The supply of social insurance
in historical perspective

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Abstract

We argue that the rise of the welfare state throughout the Western economies can be understood as the self-interested response of the wealthy to increasing social demands. Our thesis is that the Great Depression led to a permanent increase in people's perception of aggregate economic risks, and that social insurance was supplied as part of a risk-sharing contract to avoid social conflict. We propose that the rise of the modern welfare state was a process of exploitation of efficiency gains associated with the proliferation of social insurance programs that targeted heterogenous risks. Our theory also offers a novel explanation for why the growth in social transfers coincided initially with a sharp increase in tax progressivity and then a gradual decrease in progressivity. The underlying mechanism is that the wealthy use their political influence to bring about a combination of redistribution and insurance that minimizes their cost without triggering social conflict.

Keywords: supply of social insurance, redistribution, social conflict.
JEL classification: D30, H50, P16.

1. Introduction

One of the most startling facts of the twentieth century is the unprecedented expansion in social insurance programs in the Western societies between 1930 and 1980 (Lindert, 2004). The resulting growth in social transfers coincided initially with a sharp increase in tax progressivity (Kuznets, 1963) and then a gradual decrease in progressivity (Piketty and Saez, 2007). These events are difficult to understand under existing theories that attribute the rise of the welfare state to the forces of electoral competition. If electoral competition is likely to cause social spending, why did the rise of democracy lead to so little change in social transfers until the Great Depression and World War II? If the welfare state taxes the wealthy to supply transfers to others, why did taxation become less progressive after 1960? Why did transfers stabilize in the 1980s?

In this paper, we argue that the rise of the modern welfare state can be understood as a self-interested response of the wealthy to the threat of social conflict following the experiences of the Great Depression. The argument treats the wealthy minority as being both politically influential and the residual claimants for the social surplus after meeting social demands. Our thesis is that the Great Depression was not a temporary shock, but rather a watershed event that led to the general perception of a permanent increase in aggregate economic risks, and redistributive social insurance was supplied as part of a risk-sharing contract to avoid conflict. Our argument also explains why in many countries progressivity declined after 1960 and why transfers ceased growing much after 1980. As new programs targeted heterogeneous risks more finely over time, less redistribution through the tax system was required to meet social demands. By 1980, social insurance was close to complete as existing programs covered the major categories of risk faced by most individuals. Our detailed argument builds on the policy histories of the United States, Britain, and Sweden.

Our theory stresses a distinction between those individuals who control public policy, the *governing group*, and those who do not, the *non-governing groups*. This conceptual distinction is meant to capture the fact that *control* of government policies, rather than *voice*, is concentrated. Although electoral promises can be broken and the governing group is unable to commit to not confiscate the incomes of others, the threat of conflict endows non-governing groups with *de facto* political power (Weingast, 1997, Acemoglu and Robinson, 2000, Grossman and Kim, 2003). Formally, we view public policy as part of a self-enforcing social contract, in which repeated strategic interaction between the governing and the non-governing groups enables the latter to obtain a share of the efficiency gains from cooperation. The proposition that the supply of social insurance, rather than pure

redistribution, is the efficient policy for averting conflict in the presence of income risks is at the core of our arguments. By this we mean that it is in the self-interest of the governing group to make taxes and transfers contingent on income realizations and on group identity as part of a program designed to optimally meet the non-governing groups' social demands. In this context, an increase in aggregate risk makes the participation constraints of the non-governing groups harder to meet and effectively raises demands for income redistribution. Seen in this light, our interpretation is that technical improvements in the administration of taxes and programs that lift supply-side constraints over time enable more comprehensive insurance coverage and less redistribution away from the governing group.

President Woodrow Wilson (1913–1921) once remarked that "the masters of the government of the United States are the combined capitalists and manufacturers of the United States" (Wilson, 1961[1913], p.48).The exact composition of what we refer to as the governing group, as well as the actual influence of its individual members, is likely to be controversial and vary across historical contexts, although we believe that the broad self-interest of the governing group is not. As a working hypothesis, we suppose that the interests of the governing group are aligned with the economic interests of the top of the income distribution. This view is motivated by the history of top income shares and top tax rates and by the evidence that political influence rises with income (Benabou, 2000). The weight of this group is nonnegligible. The upper one percent of the income distribution in the United States in 1960, for example, earned 10 percent of total income before taxes and paid 20.8 percent of all federal taxes.

In Section 2 and Section 3, we present our main theoretical arguments in their simplest form. In Section 4, we argue that the comparative history of the welfare state in the United States, Britain and Sweden, suggests that the political influence of wealthy minorities, the increased threat of social conflict following the Great Depression, and the increasingly narrow targeting of heterogenous risks all played a major role in the evolution of social policy. Our conclusions are found in Section 5.

2. The model

Our focus is on social policy, which we formalize as a self-enforcing social contract within a simple repeated game among $N+1$ groups. Each group has a continuum of agents, with identical mass normalized to 1. We assume that all agents within a group are identical, and they have resolved all potential free-riding problems so they act as a group. Group A

is the *governing group.* By this we mean that it has the power to choose group-specific per capita transfers T_i^t every period $t \geq 0$, for each of the *non-governing groups $i = 1, \ldots, N$*. We use the word *transfer* to denote generically any net income flows (positive or negative) from the governing group toward the non-governing groups. From the perspective of the non-governing groups, a positive transfer is a subsidy and a negative transfer is tax.

The governing group's power is limited by the fact that each non-governing group chooses independently whether to participate in the social contract, or to opt out. If a non-governing group opts out of the social contract each individual in the group escapes the tax/subsidy and receives a conflict payoff, which is normalized to zero utility. Non-participation in the social contract is meant to formalize the consequences of social conflict in a simple manner. The important feature is that conflict is an inefficient outcome.

The pre-transfer per capita incomes of each group participating in the social contract are exogenous random variables, independent over time and across groups. Let $S^t \subseteq \{1, \ldots, N\}$ denote the subset of non-governing groups choosing to participate in the social contract in period t. The pre-transfer income of each individual in the governing group in period t, y_A^t, is drawn from some distribution $F_A(y_A^t; S^t)$ with positive support, provided that $S^t \neq \emptyset$. We assume that the governing group's incomes are stochastically larger when there are more non-governing groups participating in the social contract, that is, $F_A(y_A^t; S_0^t) < F_A(y_A^t; S_1^t)$, for all y_A^t, whenever $S_1^t \subset S_0^t$. For simplicity, we also assume that $y_A = 0$ with certainty if $S^t = \emptyset$. This may be interpreted as reflecting the fact that the participation of at least one of the non-governing groups is essential in the production of output. To illustrate our main arguments as simply as possible, we assume that agents in the governing group are risk neutral.

For each non-governing group i participating in the social contract, pre-transfer incomes in each period t are weighted sums of $J > 1$ risky components $y_{i,j}^t$, for $j = 1, ..., J$. An important assumption is that the governing group can make the transfers T_i^t conditional on the realizations of y_A^t and on the realizations of a subset $K \subseteq \{1, ..., J\}$ of the risky components. For concreteness, we refer to the vector of group-specific transfer schedules

$$\left\{ T_1^t \left(y_A^t, \{y_{ij}^t\}_{i \in S^t, j \in K} \right), ..., T_N^t \left(y_A^t, \{y_{ij}^t\}_{i \in S^t, j \in K} \right) \right\} \tag{2.1}$$

as the *social contract* in period t. We suppose that every period the governing group chooses the social contract and each group i simultaneously decides whether or not to opt out, *before* the realization of the shocks is observed.

