errors. The data are from the OECD (OECD, 2015).

We also choose to include year dummy-variables in order to control for time effects which are not completely time-invariant, this will allow us to reduce omitted variable bias stemming from the highly complex nature of the relationships we are analysing.

In the ideal case, we would have wanted to include a variable measuring net migration rates. However, we were unable to acquire data for a sufficient number of consecutive years, inducing us to exclude the data, lest risking biased results from extensive cases of missing data.

Table 1: Variable Overview

Variable	Description	Source
Country	10 OECD countries	–
Year	Varying, 1980-2010	–
ICTNRA	ICT fixed assets as percentage of total non-residential fixed assets	OECD and national agencies
Tert Share 25	Share of the population aged 25 and above having finished tertiary education	Barro and Lee (2011)
Union	Share of salaried workforce with trade union membership	OECD
P90/P50 Gross	Ratio of the incomes of the 90th percentile to the incomes of the 50th percentile before taxes and transfers	CWS
P50/P10 Gross	Ratio of the incomes of the 50th percentile to the incomes of the 10th percentile before taxes and transfers	CWS
Gross Skew	Ratio of P90/P50 Gross to P50/P10 Gross	OECD
Tax GDP	Tax revenue as percentage of GDP	OECD
Left Vote	Share of popular votes for a Social Democratic party	CPDS
Soc Exp GDP	Total social expenditures as percentage of GDP	CPDS
Dependency Ratio	Number of people aged 15-64 over the total population	OECD
Gini Post-Transfers	Gini coefficient after taxes and transfers	OECD
GDP Growth	Yearly growth in GDP (expenditure approach)	OECD
Employment Ratio	Civilian employment as percentage of population 15-64	CPDS
TradeGDP	Imports and Exports as percentage of GDP	OECD
NFAGDP	Share of net foreign assets as percentage of GDP	World Bank

Table 1 – The table contains a list of the variables used in the empirical section.

4.3 Descriptive Statistics

In this subsection we present an overview of the data we have collected. In general, the data in our sample exhibit the same trends as expected from previous research and our model. A table of cross-correlations between the most important variables is presented in the Appendix (Table 11).

Our central variable of interest is the share of ICT capital of total non-residential fixed assets (ICTNRA). A striking conclusion is that ICTNRA increases substantially in all countries, starting off with less than 5 % in all countries in 1980, and varying around 17 % in 2010. Moreover, the increase accelerates in the mid-1990s, and is followed by a decrease or slowdown during the late 2000s. The mean level of adoption in 1980 is 1.4 %, 4.6 % in 1995 and 16.6 % in 2010⁵. Another interesting feature of the sample is that the inequality of ICT adoption increases over time, in 1980, the standard deviation of ICTNRA is 0.006, whilst it increases to 0.024 in 2010. We interpret this as that ICT increases in all countries, but that its rate of adoption is unequally allocated between countries. Such developments is quite expected, the ICT revolution has affected a broad set of countries, but it usually takes time for new technologies to diffuse around the world.

Looking at the structure of inequality, we need to look at three measurements, the gross ratios of the 90th percentile to the 50th percentile as well as the 50th percentile to the 10th percentile, and also the skewness of the distribution, measured as the ratio of the P90/P50 to the P50/P10 ratios. The P90/P50 ratio increases continuously over the period 1980-2010, with a mean level of 1.733 in 1980, 1.825 in 1995 and 1.992 in 2010. The P50/P10 ratio is virtually unchanged between 1980 and 1995, and then increases somewhat between 1995 and 2010. Not surprising, we also see an continuous increase in the skewness of the distribution as well, from 1.012 on average in 1980 to 1.129 on average in 2010. Worth noticing is that the standard deviations of all measures of inequality increases over the period, indicating an increasing spread in the distributions of income. This is in line with the idea that SBTC increases both the relative incomes of the middle class, and the relative incomes of the capitalists.

Moving on to our variables looking at the organizational power of the working class, we have both the rate of unionization and the electoral support from Social Democratic parties. The share of workers with membership in unions decline over the period from 1980-2010 from an average value of 0.474 in 1980 to 0.321 in 2010. The same trend is visible for the share of Social Democratic votes, declining from 0.278 on average in 1980 to 0.184 on average in 2010. These two declining trends are also in line with the expectations from our model.

Our proxy measure for the size of the middle class is the share of people over the age

⁵Only 2 countries have records of ICT adoption in 2010. However, the upwards trend is evident if one looks at data for 2005. See Table 12 in the Appendix.

of 25 that has attained a tertiary education. This share increase substantially from an average value of 0.144 in 1980 to 0.32 in 2010. Such developments are not surprising, given the substantial increase in the relative supply of skilled labour. We also see an increased standard deviation between the different countries, implying that the growth has been unequal.

On the policy side we see increases in government activities until the late 1990s, and afterwards we see smaller changes. Social expenditures as a share of GDP increases from an average level of 0.174 in 1980 to 0.217 in 1995, and then increases somewhat to 0.237 on average in 2010. In other words, the large expansion is between 1980 and 1995. Looking instead at government transfers as share of GDP, we see an increase from an average value of 0.109 in 1980 to 0.124 in 1995, and then a modest increase to 0.129 on average in 2010.

Table 2: Summary statistics 1980

Variable	Obs	Mean	Std. Dev.
ICTNRA	10	.014	.006
Union	10	.474	.176
Tert Share25	10	.144	.086
P90/P50 Gross	10	1.733	.089
P50/P10 Gross	10	1.713	.09
Gross Skew	10	1.012	.024
SocExpGDP	10	.174	.058
TransferGDP	10	.109	.054
LeftVote	10	.278	.16

Table 2 – The table contains descriptive statistics of selected variables for the year 1980.

Table 3: Summary statistics 1995

Variable	Obs	Mean	Std. Dev.
ICTNRA	10	.046	.013
Union	10	.399	.215
Tert Share25	10	.216	.108
P90/P50 Gross	10	1.825	.127
P50/P10 Gross	10	1.713	.158
Gross Skew	10	1.067	.035
SocExpGDP	10	.217	.055
TransferGDP	10	.124	.059
LeftVote	10	.229	.16

Table 3 – The table contains descriptive statistics of selected variables for the year 1995.

Table 4: Summary statistics 2010

Variable	Obs	Mean	Std. Dev.
ICTNRA	2	.166	.024
Union	10	.321	.201
Tert Share25	10	.32	.132
P90/P50 Gross	7	1.992	.172
P50/P10 Gross	7	1.766	.165
Gross Skew	7	1.129	.043
SocExpGDP	9	.237	.047
TransferGDP	10	.129	.059
LeftVote	10	.184	.133

Table 4 – The table contains descriptive statistics of selected variables for the year 2010.

4.4 Potential Problems

Here we discuss the problems associated with our data sample.

We discuss the limitation of our measure of ICT adoption in section 4.1, here we comment upon our way of handling the data. The EU KLEMS project is in the transition of updating the data records between two versions of industry classifications. Data for the old system ended in 2008, and only some countries have been updated. Our base case is to use the old system, since those time-series were often longer, only adding the new series when it yields additional observations. Generally, the difference between the versions is small, and in order to obtain a larger data set, we chain link the series using overlapping data.⁶ We can not observe that the use of this method produces any visible unexpected changes to the data, however, there is always the possibility that the new data set is biased.

The data on tertiary education only has reports from every five years. In order to create a complete data set, we simply assume that the values for the observed years are unchanged until the next observation period. We do not believe that this has induced any bias on account of the five-year variations not being substantial.

Our two measures of relative incomes, P90/P50 and P50/P10, are treated in order to reduce the occurrence of missing values. The CWS presents two series for each measure, which are partially complementary. Similar to the case for ICTNRA, we merge the two series when the number of observations differed between them. We do not believe that the use of this method has produced any visible trend shifts in the data, indicating that

⁶On account of the two data sets on ICT data being collected under similar circumstances, we follow conventional ways of linking them by using chain linking, see (OECD, 2004). In order to improve the accuracy, we follow the recommendations of (Goodwin, 2009) and used the average common value instead of just the value of the first common period.

it does not produce any major problems. For missing values of only one year, we extrapolate using a linear time trend, motivated on account of the data only showing small year-to-year variation.

