Income tax progressivity and inflation during the world wars

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This paper studies the impact of inflation on income taxes in Sweden, the UK, and the United States during the world wars. As tax reforms were rising top marginal rates and reducing exemption thresholds, extraordinary levels of inflation eroded the real value of exemptions, brackets, and deductions. The micro-simulation of actual and alternative scenarios shows that inflation made the tax less progressive, particularly in Sweden during World War I and the UK during World War II. Nevertheless, its redistributive effect increased due to the related growth in tax revenue. Inflation contributed to transform a "class tax" into a "mass tax".

1. Introduction

The world wars have been associated with progressive tax policies in most Western countries. Top marginal income tax rates increased to unprecedented levels, at the same time that new taxes were introduced (Rockoff 2012). Scheve and Stasavage (2016) argued that top rates in income and inheritance taxes were boosted during the two wars as a result of the intense military mobilization: universal conscription placed most of the military burden on the shoulders of the working class, giving impetus to compensatory arguments in favor of taxing the rich. Extraordinary revenue needs exerted an enormous pressure, at a time when citizens were expected to contribute to the public budget based on their "ability to pay" (Steinmo 2003).

This leap in progressive taxation during the world wars had long-lasting effects: even if some war regulations were rolled back after the end of the conflicts, they did not return to their pre-war levels. Notably, top marginal rates remained higher, while middle and lower strata of society also contributed increasingly to the state coffers as they were brought into the income tax at a time when bottom marginal tax rates were on the rise. For instance, during World War I, the number of income tax payers in the UK increased by 2.4 million (Broadberry and Howlett 2005), altering a system that had previously shielded low and middle incomes (Balderston 1989). Similarly, discussions on how to finance World War II in the United States produced a major expansion of the income tax, which was both broadly based and steeply progressive (Brownlee 1996). Lower classes in Sweden also became income tax payers during the first half of the twentieth century (Rodriguez 1981).

In this paper, we focus on one crucial element in these developments that has not been studied in depth yet. The expansion of the income tax to low and middle classes was not only the result of regulatory changes (such as lowering exemption limits) but also of the high levels of inflation experienced during the war periods. Higher prices reduced the real value of tax thresholds, family deductions, and bracket limits, causing new individuals from the bottom of the income distribution to fall into the income tax, and pushing taxpayers into higher tax brackets. Such effects, known as bracket creep, have been mentioned by some of the existing literature. For instance, Broadberry and Howlett (1998, 2005) refer to the role of inflation in expanding the British number of taxpayers during both wars. Similarly, Brownlee (1996) alludes to wartime inflation as one of the factors leading to increases in effective tax rates in the United States during the 1940s, while Rockoff (2012) compares the inflationary experiences of the two wars in that country. However, these effects have not previously been quantified.

This paper contributes to the literature in three different ways: first, we explore the different mechanisms through which inflation contributed to expand the income tax during the two military conflicts; second, we estimate the amount of income tax revenue collected as a result of inflation; and third, we calculate the impact of inflation on income tax progressivity and redistribution. We study these developments in Sweden, the UK, and the United States. All three countries had an income tax in operation before the outbreak of World War I, which gives us the opportunity to analyze the changes experienced during both military conflicts. The last two countries implemented some of the highest top marginal income tax rates ever during the wars and have been considered illustrative examples of the war-making/state-making nexus (e.g., Rasler and Thompson 1985; Scheve and Stasavage 2016). We complement them with Sweden, a neutral country that engaged in significant military mobilization and experienced considerable revenue growth, even if with lower marginal tax rates (Henrekson and Stenkula 2015). This allows us to explore the impact of inflation under different war efforts and regulatory environments.

To do so, we compile and analyze new data on tax legislation, the distribution of income, and inflation from tax administrations and statistical agencies. These sources have been previously used to study the top of the income distribution (Atkinson and Piketty 2007, and related work). Here we employ them to analyze how income taxes affected the entire population. To identify the effect exerted by inflation on the income tax, we compare its actual operation with alternative scenarios that assume low or null inflation during wartime.

Our results suggest that inflation played a significant role in the expansion of income taxes during this period. On the one hand, it was a major contributor to their downwards extension, particularly during World War I. Near 70 percent of Swedish income tax payers in 1920 had been brought into the tax by war inflation, a figure that reached 75 percent in the UK and around 40 percent in the United States. On the other hand, high- and middle-income taxpayers were pushed to higher income tax brackets due to the erosion of the real value of tax brackets and family deductions (to the extent that they ended up paying most of the income tax revenue brought in by inflation). Both marginal and effective tax rates would have been lower across the income distribution in the absence of extraordinary price increases. Our calculations also indicate that inflation was crucial in the growth of income tax revenue collected during both world wars. For instance, 80 percent of income tax revenue in Sweden in 1920 was raised by inflation (64 percent and 57 percent in the UK and United States, respectively, in 1919).

This inflation-related expansion of income taxes not only contributed to fill state coffers in a time of fiscal stress but it also affected progressivity and redistribution significantly.

The downward expansion to low and middle incomes made the income tax less progressive. However, despite the loss of progressivity, it became more redistributive due to the increased size of an overall progressive tax.[1]

These results do not call into question the historical importance of unprecedented spikes in the top income tax rates nor their overall progressive effects; they do, however, clarify and quantify mechanisms that need to be considered if we want to fully understand the fiscal impact of the two military conflicts. Both inflation and income tax reforms increased income tax revenues, and they did so by increasing the income tax burden and expanding the tax base to incorporate lower incomes. In this sense, inflation and tax reforms reinforced each other—even if they were also substitutes from the perspective that lower taxation could have meant higher inflation (through increased debt finance and monetization). Hence, one of the drivers of the transition from a "class tax" into a "mass tax" (in Steinmo's words): less progressive but also more redistributive.

The consequences of these wartime changes were indeed far reaching. Although progressive taxation was never free of controversy, it emerged as a central part of modern fiscal systems, becoming a prominent redistributive instrument (Steinmo 2003). The large amounts of revenue that income taxes produced, on the other hand, laid down the foundations for a massive expansion of social spending and the rise of the welfare state in many Western countries (Lindert 2004). Tax progressivity and redistribution contributed, according to several authors, to lessen income inequality, mainly through their effects on capital accumulation (Piketty and Saez 2003; Roine et al. 2009; Scheve and Stasavage 2016). The paper thus contributes to understanding one of the key mechanisms that shaped income taxes for decades to come.

2. Income taxes during the world wars

The world wars fundamentally altered the tax systems of most Western countries. Even if the introduction of income taxes often preceded World War I, top marginal tax rates rarely exceeded 10 percent before 1913. Such rates only surged during the war and its immediate aftermath, blowing up again during World War II (up to well above 60 percent in many cases).[2] Bottom tax rates often increased as well in these two episodes but by smaller amounts. Consequently, the literature has identified the two wars as landmarks in the historical evolution of fiscal progressivity and redistribution in advanced countries through the institutionalization of income taxes and other fiscal instruments (Steinmo 2003).[3]

The three countries analyzed in this paper certainly experienced sweeping changes in their income taxes during both world wars. The UK was a pioneer in introducing a permanent income tax in 1842 under the leadership of the conservative Prime Minister Robert Peel (Daunton 2002). Despite hostility among members of Parliament, the new tax proved to be more resilient to the political winds than its short-lived precedent enacted during the

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[1] The calculations refer to redistribution *through the income tax*, i.e., the fact that post-tax incomes are made more equal than pre-tax incomes by a progressive tax (see Section 4). Redistribution through expenditure is an additional possible outcome that we do not explore in the paper.

[2] In some countries, such as the United States, top marginal tax rates increased also in connection with the Great Depression but without reaching their peak until World War II.

[3] This wave of reform affected other taxes too, for example, those imposed on estates and corporate profits, especially "excess profits". The excess profits duty contributed more than one-quarter of total government revenue in the United States during the war period (Steinmo 1993).

Napoleonic Wars. Despite some relevant reforms in the early twentieth century (most notably the establishment of a "super-tax" upon very high incomes in 1909–10), the most substantial changes took place during the world wars, when the tax base broadened and tax rates increased as never before (Broadberry and Howlett 2005). As a result, the income tax provided no less than 42 percent of total public revenue by the end of World War II (up from 24 percent in 1913).[4]

The United States had only implemented its permanent income tax in 1913, although there were numerous precedents.[5] The 1913 tax was very progressive, but it barely raised 4 percent of total federal tax revenue during its first year of implementation. The Revenue Act of 1916 increased tax rates on the upper classes and reduced exemption thresholds (leading to a share of 24 percent of total tax revenue in 1919), while similar developments took place during World War II (after reductions in the 1920s and new increases brought about by the New Deal). The 1941 and 1942 regulation reduced personal exemptions and increased marginal rates, while also reinforcing the taxation of profits.[6] The burden was extended to the middle classes to meet revenue needs and to reduce purchasing power, thus working against inflationary trends (Brownlee 1996). As a result, the share of income tax revenue over total federal tax revenue grew from 16 percent in 1939 to 41 percent in 1946. The predominance of the income tax has since then become a stable trait in the American tax system, something that Wallis (2000) relates to the new spending responsibilities of the post-World War II period and the growth of the federal share of public finances.

