THE VORTEX OF SOCIAL STRUCTURE AND SOCIAL MOVEMENT:
A PREY-PREDATOR MODEL OF TRADE UNIONS AND INEQUALITY IN 12 ADVANCED CAPITALISMS (1870-2013)

Abstract

This paper advances and tests the theory that – in the long historical run – trade unions and income inequality affect each other according to a prey and predator model. We show that inequality increases trade union membership. Trade union membership in turn decreases inequality. But low inequality means that trade unions encounter increasing difficulties in recruiting new members. This leads to low trade union membership. With few trade union members, inequality increases again. When inequality is high, the circle starts again. Using data on trade union membership and income inequality over the last 100 years, this model explains trade union membership and income inequality as mutually causing each other in 20th century Canada, Italy, Germany, France the UK and the US. Using a structural equation model, we show the parameters according to which income inequality and trade union membership interact in a perpetually instable equilibrium over long time periods.

1 INTRODUCTION

A large literature is concerned with the determinants of trade union membership (see the review in Wallerstein / Western 2000). A similarly vast literature tries to understand what determines income inequality (see the review by Neckerman / Torche 2007; Kenworthy 2007; for classical contributions, cf. Kuznets 1955; Piketty 2014). These two literatures are linked in the sense that there is a clear negative and well-documented relationship between inequality and trade union membership (Kahn 2000; Western / Rosenfeld 2011; Hirsch 1982; Gustafsson / Johansson 1999: 600; Checchi / Visser / Van De Werfhorst 2010). Trade unions, it appears, decrease inequality, while inequality, in turn, is harmful to trade unions. This relationship can be thought of in various ways. Superficially, it is a simple correlation: more inequality is associated with lower union density.

The linear correlation implies a simple, negative relationship between trade unions and inequality: Where trade unions are strong, they decrease inequality. Where inequality is high, trade unions have to operate in a hostile environment. While this negative link between inequality and trade union membership is widely documented, it contradicts a Marxian, and indeed, common sense notion, which is that trade unions should thrive on inequality, as it gives them a reason to recruit members. Therefore, as a simple correlation will always have problems to describe the reciprocal relationship between trade unions and inequality, where trade unions destroy, but can also thrive on inequality, we therefore argue that a better conceptualisation is provided by a Lotka (1925) / Volterra (1931) prey/predator model. Using a structural equation model, we show how trade union membership and inequality is negatively linked most of the time, but how inequality also increases trade union membership with a time gap.

In the following, we present the two ostensibly competing theories behind these ideas, notably 1) that inequality leads to trade union formation and membership in the first place (positive relationship) and that 2) strong trade unions lower social inequalities (negative relationship). We then show the data behind these alleged patterns and construct the model that can capture this relationship, in that the dependent and independent variable interchange over time. Instead of a simple negative relationship, our model will show that there are indeed four stages that one can observe historically: 1) trade unions recruit members in conditions of high inequality, 2) they then reduce this inequality, leading to the widely observed negative relationship between inequality and trade unionism. However, in conditions of low inequality, which trade unions themselves have helped to bring about, it becomes irrational to join trade unions so that 4) equality increases again as a result of prior high unionization rates. With 4) lowered trade union membership, in inequality is ready to increase again. In the following, we present the two theories which our model tried to incorporate.

1.1 THEORY 1: STRONG TRADE UNIONS COME WITH INEQUALITY

The central idea of Marxism is that the unfolding of capitalism sows the seeds for its own destruction. First of all "Marx had interpreted all social and political associations as parts of a super-structure determined by the inequalities within the organization of production" (Bendix 1974: 155). But why would trade unions form because of inequality? The idea is that wages of the proletariat are supposed to decline, compared to incomes of the bourgeoisie, so that members of the proletariat are supposed to form associations that rally for higher incomes of

the proletariat.[1] This idea, central to Marxism, claims that there is a positive relationship between long-run income inequality and trade union organization. The idea also seems intuitively plausible from a collective rational choice point of view: the more the working class is exploited, the more it has an incentive to organize against this exploitation, even though Marx did not foresee that workers would effectively organize in unions (Korpi 2006: 173ff.; Bendix 1974). Indeed, it is established wisdom that trade unions sprang out of the intolerable conditions of 19th century capitalism and thrived on inequality in their effort to recruit new members. Thus, theory and empirics let one assume that trade union density should be higher when income inequality is higher. This should be true for the formation phase of trade unions, from about 1870 to 1945.

Indeed, shortly after this period, economists still argued that unions should come along with higher, not lower inequality. Friedman argued that "unions have generally been strongest among groups that would have been high-paid anyway, their effect has been to make high-paid workers higher paid at the expense of lower paid workers" (Friedman 1962: 124; similarly, cf. Rees 1962). Thus, "[u]ntil the 1970s the dominant view was that unions tended to increase wage inequality" (Card / Lemieux / Riddell 2004: 519). Notably, economists argued that trade union density should increase inequality. Such studies have claimed that workers who are already more highly paid will come together in trade unions. These trade unions will further increase the wages of already-favored workers so that trade unions could increase income inequality (Johnson 1975: 26). In this sense, there is ample reason to believe that trade union density and inequality are positively correlated.

1.2 THEORY 2: STRONG TRADE UNIONS COME WITH EQUALITY

The so-called power resources theory not only assumes that trade unions could thrive because of inequality, but then proceeds to also show the opposite causal relation (Korpi 1985; Korpi 2006). Notably, Esping-Andersen's (1990) classical typology of welfare states does not rely on the idea that those countries with the strongest inequalities brought about the strongest trade unions. Instead, in this theory, the ability of the working class to forge alliances with smaller or larger parts of society brought about stronger or weaker trade union movements (Esping-Andersen 1985).

