A prey-predator model of trade union density and inequality in 12 advanced capitalisms since the early 20th century

**Abstract**

We show that in the long historical run, trade unions and income inequality influence each other according to a prey and predator model. As is well-known, high current inequality goes along with low current trade union membership. However, using long-run historical data, we show that high inequality leads to higher, not lower union membership with a time lag. This is likely the case because trade unions recruit members to fight high inequality. Therefore, by lowering inequality, unions – again with a time lag – destroy their capacity to recruit members. Low trade union membership opens the way for inequality to increase, and higher inequality then re-incentives workers to join unions. Using a structural equation model with data on trade union membership and income inequality, we show how trade union membership and income inequality mutually cause each other in a perpetually instable equilibrium in twelve countries over more than 100 years.

**Keywords**

Trade union density, inequality, prey-predator model, top incomes

# Introduction

An extensive literature is concerned with the determinants of trade union membership ([see the review in Wallerstein and Western, 2000](#_ENREF_42)). Another, similarly vast literature, explains what causes income inequality (see the review by [Neckerman and Torche, 2007](#_ENREF_31); [Kenworthy, 2007](#_ENREF_24)). These two literatures are connected, since inequality and trade union membership are inimical to each other ([Kahn, 2000](#_ENREF_23); [Western and Rosenfeld, 2011](#_ENREF_43); [Hirsch, 1982](#_ENREF_21); [Gustafsson and Johansson, 1999: 600](#_ENREF_20); [Checchi et al., 2010](#_ENREF_11); [Card, 2001](#_ENREF_9)). Trade unions decrease inequality, while inequality harms trade unions. Superficially, this relationship is a simple negative correlation: more inequality is associated with lower union density.

While this negative link between inequality and trade union membership is widely documented, its simplicity contradicts a Marxist, and indeed, common sense notion, which is that trade unions can use persistently high inequality as a rallying cry to recruit new members, so that inequality would cause higher, not lower trade union membership. We therefore argue that Lotka’s ([1925](#_ENREF_27)) and Volterra’s ([1931](#_ENREF_41)) prey/predator model offers a better conceptualization of how trade unions and inequality influence each other. Using a structural equation model, we show that trade union membership and inequality are negatively linked at most points in time, but that inequality also increases trade union membership with a time gap, so that unions not only decrease inequality (negative relationship), but also grow when past inequality is high (positive relationship).

In the following, we present the two ostensibly competing theories behind these ideas, notably 1) that inequality promotes trade union membership (positive relationship) and that 2) strong trade unions lower social inequality (negative relationship). We then show the data behind these alleged patterns and construct a model that can capture both relationships. Instead of a simple negative relationship, our model shows that there are indeed four historical stages: 1) trade unions recruit members in conditions of high inequality, 2) strong trade unions then reduce this inequality, leading to the widely observed negative relationship between inequality and trade union density. However, with low inequality, workers have no incentive to join trade unions, so that 3) trade union membership decreases. With 4) low trade union membership, inequality increases again and when inequality is high, the vortex starts again. In the following, we present the two theories which this model incorporates.

## 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. Marx argued that “social and political associations” must be explained through “the inequalities within the organization of production” ([Bendix, 1974: 155](#_ENREF_5)). In this sense, a central view of Marxism is that trade union density must be explained with reference to historical structures of material inequality. Notably, Marxism posited that the wages of the proletariat are bound to decline, so that members of the proletariat have an incentive to form associations that rally for higher incomes of the proletariat.[[1]](#endnote-1) Even though Marx did not foresee that workers would effectively organize in trade unions, this central idea of Marxism argues for a positive relationship between long-run income inequality and trade union organization. This 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 ([Korpi, 2006: 173ff.](#_ENREF_26); [Bendix, 1974](#_ENREF_5)). Indeed, it is established wisdom that trade unions sprang out of the intolerable conditions of 19th century capitalism and increased their membership by rallying against this inequality. Thus, theory and history suggest that trade union density is higher when inequality is higher. This should be most true for the formation phase of trade unions, from about 1870 to 1945.