Even in a non-belligerent country like Sweden, the income tax rose significantly during the wars due to renewed military efforts. The Swedish income tax dated from 1902, and it also provided 4 percent of total tax revenue in its first year of application. A reform in 1910 reinforced its progressivity with the inclusion of a wealth imputation in the tax base (Stenkula et al. 2014); by 1914, its share in total tax revenues had reached 9 percent. Wartime brought about the enactment of temporary tax increases, some of which later became permanent (1920, 1948). The marginal tax rate for low-income earners almost tripled during World War II and more than tripled for high-income earners (Du Rietz et al. 2015). Nevertheless, tax rates remained significantly lower than in the two belligerent countries considered here (Steinmo 1993),[7] and it provided a lower share of total tax revenue (12 percent in 1919 and 32 percent after World War II).[8]

Figure 1 displays the spread in marginal income tax rates in the three countries from 1900 to 1960. As mentioned above, the world wars pushed the top rates up to their historical maximums, climbing above 90 percent in the two Anglo-Saxon countries during World War II. Similar raises were only experienced in the 1930s, albeit at lower levels. Minimum marginal tax rates also increased during the wars, particularly in the UK and the United States in the 1940s, but the distance between top and bottom rates did nothing but grow.

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[4] The share of income tax revenue comes from Tomas and Dimsdale (2017).

[5] A proposal during the war of 1812, a temporary income tax during the Civil War, and the 1894 tax which was soon ruled unconstitutional (Mehrotra 2013).

[6] Importantly, the 1942 Revenue Act also introduced withholding at source for earned incomes, extending "information at source", which had existed since 1916.

[7] Furthermore, it has recently been shown that the Swedish tax system became increasingly regressive in the second half of the century (Lantz 2021).

[8] These percentages refer to the state income tax, which we analyze in the paper. Sweden also had local income taxes, which were for the most part proportional (a progressive local income tax was in place between 1920 and 1938; see Du Rietz et al. 2015).
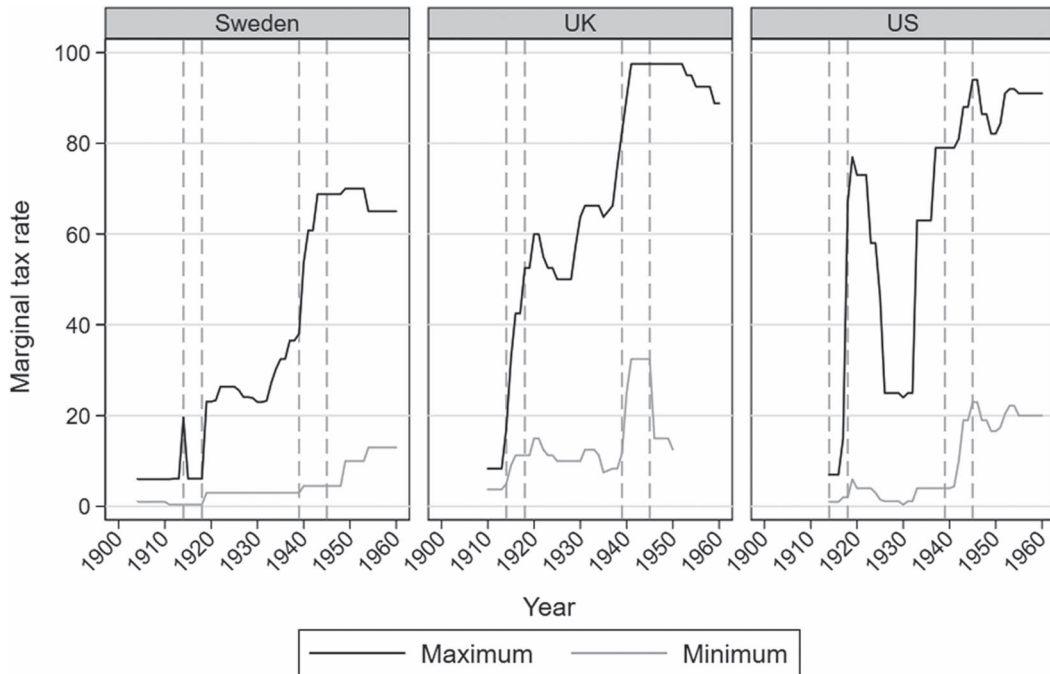
Figure 1. *Maximum and minimum marginal tax rates (1900–60)*.
Sources: Sweden from Du Rietz et al. (2015), the UK from *Report of the Commission-ers...*, and the US from Internal Revenue Service (2021), Historical Tables, Table 23.
Note: the vertical dotted lines represent the world wars.

As mentioned above, the world wars also profoundly affected exemption limits. Figure 2 illustrates this phenomenon: the threshold in the United States went from eight times the GDP per capita in 1914 to barely 1.2 times in 1920. While the changes in other countries were not as pronounced, their exemption limits were also significantly reduced during World War I. When looking at thresholds in real terms, similar patterns emerge: exemption limits in Sweden and the United States diminished about 80 percent during World War I, while the reduction in the UK amounted to slightly above 70 percent. As a result, Whiting (1990) argues that manual workers became the majority of new taxpayers in the UK in 1918–9. The erosion of these limits was less intense during World War II, but it brought them down to the lowest levels of the period.

3. The role of inflation

The transition from "class tax" to "mass tax" was not solely the result of legislative changes. As has been suggested by earlier literature, inflation contributed to the downward expansion of the tax by pushing new citizens into it due to their higher nominal wages. This inflationary effect was not missed by some contemporaries. The Labour MP Vernon Hartshorn, for example, put it very clearly when he lamented that "*all these people who have that pay increase and are brought under the tax are simply being taxed on the extra cost of living; they have simply to pay the tax with money that has been allowed them on account of the extra cost of living...*" (quoted in Whiting 1990, p. 907).
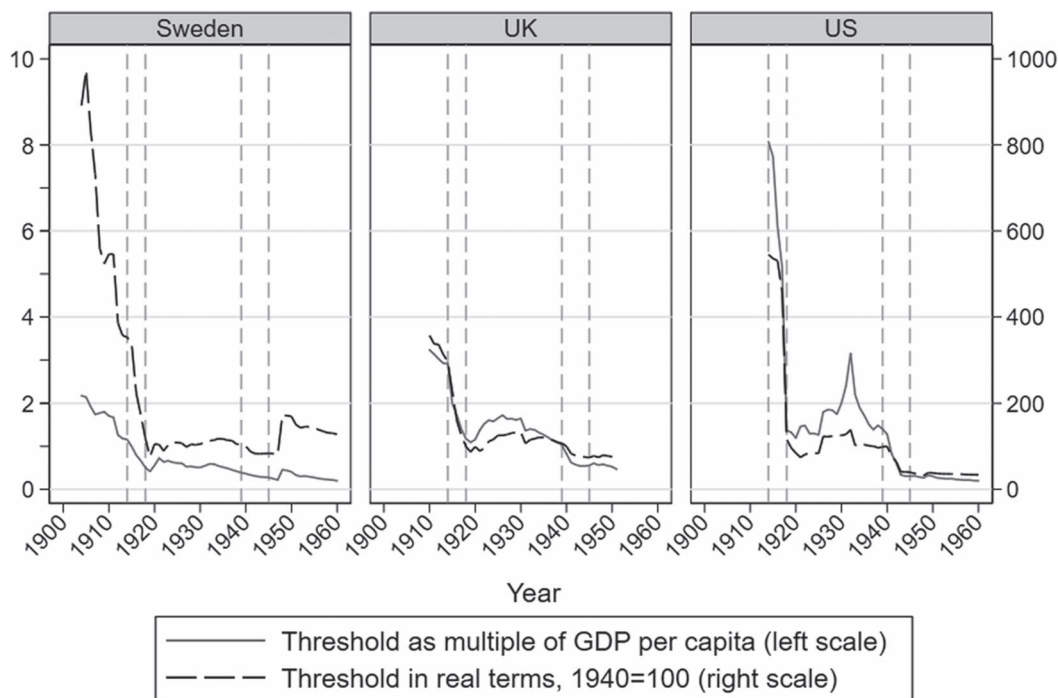
Figure 2. *Thresholds as percentage of GDP per capita and in real terms (1900–60).*
Sources: Sweden from *Taxeringen . . .* (before 1920) and Du Rietz et al. (2015), the UK and the United States from same sources as figure 1.
Notes: in Sweden, before 1920, the threshold shown corresponds to the obligation to make a return, but it was not an exempted fraction of income. After 1920, there was a basic deduction which differed depending on the city of residence (to take into account differences in costs of living). We have depicted here the levels of the third of five city groups (even if, for 1920, it lies somewhat above the weighted average that we calculate for our simulation). Basic deductions also varied by income levels. In the UK, the threshold also corresponds to the obligation to make a return, but most of the income below it was in fact exempted through the operation of personal deductions.
Note: the vertical dotted lines represent the world wars.