Each factor $j \in K$ can thus be described as being insurable, while each factor $j \notin K$ is

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uninsurable. Accordingly, the pre-transfer income y_i^t of each agent in group i is

$$y_i^t = \sum_{j \in K} a_{i,j} y_{i,j}^t + \sum_{j \notin K} a_{i,j} y_{i,j}^t, \tag{2.2}$$

where $a_{ij} > 0$ are constant weights. The components $y_{i,j}^t$ are independent across risks, groups and time periods. For simplicity, we assume that they have a common distribution $F\left(y_{i,j}^t; S^t\right)$ with positive support, and also that $F(y_{i,j}^t; S_0^t) < F(y_{i,j}^t; S_1^t)$, for all $y_{i,j}^t$, whenever $S_1^t \subset S_0^t$. This implies that the non-governing groups' incomes are stochastically larger when more groups participate in the social contract. The weights a_{ij} can vary across groups to capture the idea that the groups have different sources of income or are affected by a given risk in different ways. In general, one could allow for some of the weights a_{ij} to be positive and others negative, in which case the latter can be interpreted as expenditures. For simplicity, however, we will maintain the assumption that $a_{ij} > 0$, for all i and for all j.

For simplicity, we also assume that agents in a non-governing group can never be made to pay an amount greater than its insurable income, that is,

$$T_i^t\left(y_A^t, \{y_{ij}^t\}_{i \in S^t, j \in K}\right) \geq -\sum_{j \in K} a_{i,j} y_{i,j}^t. \tag{2.3}$$

Thus, each factor $j \in K$ is both insurable and taxable, while each factor $j \notin K$ is both uninsurable and non-taxable. This may be thought of as reflecting the fact that only the realizations of the insurable risk factors are verifiable, and that subsidies and taxes can be tied only to verifiable realizations of the underlying risk.

Finally, individuals in each non-governing group i are risk averse, with per-period utility

$$u(y_i^t + T_i^t) = \frac{(y_i^t + T_i^t)^\theta}{\theta}, \tag{2.4}$$

with $\theta \in (0, 1)$, whenever they participate in the social contract. Since we have normalized conflict payoffs to zero, we restrict the coefficient of relative risk aversion $(1 - \theta)$ to be less than unity in order to ensure that there are gains from trade.

2.1. Self-enforcing social contracts

In this section, we characterize social policy as the outcome of a self-enforcing contract between the governing and the non-governing groups. First, suppose that the stage game is played just once. It is easy to see that the unique Nash equilibrium is such that all non-governing groups participate in the social contract and the governing group appropriates

all insurable incomes. This is the case whether the governing and the non-governing groups move simultaneously or sequentially.

Now, consider the infinitely repeated game. In the interest of clarity, we restrict attention to equilibria in pure strategies, which map possible period-t histories to non-mixed actions. The play of the game describes the profile of actions $\{T_1^t(\cdot), ..., T_N^t(\cdot), x_1^t, \ldots, x_N^t\}$ that is played every period $t = 0, 1, 2\ldots$, where $\{T_1^t(\cdot), ..., T_N^t(\cdot)\}$ indicates the schedules of transfers chosen by group A in period t and $x_i^t = 0, 1$ indicates the action of group i in period t, where $x_i^t = 0$ indicates that group i opts out of the social contract in period t.

All agents discount the future using the common discount factor $\delta < 1$. Each agent in the governing group seeks to maximize the normalized expected payoff

$$v_A = (1 - \delta) \sum_{t=0}^{\infty} \delta^t E \left[u \left(y_A^t - \sum_{i \in S^t} T_i^t \right) \right]. \tag{2.5}$$

and each agent in non-governing group i seeks to maximize

$$v_i = (1 - \delta) \sum_{t=0}^{\infty} \delta^t x_i^t E \left[u \left(y_i^t + T_i^t \right) \right], \tag{2.6}$$

for all $i \in \{1, \ldots, N\}$, respectively.

Each non-governing group derives some power from its ability to opt out of the contract, because group A loses access to the group's income, and because exit by one group has a negative effect on the incomes of others. Furthermore, the non-governing groups have the power to opt out simultaneously, in principle, in which case group A's payoff is zero. More generally, the model captures the idea that social groups can hurt group A relatively more when they are able to coordinate their opting out decisions.

For simplicity we will focus on stationary plays and thus omit all time superscripts from here on. Each play defines an expected payoff for each agent in each group, $\{v_A, v_1, \ldots, v_N\}$. The set of feasible payoffs for each group is determined by aggregate expected incomes associated with each possible play. Specifically, if S is the set of non-governing groups participating in the social contract, the set of feasible payoffs for group A is

$$0 \leq v_A \leq E \left[y_A + \sum_{i \in S} \sum_{j \in K} a_{i,j} y_{i,j} \right], \tag{2.7}$$

and the set of feasible payoffs for each non-governing group i is

$$E \left[u \left(\sum_{j \notin K} a_{i,j} y_{i,j} \right) \right] \leq v_i \leq E \left[u \left(\sum_{j \notin K} a_{i,j} y_{i,j} + y_A + \sum_{i \in S} \sum_{j \in K} a_{i,j} y_{i,j} \right) \right]. \tag{2.8}$$

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Note that group A chooses a schedule of transfers, which specifies the post-transfer income distribution for all realizations of the insurable/taxable components of incomes. Thus, a deviation by group A in the present context is a deviation from the contract that applies to all insurable/taxable income realizations. We assume that all deviations from the equilibrium play are observable.

Analysis of this repeated game is straightforward. First, consider the lowest payoffs that all other groups can jointly impose on each single group given that the latter responds optimally. The minmax payoff is zero for group A, which occurs when all non-governing groups exit the social contract. For each non-governing group i the minmax payoff is the expected utility of the non-taxable components of income $\sum_{j \notin K} a_{i,j} y_{i,j}$. This occurs when only group i remains in the social contract and the taxable components of income are fully expropriated. A folk theorem applies in the present context.[1] That is, any feasible, individually rational payoffs v_A and v_i for all $i \in \{1, \ldots, N\}$ can be enforced by a subgame perfect equilibrium if the discount factor δ is sufficiently high.

The relevance of the folk theorem in the present context lies in that it indicates that the non-governing groups can get some of the surplus from the social contract, even though the contract is controlled by the governing group. The general insight is that informal enforcement mechanisms can play an important role in the redistribution of income through social policy.

We now characterize stationary self-enforcing social contracts as solutions to a simple maximization problem. In any given period, suppose that all non-governing groups choose to participate and fix their payoffs to $\{v_1^*, \ldots, v_N^*\}$. Consider group A's choice of transfers $\{T_1 \left(y_A, \{y_{ij}\}_{i \in \{1,\ldots,N\}, j \in K} \right), \ldots, T_N \left(y_A, \{y_{ij}\}_{i \in \{1,\ldots,N\}, j \in K} \right)\}$ to solve the problem

$$\max_{\{T_1,\ldots,T_N\}} E \left[u \left(y_A - \sum_{i=1}^{N} T_i \right) \right] \tag{2.9}$$

subject to

$$E \left[u \left(y_i + T_i \right) \right] \geq v_i^*, \quad i \in \{1, \ldots, N\}, \tag{2.10}$$

$$T_i \geq - \sum_{j \in K} a_{i,j} y_{i,j}, \quad i \in \{1, \ldots, N\}, \tag{2.11}$$

$$v_A^* \geq 0 \text{ and } v_i^* \geq E \left[u \left(\sum_{j \notin K} a_{i,j} y_{i,j} \right) \right], \quad i \in \{1, \ldots, N\}. \tag{2.12}$$

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[1]See Fudenberg and Maskin (1986).