Indeed, shortly after this period, economists still argued that unions 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](#_ENREF_18); [similarly, cf. Rees, 1962](#_ENREF_35); [Johnson, 1975: 26](#_ENREF_22)). Thus, “[u]ntil the 1970s the dominant view was that unions tended to increase wage inequality” ([Card et al., 2004: 519](#_ENREF_10)). In this sense, there is ample reason to believe that trade union density and inequality are positively correlated.

## Theory 2: Strong trade unions come with equality

Contrary to the aforementioned view, Esping-Andersen’s ([1990](#_ENREF_16)) typology of welfare states does not rely on the idea that countries with the most inequality brought about the strongest trade unions. Instead, power resources theory claims that trade unions became more encompassing when the working class was more successful in building coalitions, which was possible in more equal societies ([Esping-Andersen, 1985](#_ENREF_15); [also cf. Korpi, 1985](#_ENREF_25); [2006](#_ENREF_26)). In more equal countries, trade union could gain strength, which they then used to further equalize wages. Though the two views are often seen as contradictory, the Varieties of Capitalism-view also argues that trade unions could thrive in more egalitarian countries ([Mares, 2001](#_ENREF_28); [Paster, 2011](#_ENREF_32)). Thus, trade unions could spring up where inequality was low, but then strong trade unions decreased inequality even further, especially in the 30 years after the Second World War.

When in the 1970s welfare states had “grown to limits” ([Flora, 1986](#_ENREF_17)), a negative link between trade unions membership and inequality existed. It now went in the opposite direction however. One could observe declining trade union membership coupled with increasing inequality, especially in the US and the UK, but also in Western Europe ([Card et al., 2004: 528](#_ENREF_10); [Card, 2001](#_ENREF_9)). Indeed, the period starting around 1975 is the period for which good data on trade union density and inequality exists, and the negative relationship between union density and social inequality for this period is well-documented and undisputed ([Western and Rosenfeld, 2011](#_ENREF_43); [Asher and DeFina, 1997](#_ENREF_4); [Acemoglu et al., 2001](#_ENREF_1)). For this period, between- and within-country regressions show that “a high percentage of the population belonging to trade unions negatively affects income inequality” ([Gustafsson and Johansson, 1999: 600](#_ENREF_20)). The question is however, which causes which.

While most researchers argue that unions are the independent, and inequality the dependent variable, as they “treated union decline as one of the causes of rising earnings inequality” ([Checchi et al., 2010: 86](#_ENREF_11)), inequality might also undermine union strength. This is because with high inequality, the “across-the-board” wage increases that unions typically bargain for, are less satisfying for those that profit from high inequality ([Hirsch, 1982: 38](#_ENREF_21)). This is because unions mostly represent workers from the middle of the income distribution. Also, when inequality moves people to the top and bottom of the inequality-divide, fewer workers are left in the middle that unions can organize ([Checchi et al., 2010: 101](#_ENREF_11)). Thus, not only do strong unions decrease inequality, but high inequality can also weaken unions.

Economists also propose a negative link between inequality and trade union membership. They argue that during low inequality, workers with high skills are forced to accept that unions redistribute their wages to low-skilled workers. The more unions equalize incomes however, the more high-skilled workers have an incentive to leave unions. This should lead to simultaneous union-decline and inequality-increases, which is why low inequality comes with high union membership and high inequality comes with low union membership ([Acemoglu et al., 2001: 251](#_ENREF_1)).

## A prey-predator model of trade unions and inequality

There are thus reasons why inequality should *increase* trade union membership, but there are also reasons why inequality should *decrease* trade union membership. In turn, there are reasons why trade unions membership *decreases* inequality, but there are also reasons why trade union membership *increases* inequality. Is it possible to reconcile these apparently contradictory dynamics? Existing accounts have not done this so far. Boswell and Chase-Dunn ([2000](#_ENREF_8)) argue that inequality produces social movements to fight it, which leads to a “Spiral of Capitalism and Socialism.” However, critics argue that they leave unexplained the dynamics through which exploitation creates a countermovement ([Arrighi, 2002](#_ENREF_3)). Existing empirical studies also cannot answer whether there is a systematic, quantifiable link between labour and capital, as conventional data sources only cover short time spans. Existing studies therefore complain that to understand the relationship between organized labour and income inequality, one has to look at longer time periods than typical data sources can provide ([Kahn, 2000: 577](#_ENREF_23); [Wallerstein and Western, 2000](#_ENREF_42)).