While the power resources view of trade union formation is often seen as a view of "trade unions against markets", the literature around varieties of capitalism claims is often juxtaposed against this, as it claims that countries with highly developed markets supported the formation of trade unions (Mares 2001; Paster 2011). While the power resources view claims that trade unions decreased inequality, the varieties of capitalism view rather argues that trade unions could thrive better in more egalitarian non-liberal countries in the first place.

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[1] „Aber mit der Entwicklung der Industrie vermehrt sich nicht nur das Proletariat; es wird in größeren Massen zusammengedrängt, seine Kraft wächst und es fühlt sie mehr. Die Interessen, die Lebenslagen innerhalb des Proletariats gleichen sich immer mehr aus, indem die Maschinerie mehr und mehr die Unterschiede der Arbeit verwischt und den Lohn fast überall auf ein gleich niedriges Niveau herabdrückt. […] immer mehr nehmen die Kollisionen zwischen dem einzelnen Arbeiter und dem einzelnen Bourgeois den Charakter von Kollisionen zweier Klassen an. Die Arbeiter beginnen damit, Coalitionen gegen die Bourgeois zu bilden; sie treten zusammen zur Behauptung ihres Arbeitslohns. Sie stiften selbst dauernde Associationen, um sich für die gelegentlichen Empörungen zu verproviantiren." (Marx / Engels 1848: 10)

According to both theories however, there is a negative relationship between inequality and trade union membership: powerful trade unions should come along with low inequality. While the Marxist view (and varieties of capitalism) rather try to explain why trade unions formed in the first place (with opposite predictions however), the power resources view claims that at the latest from 1945 to 1975, strong trade unions decreased inequality by supporting egalitarian wages as welfare states.

When in the 1970s welfare states had "grown to limits" (Flora 1986), the negative link between trade unions membership and inequality stayed the same. However, by then it was not a link not of increasing or high membership leading to low inequality, but instead by then one could observe a tandem of declining trade union membership and increasing inequality especially in the US and the UK, but also in Western Europe (Card / Lemieux / Riddell 2004: 528). Indeed, the period starting around 1975 is the period for which data on trade union density and inequality exists and the negative relationship between union density and social inequality is one of the least disputed and best-documented findings of that period (Western / Rosenfeld 2011; Asher / DeFina 1997; Acemoglu / Aghion / Violante 2001). Generally, between- and within-country regressions show that "a high percentage of the population belonging to trade unions negatively affects income inequality" (Gustafsson / Johansson 1999: 600).

While most researchers have "treated union decline as one of the causes of rising earnings inequality" (Checchi / Visser / Van De Werfhorst 2010: 86), there is also reason to believe that inequality itself undermines union strength. This is because when inequality is high, the "across the board" wage increases that unions typically try to get for their members, will be less adequate the more disparate the earnings of their members are in the first place (Hirsch 1982: 38). Also, unions mostly represent workers from the middle of the income distribution. Thus, when inequality moves more and more people to both sides of the inequality-divide, fewer workers are left in the middle of the income distribution that unions can organize (Checchi / Visser / Van De Werfhorst 2010: 101). Thus, not only do strong unions decrease inequality. But also, high inequality weakens unions.

Similar to these political-economy theories, economists propose a negative link between inequality and trade union membership. They argue that in a situation of low inequality, workers with higher skills have to accept higher union-induced redistribution of wages towards low-skilled workers. Thus, the more unions have equalized incomes, the more incentives high-skilled workers have to leave unions. This should not only let union membership decline, but also let inequality increase. Thus, these theories see states of low-inequality, high union membership and situations of high inequality, low union membership (Acemoglu / Aghion / Violante 2001: 251).

1.3   A PREY-PREDATOR MODEL OF TRADE UNIONS AND INEQUALITY

Boswell and Chase-Dunn (2000) have presented a model of a "Spiral of Capitalism and Socialism", where social movements form in response to capitalism and fight inequalities. However, critiques of this model argue that what remains unexplained in their model is how capitalism and the countermovement that it creates act empirically (Arrighi 2002). Existing empirical studies on the link between trade union density and inequality cannot resolve this question, as the time frame that they observe is too small. They urge to look at longer time

periods to understand whether a simple negative linear relationship is indeed realistic (Kahn 2000: 577; Wallerstein / Western 2000).

We do this, thereby reconciling the idea that people join trade unions when there is more inequality (positive relationship) with the widely documented descriptive fact that higher trade union density goes along with lower inequalities (negative relationship). To reconcile these ostensibly contradicting views, we propose a non-linear model of trade union density and inequality, where trade unions and inequality act like prey and predator, or, in other words, as an over- and undershooting thermostat (for the thermostat model, cf. Schelling 1978: 83ff.; for the prey and predator model, cf. Lotka 1925; Volterra 1931).

In economics, this prey-predator model is not a novelty. Goodwin (1967) claims that when capitalists invest more, additional workers become employed, lowering the unemployment rate and driving up the price of labor. During this time, labor increases its share of national income. However, as the price of labor rises and labor gets a larger share of national income, investments become less profitable, so that capitalists stop investing. With less investment, workers become unemployed, which lowers the price of labor. In this situation, capital starts to get a higher percentage of national income. With this more favorable investment climate, investments increase, driving down the unemployment rate and driving up the price of labor, so that a new "growth cycle" starts. However, this model failed empirical tests (Harvie 2000). We argue that this may be the case because it looked at the wrong variables. Instead of looking at worker unemployment and capital share of national income, we propose that trade unions and inequality regulate each other over time as a prey and predator model would predict.