Price increases were indeed acute during the world wars (see figure 3). In World War I, they attained an annual average of nearly 10 percent in the United States and 14 percent in the UK (1914–9). Non-belligerent countries such as Sweden also experienced high rates of inflation (19 percent in the same period).[9] During World War II, rates were not as extreme because of a different economic management (Broadberry and Howlett 1998), but they were still around

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[9] The Swedish inflationary experience during World War I looks very extreme in figure 3, when shown together with the lower levels of the UK and the United States. But Swedish inflation was quite similar to that of other continental European countries, both neutral (Switzerland and Norway) and belligerent (Italy and Portugal). See Ljungberg (2021).
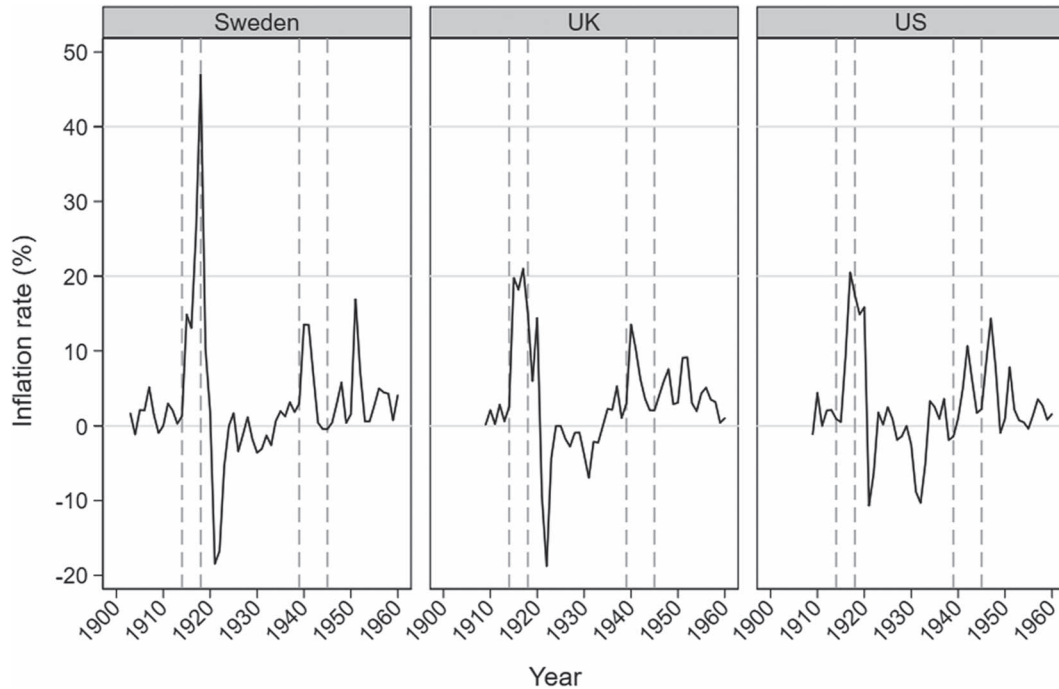
Figure 3. *Yearly inflation rate (1900–60).*
Sources: Sweden from Statistics Sweden; the UK and the United States from Williamson (2020). In Sweden and the United States inflation series are based on consumer price indices (CPI), which provide a measure of the cost of a basket of goods and services for a working class family. For the UK, Williamson (2020) uses the retail price index (RPI) instead of the CPI in order to ensure long-term consistency in the series (the RPI is similar to CPI but differs slightly in the number of items included and their weights; see Pike et al. 2008).
Note: the vertical dotted lines represent the world wars.

4–5 percent per year on average in our three countries, clearly above pre-war levels.[10] Hence, price increases were a non-negligible part of the growth in nominal incomes—above what has been the standard in more recent decades, with only some parallel to the 1970s—and arguably contributed to bringing low-income households into the income tax and middle-income households into paying higher rates.

While the previous literature has acknowledged the role that inflation played in the downward expansion of the income tax in this period, the magnitude of the effect and, more importantly, its impact on revenue growth and on the evolution of tax progressivity and redistribution remain unexplored. In this section, we aim to clarify the key mechanisms

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[10] The management of inflation included rationing, price controls, higher direct taxation, and differential rates in indirect taxation. See Daunton (2002, p. 217 and ff) about the UK during World War II. These measures affected the connection between real income levels and living standards in terms of what could be consumed.

through which inflation affected income taxes and to explain how these could affect both progressivity and redistribution.[11]

Inflation reduced the real value of several elements of the tax that were established in nominal terms, such as exemption thresholds, family deductions, and bracket limits. Consequently, high levels of inflation could have pushed previously excluded individuals into being taxpayers. This same mechanism would have affected the payments of those who were already taxpayers: the erosion of the real value of bracket limits and family deductions could make them jump into higher brackets as their (nominal) taxable income increased.[12]

Both changes would have impacted on the progressivity of the income tax. Progressivity would have decreased if the effect of higher taxation on low and middle incomes (which sometimes fell for the first time under the tax) outweighed that of higher taxation at the top. In this situation, tax payments would have become less concentrated, and low and middle incomes would have borne a higher share of the tax burden than before. By contrast, progressivity would have increased if the effect of bracket creep on top income taxpayers had been higher than that on low and middle incomes. The final direction of the effect depends on the shape of the income distribution, the tax schedule, or the design of family deductions. Because the super-rich at the top bracket did not face a potential bracket jump (and were therefore not affected by bracket creep) and given the deep drops in the real value of tax thresholds (see figure 2), we expect regressive effects to prevail.

This would be consistent with the results of previous literature focusing on more recent decades. For instance, Smith (2001) argues that the decline in income tax progressivity during the 1950s and 1960s in Australia was the result of rising nominal incomes in connection to an unchanged tax schedule. Immervoll (2005) reaches similar conclusions when applying a range of inflation scenarios to Germany, the Netherlands, and the UK with baseline year 1998.

We also expect bracket creep to have an impact on the redistributive effects of the income tax, i.e., on the difference between pre-tax and post-tax income Gini coefficients. Once again, effects might run in different directions. First, high levels of inflation could have affected redistribution negatively through reduced progressivity. But the increase of the size of a still overall progressive tax could have exerted the opposite effect. If the second channel prevailed, the income tax would have had a larger redistributive effect, even if at reduced progressivity levels. Such has been found for contemporary times; for instance, Haan and Steiner (2004) for the German fiscal reform of 2000 and the abovementioned study of Immervoll (2005).

In light of this discussion, we hypothesize that world wars inflation had a negative impact on the progressivity of the income tax, although it could have led to increases in redistribution via growth in tax revenue. We expect higher prices to translate into higher effective tax rates for low- and middle-income groups, reinforcing regulatory changes in the same direction.

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[11] Throughout the text, we use the expressions "impact of inflation" and "effect of inflation" to convey the idea that inflation determined to a certain extent how the income tax system operated. We do not confer on them any causal interpretation.

[12] In this paper, we take income tax bases as given and do not attempt to measure the potential impact of inflation on them. Our results therefore do not cover, for example, the differential effects of inflation on debtors and creditors. We do not consider the "inflation tax" either (understood as a levy on holdings of money. See, for instance, Rockoff 2015).

4. Data and methods

We micro-simulate different inflation scenarios and compare between them the number of income tax payers and tax revenue (differentiating the shares of the additional revenue paid by new and old taxpayers), the effective tax rates at different percentiles of the income distribution, and synthetic measures of tax progressivity and redistribution. In this way, we can identify the most important channels through which inflation affected the income tax. Finally, we estimate the impact of inflation in the absence of wartime legislative reforms.

Our calculations are based on a previous baseline estimation of how the income tax actually operated in each country during this period (Torregrosa-Hetland and Sabaté 2021b). This estimation combines the original tax statistics compiled by tax administrations and statistical agencies with the corresponding tax regulation (i.e., it simulates the operation of the tax on reported incomes). More details about this procedure, including country-specific adjustments, are given in Torregrosa-Hetland and Sabaté (2021a), to where we refer the interested reader. Here the main aspects are outlined.

The original data (distribution of taxpayers, reported income, and tax paid for selected years) had to be reworked before being used for our purposes. On the one hand, the information is in grouped form: it comes in certain income brackets that change over the years and do not always coincide with those of the tax schedules. Moreover, tax statistics only provide information for taxpayers, so we lack data on the distribution of income of non-taxpayers. In order to make calculations comparable across countries and over time, and referred to the whole population, we generate a synthetic distribution of income of all tax units for each country and year following Blanchet et al. (2017). This procedure estimates a synthetic sample based on the number of tax returns in each original bracket, the corresponding income, and the total average income for a given year, using the properties of the Pareto coefficients.[13] With this, we obtain a sample of 1 million equally weighted observations for each country and year. These samples are largely consistent in mean and distribution with the original grouped information.[14]

Once the synthetic sample has been generated, we estimate the tax payments and effective tax rates corresponding to each observation, based on the tax regulations.[15] We first deduct family deductions from gross income, thus obtaining taxable income. Since these deductions depend on the family circumstances (presence of spouse and children), we generate eight synthetic taxpayer types within each income-level observation: singles and couples with zero, one, two, or three children. This general procedure is adapted to some of the peculiarities of each country.[16]

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[13] Total average income is based on total income estimations from Roine and Waldenström (2010) for Sweden (adjusted for consistency with the tax base definition in the income tax), Atkinson (2007) for the UK, and Piketty and Saez (2007b) for the United States.