We therefore test 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.](#_ENREF_36); [for the prey and predator model, cf. Lotka, 1925](#_ENREF_27); [Volterra, 1931](#_ENREF_41)). In economics, such a prey-predator model is not a novelty. Goodwin (1967) claims that when capitalists invest more, additional workers find employment, which lowers the unemployment rate and drives up the price of labour. During this time, labour increases its national income share However, as the price of labour increases, labour gets a larger share of national income, so that investments become less profitable, and capitalists stop investing. With less investment, unemployment rises, which lowers the price of labour. In this situation, capital can re-appropriate a higher percentage of national income; investments increase, driving the unemployment rate down and the price of labour up, so that a new “growth cycle” starts. However, this model failed empirical tests (Harvie 2000). We argue that this may be because it looked at the wrong variables. Instead of looking at unemployment and the capital share of national income, we suggest to look at trade union membership and income inequality.

The idea behind this is that trade unions and inequality “regulate” each other over long periods with a circular dynamic: Inequality gives trade unions a base to mobilize workers. Encompassing trade unions then decrease inequality. However, just like a predator that eats up its own prey, when trade unions have lowered inequality, they have also pulled the rug from under their own feet by having destroyed what they have used as a rallying cry to recruit new members. Trade unions then lose members, as fewer workers see why – given a situation of relatively low inequality – they should still be union-members. With low trade union membership, social inequality starts to increase again. When inequality is high however, trade unions also have a compelling argument to recruit new members again and the vortex begins anew. The fourfold table below sums up the steps in this circle, where one situation leads to the next. The table consists of four possible combinations, as inequality and trade union density can each be high or low.

[Figure 1 here]

One can begin to explain the dynamic in the lower right corner (cell 1), from a situation one can call “Alienation”, where unions are weak but growing stronger, due to high inequality. This situation, in the lower right part of Figure 1, is instable because high inequality enables trade unions to mobilize workers. Emboldened trade unions lead to the next stage of the dynamic, in the upper right part of the table (cell 2), which is a situation of “Class Clash”, in which strong unions 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 one can call “Success of Labour.” Here, strong labour unions succeeded in limiting inequality. However, this situation is instable as well, because when inequality is low, unions hardly recruit new members, so unions grow weaker. This leads to cell 4, the “Twilight of Equality”, where weakened trade unions cannot stop inequality to increase from a relatively low level. When inequality has risen to a higher level, the vortex has returned to the lower right quadrant and begins anew. We show in the following that this vortex-like relationship is indeed visible in the history of many countries, when graphing trade union membership and inequality on an x- and a y-scale. Also, this perpetually instable equilibrium can be expressed through a dynamic differential equation model, which includes inequality and trade union density as variables. This equation takes the following formula:



The “dt” variable denotes the derivative, where α and 𝛿 are positive, the absolute value of β and 𝛾 should be small for the sake of stationarity, while densityo and inequalityo are constants that denote the long term intertemporal average value of trade union density and inequality. This simple expression can be adapted to a 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 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 the case.

Before we proceed to introducing our data and method, let us clarify however, that we are aware that both trade union density and inequality result not only from their mutual dependence – by whichever model defined. We thus do not claim to explain trade union membership and inequality simply result from each other. Instead, we aim to show that a discernible relationship as presented above can be found in the long-run development of many countries, regardless of what other variables interfere with it. 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 Labour” to “Twilight of Inequality”, as they kept trade union membership from falling, even though inequality was low, so that the vortex stopped at a situation of strong trade union density and low income equality. Before we proceed to show our results, we present our data below.