We know that any payoffs $\{v_A^*, v_1^*, \ldots, v_N^*\}$ that satisfy the constraints (2.12) can be enforced by a subgame perfect equilibrium if the discount factor δ is sufficiently high. Moreover, for fixed payoffs $\{v_1^*, \ldots, v_N^*\}$, a solution to the above maximization problem requires the participation constraint of all non-governing groups to be binding. In addition, an interior solution to problem (2.9) satisfies

$$1 = \lambda_i E \left[u' \left(\sum_{j \in K} a_{i,j} y_{i,j} + \sum_{j \notin K} a_{i,j} y_{i,j} + T_i \right) | y_A, \{y_{ij}\}_{i \in \{1, \ldots, N\}, j \in K} \right], \qquad (2.13)$$

for all insurable/taxable income realizations $\{y_A, \{y_{ij}\}_{i \in \{1, \ldots, N\}, j \in K}\}$, for all non-governing groups $i = 1, \ldots, N$, where λ_i is the Lagrange multiplier for group i's participation constraint, and u' denotes marginal utility. Thus, the governing group trades-off, state by state, the marginal benefit from taking (or giving) additional income from group i and the marginal cost of doing so, which in turn depends on the value that group i places on additional income in a given state. It is easy to see that the solution to problem (2.9)-(2.12) must involve efficient risk sharing, in the sense that it is optimal for the governing group to provide full insurance to the non-governing groups against fluctuations in the insurable component of their pre-transfer incomes. Moreover, note that stationary self-enforcing social contracts must be such that all groups choose to participate. Thus, we have the following proposition.

Proposition 2.1. *For fixed equilibrium payoffs $\{v_1^*, \ldots, v_N^*\}$, for all $t \geq 0$, the self-enforcing social contract, $\{T_1^*, \ldots, T_N^*\}$, is characterized by*

$$\sum_{j \in K} a_{i,j} y_{i,j} + T_i^* = c_i^*,$$

where $c_i^* \geq 0$ is the unique constant satisfying

$$E \left[u \left(c_i^* + \sum_{j \notin K} a_{i,j} y_{i,j} \right) \right] = v_i^*, \quad i = 1, \ldots, N.$$

3. Aggregate risk and redistribution

Proposition 2.1 in the previous section shows that the governing group provides full insurance to the non-governing groups against all insurable risks, and it implies that the expected tax paid by the governing group to finance subsidies to the non-governing groups is simply

$$E \left[\sum_{i=1}^{N} T_i^* \right] = E \left[\sum_{i=1}^{N} \left(c_i^* - \sum_{j \in K} a_{i,j} y_{i,j} \right) \right]. \qquad (3.1)$$

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This expected tax $E\left[\sum_{i=1}^{N} T_i^*\right]$ provides a natural measure of the progressivity of social policy in terms of the expected redistribution from the governing group towards the non-governing groups.

In this section, we discuss how this measure of progressivity is influenced by increases in aggregate risk and also by the introduction of additional insurance programs. First, note that, for given payoffs $v_1^*, \ldots, v_N^*$, the expected tax is a function of the distribution of insurable realizations $\{y_A, \{y_{ij}\}_{i \in \{1,\ldots,N\}, j \in K}\}$ only through $E\left[\sum_{j \in K} a_{i,j} y_{i,j}\right]$, but it is a more complicated function of the distribution of the uninsurable components $\{y_{ij}\}_{i \in \{1,\ldots,N\}, j \notin K}$. An increase in aggregate risk can be understood in terms of a mean-preserving spread in the distribution of the sum of uninsurable risks $\sum_{j \notin K} a_{i,j} y_{i,j}$. Since we have assumed, for simplicity, that all risky components are independent and identically distributed we can formalize an increase in aggregate as a mean-preserving spread in the common distribution $F(y_{i,j}; i \in \{1, \ldots, N\})$.

Furthermore, note that risks overlap across the non-governing groups, and variation in the weights a_{ij} across i reflects the fact that a common risk may affect individuals differently. We have introduced multiple overlapping risks to capture a notion of different insurance programs, as public programs that target specific risks. For concreteness, we interpret the equilibrium in Proposition 2.1 as relying on a single social insurance program for each insurable risk $j \in K$, and thus, we view the number of social insurance programs as being identical to the number of insurable risks $j \in K$. With this perspective, we formalize the effect of introducing additional social insurance programs as an expansion in the subset of insurable risks from K to K', with $K \subset K'$.

Proposition 3.1. *For fixed payoffs* $\{v_1^*, \ldots, v_N^*\}$, *the expected tax paid by the governing group,* $E\left[\sum_{i=1}^{N} T_i^*\right]$, *increases with aggregate risk—measured as a mean-preserving spread in the distribution of* $\sum_{j \notin K} a_{i,j} y_{i,j}$ *— and it decreases with the introduction of additional insurance programs — measured as an increase in the subset of insurable risks from K to K', with $K \subset K'$.*

The intuition for both properties characterized in Proposition 3.1 rests on the fact that the governing group are the residual claimants to the social surplus. Thus, starting from a situation where group i enjoys a given payoff v_i^*, an increase in aggregate risk makes group i's participation constraint more difficult to meet, and it must be fully absorbed by the governing group, therefore resulting in redistribution towards the non-governing group. Similarly, starting from a situation where group i enjoys a given payoff v_i^*, an expansion

in the set K of insurable risks allows the governing group to appropriate all the efficiency gains from additional insurance, which translates into a fall in redistribution towards the non-governing groups.

Proposition 3.1 is a comparative static result that takes the *equilibrium* payoffs as given. In the present context those payoffs arise from social demands that are a fundamental component of the social contract. It should be noted that such a background is one in which the degree of social coordination among the non-governing groups and the ability of the governing group to prevent such coordination play a critical role.

A corollary of the foregoing analysis is that, whenever feasible, it is in the best interest of the governing group to design distinct group-specific transfer schedules, each restricting eligibility to individuals who face common income risks. To appreciate the broader implications of this corollary for the welfare state, note that our analysis rests on the assumption that the governing group is able to condition transfers on income realizations as well as group identity. More generally, the governing group may not have enough instruments to achieve this outcome, which is a source of inefficiency. For instance, some transfers may be conditioned only on observable group characteristics, such as race, gender, union membership or old age, which can serve as proxies for socioeconomic groups of individuals with similar risk characteristics and/or social demands. Other transfers may be conditional on income alone, without respect to the differences in the actual risk faced by different individuals. This too is a source of inefficiency. The governing group becomes better off as this constraints are lifted, because it can meet any given social demands at a lower cost for themselves. In this sense, redistribution and insurance are substitutes.

The previous, intuitive, argument is interesting because it can explain why the growth of the welfare state has consisted of an enlargement of insurable events characterized by the increasing number and complexity of transfer programs as well as the narrowing targeting of each program. With respect to this, our model suggests a view of the growth of the welfare state as being driven by the lifting of technical constraints faced by the public administration.

Finally, we note that transfers in the present context should be interpreted broadly. In practice, reductions in redistribution may show up as a reduction in some social transfers, rather than money flows. For some states of the world, actual transfers from the non-governing to the governing groups can take the form of business subsidies, agricultural subsidies, reductions in taxes etc. In addition, income redistribution may take the form of changes in the provision of public goods (e.g., Boadway and Marchant, 1995).

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4. The supply of social insurance in historical perspective

In this section, we begin by observing a common but puzzling fiscal trajectory in the United States, the United Kingdom, and Sweden over the twentieth century. We then discuss, for each country, the history of social insurance and tax legislation in relation to the threat of conflict and the role of elites in the formation of the welfare state.

Lindert (2004, Table I.2) reports that social transfers as a share of GDP in 1930 were 0.56, 2.24 and 2.59 in the US, Britain and Sweden, respectively. Figure 1 shows social transfers as a proportion of GDP in the United States, Britain and Sweden between 1960 and 2000.[2]

[Figure 1]

The three-country average size of transfers was 9.43 percent in 1960 and 19.13 percent in 1980. Figure 1 reflects the remarkable growth of social transfers between 1960 and 1980, and their stability thereafter. Over this period, about three-quarters of transfers every year are in the form of social insurance payments.