[14] The data that we use are of *reported incomes*, and these thus exclude in-kind sources of income (such as health insurance benefits). We do not make any correction for fraud (for example, related to black market activity), which is potentially an important issue that deserves consideration in future work.

[15] A similar exercise was performed by Piketty (2001, see annex B.3) for the case of France.

[16] For example, after 1920 Swedish personal deductions varied according to the price levels in the municipality of residence of the taxpayer; to take this into account, we use the distribution of taxpayers in five different city groups to calculate weighted deductions. Similarly, in the UK, we consider the reforms implemented with the Financial Act of 1920, which profoundly changed the system of basic and family deductions and the treatment of earned income.

After this, we apply the corresponding tax schedules to each synthetic taxpayer type. In all three countries, this includes not just the regular tax rates but also the surtaxes, when they were in place.[17] Once again, the system varied slightly in each country and over time, which we have taken into account in our calculations. When we have obtained the tax due paid by each synthetic taxpayer type, we calculate the corresponding value for each observation as a weighted average (based on the share of each family type on the total population of tax units). Average effective tax rates for each observation are then obtained by dividing the tax due over the tax base.

The graphic representation of effective tax rates by income levels shows the extent to which taxation increases or decreases with income. We make use of them to show the differences in the tax burden across income levels in different inflation scenarios (defined below). It is convenient, however, to summarize this information in progressivity and redistribution indices as well. We do this following the usual framework in public economics, which is based on concentration curves (Lambert 2001; Boadway and Keen 2000). Progressivity and redistribution are two closely related concepts, but they are not interchangeable. A tax is *progressive* if effective tax rates increase with income, which can also be expressed as tax payments being more concentrated than income. *Redistribution* refers to the corresponding change in inequality, which depends both on progressivity and the size of taxation (i.e., a very concentrated tax might not reduce inequality much if it raises limited revenue).[18] We use the Kakwani index to measure progressivity, which is obtained as the difference between the concentration of tax payments C_T and the Gini of gross incomes G_Y:

$$K = C_T - G_Y \tag{1}$$

The index would be 0 for a proportional tax (i.e., where tax payments were concentrated to the same extent as incomes) and gets positive values when the tax is progressive.

Redistribution is measured with the Reynolds–Smolensky index, which corresponds to the difference between the Gini indices of gross and net incomes (i.e., before and after tax):

$$KS = G_Y - G_{Y-T} \tag{2}$$

A tax is redistributive if RS > 0.

The relationship between these two indices is given by the expression:

$$RS = \left[\frac{aetr}{(1 - aetr)} K \right] - RR \tag{3}$$

where RR is the effect of re-ranking between tax units. Redistribution by the income tax is thus positively affected by both progressivity (K) and the average effective tax rate (aetr). All these calculations are performed using the stata "progres" module developed by Peichl and van Kerm (2007).[19]

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[17] Surtaxes took different names in different periods in the three countries. For instance, in Sweden additional taxes were called *extraskatt* in 1919, *extra statlig inkomstskatt* in 1932–38, and *värnskatt* in 1945–1946.

[18] As mentioned before, we refer to the redistribution of the income tax itself. Hence, we do not take into account the potential redistributive impact of public expenditure financed by income tax revenue.

[19] These indices are based on the Gini coefficients for inequality measurement, so they might be subject to the associated criticisms. We think, however, that this framework is convenient because the concepts are intuitive and enable comparability with other work on both modern and historical taxes (e.g., Torregrosa-Hetland 2015; Bengtsson et al. 2016; Lantz 2021).

Since we want to depict the cumulative effect of war-related inflation, we do not need these estimates on a yearly basis but just at the end of each war. We use the first post-war year when data were available, namely 1919 for World War I in the UK and the United States and 1920 in Sweden. Regarding World War II, our estimates correspond to 1946 in Sweden and the United States, while 1949 in the UK.[20] This last estimate also captures the effect of some post-war inflation and relevant tax reforms, which might contribute to explaining the magnitude of the results shown in the next section.[21]

We simulate two alternative inflation scenarios. Scenario 1 depicts the operation of the income tax under the assumption of no inflation since the pre-war years (1913 and 1938 are taken as a reference for WWI and WWII respectively). Scenario 2 keeps yearly wartime inflation at the average level of the five preceding years (1909–13 and 1934–8, respectively). These two scenarios allow us to estimate the tax that each income-level observation would have paid if we take out purely nominal growth in incomes.[22]

In order to do so, we deflate incomes to 1913 dollars/pounds/kronor in the first scenario (1938 in the case of World War II) and, in the second, we use a price deflator constructed only taking into account the "excess inflation" of the war years. For the first scenario, we begin by estimating the price deflator following the usual equation:

$$PD\_WWI_t = PD\_WWI_{t-1} * (I_t + 1) \tag{4}$$

$$PD\_WWII_t = PD\_WWII_{t-1} * (I_t + 1) \tag{5}$$

where PD_WWI_t stands for "price deflator for World War I" at time t, PD_WWI_{t-1} represents the same deflator at time t-1, and I_t stands for inflation at time t, with PD_WWI_{1913} equal to 1 (the same applies to PD_WWII_t, with PD_WWII_{1938} equal to 1). We then use this price index to adjust nominal incomes to their 1913 values:

$$RGI_t = GI_t / PD\_WWI_t \tag{6}$$

$$RGI_t = GI_t / PD\_WWII_t \tag{7}$$

where RGI_t stands for "real gross income" at time t, GI_t for "nominal gross income" at time t, and PD_WWI_t and PD_WWII_t reflect the aforementioned price deflators. As for the second scenario, we first calculate the price deflators by taking into account only the wartime "excess inflation":

$$EPD\_WWI_t = EPD\_WWI_{t-1} * (I_t - PWWI + 1) \tag{8}$$

$$EPD\_WWII_t = EPD\_WWII_{t-1} * (I_t - PWWII + 1) \tag{9}$$

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[20] In this last case, similar data were available in 1948, but we deemed the 1949 benchmark more reliable due to the *Survey of Personal Incomes* conducted that year. Additionally, Scott and Walker (2020) provide some corrections to the original income distribution based on posterior official sources, which improve the overall accuracy of the exercise.

[21] For instance, the earned income deduction was cut in half from 1945 to 1949, while the exemption limit increased from £110 to £135 in the same period.

[22] It is important to notice that this exercise is purely theoretical in its conception. In both Scenarios 1 and 2, we use actual wartime tax regulation. However, fiscal reforms are in part determined by the level of inflation (among many other considerations), so they would have probably been different in an alternative inflation scenario. Thus, these scenarios are instrumental to mathematically isolate the impact of inflation, but they are not a realistic depiction of how tax regulation would have looked like. Similarly, we do not take into account the impact that fiscal reforms (or other wartime economic reforms, for that matter) could have on inflation: we always take the level of wartime inflation as a given.

where EPD_WWI_t stands for "excess price deflator for World War I" at time t, EPD_WWI_{t-1} represents the same deflator at time t-1, I_t stands for inflation at time t, and $PWWI$ reflects the average pre-war inflation (1909–13), with EPD_WWI_{1913} equal to 1. The same applies to equation (9), with the pre-war inflation based on the period 1934–8 and EPD_WWII_{1938} equal to 1.

Although we use the most reliable inflation series available (shown in figure 3), it is possible that they underestimate the actual increase in prices during the world wars. This issue is discussed, for example, by Higgs (1992) with respect to the United States, by Mills and Rockoff (1987) for both the United States and the UK, and by Edvinsson and Söderberg (2010) in relation to Sweden. Higgs (1992, p. 51) stated that *"Everyone who has looked closely at the official price indexes recognizes that they understate the actual inflation during the war and—an important point usually overlooked—overstate the actual inflation during the immediate postwar period"*. Indeed, inflation estimates were considered very uncertain by contemporary experts, given the difficulties in accounting for aspects such as quality deterioration or the impact of black markets.[23] To address the possible under-estimation of inflation in the main series, we make some additional calculations in the appendix using alternative series for World War II that depict higher price increases than our preferred ones: Friedman and Schwartz (1980)´s deflator for the United States and Reinhart and Rogoff (2011)'s price indices for Sweden and the UK.