# Data

To model the historical relationship between union density and inequality, we use the dataset with the longest internationally comparable income inequality data, The World Top Incomes Database ([Alvaredo et al., 2015](#_ENREF_2); [Piketty, 2014](#_ENREF_34)). We estimate the income share of the richest 1 and 10 percent of the population (including capital gains), to model the inequality between a small elite, which thrives on capital accumulation, and a large working class, which is likely to profit from higher wages. Our measures of income inequality are also highly correlated with the Gini for the time period for the Gini index exists.[[2]](#endnote-2) We interpolate our inequality-data on the base of neighbouring years. In our main analyses, we focus on incomes of the top 10 percent, as they contain fewer missing values. However, we use the income share of the top 1 percent as a robustness check.

To measure trade union density since 1960, we use of the Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts ([Visser, 2013b](#_ENREF_40)), which measures the “net union membership as a proportion of wage and salary earners in employment” ([Visser, 2013a: 23](#_ENREF_39)). For France 1954-1959, Germany 1950-1959, Italy 1950-1959, the Netherlands 1945-1959, Sweden 1945-1959 and the UK 1945-1959, we supplemented data from the variable “net density employed rate” of the dataset that accompanies the Handbook on Trade Unions in Western Europe since 1945 ([Ebbinghaus and Visser, 2000a](#_ENREF_13); [Ebbinghaus and Visser, 2000b](#_ENREF_14)). For the US 1950-1959, Denmark 1950-1959, France 1950-1953, Australia 1950-1959 and Japan 1953-1959, we use the variable “netden” from Golden et al. ([2009](#_ENREF_19)). For data before this, we used trade union data from Colin Crouch’s ([1993: 73, 96](#_ENREF_12)) “Total known union membership as % of dependent labour force.” Such measures are widely accepted to measure the strength of organized labour ([Wallerstein and Western, 2000: 356f.](#_ENREF_42)). Finally, we use all countries for which long-run inequality and trade union density data exists. These are Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the UK and the US.

# Method

First, we graphically show what shape the vortex between union strength and inequality takes in different countries over time. We then use cross-correlograms to show that trade union strength and inequality are negatively related with a time gap of 0 years, but the relationship turns into a non-significant or even positive correlation with successive time-gaps between the two variables. To model this, we use an autoregressive structural equation model, which takes into account that current inequality is correlated negatively with current trade union density, while trade union density and prior inequality are positively related with a seven-year time lag. Our structural equation model (SEM) applies Bollen and Curran’s ([2004](#_ENREF_7)) Autoregressive Latent Trajectory (ALT). In recent years, traditional types of path analysis ([Blau and Duncan, 1967](#_ENREF_6)) have been adapted to make more causal claims about status attainment and social mobility ([Pfeffer and Hällsten, 2012](#_ENREF_33) ). Our approach relies on the development of time series analysis and structural models analysis that uses cross-lagged autoregressive variables ([Schlueter et al., 2007](#_ENREF_37)), where 1) changes in trade union density depend on prior trade union density and prior inequality, 2) changes in inequality depend on prior inequality and prior trade union strength and 3) past inequality and past trade union density are related. The model we use therefore looks like the following:

[Figure 2 here]

# Results

## Descriptive Results

The following figure starts by graphing our two long-run time trends for the twelve countries for which data exists. It shows inequality on the x-axis, by the percentage share of all income that flows to the top 10 percent, and it shows net union density on the y-axis.

[Figure 3 here]