We have not been able to collect data on net migration that are satisfactory with regards to the amount of observations. Some authors claim that net migration can explain variations in inequality. However, on account of the disagreement on the effect of net migration, with many scholars arguing that it does not have any impact, we do not believe that the exclusion of this variable will induce any problems. It is worth noticing that it would have been possible to extrapolate using a linear trend, however, we abstain to do so since we fail to identify any clear patterns, on account of the substantive variations between the observed values.

5 Method

This section details our empirical approach in testing the hypotheses extracted from the model described in section 3. The first subsection presents the preliminaries with respect to what we aim to accomplish with the empirical investigation. The second subsection presents the estimator we will use with a corresponding discussion of its qualities. In the final subsection, we critically evaluate our empirical approach as well as discuss other approaches.

5.1 Preliminaries

The purpose of the empirical part is to subject the logic of the theoretical model presented earlier to the data in order to test to what extent the theory corresponds to the facts of the real world. More concretely, the objective is to fulfill the original research question in this paper, which is worth restating:

Do the beneficiaries of the new economic conditions, induced by skill-biased technological change, improve their economic well-being additionally via an increase in political power?

In order to operationalize the broad research question we construct a model that relates the race between education and technological adoption to incentives and possibilities for political organization and the consequent impacts on policy choices. We use the model to generate three hypotheses, which are the following:

- H1** Increased SBTC induces a relatively richer middle class and capitalist group, while at the same time resulting in a growing middle class.
- H2** A rightward shift in the structure of the distribution of income and a growing middle class weakens the relative power of the working class.

H3 Less relative power with the working class results in less redistributive policies.

5.1.1 Model Specification Hypothesis 1

The first hypothesis can be decomposed into four classes of regressions. The first class relates the ratio of gross incomes between the middle class and the working class, proxied by the P50/P10 ratio, to the level of ICTNRA. Our hypothesis is that the coefficient of ICTNRA is positive.

$$\left(\frac{P50}{P10}\right)_{it} = \beta_0 + \beta_1 ICTNRA_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (1)$$

The second class relates the ratio of gross incomes between the capitalists and the middle class, proxied by the P90/P50 ratio, to the level of ICTNRA. The hypothesis is that the coefficient on ICTNRA is positive on both ratios but that the coefficient is larger on the P90/P50 ratio.

$$\left(\frac{P90}{P50}\right)_{it} = \beta_0 + \beta_1 ICTNRA_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (2)$$

The third class looks at the relationship between the skewness of the income distribution and the level of ICTNRA adoption. Our hypothesis is that the coefficient on ICTNRA is positive.

$$Skew_{it} = \beta_0 + \beta_1 ICTNRA_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (3)$$

For the above regressions, X is a vector of control variables, i is the index for country panels and t is a time index. a is a time-invariant factor and ε is a time-variant error term. The control variables are mostly other factors believed to affect inequality, such as trade and financial openness, education levels and unionization.

The fourth class analyses the relationship between the size of the middle class, proxied by the share of 25 years and above having finished tertiary education, and ICTNRA. The hypothesis is that the coefficient on ICTNRA is positive.

$$Tertiary\ Education_{it} = \beta_0 + \beta_1 ICTNRA_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (4)$$

We include control variables which are believed to affect educational attainment, such as globalization and relative incomes, as proxies for the skill premium.

5.1.2 Model Specification Hypothesis 2

In order to operationalize the second hypothesis, we use two measurements of the power of the working class, unionization and electoral support for Social Democratic parties. Our independent variables are the share of the middle class, as proxied by the share

with tertiary education, and the structure of the income distribution, as proxied by the P50/P10 ratio. Our hypotheses are that tertiary education is negatively associated with the rate of unionization, and that the P50/P10 is positively associated with the rate of unionization, as the incentives for the working class to organize (as mainly done via trade unions), increases with increased inequality.

$$Union_{it} = \beta_0 + \beta_1 Tertiary\ Education_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (5)$$

Our second class is a robustness check, where we use the vote share of Social Democratic parties instead of unionization as proxy for the power of the working class. We have the same hypotheses as for the case where the rate of unionization is the dependent variable.

$$LeftVote_{it} = \beta_0 + \beta_1 Tertiary\ Education_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (6)$$

The control variables in these two cases are various measures of relative incomes, and for the share of votes we also include the rate of unionization. We include inequality since it is expected to affect the incentives for the working class to organize and act, while unionization is included since higher levels of unionization ought to imply increased support for parties promoting the cause of the working class.

5.1.3 Model Specification Hypothesis 3

Moving on, the third hypothesis is evaluated by measuring the impact of our proxies for political power on different policy measures, social expenditures, tax revenues and transfers. Our consistent hypotheses are that the coefficients on unionization, the share with tertiary education and the P50/P10 ratio are positive, negative and negative, respectively.

$$TaxGDP_{it} = \beta_0 + \beta_1 Union_{it} + \beta_2 Tertiary\ Education_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (7)$$

Here we look at a variety of variables which might plausibly affect the level of tax revenues. Unionization, education and distributional measures are our proxies for the joint effect of preferences and power. In order to account for the complexity surrounding a regression of this sort, we also choose to include a variable for each year to filter out year-to-year variations.

$$TaxGDP_{it} = \beta_0 + \beta_1 ICTNRA_{it} + \beta X_{it} + a_i + \varepsilon_{it} \quad (8)$$

5.2 The Fixed Effects–Estimator

In this subsection, we discuss our choice of estimator to use in the empirical approach. In the simplest case, we could simply regress the effect of, for instance, SBTC on the structure of inequality, with appropriate control variables. However, there are likely

factors affecting the countries across time that we cannot control for. Many of these are might be time-invariant, or, at least time-invariant across the 30 years we are analysing. One important set of factors we believe to be invariant are cultural factors, both regards to values at large, such as religious values, but also what concerns the political climate in particular. These factors likely cannot be accounted for on account of them being subjective and hard to quantify. Failure to account for this likely results in a substantial problem with omitted variable bias.

One relatively straightforward way to account for this issue is to use the Fixed Effects-estimator (FE). The logic of FE is to remove all time-invariant factors by estimating only using the deviation from the average values for each panel. In our case, FE estimates the average effect of an independent variable deviating from the average variable for that country on the deviation from the average for the dependent variable for that country. Since the average value of any time-invariant factor is the same across all years, the deviation from the average will always be zero. Consequently, the impact of any such variable is eliminated from the regression, and consequently cannot induce any omitted variable bias.

The central assumption needed for FE to yield unbiased estimates is the assumption of *strict exogeneity*, namely that the error term (i.e., the part of the error term varying over time) is independent of the independent variables for all values across time, $E[x_{it}, u_{it}] = 0$. We will further discuss the nature of our regressions in the results section, still, the way we gather, it is not unreasonable to assume that our estimated coefficients will be unbiased.

Our usage of FE might induce two problematic situations. The first one is that the total variation is reduced. Since FE only compares values against the average value within countries, we will only estimate using the variation within countries, i.e., we lose the variation between countries. This does not risk any biases, however, it might weaken our opportunities in receiving statistically significant results. Nonetheless, since we do believe that time-invariant factors are at hand, there is little else to do but accept the reduced variation, or risk biased estimates. The other problem comes from possible correlations across the time-invariant factors. In order for FE to yield unbiased estimates, we need the factors that are constant across time to be uncorrelated across countries. Since cultural and religious factors are shaped by historical and accidental factors it is not unreasonable to assume that these are uncorrelated across countries. Political culture is also likely to be national since they are affected by historical political activities. However, Protestant countries having developed extensive welfare states, such as Norway and Finland, might have similar political and cultural experiences affecting people today. Even if this is the case, Norway and Finland have different political histories, which then results in them having different political cultures. To sum up, the actual correlation between time-invariant factors is unclear, but we do believe that the assumption of zero correlation is not unreasonable.