5. Results

5.1. Effects on number of taxpayers and income tax revenue

We first present estimates of the additional number of taxpayers and tax revenue brought in by inflation. To do so, we calculate the difference in the number of taxpayers and the amount of tax revenue between the original scenario and the two alternative inflation scenarios (i.e., no inflation and pre-war inflation). The discussion of the results (here and in the following sections) focuses on the pre-war inflation scenario (2); results for the no-inflation scenario, as can be seen, lie always above.

Inflation was a powerful mechanism for the downward expansion of the tax, both in terms of new taxpayers and additional income (see table 1). The highest *number* of new taxpayers is found in the UK during World War II, with 4 million taxpayers incorporated by excess inflation. However, in relative terms, these new taxpayers represented the highest share of income tax payers in World War I: 75 percent in the UK, 68 percent in Sweden, and 38 percent in the United States. The impact of inflation by 1920 in Sweden was so extreme that these new taxpayers amounted to 28 percent of the total tax units in the country (i.e., of the total number of potential tax returns if everyone would have been required to file). Second in this respect comes the UK in 1949, with 15 percent. All our estimations lie above one million taxpayers affected in the two Anglo-Saxon countries, while they are close to or above 200,000 in Sweden, where total population was considerably lower.

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[23] Some data on the latter can be found, for example, in Clinard (1969) for the United States during World War II. His account shows black markets to be very prevalent in a wide range of products (such as meat or gasoline). Surveys from the Bureau of Labor Statistics indicated that between 5 and 40 percent of items checked in retail stores in certain cities had prices above the official ceilings. In 1944, 57 percent of firms investigated by the Office of Price Administration were shown to be in some kind of violation; the number went up to approximately 70 percent in the case of big companies. These data, however, need to be interpreted with caution.

Table I. *Additional taxpayers and income tax revenue brought in by inflation*

Country	Year	Scenario	New taxpayers brought in by inflation			New tax revenue brought in by inflation	
			Absolute number	Percent of total taxpayers	Percent of total tax units	Million current krs/£/$	Percent of total income tax revenue
Sweden	1920	I	933,924	71 percent	30 percent	145	82 percent
	1920	2	876,513	68 percent	28 percent	142	80 percent
	1946	I	292,665	11 percent	8 percent	588	44 percent
	1946	2	166,053	6 percent	4 percent	391	29 percent
United	1919	I	2,913,250	77 percent	12 percent	210	67 percent
Kingdom	1919	2	2,840,603	75 percent	12 percent	200	64 percent
	1949	I	6,282,209	45 percent	24 percent	822	67 percent
	1949	2	4,013,889	29 percent	15 percent	602	49 percent
United	1919	I	1,488,373	44 percent	4 percent	880	63 percent
States	1919	2	1,300,997	38 percent	3 percent	801	57 percent
	1946	I	2,670,648	6 percent	5 percent	7,629	41 percent
	1946	2	1,484,428	4 percent	3 percent	4,966	27 percent

Source: authors' calculations with tax data from *Taxeringen till inkomst…, Skattetaxeringarna…, Report of the Commissioners…, Statistics of Income…*; inflation from Williamson (2020) and Statistics Sweden; and total income controls from Atkinson (2007), Piketty and Saez (2007b), and Roine and Waldenström (2010). Notes: the column "New taxpayers brought in by inflation" refers to taxpayers who would not have paid the tax in absence of inflation (Scenario I) or in a context of pre-war inflation levels (Scenario 2). The deflated incomes of these taxpayers, after considering family deductions, fell below the exemption limits. Similarly, the column "New tax revenue brought in by inflation" accounts for additional revenue due to inflation (which corresponds both to these new taxpayers and to increased taxation of "old" taxpayers). New taxpayers brought in by inflation are shown in absolute numbers and also in relation to the total number of taxpayers and the total number of tax units (i.e., the potential number of tax returns if everyone was obliged to file) in each year.

Through this incorporation of new taxpayers and increases in the tax burden across the board, inflation also had a significant impact on revenue. In 1919, as much as 57 percent of total income tax revenue in the United States can be attributed to the effect of excess cumulative inflation since 1913.[24] After World War II, the corresponding figure was 27 percent (excess cumulative inflation since 1938). Impacts were higher in the UK (64 percent and 49 percent in World War I and II, respectively) and Sweden (80 percent and 29 percent).[25]

But *who paid* this inflation-related income tax revenue? Was it the new taxpayers, who would not have paid anything in the absence of (extraordinary) inflation? Or was it mostly those who already were on the tax rolls? Table 2 shows that it was those who were already paying the tax who ended up paying most of the new inflation-related revenue (more than 80 percent in all cases). The progressive tax schedules in place made the top percentiles the largest contributors. New taxpayers paid the highest share in the two instances with the highest expansions in the number of taxpayers, namely Sweden in World War I (15 percent) and the UK in World War II (13 percent). The opposite case is the United States during World War II, where the contribution of the new taxpayers was below 1 percent. While the rich paid the majority of this additional tax revenue, lower-middle incomes experienced the meaningful qualitative change of becoming taxpayers.

5.2. Distribution of the income tax burden

We now look at the effective tax rates by percentiles of the income distribution and the indices of progressivity and redistribution. Again, we compare actual and alternative scenarios to isolate the impact of price increases.[26] Figures 4 and 5 display the average effective tax rates under the three scenarios. The baseline estimation shows how top effective tax rates increased in the post-World War II period compared to the post-World War I benchmark in the three countries of our sample, particularly in the United States (moving from 8.1 percent to 33.1 percent in the highest percentile). Top effective tax rates attained the highest level in the UK in 1949 (40.3 percent), although World War I levels were already above those of Sweden and the United States (25.5 percent compared to below 10 percent).[27] The income tax also expanded downwards along the income distribution, with percentile 29 falling under the income tax system in the three countries after World War II. Effective tax rates, however, remained fairly low for middle and low incomes, even in the aftermath of the military conflicts.

The deflated scenarios confirm our expectations: they present lower tax rates compared to the baseline, and the effect increases (in relative terms) as we move downwards along the income distribution. For instance, the effective tax rate imposed upon the top percentile in the United States would have been 9 percent lower in the absence of excess inflation during World War II, whereas the relative difference found in the median of the income distribution

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[24] Table A3 re-estimates table 1 with the alternative series mentioned in the previous section. As expected, the results show that higher inflation levels would have led to even larger effects in terms of new taxpayers and revenue. We have also replicated our analysis using the series compiled by Ljungberg (2021) (which are very similar to our preferred ones), and results are consistent with our previous findings.

[25] If we consider total tax revenue as a reference, the additional tax revenue brought in by inflation in our post-World War I benchmarks represented around 16 percent in the US, 11 percent in Sweden, and 22 percent in the UK, reaching 13 percent, 10 percent, and 16 percent in the aftermath of World War II (Scenario 2).

[26] The results of the actual operation of income taxes ("baseline" estimation) come from Torregrosa-Hetland and Sabaté (2021b).

[27] It should be noted that, in the case of Sweden, additional income taxes enacted during the war were in effect in 1919 but no longer in 1920, so these estimates do not represent the maximum progressivity reached in wartime.

Table 2. *Distribution of the additional revenue caused by inflation between taxpayer groups*

Country	Year	Scenario	New taxpayers brought in by inflation	Rest of taxpayers	Top 10 percent of tax units	Top 1 percent of tax units
Sweden	1920	1	17.3 percent	82.7 percent	80.6 percent	52.3 percent
	1920	2	15.2 percent	84.8 percent	80.3 percent	52.0 percent
	1946	1	3.9 percent	96.1 percent	57.0 percent	27.3 percent
	1946	2	2.9 percent	97.1 percent	56.9 percent	27.1 percent
United Kingdom	1919	1	8.0 percent	92.0 percent	97.8 percent	76.6 percent
	1919	2	7.6 percent	92.4 percent	97.6 percent	76.1 percent
	1949	1	17.3 percent	82.7 percent	66.7 percent	33.5 percent
	1949	2	13.4 percent	86.6 percent	65.0 percent	32.3 percent
United States	1919	1	8.0 percent	92.0 percent	99.9 percent	80.6 percent
	1919	2	7.1 percent	92.9 percent	99.9 percent	80.4 percent
	1946	1	0.7 percent	99.3 percent	55.0 percent	31.0 percent
	1946	2	0.4 percent	99.6 percent	54.7 percent	30.6 percent

Source: authors' calculations with same data as in table 1.
Notes: columns 4–7 all represent shares of the additional income tax paid due to inflation. Columns 4 and 5 sum 100 percent: they distribute the additional income tax payments over the "New taxpayers brought in by inflation" (same as table 1) and those who would have paid tax anyway. As for the last two columns on the right, they show the shares paid by top income groups, with quantiles defined over the whole population of tax units (not only taxpayers). All estimates are measured in the absence of inflation (Scenario 1) and in a context of pre-war inflation levels (Scenario 2).

reached 22 percent.[28] These results tell us, first, that inflation pushed the overall effect of the income tax up, since tax rates without excess inflation would have been lower across the board. Secondly, low and middle incomes were more severely hit by this effect than the highest incomes. This, on the one hand, was the result of new inflation taxpayers being brought into the tax system due to the erosion of deductions and exemption limits (for instance, percentiles 52 to 81 in Sweden would have been completely exempted during World War I had it not been for the inflationary pressure). On the other hand, lower and middle incomes benefitted more from family deductions in some cases than the upper classes (for instance in the UK, where child deductions during World War I were restricted to certain income levels). Although absolute differences between the deflated and the baseline scenarios were higher at the top of the income distribution, the relative differences in their tax rates were higher for low and middle incomes.