One can see that for most of the time, a line runs from the upper left to the lower right corner of each graph, indicating a negative relationship between trade union strength and inequality. In other words, situations where trade unions are strong tend to be situation where inequality is low (“Success of Labour”), and situations where trade unions are weak tend to be situations where inequality is high (“Alienation”). Given long periods where trade unions and inequality seem to exert a negative influence on each other, the two are strongly negatively related in Germany, the US, the UK, Japan, Sweden, Italy and Denmark (r > .8, sig=.0000). For example, Danish trade unions gained members from 1870[[3]](#endnote-3) onwards and inequality decreased, until a relatively stable situation of strong trade unions and weak inequality was reached which lasts until the year 2010. Similar trends can be observed in Sweden and Norway. So why did trade union membership not decrease in these countries, even though inequality is low? This is likely the case because Scandinavian countries let trade unions handle unemployment insurance, so that workers have an incentive to remain organized even in a situation of low inequality, so that the vortex can stabilize in an equilibrium of low inequality, high trade union membership. However, while trade union membership in the Nordic countries did remain remarkably high in international comparison, Sweden’s trade union density rate did drop by 18 percentage points from 1995 to 2010, Denmark’s dropped by 8.5 points and Norway’s by 2.5. Whether high equality will further depress union membership in these countries remains to be seen. The historical process of the Nordic countries is inversed in Japan, where ever-weaker unions went along with ever-higher inequality. In the UK, both processes are apparent. Unions became stronger from 1928 until 1978; then inequality increased, while trade union density decreased until 2007.

However, the simple negative linear relationship between trade union density and inequality is weaker in other countries, such as Canada and Italy (r=.6, sig=.0000) and in yet other countries, no long-run significant relationship between trade union density and inequality exists. This is the case in Norway, the Netherlands and France. In this sense, the graphs also reveal a vortex-like relationship between trade union strength and inequality. For example, trade union density increased under conditions of high inequality in France from 1905 to 1938, in Germany from 1891 to 1919, in Norway from 1900 to 1938 and in the US from 1925 to 1940. In these situations, countries were moving from a situation of Alienation to a situation of Class Clash, where trade union power increased, but without yet 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 is 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 Labour. Last, there are situations where a strong labour movement cannot survive in a situation of low inequality and loses members, such as in France from 1947 to 2009, in the Netherlands from 1973 to 1999 and in the US from 1954 to 1986. These are situations where union density declines, but inequality does not yet rise, going from the upper left corner (Success of Labour, strong unions, low inequality), to the lower left corner (Twilight of Inequalities, weak unions, low inequality). With weak trade unions, inequality then started to increase in many countries. In this sense, many countries indeed show the vortex-like pattern between trade union strength and inequality that we have proposed in Figure 1.

Thus, as the graphs of Figure 3 show, the long-run historical relationship between trade union density and inequality is better captured by a prey and predator model than by a simple negative relationship. This is because a vortex-like prey and predator model allows for periods with negative relationships between prey and predator – notably when predators grow to limits by diminishing their prey. These are the times in Figure 3 when trade unions thrive on reducing inequality, thereby diminishing the cause however, that they can rally around. A second type of negative relationship exists when predators have hunted down prey to a degree that it threatens their own survival. 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). These two phases lead to the much observed negative linear relationship between trade union density and inequality. However, they are only two phases – though the predominant ones most of the time. Because of four time-lags, there can also be positive relationships between trade union membership and inequality: 1) Trade unions need time to gain members when inequality is high. 2) Trade unions need time to lose members when inequality is low. 3) Even strong trade unions need time to decrease inequality. 4) Weak trade unions let inequality decrease with a certain time lag. To show that the relationship between trade union density and inequality can move from a negative, to a positive one with successive time lags, we use cross-correlograms in the following.

## Cross-correlograms

The preceding Figure 3 has shown that a negative relationship between inequality and trade union density exists most of the time. However, Figure 3 has also shown, in accordance with our theoretical model, that under conditions of high inequality, unions first gain members, with which they then decrease inequality; but lower inequality then leads to fewer members, which then lets inequality increase – in each case with a time lag. So strong unions should coincide with high prior inequality (positive correlation), low actual inequality (negative correlation) and high later inequality (positive correlation). Figure 4 below shows that this is indeed the case in many countries.

[Figure 4 here]

One can see that in all countries, trade union density correlates negatively with income inequality of the same year (lag 0 and around). 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). However, unionization rates are also strongly negatively correlated with prior inequality (see the high negative correlations at negative lags). In Austria, high inequality results from low unionization rates in the last 7 years (using a cut-off point of r=.5). Trade union membership is also negatively influenced by inequality in the preceding years in Japan, Italy, Canada, the US, Sweden and the UK.