5.3 Critical Discussion

Here we present some of the main problems facing our empirical approach, namely the difficulties associated with finding causality, unbiased estimates and dealing with heteroskedasticity and cluster.

Our topic is complex and the relationships we pose to analyse are not always clear-cut on the theoretical side, e.g. more people having higher education might be both a precondition for the adoption of ICT as well as a consequence as more ICT increases the incentives to achieve higher education. This complexity makes it more difficult in disentangling causal relationships using simple econometrical models. Consequently we have to be careful in not drawing too strong conclusions from the regressions results about actual relationships. Still, we do believe that finding relationships in line with those hypothesized by our model is a first step in finding the mechanisms actually at work.

Another central problem is the case of unbiasedness: even though we include relevant and plausible control variables, it is highly unlikely that we control for everything that could be controlled for, indeed, some variables might not even be possible to control for at present. The usage of proxy variables further complicates this if they are not perfect proxies for the variable, we might have inconsistent estimates. Nevertheless, our way to handle these problems is to remain cautious in our interpretations and include robustness checks in order to further shed light on the plausibility of our results.

Finally, we comment upon the potential problem of heteroskedasticity and clusters. On account of our data set only having 10 panels⁷ (i.e. countries) we might induce bias by using clustered or heteroskedasticity-robust standard errors. This choice does heighten the uncertainty required when interpreting the results. However, we still find this approach sufficient for our current purpose.

6 Results

In this section we present our empirical results, starting with the relationship between inequality and various macroeconomic trends, then the relationship between inequality and various policy outcomes, and, ultimately, the relationship between SBTC and our policy outcomes of interest.

⁷The general rule-of-thumb when using clustered standard errors of *panels* ≈ 50 is far from satisfied.

6.1 Skill-Biased Technological Change, Structure of the Distribution of Income and the Growth of the Middle Class

Our first set of regressions analyse the relationships between SBTC and the structure of the income distribution as well as SBTC and the size of the middle class. Looking at Table 5 we can generally reject the hypotheses that ICTNRA has no impact on the income ratios; ICTNRA is positively associated with both the P50/P10 ratio and the P90/P50 ratio and significantly so at the 1 % level, and positively associated with the skew, yet only significant at the 10 % level. The estimates are also consistently higher for the P90/P50 ratio than for the P50/P10 ratio.

Moving on to economic significance, ICTNRA appears to have a non-trivial effect as well. Looking at the first regression, an increase in ICTNRA by one percentage point is associated with an increase in the P50/P10 ratio of 0.00251. Noticing that the average increase in ICTNRA is roughly 15 percentage point, this leads us to conclude that the change in ICTNRA is an important determinant of the variation in the P50/P10 ratio. Since the effect on the P50/P10 ratio is estimated to be smaller than on the P90/P50 ratio, the variable ICTNRA is even more economically significant in explaining the variation in the upper half of the income distribution. Looking at the final regression, we see that a one percentage point increase in ICTNRA is also relevant when discussing the skew.

Looking at the other explanatory variables, we see that trade openness, as proxied by imports and exports over GDP, appears to be an important explanatory variable in most model specifications. Its point estimates are negative for the P50/P10 ratio but positive for the P90/P50 ratio. Still, the coefficients are consistently smaller than the coefficient on ICTNRA, indicating that trade is a less important factor in explaining variation in the income ratios. It is also worth noticing that the lagged income ratios are both statistically and economic significant, however, this is hardly surprising, given the high correlation in year-to-year measures of the relative incomes.

Given the substantial theoretical support for the relationship between the relative incomes and ICT adoption, the fundamental logic of SBTC, we are likely to have a causal relationship between these variables. Rather, it is the size of the effect that is more interesting to analyse. Our robustness checks show some variation in the coefficients on ICTNRA, indicating that the we have not captured the exact effect. The effect still seems to be positive and economically significant.

With regards to the size of the middle class, as proxied by the share of people 25 years and above having received tertiary education, we can also reject the null hypothesis that higher adoption of ICT does not increase the size of the middle class (see Table 6). A one percentage point increase in ICTNRA is associated with an increase in the share of 25+ having finished higher education by 0.5 percentage points. This result is both

statistically significant at the 1 % level across our model specifications and moderately consistent across the models. This point estimate is also economically relevant, since the standard deviation of tertiary education across the year varies from 0.086 to 0.132. In addition, the coefficient estimates on trade and net foreign assets are statistically and economically significant across all specifications, even though the estimates are smaller than the coefficient on ICTNRA.

It is unlikely that we have found causal estimates from ICT to a growing middle class, even though there are sound theoretical reasons. The possibility for reverse causality is glaring: more educated people open up new possibilities for companies to adopt new technologies, since they need people to handle and use them. Moreover, globalization also leads to more educated people being able to move around in the world, inducing the partial correlations between trade, net foreign assets and education. We do have robust estimates on ICTNRA between the model specifications, which increases the likelihood of us having unbiased estimates. In essence, we do have a situation of a widespread increase in educational attainment, however, it is far too soon to draw any conclusions on the directions of causality.

Table 5: Fixed Effects–Regression on the Determinants of Relative Incomes

VARIABLES	P50/P10 Gross	P50/P10 Gross	P90/P50 Gross	P90/P50 Gross	Gross Skew
ICTNRA	0.251*** (0.0796)	0.142** (0.0582)	0.582*** (0.0913)	0.336*** (0.0870)	0.132* (0.0730)
TradeGDP	-0.150*** (0.0295)	-0.0324 (0.0230)	0.212*** (0.0338)	0.181*** (0.0305)	0.240*** (0.0271)
NFAGDP	0.0282 (0.0257)	0.0269 (0.0187)	-0.0658** (0.0295)	-0.0585** (0.0263)	-0.0580** (0.0236)
Union	0.0305 (0.0491)	0.0270 (0.0363)	-0.0565 (0.0563)	-0.0485 (0.0512)	-0.0657 (0.0450)
Tert Share 25	0.169** (0.0735)	-0.0260 (0.0554)	0.358*** (0.0843)	0.233*** (0.0770)	0.0844 (0.0675)
P50/P10 Gross Lag		0.617*** (0.0417)			
P90/P50 Gross Lag				0.332*** (0.0412)	
Constant	1.725*** (0.0283)	0.659*** (0.0750)	1.642*** (0.0325)	1.088*** (0.0741)	0.954*** (0.0260)
Observations	274	271	274	271	274
R-squared	0.121	0.531	0.803	0.842	0.678
Number of Countries	10	10	10	10	10

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 5 – The table contains regression results using the FE estimator, estimating the relationship between different measures of relative incomes, ICT adoption and control variables.

Table 6: Fixed Effects–Regression on the Determinants of the Share of Tertiary Education

VARIABLES	Tert Share 25	Tert Share 25	Tert Share 25
ICTNRA	0.500*** (0.0578)	0.464*** (0.0643)	0.551*** (0.0582)
TradeGDP	0.109*** (0.0242)	0.0673*** (0.0238)	0.0645** (0.0281)
NFAGDP	0.103*** (0.0200)	0.108*** (0.0202)	0.113*** (0.0207)
Union	-0.0172 (0.0408)	-0.0166 (0.0413)	-0.0183 (0.0415)
P50/P10 Gross Lag	0.185*** (0.0452)		
P90/P50 Gross Lag		0.105*** (0.0326)	
Gross Skew			0.0711 (0.0569)
Constant	-0.197** (0.0827)	-0.0497 (0.0598)	0.0637 (0.0593)
Observations	273	273	274
R-squared	0.753	0.747	0.738
Number of Countries	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 – The table contains regression results using the FE estimator, estimating the relationship between the share of 25+ having finished tertiary education, ICT adoption and control variables.