Let us take the case of the United States to illustrate these findings. In 1918, the compensation of Members of Congress was $7,500, which placed them in percentile 100 in our post-WWI data (Congressional Research Service 2021). With this income, they would have paid an average effective tax rate of 5 percent, which amounted to $374. However, with pre-war inflation, their tax rate would have been limited to 3.2 percent (ca. $145 out of a lower income). In World War II, Members of Congress earned $10,000 (percentile 99 in our income distribution), corresponding to an average tax rate of 23 percent and a tax due of $2,320. According to our calculations, the average tax rate in the absence of extraordinary

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[28] Table A2 in the Appendix shows the percentage differences between the baseline scenario and the two alternative ones for selected income percentiles.
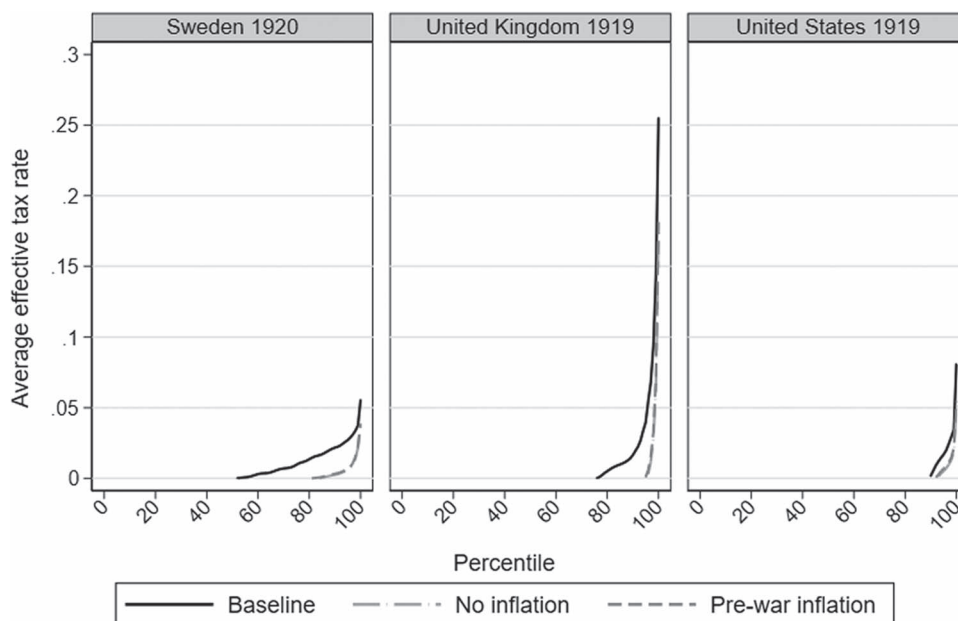
Figure 4. *Average effective tax rates under different inflation scenarios in the aftermath of World War I.*
Source: authors' calculations with same data as in table 1.
Notes: the graphs display the average effective tax rates along the entire income distribution. The line "baseline" shows the actual rates paid, whereas the next two lines present those estimated in the absence of inflation ("no inflation") and in a context of pre-war inflation levels ("pre-war inflation"). The two lines representing alternative inflation scenarios overlap to a large degree in the three countries.

inflation would have been 2 percentage points lower (around 21 percent), while tax due would have been limited to $1,750.

World War II also brought lower and middle incomes into the tax. For instance, instructional staff in public day schools (supervisors, principals, and teachers) earned on average $1,995 in 1945–46 (US Office of Education 1950). This salary would place them at percentile 62 with an effective tax rate of 8.6 percent. However, in the absence of excess inflation their tax rate would have reached only 7 percent, and their tax due would have been $57 lower. Similarly, in 1944, the average annual wage for non-governmental non-agricultural employees (including workers in manufacturing, mining, railroad transportation, and retail trade) reached $2,255 (US Bureau of Labor Statistics 1946), corresponding to percentile 67 of the income distribution in tax year 1946.[29] This typical worker would have also been on the tax roll without extraordinary inflation, but the amount of tax paid would have differed significantly: the effective tax rate under our pre-war inflation scenario would have been almost 3 percentage points lower (7.7 percent compared to 10.2 percent) with a tax due of $163 instead of $231.

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[29] The report published by the United States Bureau of Labor Statistics mentions that salaries did not change much from 1944 to 1945, which is the year of incomes taxed in 1946, our postwar benchmark.
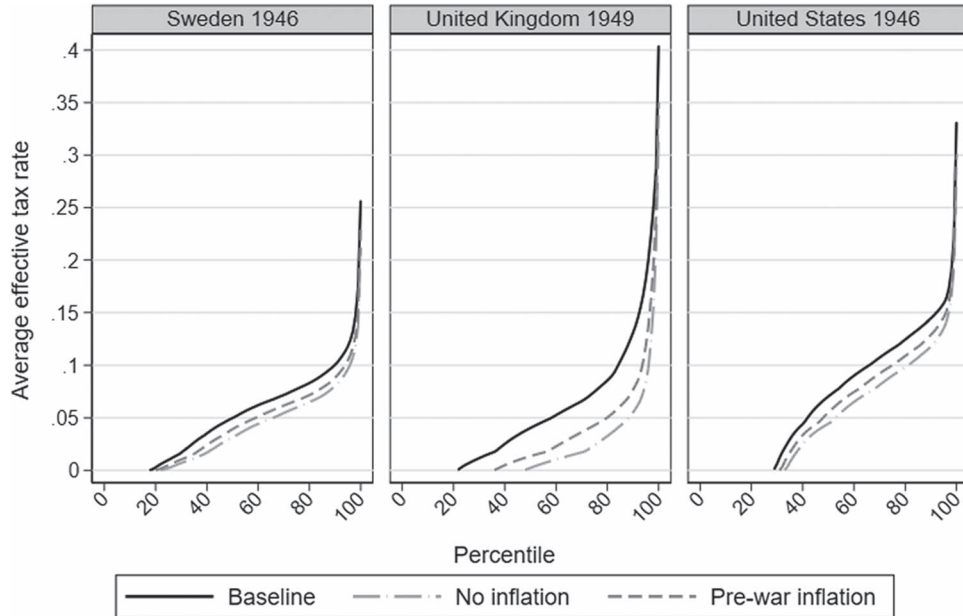
Figure 5. *Average effective tax rates under different inflation scenarios in the aftermath of World War II.*
Source: authors' calculations with same data as in table 1.
Notes: the graphs display the average effective tax rates along the entire income distribution. The line "baseline" shows the actual rates paid, whereas the next two lines present those estimated in the absence of inflation ("no inflation") and in a context of pre-war inflation levels ("pre-war inflation").

In table 3, we explore the distributive effects further with the indices of progressivity and redistribution. The Kakwani index is higher in the two alternative scenarios than in the actual operation of the tax: i.e., inflation made the tax less progressive. This is particularly relevant in Sweden during World War I, where the tax would have been 20 percent more progressive without excess war inflation [(39.66–32.92)/32.92], and in the UK for World War II [15 percent: (45.38–39.55)/39.55]. The impact in the United States appears to be noticeable yet smaller, especially during the first war: even if price increases were more pronounced, the tax remained very concentrated at the top of the income distribution due to the high exemption limit. The impact of inflation in the three countries varied depending on the inflationary pressure, the structure of the income tax in place, and the existing income distribution.[30] Crucially, however, the effect was qualitatively the same in all of them.[31]

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[30] The concentration of tax units near the exemption limit would increase the effect of any erosion of their real values.

[31] In table A4 in the appendix, we estimate the impact of inflation on income tax progressivity and redistribution by making use of the alternative inflation series mentioned in Section 4 (which we use as top boundaries for price increases during the period of study). The impact of inflation is the same as with our preferred inflation series but stronger.