Figure 2 shows top marginal personal income tax rates, as a rough indicator of the policy stance on tax progressivity over the twentieth century.[3]

[Figure 2]

In the United States the top marginal tax rate increased from 25 percent in 1930 to 63 percent in 1932, continuing upward to reach 91 percent from 1951 to 1963, before declining toward 50 percent by 1972. Similarly in the United Kingdom the top marginal tax rate went from 50 percent in 1928 to 90 percent in 1940, remaining above 88 percent every year until 1970, before falling to reach 60 percent in 1979. In Sweden, the top statutory rate increased from 39 percent in 1930 to 70 percent in 1948, remaining at 65–70 percent until 1970. After the temporary increase in the top tax rates in the 1970s, it declined to 51 percent by 1991. Despite the obvious differences in decade-by-decade behavior, top statutory rates followed similar trends in the three countries over the twentieth century, with the rates increasing between 1930 and 1950, remaining high in the 1960s, then falling, first in the United States, followed by the United Kingdom, and then Sweden.

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[2]The data is from the OECD Social Expenditure Database (1960–1981) and (1980–2000), respectively. A break in the series makes the post-1980 series not directly comparable to the pre-1980 series.

[3]The data is from Roine et al. (2009).

Top statutory tax rates on personal income are an imperfect indicator of tax progressivity. Figure 3 shows the proportional difference between the pre-tax income share and the post-tax income share of the top 1 percent of the income distribution in different years.[4] This effective tax rate captures a broad measure of tax progressivity in the three countries over different periods. Overall, Figure 3 reflects the fact that progressivity increased in the 1930s and 1940s, then declined gradually. This decline is due in part by the decrease in the share of corporate taxes in revenues and an increase in the use of payroll taxes.

[Figure 3]

Previous theories of the welfare state typically focus on the demand for social transfers. The evidence suggests that those demands rose in the Western economies as a result of political, economic and demographic changes that began in the 19th century. Arguably, democratization, industrialization, urbanization, globalization, and later, population aging, are the main underlying forces (e.g., Boix, 2001, Lindert, 2004). The empirical evidence also supports the view that countries that are exposed to more aggregate risk spend more on social transfers. Rodrik (1998) finds that measures of a country's exposure to external risks explain government spending on social transfers in the advanced economies between 1960 and 1992. He also provides evidence that external risks are persistent and that they are correlated with a country's exposure to aggregate risk. Iversen and Soskice (2001) argue that different risks associated with differences in human capital can explain variations in the demand for social transfers across countries.

While these secular forces are surely important determinants of the demand for social insurance, they fail to explain why programs were supplied. For instance, many have noted that the achievement of near universal suffrage before 1930 makes it difficult to understand how the rise of democracy by itself could be the main source of the rise in transfers after 1930 (Lindert, 2004: ch. 7, Aidt et al., 2006). Near universal suffrage was achieved in the United States in 1920, in the United Kingdom in 1918, and in Sweden in

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[4]We calculated the effective tax rate using data on pre-tax and post-tax income shares for the U.S., from Kuznets (1953) for the period 1930–1946 and from Piketty and Saez (2007) for the period 1960–2000; for the U.K., from Atkinson (2007) for the period 1937–2000; and for Sweden, from Statistics Sweden (2008) for the period 1975–2000. The data sources are not directly comparable. The data for the United States refers only to federal taxes. The data from Kuznets (1953) refers only to income taxation. The post-tax income share reported by Piketty and Saez (2007) is net of personal, corporate and estate taxes, as well as payroll taxes. The share reported by Atkinson (2007) is net of personal income taxes only. Data for Sweden is available from 1975 onwards and it includes income taxes as well as social security contributions, and transfers. Since the proportion of transfers accruing to the top group is minute, the pattern of post-tax income shares is largely unaffected by transfers.

1921. The dates are reflected in the proportion of the population over 20 years old voting in national elections before and after the extension of the franchise. In the United States, 33 percent voted in the presidential election in 1916 and 44 percent voted in 1920; in the United Kingdom, 29 percent voted in 1910 while 75 percent voted in 1918; in Sweden 33 percent voted in 1920 but 88 percent voted in 1921.[5] The effect of the new voters on social transfers was clearly minimal before 1930. On the other hand, as Acemoglu and Robinson (2000) have argued, earlier redistributive spending is likely to have been associated with the rise of democracy. Aidt et al. (2006) have argued that this was the case for spending on infrastructure and internal security. Another possibility is that the burden of Great Depression and World War II fell disproportionately on the bottom half of the income distribution, and that worsening inequality led subsequently to larger demands for redistribution (e.g., Meltzer and Richard, 1981). However, the evidence does not support this hypothesis.[6] The large growth in social transfers from 1930 to 1980 coincided with *reduced* pre-tax income inequality. The shares of the top groups in the income distribution declined dramatically during the Great Depression and World War II and continued to fall gradually until 1980 in many countries.[7] The Gini coefficient in the United States was stable at 0.35–0.36 between 1955 and 1980 (U.S. Census Bureau, Historical Income Tables); in the United Kingdom it fell from 0.41 in 1949 to 0.37 in 1975 (Lowe, 1999); and in Sweden it fell from 0.38 in 1951 to 0.32 in 1973 (Bjorklund and Palme, 2000).

The period of high tax progressivity cannot be attributed to the cost of World War II alone. Top tax rates remained high into the 1960s whereas, in contrast, after World War I the top statutory tax rates fell in each country within five years after the war. Moreover, it is difficult to reconcile the continued growth in transfers until 1980 with the reversal in tax progressivity that occurred after 1960. If the purpose of transfers is to redistribute incomes away from the top, why would tax progressivity rise and then fall? The slowdown of the welfare state by the 1980s is also hard to understand in terms of limits to social demands for redistribution. In particular, the view that the welfare state was unsustainable after 1980, because of the distortionary effects of taxes and transfers, is not well supported by the evidence.[8] According to Lindert (2004, pages 17–18), "[N]ine decades of historical

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[5]Figures for the United Kingdom and Sweden are from Flora (1983). We calculated figures for the United States using Mackie and Rose (1991) for the number of votes and the U.S. Bureau of Census report (Hobbs and Stoops, 2002) for the population over 20 in 1920; the population over 20 in 1916 is interpolated from the 1910 and 1920 census.

[6]See Benabou (1996) for a discussion of the cross-country evidence.

[7]See Piketty and Saez (2003) for top income shares in the United States, Atkinson (2007) for the United Kingdom, and Roine and Waldenstrom (2008) for Sweden.

[8]See Atkinson (1995) for a critical assessment of this view.

experience fail to show that transferring a larger share of GDP from taxpayers to transfer recipients has a negative correlation with either the level or the rate of growth of GDP per person."

Our theory complements previous work by analyzing what we refer to as the supply side of social insurance, and the link between insurance and tax progressivity in the presence of economic risks.[9] We view these economic risks as being broadly associated with industrialization, urbanization and globalization. Our premise is that the Great Depression sharply changed peoples perception of aggregate risk and that this change was permanent. The reason why the Great Depression led both to the creation of social insurance programs and to more progressive taxes is that supplying redistributive insurance is the efficient response of the governing group to an increase in aggregate risk, in order to avoid social conflict. We believe that the evolution of taxation and transfers and their impacts on the top of the income distribution can be best understood in terms of a risk-sharing social contract in which the wealthiest are the residual claimants from social cooperation.[10] From this perspective, the decline in tax progressivity after 1960 can be regarded as the concomitant of a more efficient supply of social insurance. In this sense, we regard social insurance and redistribution as substitutes across which the governing group optimizes. Finally, our interpretation is that the rise of social transfers slowed down in the 1980s because by then, programs existed to cover the major categories of risk faced by most households.

Next, we examine the history of social policy in the United States, Britain and Sweden, and argue that the political influence of wealthy minorities, the increased threat of social conflict following the Great Depression, the targeting of heterogenous risks, and improvements in public administration, all played a major role in the evolution of social policy over the 20th century.

United States

Four episodes of high unemployment occurred in the United States from 1890 until just prior to the Great Depression. Before 1929, however, not a single American state had passed legislation for unemployment insurance, old-age insurance, or health insurance. One possible reason for the muted effect of the 1890s depression on social insurance reform is

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[9]Voters' demands for insurance versus redistribution are also considered in Benabou (2000) and Hindriks and De Donder (2003).