6.2 Inequality, Size and Power

Moving to the relationship between changes in the income distribution and the size of the middle class and the rate of unionization, the regression results are shown in Table 7. The estimations consistently allow us to reject the null hypothesis that a higher level of education is not associated with lower level of unionization. The point estimates are statistically significant at the 1 % level and this result is robust across model specifications. What are not robust, however, are the estimates themselves. Apart from the negative sign, the estimates vary from -0.187 to -0.635. Nevertheless, the results are economically significant, taken at large. However, we fail to reject our null hypothesis that the P50/P10 ratio increases unionization. Changes in the lower part of the income distribution give us no consistent point estimates, while changes in the upper half of the distribution are both statistically significant and economically significant. The coefficient on the employment ratio is significant at the 1 % level and robustly negative.

The relationship between union density and the share of educated people is not unlikely to be causal, in that the growing middle class is less interested in organizing themselves in trade unions. However, it is quite unlikely that we have any unbiased estimates of the effect of education on unionization. With regards to changes in inequality, the case with the upper half of the income distribution might be a case of reverse causality, since lower union density might weaken the possibilities for the low-educated workers to increase their share of national income. One plausible reason is that increased employment is associated with increased relative supply of educated labour, and this group generally has weaker incentives to organize in trade unions.

Another way to measure the power of the working class is the share of votes received by Social Democratic parties. An inherent problem with using this proxy variable is, as mentioned earlier, that some countries do not have any influential Social Democratic parties, e.g. the US. Since we still expect, e.g. the US, to be subject to the same effects of SBTC and organization as other countries, but cannot measure the outcome of these changes, our results are likely to be biased in some direction, since the existence of a Social Democratic parties is not likely to be random. Looking at Table 8, we see a consistent association between higher union density and Social Democratic votes, allowing us to reject this hypothesis at the 1 % level. This result is in line with our model.

What is more interesting is the inconsistent results with regards to educational attainment, both regards to significance and sign. Controlling for country-fixed factors, educational levels are negatively associated with Social Democratic votes, and importantly so: a one percentage point increase in the share of those 25 years and older having finished tertiary education is associated with a reduction in Social Democratic electoral support by 0.274 percentage points. One reason for the inconsistency of the estimates for education might be that union density and educational attainment are highly correlated, implying that the partial effect of education that is not picked up by lower levels of unionization is trivial.

Table 7: Fixed Effects–Regression on the Determinants of Unionization

VARIABLES	Union	Union	Union	Union
Tert Share 25	-0.635*** (0.0470)	-0.387*** (0.0524)	-0.187*** (0.0655)	-0.276*** (0.0597)
GDP Growth		-0.00423 (0.117)	0.0331 (0.113)	0.0286 (0.117)
Emp Ratio		-0.706*** (0.0855)	-0.638*** (0.0830)	-0.624*** (0.0877)
P50P10 Gross Lag	0.0152 (0.0752)	-0.0359 (0.0681)		
P90P50 Gross Lag			-0.209*** (0.0434)	
Gross Skew Lag				-0.241*** (0.0647)
Constant	0.503*** (0.128)	0.970*** (0.129)	1.206*** (0.0767)	1.091*** (0.0680)
Observations	299	299	299	295
R-squared	0.392	0.510	0.546	0.524
Number of Countries	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 – The table contains regression results using the FE estimator, estimating the relationship between unionization, the share of tertiary education and control variables.

Looking at the income ratios, we see that a increase in P50/P10 ratio is associated with a higher vote share, and is significant at the 1 % level. This seems intuitively reasonable: for a given level of unionization and share of educated people, an increased distance between the middle class and the voting class ought to increase incentives for the working class to vote for Social Democratic parties. We can also see that the skew measure is negative and statistically significant and economically significant. Such an estimate is surprising given that increased skew ought to be associated with increased demands for redistribution. One possible explanation might be that voting outcomes are affected by the political mechanism we describe in the model, implying that the coefficient on the skew also capture the impact of lobbying from the capitalists. We could also have an instance of reversed causality, where an increase in Social Democratic votes results in policies redistributing from the richest to those with lower incomes.

6.3 Power and Policy Outcomes

Our final sets of regressions look at the relationship between power and policy outcomes. The first policy we look at is the share of tax revenues of GDP, this measure is commonly used since higher taxes facilitate social spending and other transfers. We do robustness checks by looking at social expenditures.

Table 8: Fixed Effects–Regression on the Determinants of Social Democratic Votes

VARIABLES	LeftVote	LeftVote	LeftVote	LeftVote
Union		0.361*** (0.0557)	0.346*** (0.0628)	0.287*** (0.0592)
Tert Share 25	-0.274*** (0.0475)	-0.0265 (0.0577)	0.0169 (0.0768)	0.112* (0.0665)
P50/P10 Gross		0.229*** (0.0780)		
P90/P50Gross			-0.0320 (0.0590)	
Gross Skew				-0.236*** (0.0770)
Constant	0.291*** (0.0104)	-0.292** (0.137)	0.156 (0.113)	0.354*** (0.0892)
Observations	310	300	300	296
R-squared	0.100	0.219	0.196	0.211
Number of Countries	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 – The table contains regression results using the FE estimator, estimating the relationship between Social Democratic electoral support, unionization, the share of tertiary education and control variables.

Beginning with tax revenues (Table 9), we can reject the hypotheses that unionization or the share having higher education are insignificant; both coefficients are of the expected sign and the estimates are consistent and significant when we use various model specifications. An increase in union density by one percentage point is associated with an increase in tax revenues of about 0.10–0.15 percentage point, which is definitely economically significant. Tertiary education, a proxy for the size of the middle class, is negatively associated with tax revenues, and the estimates vary from -0.21 to -0.29, also an economically interesting estimate. It is also worth noticing the estimated coefficients on employment ratio. The estimated coefficient for employment is significant and consistently around -0.26. This result is expected, on account of a higher share of employment requiring fewer in need of social benefits, funded through taxes. Looking at the different measures of inequality leads us to conclude that the P50/P10 ratio is negatively associated with Tax GDP. However, this does not necessarily imply any causality between the two.

The case of causality is more complex in this class of regressions. While the chain from employment to policy is quite clear, the logic with regards to the other variables is not as straightforward. It is unlikely that we have a case of reversed causality, tax revenues have generally little to do with incentives to enter trade unions, for instance. There might be some issues concerning the dependency ratio, employment ratio and GDP growth,

however, these are not central for our discussion. With regards to union density, higher education and inequality, the main problem is the interdependencies between the independent variables, which makes it more difficult for us to disentangle the unbiased correlations. Still, it is not implausible to argue that the direction of causality goes towards tax revenues.

In order to check the robustness of these results, we redo the same regressions, but change our dependent variables to social expenditures as share of GDP (see Table 13) or use the Gini-coefficient after taxes as a control variable (see Table 15). Our previous results are quite robust, both unionization and tertiary education have the same coefficients as found previously. While the estimates for tertiary education are significant and consistent across the model specifications, the estimates of unionization become smaller and less significant as we add more control variables.

Table 9: Fixed Effects-Regression on the Determinants of Tax Revenues

VARIABLES	Tax GDP	Tax GDP	Tax GDP	Tax GDP	Tax GDP	Tax GDP
Union	0.135*** (0.0315)	0.119*** (0.0315)	0.136*** (0.0316)	0.188*** (0.0325)	0.143*** (0.0304)	0.119*** (0.0317)
Tert Share 25	-0.285*** (0.0388)	-0.242*** (0.0403)	-0.272*** (0.0393)	-0.262*** (0.0379)	-0.249*** (0.0348)	-0.203*** (0.0371)
P50/P10 Gross		-0.0859** (0.0339)				-0.0687** (0.0319)
Year	0.00290*** (0.000323)	0.00263*** (0.000346)	0.00279*** (0.000406)	0.00255*** (0.000321)	0.00298*** (0.000301)	0.00258*** (0.000328)
Gross Skew			0.0242 (0.0393)			
Dep Ratio				-0.562*** (0.121)	-0.556*** (0.111)	-0.514*** (0.118)
Emp Ratio					-0.268*** (0.0358)	-0.259*** (0.0394)
GDP Growth						0.0432 (0.0480)
Constant	-5.419*** (0.646)	-4.738*** (0.711)	-5.224*** (0.789)	-4.521*** (0.654)	-5.216*** (0.608)	-4.324*** (0.678)
Observations	310	300	296	310	310	300
R-squared	0.224	0.235	0.218	0.276	0.392	0.373
Number of Countries	10	10	10	10	10	10

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 – The table contains regression results using the FE estimator, estimating the relationship between tax revenues, unionization, the share of tertiary education and control variables.