In many countries, the relationship changes from a negative influence towards a positive one over time successive time gaps. For example, high inequality decreases trade union membership in the next 12 years in Austria, but inequality of more than 12 years ago positively influences trade union membership. In France, preceding income inequality always influences trade union membership positively. In Norway, inequality influences trade union membership in the next years negatively, while positively influencing trade union membership after more than 9 years. Conversely, trade union membership decreases inequality in the following 9 years in Canada, while it increases inequality after more than 9 years. In the UK as well, inequality and trade union membership are negatively linked over few time lags, and positive linked over longer time lags.

Thus, trade unions go along with lower immediate inequality – as the clearly negative correlations around lag zero indicate. After some years however, the relationship between trade union density and inequality turns positive in some countries (at larger positive and / or negative lags). So it seems that high trade union membership lowers current inequality or is lowered by current inequality. However, trade union density is higher, when inequality of the past is higher. This would imply that trade unions increase their members based on income inequality of the past.

In other words, the relationship between trade union membership and inequality is non-linear: High current trade union membership and high current inequality are inimical to each other (negative link). However, high past inequality helps trade unions to gain members (positive link) with a time lag of 10 to 20 years, which might be the time that social movements need to form in response to high inequality. As these social movements gain power, they decrease inequality in the years before they become most powerful (the negative lags), when they are the most powerful (lag 0), and shortly afterwards (positive lags). However, the more trade unions lower inequality now, the more they sow the seeds for their own destruction, as trade unions members leave and inequality begins to increase again many years after trade unions were at the peak of their power (and inequality was low).

## Structural equation model

In the last step, we model this relationship between inequality and trade union membership statistically. Model 1 first shows that inequality declines when inequality seven years ago was high, and that inequality declines when trade union membership seven years ago was high. Model 2 explains changes in trade union density. It shows that inequality seven years ago increases union density, which indicates that unions recruit members on the basis of past inequality.

[Table 1 here]

Model 3 sums up both models into one dynamic structural equation model, where both inequality and trade union density depend on inequality and trade union density seven years ago. It shows that the model explains 12.7 percent of the variation in trade union rates and inequality, simply by how they mutually cause each other. Model 4 shows that one gets similar results when using a ten year time lag. In this case, inequality and union density ten years ago explains changes in union density a bit better than inequality and union density seven years ago do, but changes in inequality are a bit better explained by union density and inequality seven, rather than ten years ago. The following Figure 5 sums up Model 3 graphically, showing standardized coefficients instead of effect sizes for all relationships, and explaining changes in inequality through prior trade union membership and inequality, as well as explaining changes in trade union density through prior trade union density and prior inequality.

[Figure 4 here]

The figure underlines in visual form that union density and inequality in the same year are strongly negatively related (r=-.67). Prior union density also decreases later inequality (r=-.15). Both reflect a negative relationship between inequality and trade union density. But while inequality decreases inequality seven years later and while current trade union density lowers trade union density seven years later, the vortex-like structure of the model comes into play because current inequality increases later union density (r=.19). This is the vortex we are talking about, in the sense that current trade union density lowers – or is lowered by – current inequality, while thriving on the inequality that existed seven years ago. What this circularity means is discussed in the following.

# Discussion

Studies have looked at different indicators to explain union strength ([cf. the review by Wallerstein and Western, 2000](#_ENREF_42)). Other studies have looked at different indicators to explain inequality ([cf. the review by Neckerman, 2004](#_ENREF_30)). However, no study has so far conceptualized the reciprocal influence of union density on inequality and of inequality on union density, to show how both co-vary over long periods of time. We did not question that inequality and union density are negatively correlated at each point in time; but we suggested that a positive correlation could exist in the sense that inequality allows trade unions to recruit more members with a time lag, while lower inequality, again with a time lag, makes it difficult for trade unions to recruit or retain members.