The idea that trade unions and inequality "regulate" each other over long periods of time is based on the following idea: Inequality gives trade unions a base for mobilization, which happened in most countries in the second half of the 19th and early 20th century. Once trade unions have mobilized around the rallying cry of inacceptable inequality, they build up a power base (roughly until the end of World War II, where trade unions were established in most countries). This power base allows trade unions to decrease inequality, which historically happened from 1945 to 1975. However, just like a predator that eats up its own prey, when trade unions have managed to decrease inequality, they pulled the rug from under their own feet. Having diminished inequality, they have diminished their own base for mobilizing the working class, which happened in most countries starting in the 1970s. With weak trade unions, social inequality starts to increase, as historically it did starting in the early 1980s in most countries. With high inequality, as is currently witnessed in most countries, trade unions should however have a fertile base for mobilization.

This dynamic system sums up to the fourfold table below, in which one field leads to the next. The table consists of four possible combinations because inequality and trade union density can each be high or low, leading to four possible situations, each of which leads to the next.

Figure 1: A Dynamic Typology of Inequality and Unions Relations

	Weak Inequalities	*Strong Inequalities*
Strong Union density	***(3): Success of Labor*** *Weaker inequalities hampers Union membership*	***(2): Class Clash*** *Strong Unions pressure for increasing regulation of inequalities*
Weak Union density	***(4): Twilight of equality*** *The declining power of unions threatens old labor regulations*	***(1): Alienation*** *Social Problems developed by strong inequality foster the organization of social movements*

This dynamic typology begins in the lower right corner (cell 1), from a configuration one can call "Alienation", where unions are still weak, even though inequality is high. This position in the lower right part of figure 1 is instable, as the high inequality gives trade unions the possibility to mobilize workers. More powerful trade unions lead to the next stage of the conflict in upper right part (cell 2), which one could call "Class Clash", as strong social movements fight inequality that is still high. This situation is also unstable, since trade unions use their power to lower inequality, leading to the situation in the upper left corner (cell 3), which we call "Success of Labor." Here, strong labor succeeded in limiting inequality. However, this situation is instable, because with low inequality, unions hardly recruit new members. This leads to cell 4, the "Twilight of equality", where inequality is still low, but trade unions have weakened membership as well. With little power, labor unions cannot stop inequality from rising, so that the circle returns to the lower right quadrant and begins anew.

This perpetually instable equilibrium can be expressed through a dynamic differential equation model, with inequality and trade union density included as variables. This equation takes the following formula:

$$(1) \begin{cases} \dot{inequality} = -\alpha \, (density - density_o) + \beta \, (inequality - inequality_o) \\ \dot{density} = \gamma \, (density - density_o) + \delta \, (inequality - inequality_o) \end{cases}$$

Where the dotted variable denotes the derivative, and where α and δ are positive parameters, the absolute value of β and γ should be small for the sake of stationarity, while $density_o$ and $inequality_o$ are constants that denote the long term intertemporal average value of trade union density and inequality. This is simple expression can be adapted in a discrete time series context. Therefore, this model, in which the situation is changing counter-clockwise from one cell to the next, can be modelled empirically. The first requirement for this model to work is that inequality and trade union membership are negatively linked at each time period, but that the correlation

changes to a positive one (more inequality=more trade union members) over successive time lags. As we show in the following, this is indeed the case.

Before we proceed by introducing our data and method, a work of caution is due. We are of course aware that both trade union density and inequality result from much else but their mutual dependence – by whichever model defined. We thus do not claim to explain that trade union membership and inequality simply result from each other. Instead, our aim is the more modest one of showing that a discernible relationship as presented above can be found in the long-run development of many countries. Indeed, our data also shows that the relationship between trade union density and inequality is amenable to political intervention. For example, we will show that Scandinavian countries have prevented the move from "Success of labor" to "Twilight of inequality", as they have kept trade union membership from falling, even though inequality was low so that fittingly, the circle stopped at a situation of strong trade union membership and income equality.

2 DATA

Trade union data

So far, the data to model the relationship between trade union density and inequality over the long run did not exist. We make use of the Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (Visser 2013b), looking at the variable "UD", which is the "Union density rate, net union membership as a proportion of wage and salary earners in employment" (Visser 2013a: 23). The ICTWSS delivers trade union data after 1960. So for France 1954-1959, Germany 1950-1959, Italy 1950-1959, the Netherlands 1945-1959, Sweden 1945-1959, the UK 1945-1959, we supplemented data from the variable "net density employed rate" of the CD that accompanies the Handbook on "Trade Unions in Western Europe since 1945" (Ebbinghaus / Visser 2000a; Ebbinghaus / Visser 2000b). For the US 1950-1959, Denmark 1950-1959, France 1950-1953, Australia 1950-1959 and Japan 1953-1959, we have used the variable "netden" from (Golden / Lange / Wallerstein 2009). For data before this, we had to rely on relatively sparse trade union data from Crouch (1993: 73, 96), where we have coded what Crouch has given as "Total known union membership as % of dependent labour force."

We look at net union density to conceptualize the strength of labor even though it would have been possible to look at actual strike data or other indicators of labor unrest, as summarized in the seminal work by Shorter and Tilly (1974). However, it is difficult to find such data in a standardized form, which is different for union density across countries. Also, union density is universally accepted to measure the strength of labor (Wallerstein / Western 2000: 356f.).