Table 3. *Progressivity and redistribution under the alternative scenarios*

Sweden, 1920			
	Baseline	No inflation	Pre-war inflation
Redistribution	0.96	0.58	0.60
Progressivity	32.92	39.89	39.66
Average effective tax rate	2.85	1.44	1.50
Sweden, 1946			
	Baseline	No inflation	Pre-war inflation
Redistribution	3.08	2.62	2.80
Progressivity	26.58	29.35	28.13
Average effective tax rate	10.38	8.21	9.04
UK, 1919			
	Baseline	No inflation	Pre-war inflation
Redistribution	5.11	3.54	3.66
Progressivity	55.67	56.89	56.85
Average effective tax rate	8.40	5.86	6.05
UK, 1949			
	Baseline	No inflation	Pre-war inflation
Redistribution	6.43	4.40	5.15
Progressivity	39.55	48.97	45.38
Average effective tax rate	13.99	8.24	10.19
US, 1919			
	Baseline	No inflation	Pre-war inflation
Redistribution	1.93	1.29	1.37
Progressivity	69.37	69.99	69.90
Average effective tax rate	2.71	1.81	1.92
US, 1946			
	Baseline	No inflation	Pre-war inflation
Redistribution	4.70	4.12	4.36
Progressivity	27.07	29.82	28.63
Average effective tax rate	14.81	12.15	13.21

Source: authors' calculations with same data as in table 1. Notes: the redistribution indicator is the Reynolds–Smolensky index (difference between the Ginis of pre-tax and post-tax incomes). The progressivity index is Kakwani, which measures the concentration of the tax due with respect to income. All indices are calculated under the actual inflation scenario ("baseline"), the no-inflation scenario ("no inflation") and the pre-war inflation scenario ("pre-war inflation").

Interestingly, the Reynolds–Smolensky index shows that the impact of inflation on redistribution was actually positive. Why did redistribution increase while progressivity declined? The answer lies on the growth of tax revenue, which placed more income into the redistributive channel. As shown in Section 4, redistribution by the income tax depends on both the level of progressivity and the average effective tax rate: while inflation reduced the former in all our cases (for instance, from 56.85 to 55.67 in the UK in 1919), it also increased the latter (from 6.05 to 8.40 in the same country-year). Empirically, the increase in the average effective tax rate outweighed the loss of progressivity in the three countries. The British income tax reduced inequality by 5.11 Gini points in 1919, and no less than 28 percent of this effect was caused by accumulated excess inflation since 1913 [(5.11–3.66)/5.11]. By 1949, the tax

had become more redistributive, reducing inequality in 6.43 Gini points, of which 20 percent were the result of accumulated excess inflation since 1938.[32]

5.3. Legislative changes and inflation

We have shown inflation to have ample effects on both the low/middle- and high-income segments of the population. The better off citizens faced increasing rates, partly due to bracket creep, and shouldered most of the income tax burden brought in by wartime inflation. As a result, growth in revenue led to reinforced redistribution through the income tax (net incomes were increasingly made more equal than pre-tax incomes).[33] The low-middle classes, on the other hand, paid a smaller share of income tax revenue, but they experienced the very significant qualitative change of becoming taxpayers (in the income tax). In this way, their burden increased relatively more, making the income tax less progressive.

In our view, one of the most interesting questions that arise from these results is to what extent policy-makers understood these impacts, and whether they actively used them in their favor.[34] While we leave this issue for further research, we do explore in this final section the extent to which fiscal regulation and inflation reinforced each other, by having similar effects (reducing the value of tax thresholds and bracket limits, and ultimately increasing effective tax rates). To do so, we compare the revenue estimates reported in table 1 (income brought in by inflation with the actual fiscal rules) with the revenue that inflation would have brought in if there had not been any wartime regulatory changes.

We find the latter following a three-step procedure (see table 4 for a schematic presentation of all estimated scenarios). Firstly, we simulate the operation of the tax keeping pre-war tax regulations in place (1913 and 1938, respectively, for the two wars)—*Scenario 3*. Secondly, we simulate the operation of the tax combining pre-war regulation *and* pre-war inflation—*Scenario 4*.[35] Finally, we subtract the revenue obtained in the latter from the revenue obtained in the former (*Scenario 3—Scenario 4*). We are thus calculating the income brought in by inflation in a context of no wartime regulatory changes.[36]

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[32] These indices have empirically a low variation. The RS index in the United States, for which we have calculated a yearly series elsewhere (Torregrosa-Hetland and Sabaté 2021b), was between 1 and 2 Gini points for most of the years between 1918 and 1940. Around 1990, its value has been estimated between 3 and 4 for the three countries discussed here (Wagstaff et al. 1999)—the same study found values between 1.5 and 4.5 Gini points for the twelve OECD countries included, with an average of 3.2.

[33] Additional potential indirect effects that we do not analyze in this paper include the redistributive impact of social spending, which became more feasible to fund after the war (but that remains outside the scope of this paper). See, e.g., Beetsma et al. (2016) on the United States after World War II.

[34] Peters (1991) did mention, not referring specifically to the wars, that governments in Western countries have often consciously allowed income tax revenue to increase as a result of inflation.

[35] For the sake of simplicity, we only focus on the pre-war inflation scenario.

[36] In the United States, our alternative scenarios with no wartime regulatory changes (Scenarios 3 and 4) are estimated based on the pre-war tax schedules, exemption limits, and personal deductions, but on the post-war distribution of non-family deductions. Due to the lack of sufficient data, we cannot simulate the operation of the regulation in the policy area of non-family deductions; instead, we directly use data on their distribution by income levels from primary and secondary sources (mostly from Geloso et al. 2018). Nevertheless, the basic regulations regarding the non-family deductions that we cover stayed in place during the war (even if others were created at that time, like the deduction for medical and dental expenses). The standard deduction, for taxpayers who did not wish to itemize all their deductions, was introduced in the tax year 1945, but it relates to the same items that were already deductible.

Table 4. *The different regulation-inflation scenarios*

		Inflation	
		Actual	Pre-war
Regulation	Actual	*Baseline*	*Scenario 2*
	Pre-war	*Scenario 3*	*Scenario 4*

Source: the authors. Notes: for the sake of simplicity, we focus here on the scenarios with pre-war inflation and do not use the case of no inflation. The impacts of inflation presented in the paper have so far compared the *Baseline* scenario with *Scenario 2*. To obtain the impact of inflation in a context of no regulatory change, we compare *Scenario 3* with *Scenario 4*.

Table 5. *Impact of inflation under different regulatory scenarios*

Country	Year	Increased tax revenue with the actual tax regulation in place		Increased tax revenue with the pre-war tax regulation in place	
		Million current krs/£/$	Percent of total income tax revenue	Million current krs/£/$	Percent of total income tax revenue
Sweden	1920	142	80 percent	85	78 percent
	1946	391	29 percent	149	28 percent
United Kingdom	1919	200	64 percent	36	56 percent
	1949	602	49 percent	391	50 percent
United States	1919	801	57 percent	54	58 percent
	1946	4 923	27 percent	1 030	31 percent

Source: authors' calculations with same data as in table 1.

Our results indicate that the amount of income brought in by inflation would have been lower in the absence of wartime regulatory changes (see table 5). The clearest example is the United States in the aftermath of World War I, when the amount of inflation tax revenue in 1919 would have been 93 percent lower if the 1913 regulation had been kept untouched (from $801 to 54 million). Higher marginal tax rates and lower exemption limits and deductions amplified the effect of bracket creep. A similar situation can be found in the other country-year cases, clearly indicating that inflation and regulation worked together to expand the tax system.

It is worth noting that the exercise presented above is purely theoretical in its conception, as it is only meant to show the degree to which inflation and tax reform reinforced each other. These scenarios do not intend to be a realistic depiction of how inflation and tax regulation would have looked like in the absence of the other. In fact, the political economies of taxation and inflation were in a complex dialog with one another. Although their results in terms of public revenues were mutually reinforcing (as shown above), they were also perceived as substitutes in the minds of some economists and policymakers (Rockoff 2015). Unlike war financing via bonds, which could, and did, lead to inflation, wartime taxes provided revenue to the state at the same time that they reduced consumption and pushed down inflation. Such was the rationale behind Keynes' proposal of high taxes and deferred pay, who saw these policies as the best alternatives to other inflationary financial instruments during World War II (Keynes 1940). In this regard, the world wars were distinctively different than other historical occurrences of high inflation, since there was a fundamental consensus that public

revenues had to increase to face the costs of war (through higher taxation, indebtedness, or monetization). Inflation was probably the back door to further tax increases, but without it, one could expect that taxes would have increased even more to meet the military needs.

6. Conclusions

Major warfare and mass mobilization during the two world wars were associated with increasing top rates in income taxes in most Western countries. At the same time, income taxes included more citizens into their nets and raised more revenues, becoming a fundamental instrument in financing not only the wars but also the modern welfare states that emerged thereafter. In this paper, we explore the role that inflation played in this evolution. While we do not dispute the progressive impact of war-related fiscal reforms, we argue that wartime inflation exerted a counteracting impact by pushing citizens into higher tax brackets and by including new individuals from the middle and bottom of the income distribution into being taxpayers. Inflation made exemption limits less restrictive over time (often reinforcing legislative reforms in the same direction), which caused a substantial expansion in the number of taxpayers. The effect on redistribution through the income tax was overall positive, due to revenue growth.