By using long-run inequality and trade union data for the first time, we could show how union density and inequality in the 20th century interact according to a prey-and-predator model. Trade unions may destroy inequality so thoroughly that they also destroy their base for mobilization. However, with few members in trade unions, inequality can increase to such a degree that people start to join trade unions again. For this reason, a negative linear relationship explains much of the interaction between trade union density and inequality over many time periods. However, we also showed that during certain time periods, increasing inequality goes along with increasing union membership, so that one can observe a positive relationship between the two variables.

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 vortex from turning at a level of low inequality and high trade union density, by letting trade unions administer unemployment schemes. So even though people have an incentive to leave trade unions when inequality is low, countries can “artificially” prevent trade union density decline, so that strong trade unions go along with continually low inequality. However, even in Sweden and Denmark, it is difficult to keep high levels of union density in a long-run situation of low inequality, which could mean an eventual end of the Scandinavian exception. Even apart from these cases, we find it important to highlight that our model can only explain some of the dynamic between inequality and union density, as both depend on many exogenous influences that our model does not integrate.

We do believe however, 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 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 et al., 2001](#_ENREF_1)). While such explanations of union density and inequality may be true for the 1970s onwards, our data shed doubt on this mechanism as the sole force to explain inequality and union density in the long run. As we have shown, there seems to be a more general link between trade union density and inequality, which extends beyond the post-1970 era. Notably, it seems that trade unions thrive on past inequality, but decrease current inequality.

The model proposed in this paper complements existing approaches that postulate a “Spiral of Capitalism and Socialism” ([Boswell and Chase-Dunn, 2000](#_ENREF_8)), according to which social movements fight capitalism’s 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 showing statistically how one leads to the other ([Arrighi, 2002](#_ENREF_3)). In our model, the Kondratiev-waves between inequalities and social movements against these inequalities have no role of *primum movens*, but simply result from a non-linear dynamic. Namely, trade union density increases in response to social inequality, but with a significant time lag. It seems that strong trade unions in turn decrease inequality, but this happens again with a time lag. Decreasing inequality leads to trade union decline, but again – this happens 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 spiral between “capitalism and socialism”, when one sees this spiral as an interaction between inequality and trade union density, where one aspect reacts to the other with 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 problems and consciousness about them. A social problem leads to social movements that try to deal with it. Then those social movements indeed decrease the intensity of the social problem. With a lower problem-intensity, social movements that mobilized around this issue wither away. 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 on the one side, and historical data about the objective degree of social problems on the other side, there is now unprecedented opportunity to look at the often non-linear historical dynamics between social problems and how social movements deal with them.

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# Annex: Tables and Figures

**Figure 1: A Dynamic Typology of Inequality and Unions Relations**

|  |  |  |
| --- | --- | --- |
|  | *Weak inequalities* | *Strong inequalities* |
| *Strong union density* | ***(3): Success of Labour****Low inequality leads to lower union density* | ***(2): Class Clash****Strong unions fight inequality* |
| *Weak union density* | ***(4): Twilight of Equality*** *Weak unions let inequality increase* | ***(1): Alienation*** *Inequality nourishes trade union membership* |