[10]Piketty and Saez (2007) have suggested that the behavior of the pre-tax income share of the top group after the Great Depression and World War II may itself be largely the effect of progressive taxation on wealth accumulation. Our focus is on explaining the pattern of income tax progressivity after 1930 and its connection to social transfers, rather than its effect on the pre-tax distribution.

that industrial business cycles were a relatively new phenomenon. Thus, William Jennings Bryan was unsuccessful in his campaign for the presidency in 1896 on a platform of relief for the unemployed. Another reason is that there was a lack of common interest among American workers in the late 19th century: in terms of our model, a lack of coordination among non-governing groups. In comparing the depression of the 1890s with the Great Depression of the 1930s, Rauchway (2008: 38) notes, "the 1890s fell during an age of globalization, ... so many of the country's workers had been immigrants, literally of another people. By the Great Depression, this was no longer true." This observation may help explain why social protest escalated during the Great Depression, but not before then. For instance, Kerbo and Shaffer (1986) have estimated the number of unemployed protestors in the key years of recession/depression before 1929. The numbers of protestors were: 500 in 1894; 4,800 in 1908; 3,500 in 1914; and 450 in 1922. In contrast to this earlier period, there were 102,500 protestors in 1930 and the annual average number of protestors from 1930-1940 was 49,479. The Great Depression resulted not only in massive unemployment that cut across social classes, but also bankrupted many trade union pension plans (Weaver, 1983).

The Social Security Act of 1935 marks the birth of the welfare state in the United States. It provided federal benefits to retirees and grants to states for the unemployed, old-age assistance, aid to dependent children, vocational rehabilitation, maternal and child welfare, and public health work. Prior to 1935 social assistance in the U.S. consisted of minor programs from state and local governments and self-help trade associations. Quadagno (1984), Domhoff (1990, 1996), and Alston and Ferrie (1993) have all stressed the role of elites in the adoption of the Act. Quadagno (1984: 644–645) remarks that the Act "was implemented with almost no working-class input" and:

> Business executives had a direct impact on the Social Security Act by serving on policy-forming committees and by testifying before Congress. They also exerted influence in a less formal manner through a variety of interactions with state managers who held varying degrees of power. Tactics included informal discussions with Roosevelt and committee members, letter writing, proposal development, and attempts to coopt lesser figures.

Alston and Ferrie (1993) observe that Southern large plantation owners formed a major segment of the U.S. governing group for a century preceding 1970, operating through overwhelming Congressional committee control by the Democrats. The rural elite's political objectives were to maintain low wages and to secure federal agricultural subsidies for large

plantations. The Southern landowners ensured that the unemployment insurance component of the 1935 Act excluded farm workers and that public assistance programs were administered by the states rather than the federal government. Alston and Ferrie also note that farm mechanization in the 1950s significantly reduced the need for plantation workers and that it was increasingly in the interest of Southern landowners to promote the out-migration of blacks to Northern states. Thus, commenting on the Economic Opportunity Act, which was the centerpiece of the Johnson Administration's War on Poverty, they argue that, "[I]t is extremely unlikely that the welfare state programs of the 1960's could have emerged from Congress without the countenance of Southern Congressmen."

The New Deal programs were legislated as social insurance to combat economic insecurity, with an emphasis on the fact that "funds for the payment of insurance benefits should not come from the proceeds of general taxation."[11] However, they were accompanied by sharp rises in tax progressivity (see Figure 2). For instance, the top marginal tax rate on personal income went from 24 percent in 1929 to 63 percent in 1932 and 79 percent in 1938. Our interpretation is that the need for redistribution as an accompaniment to social insurance to avert social conflict was recognized at the time. Thus, while advocating the introduction of an inheritance tax, President Roosevelt stated in a message to Congress on Tax Revision in 1935: "Social unrest and a deepening sense of unfairness are dangers to our national life which we must minimize by vigorous methods."[12]

The development of the welfare state since the Great Depression has been one of enlargement of insurable events and gradual extensions of eligibility to include previously excluded groups of individuals. The original Social Security Act excluded numerous job categories encompassing about half the working population. Coverage was added for various workers in subsequent decades, including the 1954 addition of self-employed farmers, homeworkers, and some self-employed professionals. The inclusion of disability benefits into Social Security Act in 1956 is an example of an increase in transfers resulting from an enlargement of insurable events. Medicare and Medicaid were established in 1965. Old Age Insurance paid benefits to 16 percent of the aged in 1950, but to 92 percent by 1978 (Lampman, 1984). [13]

The total tax burden imposed by federal taxation has been approximately constant from 1953 onwards, but the composition has changed substantially. In particular, social

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[11]President Roosevelt's message to Congress on Social Security, January 17, 1935.

[12]President Roosevelt's message to Congress on Tax revision, June 19, 1935.

[13]See Kollman (1996) for the major legislative changes in social security benefits and coverage by employment categories, and Currie (2004) for a discussion of take up in different programs.

insurance payments have risen steadily since 1950 while corporation income taxes have fallen by a similar magnitude beginning in 1953 (see Table 2.3 in the Budget of the United States, 2005). Since payroll taxes are regressive and the corporation income tax is progressive, the replacement of corporate taxes with payroll taxes in federal receipts corresponds to the decline in tax progressivity after the 1950s. Piketty and Saez (2007) find that the average federal tax rate, including individual, corporate, payroll, and estate taxes, for the top 0.1 percent of the income distribution remained around 60 percent from 1960 to 1976, then fell, reaching 42 percent in 1983. In contrast, average federal tax rates faced by income groups between the 40th and the 95th percentiles were higher in 1980 than they were in 1960. These events suggest to us that the golden age of the welfare state, like the period before, was one where policy met social demands for *insurance*, rather than redistribution *per se*.

Our interpretation of this process is that a gradual lifting of supply-side constraints enabled more comprehensive social insurance coverage and, consequently, a decline in tax progressivity. In our formal model, this tradeoff between insurance and redistribution is associated with the fact that the wealthy members of the governing group are the residual claimants to the social surplus. However, our model does not explain what drives these efficiency improvements. Our view is that learning-by-doing and technical improvements in the administration of programs and taxes played an important role in expanding coverage and lowering the cost of tax compliance. The payroll tax in the Social Security Act, for example, was a precursor to the general withholding tax on wages introduced in 1943. Quoting from U.S. Senate Hearings (July-August 1942: 136): "All of the employers have had 7 years' experience [and] they will be in a much better position to do this job than they were to do the social security job back in 1936 when it first went into effect."[14]

Advances in record-keeping technology, especially automated data processing which originated during World War II, may have facilitated the extensions of social insurance programs in the United States in the 1960s and the 1970s. In 1956 the Social Security Administration installed the first large-scale computer to maintain records and in 1958 the Index was microfilmed.[15] Before then:

[T]he names were typed on flexible strips inserted in metal panels and hung on racks like pages in a book. With 119 names to a panel and 1,600 panels to a rack, the mammoth file took up a city block of floor space. It was growing at the rate of about 3 million names a year

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[14]Cited in Twight (1995).

[15]Microfiche is a German invention of the 1940s.

and required 6,000 additional square feet of space every 12 months.[16]

An integrated data processing system was put into effect in 1965.

Great Britain

Social legislation was not prominent in local elections between 1885 and 1914 and voter turnout was low in the United Kingdom (Thane, 1984). However, social unrest during this period is apparent in the strike waves occurring in 1889 and the years immediately following and especially in 1910 (Cronin, 1979). In this setting the Old Age Pension Act of 1908 and the National Insurance Act of 1911, which covered unemployment and health, were introduced by Winston Churchill and Lloyd George in the Liberal government led by Herbert Asquith. The initiatives can be viewed as preemptive attempts to improve industrial relations. According to Steinmo (1993):

> The two programs [health and unemployment insurance], conceived and designed by relatively insulated groups of party officials and civil servants, were not directly the result of pressure from the Left, but rather stemmed from the government's attempts to head off growing support for socialism generally and the Labour party specifically.