Income inequality data

Apart from trade union data, our second large indicator if interest is income inequality. As it constitutes the longest-running continuous and internationally comparable database on income inequality, we use the "The World Top Incomes Database" to estimate the income share of the richest 1 and 10 percent of each society (including capital gains), to understand how much the

top income earners in a society get, relative to the large majority (Alvaredo, et al. 2013; Piketty 2014).

We look at the income share of the 10 percent for two reasons. First, they are the only indicators that are available over the long period that one has to look at to understand the prey-predator dynamic between trade unions and inequality. Second, these indicators are the closest one can get, to model the Marxist idea of a conflict between a small bourgeoisie, versus a large proletariat, which comprises the vast majority of the population. In addition, the income share of the top 10 percent is highly correlated with conventional measures of inequality such as the Gini index.[2]

3 METHOD

We use the data on unionization and the income share of the top 1 and top 10 percent. We interpolate this data for missing years. We will first show that circle between union strength and inequality graphically over time. We then first use a simple correlation over various time gaps to show that unions decrease current income inequality and that current income inequality decreases union density. But at the same time, income inequality and union strength are positively related over a lag of about 10 to 20 years. The stronger unions were about 40 years ago, the higher current inequality. This can only be explained through the circle of inequality, which we model with a structural equation model. In this model, we first take into account that current inequality and current trade union strength are correlated negatively. However, we also model that with a ten-year time lag, trade unions increase their size due to prior inequality (positive correlation).

yxc

where changes in trade union density depend on prior trade union density and prior inequality and where changes in inequality also depend on prior inequality and prior trade union strength (while at the same time past inequality and past trade union density are also related).

4 RESULTS

4.1 DESCRIPTIVE

The following figure starts by graphing our two long-run time trends. It shows inequality by the percent of income that the top 10 percent accrue and net union density.

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[2] For the period for which we have Gini indices (1960 and later) the income share of the top 10 percent is significantly (.01-level) correlated to the net and gross Gini in all of our countries but Germany and Japan. The incomes for the top 1 percent are significantly (again .01-level) correlated in all countries to gross and net Gini apart from Germany (Gini of gross incomes); Japan, Denmark and France (Gini of net incomes) and Italy (Gini of gross incomes). For the Gini, we used The Standardized World Income Inequality Database (Solt 2013).

Figure 2: The long-run connection between trade union density and the income share of the top 10 %
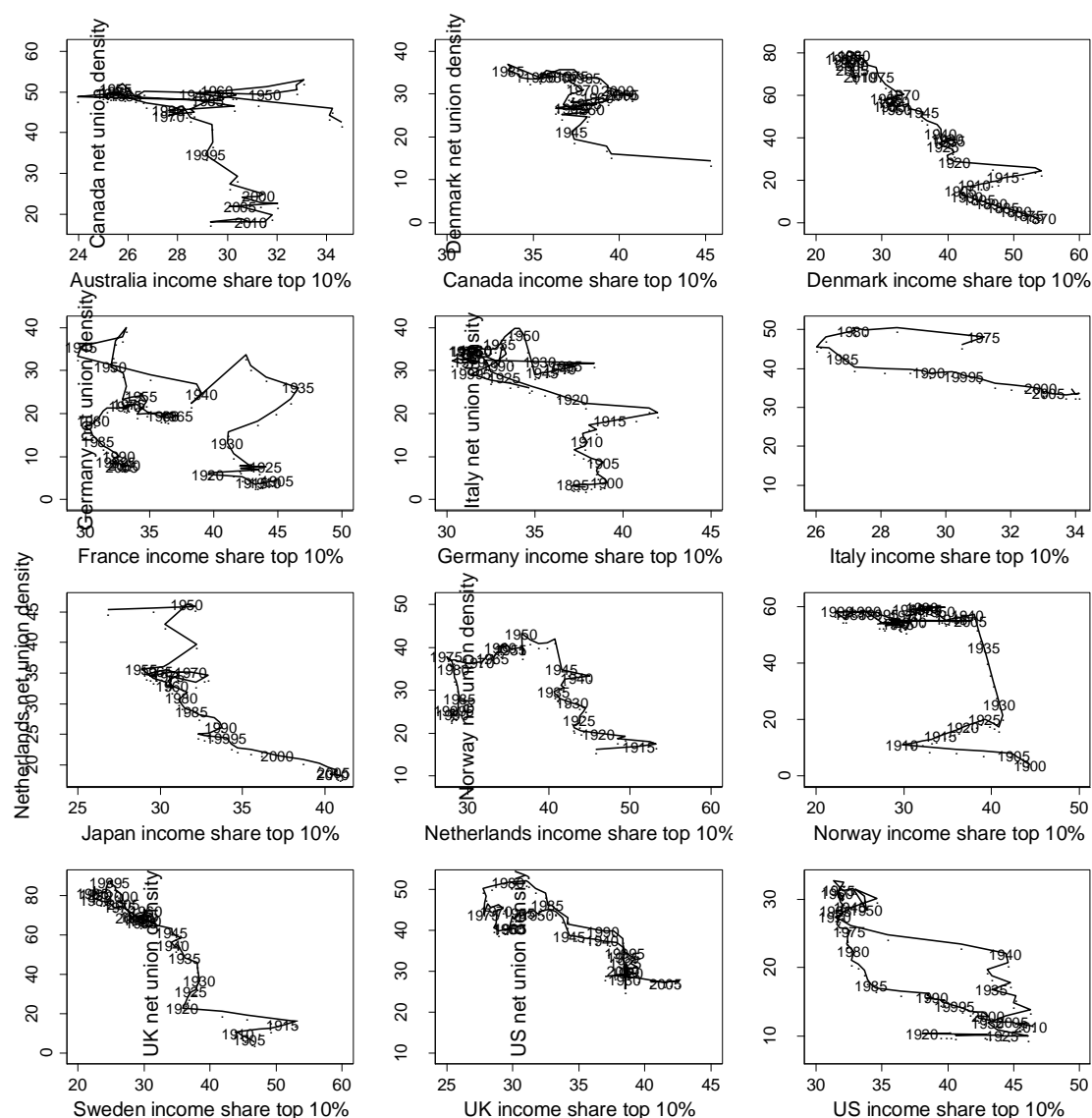
One can see that most of the time there is a line running from the upper left to the lower right corner or vice versa, which means there is a negative relationship between trade union strength and inequality. In other words, either trade unions are strong and inequality is low, or trade unions are weak while inequality is high. However, the graphs also reveal a circle-like quality of the relationship between trade union strength and inequality. For example, there are many instances where trade union density is rising under conditions of high inequality, such as in the, France from 1905 to 1938, Germany 1891 to 1919, in Norway from 1900 to 1938, US from 1925 to 1940. Under these conditions, inequality was high and trade unions were increasing their power. But they did not yet go along with decreasing inequality. In these situations, countries are moving from a situation of "Alienation" to a situation of "Class Clash", where trade union power increases but it does so without lowering inequality. Then there are many instances where persistently strong trade unions go along with decreasing inequality (movement from the upper right to the upper left corner). This the case in Australia from 1941 to 1957, in France from 1935 to 1950, in Italy from 1974 to 1983, in the Netherlands from 1946 to 1975, in Norway from 1938 to 1989. These are situation where countries are moving from a situation of Class