Ultimately, in our attempt to capture the whole chain of events – from SBTC to policy outcomes – it appears that ICTNRA is significantly associated with less tax revenues, and the estimated impact varies from -0.13 to -0.22, indicating that the results are somewhat robust (Table 10). These are the results expected from the literature and our

model: given the developments witnessed, increased adoption of ICT technologies ought to reduce the level of tax revenues as preferences and power relations change. However, on account of the chain being sufficiently long, it is difficult to evaluate if the regressions show causal effects.

With regards to the other variables, neither our measurements of trade openness or financial openness are consistent across the model specifications. The employment and dependency ratios are instead consistently significant and negative across the models. However, it is unlikely that we have a clear causal direction, perhaps higher taxes reduce the incentives for people to enter the labour force, reducing the employment ratio.

In order to check the robustness of our results, we redo the regressions using social expenditures as the dependent variable (see Table 14) or using the Gini-coefficient after taxes as a control variable (see Table 15). ICTNRA remains negative and highly statistically significant, indicating that our previous results are not simply an artifact of the chosen policy instrument. The caution about causality remains, however.

Table 10: Fixed Effects-Regression of Tax Revenues on ICT Adoption

VARIABLES	Tax GDP	Tax GDP	Tax GDP	Tax GDP
ICTNRA	-0.219*** (0.0464)	-0.203*** (0.0448)	-0.129*** (0.0483)	-0.168*** (0.0452)
TradeGDP	-0.0973*** (0.0198)	-0.00192 (0.0214)	-0.00398 (0.0221)	-0.0127 (0.0231)
NFAGDP	-0.0139 (0.0148)	-0.0499*** (0.0151)	-0.0396*** (0.0151)	-0.0376** (0.0153)
Emp Ratio		-0.348*** (0.0441)	-0.348*** (0.0458)	-0.344*** (0.0462)
Dep Ratio		-0.302** (0.130)	-0.410*** (0.134)	-0.442*** (0.135)
P50/P10 Gross			-0.0878** (0.0351)	
Year	0.00347*** (0.000354)	0.00288*** (0.000407)	0.00224*** (0.000435)	0.00209*** (0.000454)
Gross Skew				0.0900** (0.0402)
Constant	-6.507*** (0.698)	-5.034*** (0.839)	-3.568*** (0.906)	-3.515*** (0.920)
Observations	283	283	274	274
R-squared	0.283	0.424	0.414	0.411
Number of Countries	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10 – The table contains regression results using the FE estimator, estimating the relationship between tax revenues, ICT adoption and control variables.

6.4 Summary of Results

In general, the results from the regression indicate that there are several associations that are in line with those predicted by the heuristic model. Increased adoption of ICT capital is associated with shifts in the income distribution, such that the relative distance between the middle class and the working class and the capitalists and the middle class increase. Moreover, there is a positive relationship between ICT adoption and the share of people having a higher education, our proxy for the size of the middle class. Moreover, there is a negative partial correlation between the share of educated and union density, while income ratios have little explanatory value. Variations in our other proxy for the power of the working class, the share of Social Democratic votes, can be explained by union density, and the association is positive, but no other variables show robust results. With regards to policy, both unionization and the education share are significant and robust in explaining variations in tax revenues and social expenditures. The same holds for the P50/P10 ratio, as well as for the employment and dependency ratios. Finally, a higher level of ICT adoption is associated with lower tax revenues and less social expenditures.

7 Discussion

In this section, we discuss our results, the first subsection presents our interpretation of the empirical results, the second subsection contains a discussion of our major weaknesses, and in the final subsection we reflect upon how our model can be used in the future.

7.1 Findings

The general conclusion from the empirical section is that there are interesting associations between the variables under scrutiny. Increased adoption of ICT does appear to have an impact on the structure of the income distribution, that is, skill-biased technological change can be observed in the data. Other factors seems to be important as well, most prominently trade, as a proxy for globalization. These results are in line with previous research and support the mainstream view of the impact of trade and technology on inequality.

Our second claim regarding ICT is that it would increase incentives to achieve higher education, which we took as a proxy for the size of the middle class. Our results show a robust correlation between ICT and education, however, we cannot rule out the possibility of reversed causality. Nevertheless, the idea that ICT adoption via increased relative demand for skilled labour also incentivizes increased relative supply seems plausible at least as a partial explanation.

We proceed to look at the relationship between changes in inequality and the growing middle class on the organizational power of the working class. The association between an increasingly educated population and reduced union density is robust across various specifications, even though the variations are sufficiently large so that we cannot rule out biased estimates. Still, the causal chain is more likely to run from education to unionization than the other way. The idea that a relatively larger middle class chooses to not organize themselves in trade unions appear to be supported by our results. What is more interesting is the results from our inequality measures and unionization. An increased P50/P10 ratio, our proxy for the distance between the middle class and the working class, does not appear to increase incentives for the working class to organize. We believe that there are two plausible explanations for this result, either the incentives for organization are not very sensitive to increased inequality versus the middle class, or our proxy variable is only weakly correlated with the actual ratio of middle class to working class income. Also surprising is that increases in the P90/P50 ratio and the skew have a negative partial correlation with union density. As mentioned earlier, we believe that it is not unlikely that we have picked up reversed causality, such that higher levels of unionization are associated with a weaker capitalist group. In the light of our model, a shift in the skewness imply an increase in both income and power of the capitalists, facilitating less union-friendly policies. Looking instead at the electoral support for Social Democratic parties, the result that higher unionization is positively associated with more votes is not surprising at all, given that many theories already posit both trade unions and Social Democratic parties as instruments for the working class.

Looking at the impact of these supposed power changes on policy outcomes, our results are quite robust in that unionization increases redistributive activity, proxied by tax revenues and social expenditures, and that a growing middle class is associated with less such policies. This is our best answer to why the ‘Robin Hood paradox’ is not actually a paradox at all: changes in the distribution of income need not translate into on-for-one changes in the political sphere, due to the intervention of the political apparatus. We have presented a first draft of how these political mechanisms work, however, we will not attempt to draw conclusions regarding causality, but given the broad theoretical and empirical support for the direction of causality, we would not be surprised if future studies can find a more clear causal link from organization to political power and policy. Increased inequality between the middle class and working class is associated with less redistribution. Changes in the income distribution might in itself have a causal impact, however, we caution the reader to draw such conclusions. Instead, we posit that the relationship between incentives for organization and opportunities to do so are more complex than these few regressions can disentangle.

Finally, looking at the effect of increased ICT adoption on policy outcomes, we see a robust relationship between ICT and tax levels and social expenditures, even when including various control variables. Our proposition is that the effects of SBTC are two-

fold: it changes both the distribution of income within society while also changing the relative sizes of these groups. In turn, this overturns the established distribution of power in favour of the beneficiaries of SBTC, which then results in changes in the policies conducted. We believe that our results provide a good start in the search for a causal explanation.