**Figure 2: Structural equation model**

Prior union density

Prior inequality

Change in current inequality



1

Change in current union density



2

**Figure 3: The long-run connection between trade union density and the income share of the top 10 %**



**Figure 4: Relationship between union density and inequality at different time lags**



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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
|  | Inequality | Union density | Circular Lag 7 | Circular Lag 10 |
| **Change in inequality** |  |  |  |  |
| Union density lag 7 | -0.0349\*\* |  | -0.0349\*\* |  |
|  | (-3.19) |  | (-3.19) |  |
| Inequality lag 7 | -0.0649\*\*\* |  | -0.0649\*\*\* |  |
|  | (-5.44) |  | (-5.44) |  |
| Union density lag 10 |  |  |  | -0.0178\* |
|  |  |  |  | (-2.24) |
| Inequality lag 10 |  |  |  | -0.0509\*\*\* |
|  |  |  |  | (-5.41) |
| Constant | -0.0005 | -0.0058 | -0.0005 | -0.0022 |
|  | (-0.06) | (-0.91) | (-0.06) | (-0.40) |
| **Change in union density** |  |  |  |  |
| Union density lag 7 |  | -0.0147\* | -0.0147\* |  |
|  |  | (-2.57) | (-2.57) |  |
| Inequality lag 7 |  | 0.0214\* | 0.0214\* |  |
|  |  | (2.32) | (2.32) |  |
| Union density lag 10 |  |  |  | -0.0170\*\* |
|  |  |  |  | (-2.67) |
| Inequality lag 10 |  |  |  | 0.0248\*\*\* |
|  |  |  |  | (3.49) |
| Constant | 0.0028 | 0.0079 | 0.0079 | 0.0099 |
|  | (0.44) | (1.27) | (1.27) | (1.71) |
| mean(Union density lag 7) |  |  |  |  |
| Constant | 0.2636\*\* | 0.2636\*\* | 0.2636\*\* |  |
|  | (3.24) | (3.24) | (3.24) |  |
| mean(Inequality lag 7) |  |  |  |  |
| Constant | -0.0589 | -0.0589 | -0.0589 |  |
|  | (-1.38) | (-1.38) | (-1.38) |  |
| var(e.Inequality difference) |  |  |  |  |
| Constant | 0.0465\*\*\* | 0.0487\*\* | 0.0465\*\*\* | 0.0462\*\* |
|  | (3.32) | (3.27) | (3.32) | (3.17) |
| var(e.Union density difference) |  |  |  |  |
| Constant | 0.0112\*\*\* | 0.0103\*\*\* | 0.0103\*\*\* | 0.0101\*\*\* |
|  | (3.57) | (3.56) | (3.56) | (3.47) |
| var(Union density lag 7) |  |  |  |  |
| Constant | 0.8525\*\*\* | 0.8525\*\*\* | 0.8525\*\*\* |  |
|  | (12.53) | (12.53) | (12.53) |  |
| var(Inequality lag 7) |  |  |  |  |
| Constant | 0.9172\*\*\* | 0.9172\*\*\* | 0.9172\*\*\* |  |
|  | (21.91) | (21.91) | (21.91) |  |
| cov(Union density lag 7, Inequality lag 7) |  |  |  |  |
| Constant | -0.5937\*\*\* | -0.5937\*\*\* | -0.5937\*\*\* |  |
|  | (-7.39) | (-7.39) | (-7.39) |  |
| mean(Union density lag 10) |  |  |  |  |
| Constant |  |  |  | 0.2758\*\* |
|  |  |  |  | (3.10) |
| mean(Inequality lag 10) |  |  |  |  |
| Constant |  |  |  | -0.0654 |
|  |  |  |  | (-1.26) |
| var(Union density lag 10) |  |  |  |  |
| Constant |  |  |  | 0.8478\*\*\* |
|  |  |  |  | (11.13) |
| var(Inequality lag 10) |  |  |  |  |
| Constant |  |  |  | 0.9090\*\*\* |
|  |  |  |  | (18.07) |
| cov(Union density lag 10, Inequality lag 10) |  |  |  |  |
| Constant |  |  |  | -0.5957\*\*\* |
|  |  |  |  | (-7.19) |
| r2 | 0.0454 | 0.0868 | 0.1268 | 0.1405 |
| aic | 2971 | 2927 | 2881 | 2727 |
| bic | 3025 | 2981 | 2935 | 2781 |
| Observations | 1000 | 1000 | 1000 | 964 |

*t* statistics in parentheses

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

**Figure 5: Path diagram between inequality and trade union density**



**Figure 6: The long-run connection between trade union density and the income share of the top 1 %**



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 and Engels, 1848: 10](#_ENREF_29)). [↑](#endnote-ref-1)
2. For the period for which comparable Gini indices exist (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 except Germany and Japan. The incomes for the top 1 percent are significantly (again .01-level) correlated in all countries to gross and net Ginis 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](#_ENREF_38)). [↑](#endnote-ref-2)
3. Even though our title suggests that we look at inequality and trade union density from the early 20th century onwards, we have somewhat earlier data for Denmark. [↑](#endnote-ref-3)