Clash to a situation of Success of Labor. Then there are situations where a strong labor movement under a situation of low inequality cannot survive and loses members, such as in France from 1947 to 2009, the Netherlands from 1973 to 1999 and the US from 1954 to 1986. These are situations where union power declines, but inequality does not yet rise, going from the upper left corner ("Success of Labor"), to the lower left corner ("Twilight of Inequalities"). With weak trade unions, inequality has then started to increase in many countries.

Other countries show a generally negative relationship. For example, in Denmark from 1870 until 2010 we observe a steady strengthening of trade unions while inequalities decrease until a stable situation of strong trade unions and weak inequality is reached. In Sweden and Norway as well, trade unions did not decline from a situation of low inequality. This is because Scandinavian countries let trade unions handle unemployment insurance, so that workers have an incentive to remain in trade unions even under a situation of low inequality so that the circle can stabilize in an equilibrium of low inequality, high trade union membership.

We see the reverse process in Japan, where every-weakened unions went along with ever-higher inequality. In the UK we see both process. Unions became stronger overall from 1928 until 1978 (three years into the Thatcher government), and then inequality increased together with decreasing trade union membership until 2007. This shows the obvious, namely that high inequality must not necessarily go together with decreasing union density and only afterwards with increased inequality (once unions have become weaker). Instead, actions such as those of the Thatcher government, which explicitly aimed to undermine union strength and increase inequality, can achieve both at the same time. However, a circle-like relationship, where inequality and trade union density react to each other with some time lag, is apparent in many country. One can see that the relationship is not very different when we look at the income of the top 1 percent, instead of the income of the top 10 percent (see Figure 5 in the Annex).

Generally positive, but sometimes negative. What to do?

For most of the time, there is thus indeed a negative relationship between trade unions and inequality. This is also the prevailing long-run relationship over time. Indeed, our data show strong negative relationships between trade union density and inequality in most of the countries , with r > .8 at sig=.0000 in Germany, the US, the UK, Japan, Sweden, Italy and Denmark. However, there are other countries where the relationship is weaker (Canada and Italy, r=.6, sig=.0000) or where a long-run significant relationship between trade union density and inequality does not exist, such as in Norway, the Netherlands or France.

As the graphs of Figure 2 show, this may be the case because the long-run historical relationship between trade union density and inequality is better captured by a prey and predator model. In such a model, there can also be protracted periods with negative linear relationship between prey and predator – notably when predators grow (to limits) by diminishing their prey. These are the times that we have described in Figure 2, when trade unions thrive on reducing inequality, thereby diminishing the cause that they can rally around. A second type of negative relationship exists when predators have hunted down prey to a degree that they are most populous, while prey is very low. Starting at this point, prey (inequality) may increase for a long time, while the predator population) does not recover for significant periods (trade unions do not manage to mobilize members against increasing inequality). This latter phase leads to the

much observed negative linear relationship between trade union density and inequality. However, as we tried to argue, this is only one phase – if the predominant one in the last roughly 40 years – in the interaction between trade unions and inequality. If inequality increases further and trade unions find it possible to mobilize against it, then trade union density will increase while social inequality may also still increase for a while, invalidating the often-postulated negative relationship between trade union density and inequality, which quantitative studies show, though it may only be the present historical episode that we live through in an ever over- and undershooting game where inequality and trade union density regulate each other.