To return to our research question, there is a robust empirical case that policies have changed against the working class and instead towards the high-end earners, which are the beneficiaries of the new economic climate induced by SBTC. Even though the data do appear to give some support for the mechanisms we have proposed, it is far too soon to draw any conclusions with regards to the actual mechanisms at work. Nevertheless, it appears plausible that skill-biased technological change affect the income distribution and that changes in the income distribution have an impact on policy preferences and political organization and that this in turn affects the policies ultimately conducted. The interrelationships between these mechanisms would benefit from a deeper analysis and more empirical and theoretical work.

7.2 Improving the Framework

The purpose of this subsection is to expand upon the discussions about the limitations of this paper. We have already discussed the major assumptions as well as data limitations and the problems associated with our empirical model. Here we focus on ways to improve the approach for future research.

First of all, we only look at classic measures related to redistribution, namely tax revenues and social expenditures. We believe that it would be fruitful to conduct analysis of SBTC on other policies, on account of the apparent importance of the adoption of new technologies in society. There are several policies that might be of interest. Trade barriers might be affected on account of technological change intertwining with demands for more trade openness from those with high skill levels. Labour market regulations might be of interest, as changes in the political power of the working might result in changed labour laws as well. Property rights might be relevant, if more skilled labour increase the rate of innovational activity then we might see increasing the demand for strengthened protection of property rights. These were just some examples, and we believe that this list of interesting policies could be extended.

One of the problems is the lack of data with regards to preferences and lobbying. Conducting surveys in order to acquire a deeper understanding of people's actual opinions about various issues in a way that is transferable across time and space would improve the outlook for further research since then one of the crucial steps in our model – formation of preferences – could be put under empirical testing. With regards to lobbying, we instead need a general framework to analyse organized activities across countries, or perhaps simply accept that such activities will always be so clandestine as to escape

recording processes.

Theoretically, we need both a more sophisticated theory on why people adopt the political view they have and how groups interact with the state. For instance, by including forward-looking voters, we could model a situation where low-income and middle-income earners would be in favour of less redistribution (Benabou and Ok, 1998). This dynamic would lead to a possible scenario where the rapid increase in the relative incomes of the middle class versus the working class, induced by the rapid adoption of new technologies, would induce the middle class, but not the working class, to be in favour of less redistribution. Such a development would, for example, mean that we could relax the assumption of lobbyists distorting the preferences among both individuals and politicians, but still obtain the same results. This would also lead to less measurement problems caused by the problematic nature of collecting lobbying data.

It is the connection between preferences, organization and policy outcomes that is the hardest relationship to quantify and put to empirical scrutiny. While our model posits a qualitative relationship between the organizational power of groups and their political influence, where increased power is reflected in public policy, we are affected by the difficulties associated with quantification of the effects. We need both more theory and data in order to learn more. Firstly, we need more theory on the relationship between governmental institutions and how they respond to the activities of various groups in society, and also how these responses differ when the groups range from trade unions to industry lobby groups. Secondly, in order to actually put the mechanism we propose under testing, we would need data and a quantitative assessment with regards to the effect of income inequality on preferences and of preferences on organizational activities and policy outcomes. In the absence of these two factors, we are left with having to test more or less plausible models and rejecting those models which have no support at all. Our model does survive this basic testing, which, however, only gives us a hint of where to go next.

7.3 Lessons for the Future

This paper looks at major macroeconomic changes witnessed in the Western world since the 1970s, originating from extreme technological innovation that has overturned the way we think of communication and interaction. Our purpose is to understand the consequences of these changes, explaining how changed patterns of hiring affects the distribution of income and political power. However, times are changing, and as the 21st century marches on, we are entering a world of widespread automatization, robotics and instant information-sharing. We are yet to find out who will be the beneficiaries of these new changes, and how this will be reflected in the structure of welfare states. Can we learn anything from the framework proposed in this paper? It will most likely need to be updated and fine-tuned, but the central idea that technological change that leads to sufficiently large impact on relative incomes and relative sizes of societal groups induces

new political conflicts, will likely remain.

Let us ponder a scenario where robots start to replace jobs previously done by the educated middle class, thus increasing relative demand for jobs at the low and the high ends of the spectrum. In our model, this would lead to a broadening of the working class at the expense of the middle class, a reduction of the skill premium and a capitalist group seeing their incomes skyrocketing. This would imply an intensified distributional conflict where the numerality of the working class will be challenged by the concentration of resources at the upper tail of the income distribution. However, this is but a simple thought experiment, far beyond what any data today give us. If this paper shows something, it is that history is shaped by the actions of humans, and is not set in stone. Which road lies ahead of us is in the making at this very moment.

8 Conclusion

The purpose of this paper is to analyse the relationship between skill-biased technological change, changes in the structure of the income distribution, the political organization of groups and the formation of policies.

We create a heuristic model, combining theories presented by authors on different topics. The first step discusses the race between technology and education in determining the distribution of income in society. Then we move on and describe the formation of preferences based upon the structure of inequality. Finally we analyse the incentives and opportunities for different groups to organize politically. We then test the conclusions from this model on a data set on 10 OECD countries for the years 1980–2010. The main results are as follows:

- There is substantial empirical support for the idea that technological change is a major driver in the explanation of income inequality within countries. The results appear to be robust to various specifications.
- The data support that a growing middle class is associated with a lower rate of unionization. This indicates that a more powerful middle class reduces the power of the working class.
- Changes in the rate of unionization and the share of educated people are important explanatory variables with regards to policy outcomes. Never-mind the complex relationships, it does not appear unlikely that the organization of interest groups have an impact on the policies conducted
- Our model predicts and the data reveal that more unequal societies should redistribute less. This result stands in stark contrast to the predictions of more simplistic frameworks, such as the Downs–Meltzer–Richards model and the Lupu–Pontusson approach. We reach these results by focusing on the impact of organized interests.

Even though the data indicate the relationships that we have identified, both theoretical and empirical problems make us abstain from drawing too strong conclusions from the empirical results. We do, however, find these results interesting and believe that more research on this topic will be fruitful.

References

- Alderson, A. and Nielsen, F. (2002). Globalization and the Great U-Turn: Income Inequality Trends in 16 OECD Countries. *American Journal of Sociology*, 107(5):1244–1299.
- Armingeon, K., Knöpfel, L., Weisstanner, D., and Engler, S. (2014). Comparative Political Data Set I, 1960-2012.
- Bardhan, P. and Mookherjee, D. (2000). Capture and Governance at Local and National Levels. *American Economic Review*, 90(2):135–139.
- Barro, R. and Jong-Wha, L. (2010). A New Data Set of Educational Attainment in the World, 1950-2010. *Journal of Development Economics*, 104:184–198.
- Bartel, A. P. and Lichtenberg, F. R. (1985). The Comparative Advantage of Educated Workers in Implementing New Technology: Some Empirical Evidence. Working Paper 1718, National Bureau of Economic Research, Cambridge, MA.
- Becker, G. S. (2008). A Theory of Competition Among Pressure Groups for Political Influence. *Quarterly Journal of Economics*, 98(3):371–400.
- Benabou, R. and Ok, E. A. (1998). Social Mobility and the Demand for Redistribution: The POUM Hypothesis. Working Paper 6795, National Bureau of Economic Research, Cambridge, MA.
- Berman, E., Bound, J., and Machin, S. (1998). Implications of Skill-Biased Technological Change: International Evidence. *Quarterly Journal of Economics*, 113(4):1245–1279.
- Berman, S. (2006). *The Primacy of Politics: Social Democracy and the Making of Europe's Twentieth Century*. Cambridge University Press, Cambridge.
- Brady, D., Huber, E., and Stephens, J. D. (2014). Comparative Welfare States Data Set. *University of North Carolina and WZB Berlin Social Science Center*.
- Card, D. (2009). Immigration and Inequality. Working Paper 14683, National Bureau of Economic Research, Cambridge, MA.
- Cornia, G. A. (1999). Liberalization, Globalization and Income Distribution. *WIDER: World Institute for Development Economics Research, Helsinki*, 157.
- Cornia, G. A. (2003). The Impact of Liberalisation and Globalisation on Within-Country Income Inequality. *CESifo Economic Studies*, 49(4):581–616.
- Coughlin, P. J., Mueller, D. C., and Murrell, P. (1990). Electoral Politics, Interest Groups, and the Size of Government. *Economic Inquiry*, 28(4):682–705.
- Downs, A. (1957). *An Economic Theory of Democracy*. Harper, New York, NY.