Unemployment insurance coverage was extended to include most manual workers in 1920, although the size of transfer payments remained small until the Great Depression. In 1931 the scheme was replaced by full government funding, whereby benefits were tied to need rather than to contributions. The latent threat of unrest in the inter-war period in the United Kingdom is reflected in the General Strike of 1926 and in two major phases of unemployed agitation organized by the National Unemployed Workers' Movement (NUWM) from 1919–22 and 1931–36. In early 1932, for example, thousands of unemployed battled with police in London and Bristol and 100,000 demonstrated in Newcastle (Perry, 2000). The NUWM ceased its activities at the outbreak of the war.

Unrest in the inter-war period did not by itself produce significant policy changes, but it is part of the background for the comprehensive social insurance reforms proposed by the Beveridge Report in 1942 as a response to the experience of the Great Depression. The Report identified six classes of vulnerable populations: employees, the self-employed, housewives, others of working age but not gainfully employed, those below working age, and the retired, above working age. Implementation of the Report included the Family

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[16]SSA History: Social Security U.S.A.– The Program & Its Administration, http://www.socialsecurity.gov.

Allowances Act 1945, the National Insurance Act 1946, and the National Health Service Act 1946. Subsequently, program were tailored to vulnerable groups and became means-tested: in 1975 there were 45 major means-tested benefits, with differing assessment criteria (Lowe, 1999: 152). Enhancements in social insurance coverage included changes to pensions for widowers over the age of 50 in 1956, Supplementary Benefits in 1966, invalidity pensions in 1971, and an extension of earnings-related pensions to uncovered by occupations in 1975 (Flora, 1983).

The introduction of the Pay-As-You-Earn method of payroll tax deductions in the U.K. in 1944 was a significant tax innovation, which enabled spending growth after World War II. However, the Fulton Committee on the Civil Service (1966–68) noted critically the British civil service's lack of specialist and managerial skills (Lowe, 1999). The difficulty of administering the post-war social insurance programs is also evident in a statement by the Chairman of the Supplementary Benefits Commission from 1975 to 1980: "The book of rules, which in 1945 every National Assistance Board officer had been able to carry around in his pocket had grown to several massive volumes, so often amended and so complicated that even the staff could not understand them" (quoted in Lowe, 1999: 153). Like in the case of the United States, our interpretation is that the incrementalism apparent in the development of social insurance programs in the United Kingdom reflects gradual efficiency-enhancing adaptations in targeting programs to the needy.

Sweden

Sweden was also affected by the severe global depression in the 1890s, and the possibility of social insurance schemes was considered there too. The administrative governor of the Stockholm area established an investigation of unemployment insurance for Stockholm and other major cities in 1894, but "[T]he committee concluded that the topic was too new and that no definite recommendations could yet be made" (Heclo, 1974: 71).

A compulsory old age pension system was introduced in 1913 and a means-tested local unemployment benefits program in 1914. These were rudimentary insurance programs with very low benefits (Lundberg and Åmark, 2001). Together with progressive taxes on income, wealth, death, and corporations, the policies were a response of the ruling elite to working-class discontent (Steinmo, 2001). The elections in the 1920s were the first with the potential to reveal the political effects of universal suffrage achieved in 1921.[17] Yet, according to Heclo (1974: p. 290) the new voting rolls had no impact on social policy:

[17]Near universal male suffrage was granted in 1909 but the greatest extensions in the voting rolls happened after World War I (Heclo, 1974).

[T]he numerous succession of elections and governments during the 1920s effected no change in pension policy at all....Much the same can be said of the electoral impact on income maintenance for the unemployed.

The origin of the modern welfare state in Sweden can be traced to a historic agreement between the Swedish Employers Federation (SAF) and the major trades union congress (LO) in May of 1936. Steinmo (1993: 88) argues that the postwar social policies of Sweden reflected this historic compromise between the agenda setting power of "big business" interests and the power of labor unions to disrupt production. This event was prompted by heightened labor unrest in the 1930s depression. Workdays lost because of labor stoppages decreased almost four-fold between the periods of 1931–35 and 1936–40 (Steinmo, 1993). The Swedish compromise between elites continued with the semisecret meetings between leaders of the Social Democratic party and the SAF beginning in the early 1950s. At these so-called Thursday club meetings, government and business elites discussed economic policy issues. Later labour officials from LO were added to the meetings. According to Steinmo (1993: 125), "many of the most difficult and controversial issues of the day were, in fact, settled behind closed doors by unelected representatives of interest organizations and technocrats." Extraparliamentary politics remained important in Sweden at least until the mid-1970s.

Old age pensions were improved in 1935 and 1937 and became universal and state-financed in 1948, followed by accident insurance in 1954 and sickness insurance in 1955. Pretax inequality fell in Sweden between 1930 and 1950.[18] During this period, taxes were a relatively low share of GDP, when compared to other countries that took part in World War II. Subsequently, while pretax inequality continued to decline until 1980, both social transfers and taxes rose. Data on the earlier expansion of the welfare state in Sweden is scant. However, the evidence supports the view that tax progressivity declined over time, with the gradual shift from direct to indirect taxes, and the increase in social security contributions that accompanied the expansion of the social security system. For instance, top marginal income tax rates remained constant at 65 percent between 1953 and 1970. A general sales tax at 4 percent was introduced in 1960, and it was replaced in 1970 by a value added tax at a 10 percent rate. Social security contributions as a share of GDP doubled from 1960 to 1970 (Swedish Tax Agency, 2008) They more than doubled again from 1970 to 1980, remaining stable thereafter (OECD 2008).

Similarly to the U.S. and the U.K., changes in Swedish legislation led to a decline in the

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[18]See, e.g., Roine and Wakdenstrom (2008) for the evolution of the top shares.

progressivity of income taxes between 1975 and 1985 (Bjorklund et al., 1995). Furthermore, while the shares of personal income taxes, corporate taxes, and other taxes, in total receipts each fell from 1965 to 1985, the share of social security contributions more than doubled (OECD, 2008). Our interpretation is that even the famously redistributive Swedish welfare state is primarily a social insurance arrangement, and that a decline in tax progressivity in Sweden before 1980 was the concomitant of the expansion of social insurance.

5. Conclusion

Some commentators stress the redistribution from rich to poor as the measure of achievement of the welfare state. Others focus on social insurance coverage against risks as the historical objective of post-war policy. We argue that redistribution and insurance are substitutes for preventing social conflict. Our theory is that the wealthy use their political influence to deliver the combination of redistribution and insurance that minimizes their costs without triggering unrest. They do so because the wealthy are the residual claimants to social surplus. Using this insight, we have argued that the Great Depression led to a permanent increase in people's perception of aggregate economic risks, and social insurance was supplied as part of a risk-sharing contract to avoid social conflict. We have also offered a novel explanation for the persistent progressivity of taxation following World War II, with aggregate risk as the catalyst of redistributive social spending. Moreover, we have argued that the rise of social transfers until the 1980s can be viewed as a process of exploitation of efficiency gains associated with the proliferation of social insurance programs that targeted heterogeneous risks. This also provides an explanation for why in some countries progressivity declined after 1960. Our most detailed argument has been for the United States, but we have also argued that social policy in the United Kingdom and Sweden have followed a similar pattern that can be explained by the same forces.

We have abstracted from the role commonly assigned to economic development and negative incentive effects in explaining the sources and the limits of the welfare state. In particular, we have abstracted from the excess burden of taxation and from the fact that administering taxes and transfer programs is costly. While acknowledging that the implementation of the welfare state requires sufficient economic development to finance social programs, we have shut down this effect in order to focus on the supply of social insurance and the role of economic risks. Further, the view of the welfare state as a social insurance arrangement also suggests its own limit, once programs exist to cover the major categories of risk faced by most households. This reflects a further contrast between

our argument and the view that equates a larger welfare state with larger efficiency losses. Instead, we view the growth in the number and complexity of transfer programs as reflecting the exploitation of further efficiency gains.