Bracket creep had allegedly other long-term indirect effects: as new taxpayers were brought into the income tax, the states gained administrative capacity to extract revenue from most of their populations. Low- and middle-income taxpayers were incorporated into the fiscal net for later periods, when they would be asked to shoulder greater burdens. Similarly, the highest effective tax rates resulting from the combination of wartime inflation and legislative changes gave governments the opportunity to maintain unprecedented levels of fiscal revenue. Even if progressive taxation was attenuated soon after the end of the two military conflicts, the world wars expanded the scale and scope of the income tax irreversibly. As has been already described elsewhere (Peacock and Wiseman 1961; Rasler and Thompson 1985; Sabaté 2016), public revenues did not return to pre-war levels in the aftermath of the wars.

Our analysis of the operation of income taxes in three countries (Sweden, the UK, and the United States) is based on a novel micro-simulation exercise which compares different inflation scenarios and is applied on a new combination of data on tax regulations, the distribution of income, and wartime inflation. With these and related data, at least three related areas for further research arise. The first is the political side of the narrative, such as the extent to which governments and political elites considered these effects when committing to progressive fiscal reforms. Was inflation overlooked to expand the income tax without suffering the foreseeable political cost of such a decision? Secondly, bracket creep had strong revenue impacts, which did not seem to bring about significant negative effects on legitimacy—in contrast to the experience in the 1970s and 1980s. Exploring the reasons for this, and the extent to which they are dependent on the war context, would certainly prove interesting. Finally, our research agenda includes calculating how the increases in the overall tax burden where apportioned during the Wars and ultimately establishing the contribution of high-, middle- and low-income classes to the war effort.

Acknowledgements

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Appendix

1. Income taxes before and after the world wars

Table A1. *Income taxes before and after the world wars*

Period	Number of brackets	Maximum marginal tax rate	Minimum marginal tax rate	Exemption limit
Sweden				
Pre-WWI (1913)	18	6.1 percent	0.4 percent	800
Post-WWI (1919)	18	23.1 percent	3 percent	800
Pre-WWII (1938)	14	36.5 percent	3 percent	810
Post-WWII (1946)	11	68.8 percent	4.5 percent	810
United Kingdom				
Pre-WWI (1913)	3	8.3 percent	3.8 percent	160
Post-WWI (1919)	12	52.5 percent	11.3 percent	130
Pre-WWII (1938)	14	68.7 percent	8.3 percent	125
Post-WWII (1946)	14	97.5 percent	15 percent	120
United States				
Pre-WWI (1914)	6	7 percent	1 percent	3 000
Post-WWI (1919)	54	77 percent	6 percent	1 000
Pre-WWII (1938)	32	79 percent	4 percent	1 000
Post-WWII (1946)	24	94 percent	23 percent	500

Sources: Sweden from Du Rietz et al. (2015), the UK from *Report of the Commissioners...* (several years), and the US from Internal Revenue Service, Historical Tables.

Notes: in the UK, the number of brackets and the top and bottom marginal tax rates are calculated including the super-tax and the reduced rates (as reported in the several volumes of the *Reports of the Commissioners ...*). The same applies to the United States (normal tax and surtax). In Sweden, the last column corresponds to the limit of the filing obligation in the World War I years (but income below this threshold was not exempted for filers). In the World War II years, it shows the basic deduction for taxpayers living in cities of the central group, according to price level. The filing obligation then was at 600kr. Similarly, in the UK, the last column shows the limit of the filing obligation. Income below this threshold became liable to the tax for filers. In the United States, the last column is the requirement for filing for singles, which coincided with the personal exemption; in 1946, the standard deduction is shown.

2. Effect of inflation on average effective tax rates

Table A2. *Average effective tax rates under different inflation scenarios*

Sweden, 1920					
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
60	0.3 percent	0.0 percent	0.0 percent	100 percent	100 percent
75	1.0 percent	0.0 percent	0.0 percent	100 percent	100 percent
90	2.2 percent	0.2 percent	0.3 percent	89 percent	85 percent
95	2.7 percent	0.6 percent	0.7 percent	78 percent	75 percent
100	5.5 percent	3.8 percent	3.9 percent	32 percent	30 percent
Sweden, 1946					
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
25	1.0 percent	0.2 percent	0.5 percent	79 percent	51 percent
50	5.0 percent	3.2 percent	3.9 percent	37 percent	21 percent
75	7.7 percent	6.0 percent	6.6 percent	23 percent	14 percent
90	10.1 percent	8.0 percent	8.8 percent	20 percent	12 percent
95	11.8 percent	9.6 percent	10.4 percent	18 percent	12 percent
100	25.6 percent	21.2 percent	22.9 percent	18 percent	11 percent
UK, 1919					
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
90	1.6 percent	0.0 percent	0.0 percent	100 percent	100 percent
95	4.0 percent	0.0 percent	0.1 percent	100 percent	98 percent
100	25.5 percent	17.3 percent	18.1 percent	34 percent	31 percent
UK, 1949					
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
25	0.6 percent	0.0 percent	0.0 percent	100 percent	100 percent
50	4.0 percent	0.2 percent	1.3 percent	94 percent	67 percent
75	7.5 percent	2.4 percent	4.3 percent	68 percent	43 percent
90	13.1 percent	5.5 percent	7.6 percent	58 percent	42 percent
95	18.1 percent	8.3 percent	11.8 percent	54 percent	35 percent
100	40.3 percent	32.1 percent	35.0 percent	20 percent	13 percent

Table A2. *Continued*

			US, 1919		
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
90	0.2 percent	0.0 percent	0.0 percent	100 percent	100 percent
95	1.7 percent	0.5 percent	0.7 percent	69 percent	60 percent
100	8.1 percent	5.1 percent	5.5 percent	39 percent	34 percent
			US, 1946		
Percentile	Baseline	No inflation	Pre-war inflation	Relative difference No inflation	Relative difference Pre-war inflation
50	7.0 percent	4.4 percent	5.5 percent	37 percent	22 percent
75	11.6 percent	9.0 percent	10.0 percent	22 percent	14 percent
90	14.4 percent	11.8 percent	12.9 percent	19 percent	11 percent
95	15.9 percent	13.5 percent	14.5 percent	15 percent	8 percent
100	33.1 percent	28.3 percent	30.1 percent	15 percent	9 percent

Source: authors' calculations with same data as in table 1. Notes: the table displays the average effective tax rates for several percentiles of the income distribution. The column "baseline" shows the actual average effective tax rates, whereas the next two columns present the average effective tax rates in the absence of inflation ("no inflation") and in a context of pre-war inflation levels ("pre-war inflation"). The column "Relative difference No inflation" calculates the relative difference between the no-inflation scenario and the actual baseline, while the last column "Relative difference Pre-war inflation" presents the same calculations but with the pre-war inflation scenario.

3. Alternative inflation series: Tax progressivity, redistribution and number of taxpayers

Table A3. *Additional taxpayers and income tax revenue brought in by inflation (alternative inflation series)*

Country	Year	Scenario	New taxpayers brought in by inflation		New tax revenue brought in by inflation	
			Absolute number	Percent of total taxpayers	Million current krs/£/$	Percent of total income tax revenue
Sweden	1946	1	385,665	14 percent	695	52 percent
	1946	2	214,487	8 percent	476	36 percent
United	1949[a]	1	9,302,730	67 percent	1,004	82 percent
Kingdom	1949[a]	2	6,424,654	46 percent	833	68 percent
United States	1946	1	4,159,972	10 percent	9,692	52 percent
	1946	2	2,862,748	7 percent	7,622	41 percent

Sources and notes: see table 1. Alternative inflation series are substituted for our preferred inflation series used in table 1: for the US, we use the deflator estimated by Friedman and Schwartz (1982). Even if this deflator is for NNP (and therefore not ideally suited for our purposes), we use it as a top boundary for the period. For Sweden and the UK, we rely on Reinhart and Rogoff (2011)'s price index (compiled by Clioinfra).

Table A4. *Progressivity and redistribution under the alternative scenarios (preferred and alternative inflation series)*

Sweden, 1946

	No inflation (original)	Pre-war inflation (original)	No inflation (alternative)	Pre-war inflation (alternative)
Redistribution	2.62	2.80	2.52	2.73
Progressivity	29.35	28.13	30.24	28.60
Average effective tax rate	8.21	9.04	7.69	8.70

UK, 1949

	No inflation (original)	Pre-war inflation (original)	No inflation (alternative)	Pre-war inflation (alternative)
Redistribution	4.40	5.15	3.43	4.35
Progressivity	48.97	45.38	52.95	49.17
Average effective tax rate	8.24	10.19	6.09	8.13

US, 1946

	No inflation (original)	Pre-war inflation (original)	No inflation (alternative)	Pre-war inflation (alternative)
Redistribution	4.12	4.36	3.91	4.13
Progressivity	29.82	28.63	31.10	29.85
Average effective tax rate	12.15	13.21	11.18	12.15

Notes and sources: see table 3. The indices under the heading "No inflation (original)" and "Pre-war inflation (original)" are calculated based on our preferred inflation series (as reported in table 2). The indices under the headings "No inflation (alternative)" and "Pre-war inflation (alternative)" rely on alternative inflation series. For the latter, see the list of sources in Table A2.