4.2 XCORR

The preceding Figure 2 has shown that there seems to be mostly a negative relationship between inequality and trade union density at each point in time (in technical terms: at time lag 0). However, our circular model implies that there should be positive correlations between trade union density and inequality when the two are separated by time lags. This is because Figure 2 has shown that, in accordance with our theoretical model, under a condition of high inequality, unions move from weak to high density so that high inequality can go along with weak unions and with strong unions (move from "Alienation" to "Class Clash"). The strong unions decrease inequality, leading to the typical negative relationships between union density and inequality that existing studies observe (moving from "Class Clash" to "Success of Labor"). However, low inequality may then lead to declining and ultimately low union density ("moving from "Success of Labor" to "Twilight of equality") so that weak inequalities first go along with strong, and then with weak union density. Inequality can then increase again (moving from "Twilight of equality" to "Alienation") so that weak inequalities are first correlated with weak union density and then hight inequalities are correlated with weak union density, whereupon the circle starts again. This means that in many countries, current inequality should be negatively correlated with current union strength (the relationship that prevails most of the time). While inequality should be higher, the stronger unions were in the past and unions should be stronger, the higher inequality was in the past. In other words, there should be a positive correlation over some time lags when our theoretical model is correct. Figure 3 below shows that this is indeed the case in many countries.
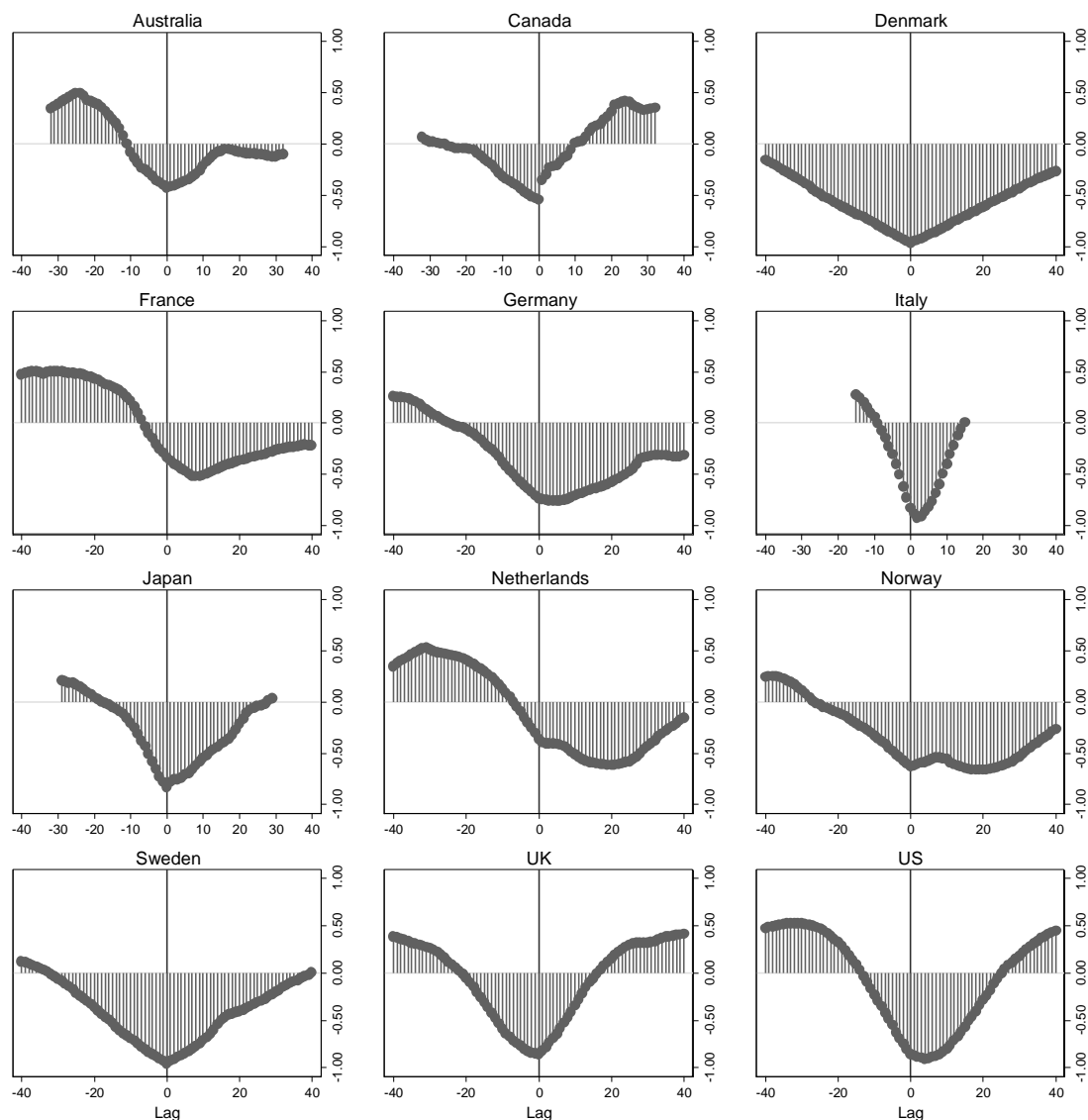
One can see that in several countries, the degree of trade unionization strongly correlates (negatively) with current income differences or income differences in the years after strong trade union organization. For example, in Italy, the strongest relationship is between unionization rates and inequality two years later. In the US, trade unionization rates strongly predict inequality in the next three years (and beyond).

Also, unionization rates are themselves a function of inequality. They are strongly (and negatively) influenced by inequality (as the negative correlations at negative lags indicate). In Austria, high inequality results from low unionization rates in the last 7 years (using a cutoff point of r=.5). The trade union organization rate is further negatively influenced by inequality in the preceding years in Japan, Italy, Canada, the US, Sweden and the UK.

Noteworthy as well is the fact that the influence changes in many countries over time. For example, while inequality of the last 12 years has a negative influence on trade union membership, inequality of more than 12 years ago positively influences trade union

membership in Austria. In France, preceding income inequality always has a positive influence on trade union membership. In Norway, the inequality of the last 9 years has a negative influence on trade union membership on inequality, while inequality before that has a positive influence.