- Emmenegger, P. (2012). *The Age of Dualization: The Changing Face of Inequality in Deindustrializing Societies*. International Policy Exchange Series. Oxford University Press, New York, NY.
- Epifani, P. and Gancia, G. (2008). The Skill Bias of World Trade. *Economic Journal*, 118(530):927–960.
- Esping-Andersen, G. (1996). *Welfare States in Transition: National Adaptations in Global Economies*, chapter After the Golden Age? Welfare State Dilemmas in a Global Economy. Sage Publications, Thousand Oaks, CA.
- Ethier, W. J. (2005). Globalization, Globalisation: Trade, Technology, and Wages. *International Review of Economics and Finance*, 14(3):237–258.
- Förster, M., Llena-Nozal, A., and Nafilyan, V. (2014). Trends in Top Incomes and their Taxation in OECD Countries. OECD Social, Employment and Migration Working Papers 159, OECD Publishing, Paris.
- Freeman, R. B. (1991). How Much Has De-Unionisation Contributed to the Rise in Male Earnings Inequality? Working Paper 3826, National Bureau of Economic Research, Cambridge, MA.
- Glaeser, E. L., La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2004). Do Institutions Cause Growth? *Journal of Economic Growth*, 9(3):271–303.
- Goldin, C. and Katz, L. F. (2007). Long-Run Changes in the U.S. Wage Structure: Narrowing, Widening, Polarizing. Working Paper 13568, National Bureau of Economic Research, Cambridge, MA.
- Goldin, C. D. and Katz, L. F. (2009). *The Race Between Education and Technology*. Harvard University Press, Cambridge, MA.
- Goodwin, J. (2009). General Guidande: Time Series Consistency. In *EMEP/EEA Emission Inventory Guidebook 2009*. European Environment Agency, EEA.
- Gouveia, M. and Masia, N. (1998). Does the Median Voter Model Explain the Size of Government?: Evidence From the States. *Public Choice*, 97(1-2):159–177.
- Greenwood, J. and Yorukoglu, M. (1997). 1974. *Carnegie-Rochester Conference Series on Public Policy*, 46:49–95.
- Heckelman, J. C. (2000). Consistent Estimates of the Impact of Special Interest Groups on Economic Growth. *Public Choice*, 104(3-4):319–327.
- Huber, E., Ragin, C., and Stephens, J. D. (1993). Social Democracy, Christian Democracy, Constitutional Structure, and the Welfare State. *American Journal of Sociology*, 99(3).
- Iversen, T. and Soskice, D. (2006). Electoral Institutions and the Politics of Coalitions:

- Why Some Democracies Redistribute More Than Others. *American Political Science Review*, 100(2):165–181.
- Iversen, T. and Soskice, D. (2009). Distribution and Redistribution: The Shadow of the Nineteenth Century. *World Politics*, 61(03):438–86.
- Jaumotte, F., Lall, S., and Papageorgiou, C. (2013). Rising Income Inequality: Technology, or Trade and Financial Globalization? *IMF Economic Review*, 61(2):271–309.
- Jovanovic, B. and Rousseau, P. L. (2005). General Purpose Technologies. Working Paper 11093, National Bureau of Economic Research, Cambridge, MA.
- Katz, L. and Murphy, K. (1992). Changes in Relative Wages, 1963-1987: Supply and Demand Factors. *Quarterly Journal of Economics*, 107(1):35–78.
- Katz, L. F., Autor, D. H., Ashenfelter, O., and Card, D. (1999). Changes in the Wage Structure and Earnings Inequality. *Handbook of Labor Economics*, 3:1463–1555.
- Korpi, M. (2008). Migration and Wage Inequality. *Arbetsrapport: Institutet för framtidsstudier, Stockholm*, 13.
- Korpi, W. (1989). Power, Politics and State Autonomy in the Development of Social Citizenship: Social Rights During Sickness in Eighteen OECD Countries Since 1930. *American Sociological Review*, 54(03):309–328.
- Krusell, P., Ohanian, L., Ríos-Rull, J.-V., and Violante, G. (2000). Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis. *Econometrica*, 68(5):1029–1053.
- Larcinese, V. (2007). Voting over Redistribution and the Size of the Welfare State: The Role of Turnout. *Political Studies*, 55(3):568–585.
- Lupu, N. and Pontusson, J. (2011). The Structure of Inequality and the Politics of Redistribution. *American Political Science Review*, 105(2):316–336.
- Mankiw, N. (2010). Spreading the Wealth Around: Reflections Inspired by Joe the Plumber. *Eastern Economic Journal*, 36(3):285–298.
- Meltzer, A. and Richard, S. F. (1981). A Rational Theory of the Size of Government. *Journal of Political Economy*, 89(5):914–27.
- Milgrom, P. and Roberts, J. (1990). The Economics of Modern Manufacturing: Technology, Strategy, and Organization. *American Economic Review*, pages 511–528.
- Mulcahy, S. (2015). Lobbying in Europe: Hidden Influence, Privileged Access. Technical report, Transparency International.
- Murphy, K. M., Riddell, W. C., and Romer, P. M. (1998). Wages, Skills, and Technology in the United States and Canada. Working Paper 6638, National Bureau of Economic Research, Cambridge, MA.

- Nelson, R. R. and Phelps, E. S. (1966). Investment in Humans, Technological Diffusion, and Economic Growth. *American Economic Review*, 56:69–75.
- OECD (2004). Feature Article: Producing High Quality Long Time Series. *Main Economic Indicators*.
- OECD (2011). An Overview of Growing Income Inequalities in OECD Countries: Main Findings. In *Divided We Stand: Why Inequality Keeps Rising*. OECD. Retrieved from <http://www.oecd.org/els/soc/49499779.pdf> [March 2015].
- OECD (2013). *OECD Compendium of Productivity Indicators 2013*. OECD Compendium of Productivity Indicators. OECD Publishing, Paris.
- OECD (2015). Statistics. Retrieved from: <http://stats.oecd.org/> [May 2015].
- O’Mahony, M. and Timmer, M. P. (2009). Output, Input and Productivity Measures at the Industry Level: the EU KLEMS Database. *Economic Journal*, 119(538):F374–F403.
- Pecoraro, B. (2014). Inequality in Democracies: Testing the Classic Democratic Theory of Redistribution. *Economics Letters*, 123(3):398–401.
- Piketty, T., Atkinson, A. B., and Saez, E. (2011). Top Incomes in the Long Run of History. *Journal of Economic Literature*, 49(1):3–71.
- Quadagno, J. (1987). Theories of the Welfare State. *Annual Review of Sociology*, 13:109–128.
- Roberts, K. W. (1977). Voting Over Income Tax Schedules. *Journal of Public Economics*, 8(3):329–340.
- Rodríguez, F. (1999). Does Distributional Skewness Lead to Redistribution? Evidence From the United States. *Economics and Politics*, 11(2):171–199.
- Roemer, J. (1997). Political-Economic Equilibrium When Parties Represent Constituents: The Unidimensional Case. *Social Choice and Welfare*, 14(4):479–502.
- Romer, T. (1975). Individual Welfare, Majority Voting, and the Properties of a Linear Income Tax. *Journal of Public Economics*, 4(2):163–185.
- Rothstein, B., Samanni, M., and Teorell, J. (2010). Quality of Government, Political Power and the Welfare State. *Quality of Government: Working Paper Series*, Gothenburg, 6.
- Saez, E. (2013). Striking it Richer: The Evolution of Top Incomes in the United States (Updated With 2012 Preliminary Estimates). *Berkeley: University of California, Department of Economics*.
- Schön, L. (2010). *Sweden’s Road to Modernity: An Economic History*. SNS Förlag, Stockholm, 2nd edition.