Appendix

A. Proof of Proposition 2.1

The discussion preceding Proposition 2.1 shows that the solution to problem (2.9)-(2.12) characterizes the self-enforcing social contract associated with stationary payoffs $v_1^*, \ldots, v_N^*$ if the discount factor δ is sufficiently high. Consider problem (2.9)-(2.12). Since u' is strictly decreasing in $y_i + T_i$, and since $y_i + T_i$ is stochastically larger when T_i is larger, then the expected value in equation (2.13) is strictly decreasing in T_i. Since λ_i is constant across all realizations $\{y_A, \{y_{ij}\}_{i \in \{1,\ldots,N\}, j \in K}\}$, there is a unique positive constant $c_i^* = \sum_{j \in K} a_{i,j} y_{i,j} + T_i^*$ that solves the first order condition (2.13). Since $u\left(c + \sum_{j \notin K} a_{i,j} y_{i,j}\right)$ is increasing in c, c_i^* is given by the participation constraint. Clearly, $c_i^* \geq 0$ for all payoffs $\{v_1^*, \ldots, v_N^*\}$ satisfying (2.12), which implies that constraint (2.11) must also be satisfied for all payoffs $\{v_1^*, \ldots, v_N^*\}$ satisfying (2.12). **QED**

B. Proof of Proposition 3.1

First, consider a mean-preserving spread in $F\left(y_{i,j}; i \in \{1, \ldots, N\}\right)$, which induces a mean-preserving spread in the distribution of $\sum_{j \notin K} a_{i,j} y_{i,j}$. This induces a mean-preserving spread in the distribution of $c + \sum_{j \notin K} a_{i,j} y_{i,j}$, for any constant $c = c_i^*$. Since u is strictly concave, $E\left[u\left(c_i^* + \sum_{j \notin K} a_{i,j} y_{i,j}\right)\right]$ must fall. To restore the incentive to participate in the social contract for group i, c_i^* must increase, and thus $E\left[\sum_{i=1}^N T_i^*\right]$ must increase.

Now denote $c_i^* = c_i(K)$ and consider a change from K to K', with $K \subset K'$. For fixed v_i^*, we have

$$
\begin{aligned}
E\left[u\left(c_i(K') + \sum_{j \notin K'} a_{i,j} y_{i,j}\right)\right] &= v_i^* \\
&= E\left[u\left(c_i(K) + \sum_{j \notin K} a_{i,j} y_{i,j}\right)\right] \\
&< E\left[u\left(c_i(K) + \sum_{\substack{j \notin K \\ j \in K'}} a_{i,j} E\left[y_{i,j}\right] + \sum_{j \notin K'} a_{i,j} y_{i,j}\right)\right].
\end{aligned}
$$

The first two equalities follow from the fact that the participation constraint for the non-governing groups must be binding, for any fixed subset of insurable risks. The strict inequality follows from the strict concavity of u.

The above relationships imply that

$$
c_i(K') < c_i(K) + \sum_{\substack{j \notin K \\ j \in K'}} a_{i,j} E\left[y_{i,j}\right],
$$

for all i, since $E\left[u\left(c + \sum_{j \notin K'} a_{i,j} y_{i,j}\right)\right]$ is increasing in c. Hence, denoting $T_i^* = T_i(K)$,

$$
\begin{aligned}
E\left[T_i(K)\right] &= E\left[c_i(K) - \sum_{j \in K} a_{i,j} y_{i,j}\right] \\
&< E\left[c_i(K') + \sum_{\substack{j \notin K \\ j \in K'}} a_{i,j} E\left[y_{i,j}\right] - \sum_{j \in K} a_{i,j} y_{i,j}\right] \\
&= E\left[T_i(K')\right],
\end{aligned}
$$

for all $i \in \{1, \ldots, N\}$. Thus, $E\left[\sum_{i=1}^{N} T_i(K)\right] < E\left[\sum_{i=1}^{N} T_i(K')\right]$, as required. **QED**
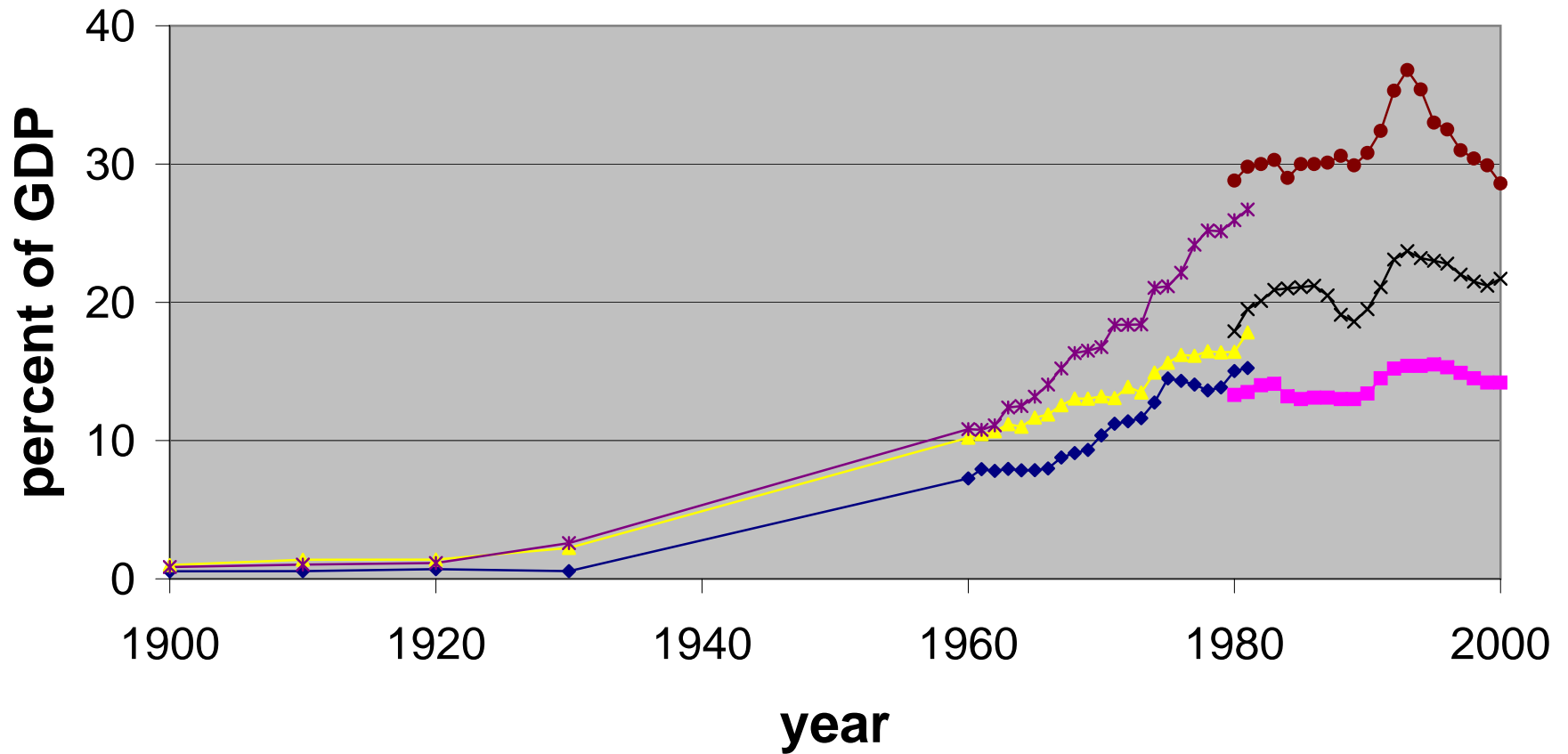
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Figure 1: Social transfers