Conversely, trade union membership decreases inequality of the next 9 years in Canada, while in increases inequality after more than 9 years. The same is true for Sweden, where trade union membership seems to decrease income inequality in the next 8 years, and increases it thereafter and the UK, where the effect inverses after 10 years.

Thus, the stronger trade unions are, the less inequality there is – the negative correlations around lag zero. Trade unions thus seem to influence inequality negatively, but are themselves negatively influenced by inequality. After some years however, the relationship between trade union membership and inequality become positive in some countries (at positive and / or negative lags). Thus, strong trade unions go along with more inequality 15 years later in the UK and 25 years later in the US. This can be the case because strong trade unions can have become so powerful at destroying inequality, that within 25 years, they can have destroyed their own mobilization base so that inequality starts to be higher again.

This data structure makes it plausible that instead of a simple linear relationship, the relation between trade union membership and inequality is a non-linear one: High trade union membership is destructive of inequality. However, when trade unions have lowered inequality, they lose members (as they have fulfilled their mission). However, low inequality lets trade unions members leave their trade unions, which lets inequality increase in the future. So high trade union membership now goes along with higher inequality 10-20 years. Conversely, this high inequality leads to higher trade union membership often about 20 to (sometimes) about 10 years later, which is the time it needs for social movements to form in response to high inequality. As these social movements gain power, they decrease inequality in the years before they have become the most powerful (the negative lags) and in most countries, in the year when they are the most powerful (lag 0). However, then again, with this destruction of inequality, trade unions have again sown the seeds of their own destruction, even if inequality high union membership will decrease the inequality in the next ten years.

4.3 FIXED EFFECTS FOR LINEAR, BUT STRUCTURAL EQUATION MODELLING IS BETTER, PROVE THAT IT IS A VORTEX, RATHER THAN A LINEAR RELATIONSHIP

In the last step, we want to model the relationship between inequality and trade union membership through a statistical model. In the following, we first estimate two separate fixed effects regression models, showing that inequality declines when inequality ten years ago was high and that inequality declines when trade union membership ten years ago was high. In a second fixed effects model, we show that trade union density increases when inequality ten years ago was high. This is interesting, because it shows that when unions had a lot of members ten years ago inequality declines. It also shows that when inequality was high ten years ago, current inequality tends to decrease, not increase further, ten years later. Model 2 explains trade union density. It shows that high inequality ten years ago actually has a positive (not the often postulated negative) impact on trade union density. Thus, the more inequality exists, the more trade union density will exist one year later. This is the circle we are talking about, where trade unions density decreases later inequality, but can itself build up due to inequality with a time lag

of about ten years. Model 3 brings all those relationships into one model, explaining trade union density with prior inequality and inequality with prior trade union density.

**Table 1: Relationship between inequality and trade union density**

	(1) Fixed effects inequality	(2) Fixed effects trade union density	(3) Structural Equation Model
Change in inequality			
Trade union members lag10	-0.0261*		-0.0178*
	(-2.75)		(-2.24)
Inequality lag10	-0.0532***		-0.0509***
	(-4.92)		(-5.41)
Constant	-0.0000930		-0.00222
	(-0.04)		(-0.40)
Change in trade union members			
Trade union members lag10		-0.0129	-0.0170**
		(-1.94)	(-2.67)
Inequality lag10		0.0273**	0.0248***
		(4.20)	(3.49)
Constant		0.00817***	0.00994
		(4.74)	(1.71)
mean(ssocm_l10)			
Constant			0.276**
			(3.10)
mean(sineq_l10)			
Constant			-0.0654
			(-1.26)
var(e.sineq_d)			
Constant			0.0462**
			(3.17)
var(e.ssocm_d)			
Constant			0.0101***
			(3.47)
var(ssocm_l10)			
Constant			0.848***
			(11.13)
var(sineq_l10)			
Constant			0.909***
			(18.07)
cov(ssocm_l10,sineq_l10)			
Constant			-0.596***
			(-7.19)
r2	0.0299	0.110	0.140
aic	-238.8	-1795.2	2727.8
bic	-229.1	-1785.4	2781.3
Observations	965	994	964

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The following Figure 4 sums up the Structural Equation model graphically, showing standardized coefficients for all relationships and explaining changes in inequality through prior trade union members and inequality, as well as explaining changes in trade union density through prior trade union density and prior inequality.