- Smith, R. A. (1995). Interest Group Influence in the US Congress. *Legislative Studies Quarterly*, 20(1):89–139.
- Sobbrio, F. (2011). Indirect Lobbying and Media Bias. *Quarterly Journal of Political Science*, 6(3-4):235–274.
- Stolper, W. F. and Samuelson, P. A. (1941). Protection and Real Wages. *Review of Economic Studies*, 9(1):58–73.
- Teixeira, R. and Abramowitz, A. (2009). The Decline of the White Working Class and the Rise of a Mass Upper-Middle Class. *Political Science Quarterly*, 124(3):391–422.
- Thomas, C. S. (2014). Interest Groups in International Politics. Web-page: <http://global.britannica.com/EBchecked/topic/290136/interest-group/257773/Interest-groups-in-international-politics>, retrieved 4th of May, 2015.
- Van Winden, F. (1999). On the Economic Theory of Interest Groups: Towards a Group Frame of Reference in Political Economics. *Public Choice*, 100(1-2):1–29.
- Violante, G. L. (2008). Skill-Biased Technical Change. In Durlauf, S. N. and Blume, L. E., editors, *The New Palgrave Dictionary of Economics*. Palgrave Macmillan, Basingstoke.
- World-Bank (2015). Data. Retrieved from: <http://data.worldbank.org/> [May 2015].
- Zakharov, A. V. (2008). Spatial Voting Models: A Review of Literature. Available from: <http://www.polit-econ.ru/zakharov/statii/polarization.pdf> [Accessed 14 March 2015].

9 Appendix

Table 11: Cross-Correlation Table for Important Variables

Variables	P50/P10	ICT	Trade	Union	TertShare	P90/P50	Skew
P50/P10	1.000						
ICT	0.320	1.000					
Trade	-0.377	0.304	1.000				
Union	-0.394	-0.298	0.202	1.000			
TertShare	0.605	0.520	-0.154	-0.432	1.000		
P90/P50	0.780	0.655	-0.172	-0.510	0.801	1.000	
Skew	-0.246	0.519	0.294	-0.204	0.346	0.408	1.000

Table 11 – The table shows correlations among the most important variables. Measures of inequality are before taxes and transfers.

Table 12: Summary statistics 2005

Variable	Obs	Mean	Std. Dev.
ICTNRA	9	.143	.053
Union	10	.338	.205
Tert Share 25	10	.286	.125
P90/P50 Gross	10	1.908	.148
P50/P10 Gross	10	1.734	.138
Gross Skew	10	1.1	.013
SocExpGDP	9	.211	.045
TransferGDP	10	.114	.054
LeftVote	10	.205	.15

Table 12 – The table contains descriptive statistics of selected variables for the year 2005.

Table 13: Fixed Effects–Regression of Social Expenditures

VARIABLES	Social Expenditures	Social Expenditures	Social Expenditures	Social Expenditures	Social Expenditures	Social Expenditures
Union	0.0986*** (0.0320)	0.103*** (0.0327)	0.103*** (0.0305)	0.0667** (0.0339)	0.00443 (0.0296)	0.0212 (0.0279)
Tert Share 25	-0.246*** (0.0398)	-0.244*** (0.0423)	-0.245*** (0.0383)	-0.261*** (0.0398)	-0.248*** (0.0341)	-0.233*** (0.0336)
P50/P10 Gross		-0.0106 (0.0365)				
Year	0.00352*** (0.000335)	0.00364*** (0.000371)	0.00423*** (0.000407)	0.00376*** (0.000344)	0.00443*** (0.000301)	0.00449*** (0.000376)
Gross Skew			-0.137*** (0.0390)			-0.110*** (0.0331)
Dep Ratio				0.346*** (0.130)	0.390*** (0.111)	0.103 (0.123)
Emp Ratio					-0.360*** (0.0350)	-0.335*** (0.0360)
GDP Growth						-0.221*** (0.0450)
Constant	-6.792*** (0.669)	-7.031*** (0.765)	-8.076*** (0.790)	-7.402*** (0.701)	-8.523*** (0.610)	-8.426*** (0.751)
Observations	301	291	287	301	301	287
R-squared	0.409	0.424	0.422	0.423	0.579	0.593
Number of Countries	10	10	10	10	10	10

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13 – The table contains regression results using the FE estimator, estimating the relationship between social expenditures, unionization, the share of tertiary education and control variables.

Table 14: Fixed Effects–Regression of Social Expenditures on ICT Adoption

VARIABLES	Social Expenditures	Social Expenditures	Social Expenditures	Social Expenditures	Social Expenditures
ICTNRA	-0.148*** (0.0410)	-0.193*** (0.0407)	-0.160*** (0.0440)	-0.203*** (0.0420)	-0.114*** (0.0436)
TradeGDP	-0.199*** (0.0171)	-0.142*** (0.0198)	-0.161*** (0.0209)	-0.147*** (0.0225)	-0.186*** (0.0200)
NFAGDP	0.0187 (0.0125)	-0.0236* (0.0135)	-0.0181 (0.0136)	-0.0260* (0.0141)	0.00786 (0.0134)
Emp Ratio		-0.206*** (0.0404)	-0.213*** (0.0417)	-0.234*** (0.0430)	-0.162*** (0.0406)
Dep Ratio		0.399*** (0.114)	0.382*** (0.119)	0.364*** (0.121)	0.522*** (0.127)
Union					0.0395 (0.0289)
Tert Share 25					-0.276*** (0.0440)
P50/P10 Gross			-0.0888*** (0.0311)		-0.0252 (0.0309)
Year	0.00492*** (0.000311)	0.00556*** (0.000365)	0.00554*** (0.000395)	0.00581*** (0.000412)	0.00724*** (0.000459)
Gross Skew				-0.0290 (0.0370)	
Constant	-9.490*** (0.614)	-10.84*** (0.754)	-10.62*** (0.821)	-11.27*** (0.836)	-14.16*** (0.954)
Observations	277	277	268	268	268
R-squared	0.561	0.620	0.621	0.610	0.673
Number of Countries	10	10	10	10	10

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14 – The table contains regression results using the FE estimator, estimating the relationship between social expenditures, ICT adoption and control variables.

Table 15: Fixed Effects–Regression of Policy Outcomes Using the Gini–Coefficient

VARIABLES	Tax GDP	Soc Exp GDP	Tax GDP	Soc Exp GDP
Union	0.133*** (0.0315)	0.0207 (0.0283)		
Tert Share 25	-0.202*** (0.0368)	-0.187*** (0.0333)		
Gini Post	-0.0874 (0.101)	-0.385*** (0.0915)	-0.337*** (0.0978)	-0.600*** (0.0869)
GDP Growth	0.0534 (0.0519)	-0.166*** (0.0470)		
Emp Ratio	-0.224*** (0.0374)	-0.361*** (0.0337)	-0.254*** (0.0478)	-0.262*** (0.0446)
Dep Ratio	-0.452*** (0.150)	-0.0957 (0.141)	-0.00706 (0.161)	0.487*** (0.142)
Year	0.00267*** (0.000361)	0.00406*** (0.000332)	0.00449*** (0.000547)	0.00685*** (0.000505)
ICTNRA			-0.235*** (0.0468)	-0.228*** (0.0434)
Trade GDP			-0.0601** (0.0245)	-0.121*** (0.0234)
NFA GDP			-0.0184 (0.0158)	-0.0384*** (0.0143)
Constant	-4.635*** (0.722)	-7.491*** (0.668)	-8.281*** (1.115)	-13.23*** (1.028)
Observations	266	257	244	238
R-squared	0.292	0.560	0.380	0.604
Number of Countries	9	9	9	9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15 – The table contains regression results using the FE estimator, estimating the relationship between tax revenues and ICT adoption or unionization and education as main control variables, or social expenditures and ICT adoption or unionization and education as main control variables.