Chart: percent of GDP (y-axis, 0–40) versus year (x-axis, 1900–2000), showing social transfers for the US, UK, and Sweden.
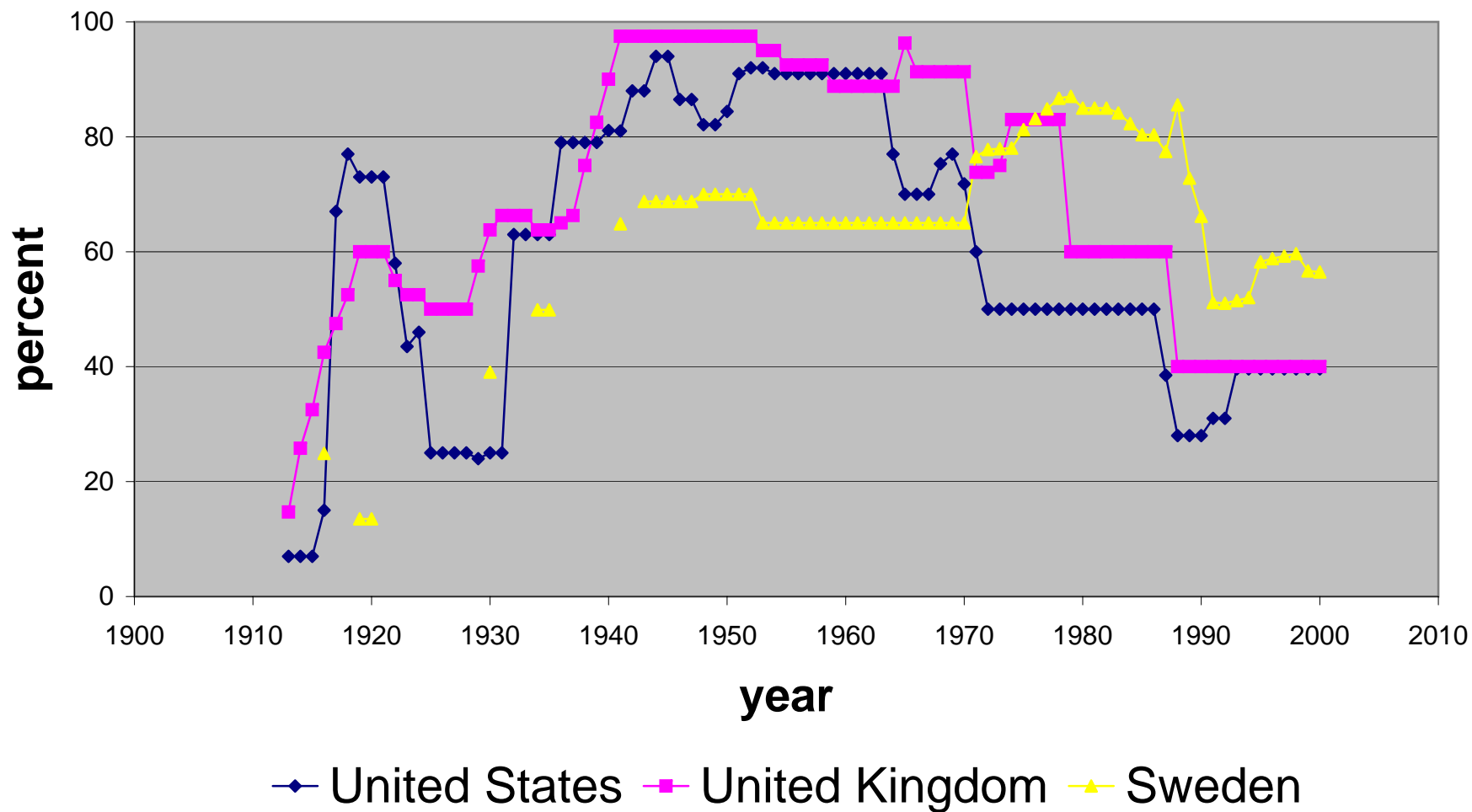
Legend:
- US (1900-1980)
- US (1980-2000)
- UK (1900-1980)
- UK (1980-2000)
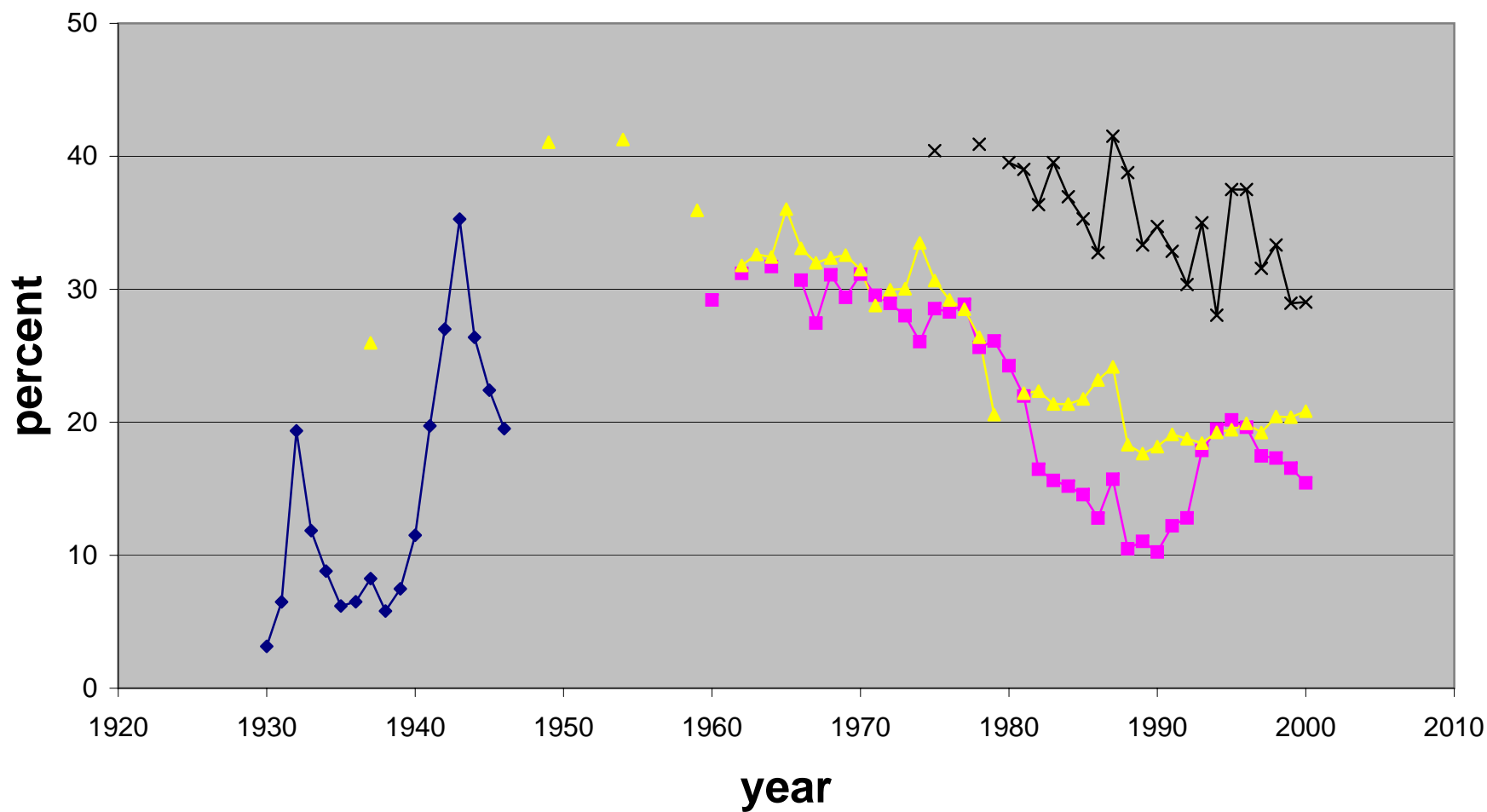- Sweden (1900-1980)
- Sweden (1980-2000)

Figure 2: Top bracket personal income tax rates

Figure 3: Top 1% effective tax rates

y-axis: percent

x-axis: year

Legend: US (1930-1946) · US (1960-2000) · UK (1937-2000) · Sweden (1975-2000)