Figure 4: Path diagram between inequality and trade union density
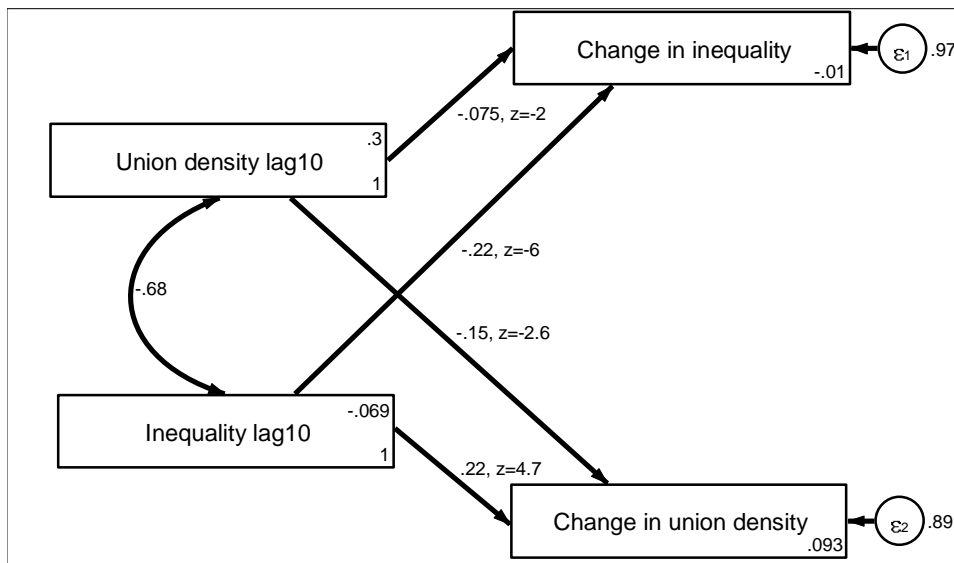
The Figure again underlines our point in visual form, depicting model 3 of Table 1. Going from left to right, we first account for the fact that past inequality and past union density negatively influence each other. The stronger unions were ten years ago, the less inequality existed ten years age (correlation of -.68). This is the well-known negative linear dependency of trade unions and inequality. However, while high union density also contributes to a decline of income inequality ten years later, the first circular process is that high income inequality also contributes to a *decline* of income inequality ten years later. Second, high union leads to decreasing union density later. But high inequality leads to more union members ten years later, which means that unions increase their membership through high inequality with a time lag of ten years. Thus on the one side unions decrease inequality. But on the other side (and in this case even stronger) high inequality increases trade union density ten years later.

5   DISCUSSION

While existing studies have looked at a number of indicators to explain union strength (see the review by Wallerstein / Western 2000) and inequality (f. the review in Neckerman 2004), we have shown that the reciprocal influence of trade unions on inequality and inequality on trade unions explains a lot of variation in each. We posit that inequality causes trade unions to get more members, that this higher trade union density decreases inequality, that lower inequality decreases trade union membership and that this leads to rising inequality. The important point here is that all of these mechanisms operate with a time lag.

Using very long-run inequality and trade union data, we could show how union density and inequality in 20th interacts in a way that follows the logic of a prey-and-predator models. Trade unions destroy inequality so thoroughly that they also destroy their base for mobilization. However, inequality then increases to such a degree that people start to join trade unions again. To be sure, it is also for this reason that a linear negative relationship explains the interaction between trade union density and inequality over long periods of time. However, we also showed that increasing inequality goes along with increasing union membership, so that one can observe a positive relationship between the two variables not only when increasing inequality increases trade union membership.

To be sure, we do not claim that the spiral between inequality and trade union density is a deterministic one. For example, Scandinavian countries have effectively stopped the circle from turning when it has reached a state of low inequality coupled with high trade union density. They have done this by letting trade unions administer unemployment schemes. So even though normally people have an incentive to leave trade unions when there is no inequality to fight, Scandinavian countries "artificially" prevent trade union density from declining and it can be observed that inequality has remained low as well.

We also believe that our model contributes to existing explanations on inequality and trade union density. For example, economic models argue that skill-biased technical change increases inequality, as those that can work with computers increase their incomes, while those that cannot work with computers are replaced by them. This means that people get divided into high-income earners on the one side and low-income earners on the other – both of which are tempted to leave unions (Acemoglu / Aghion / Violante 2001). While such explanations of union density and inequality may be true for the 1970s onwards, our data shed doubt on this mechanism as a sole force to explain inequality in the long run. As we have shown, there seems to be a more general link between trade union membership and inequality, which extends beyond the era of post-1970. Notably, it seem plausible to assume that trade unions thrive on high inequality, but at the same time decrease it. In this sense, it seems had to imagine that the link between inequality and union density is solely caused by skill biased technical change, as existing studies argue which look at relatively short time horizons.

The model proposed in this paper complements existing approaches that postulate a "Spiral of Capitalism and Socialism" (Boswell / Chase-Dunn 2000) where social movements fight capitalisms inequality. However, critics of such models argue that they simply postulate "Kondratiev" long term cycles between social movements against capitalism on the one side and the inequality that capitalism creates on the other side without explaining what these models arise from (Arrighi 2002). In our model, the "Kondratiev -waves between inequalities and social movements against this inequalities have no role of *primum movens*, but simply result of a non-linear dynamics. Namely, trade union density increases in response to social inequality, but it does so with a significant time lag. It seems that strong trade unions in turn decrease inequality, but again with a significant time lag. Decreasing inequality leads to trade union decline, but again – this may happen with some time lag, and the same is true for the effect of low trade union density on inequality. Thus, one can argue that trade unions react to inequality, but they react too late, too much, and face a delayed backlash due to prior overshooting so that decreased inequality in turn lowers their members base. In this sense, we argue that there may indeed exist a sort of spiral between "capitalism and socialism", when one sees this as an interaction between inequality and trade union density, where one aspect reacts to the other with some delay and with some "overshooting" so that the whole dynamic is akin to a prey and predator model.

What is more, such a model can be applied to any interaction between social problem and consciousness about that problem. A problem raises social movements that deal with it. Then those social movements decrease the intensity of that problem. With a lower problem-intensity, social movements start to neglect the issue. The underlying problem is then free to resurface again. With the increasing availability of long-run historical data on social movements as representations of the consciousness about a problem, as well as historical data about the objective degree of such phenomena, we hope that we can encourage researchers to focus on the

often non-linear historical dynamics between social problems and how social movements deal with them.

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6 ANNEX

Figure 5: The long-run connection between trade union density and the income share of the top 1 %