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Income tax progressivity and war inflation during the two World Wars

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Income tax progressivity and war inflation during the two World Wars*

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Abstract

Top marginal rates in income taxes increased significantly during the two World Wars in most Western countries, which points towards increases in their progressivity. We argue, however, that this war-related effect is less clear-cut than previously thought: wartime inflation could have exerted a counteracting impact by pushing citizens into higher tax brackets, including new individuals from the bottom of the income distribution into being taxpayers, and reducing the real value of allowances. We study the impact of wartime inflation by calculating tax revenue, the number of taxpayers, effective tax rates and indices of tax progressivity and redistribution under different inflation scenarios in Sweden, the United Kingdom, and the United States, during World War I and World War II. Our results show that inflation partially counteracted the progressive effect of increases in top marginal tax rates, particularly in Sweden during World War I and in the United Kingdom during World War II. However, the growth in income tax revenue as a result of bracket creep increased its redistributive impact.

Keywords: Taxation, Fiscal redistribution, World Wars, Bracket Creep, Progressivity, Income tax

JEL codes: H23, H24, N42, N44

I Introduction

Major warfare and mass mobilization during the two World Wars have been associated to increasing top rates in income and inheritance taxes in most Western countries. Scheve and Stasavage (2010, 2012, 2016) recently argued that governments tried to compensate the greater battle efforts made by poorer social groups during wartime by taxing the rich. Other authors have emphasised the 'ability to pay' principle and the aim to redistribute income through the income tax system, as well as the enormous fiscal pressure exerted by the military conflicts (e.g., Steinmo, 2003). As a result, many countries extended their income taxes in the war period, notably through increased marginal rates. The outcome of this fiscal policy points towards increases in the progressivity of the income tax systems.

We argue, however, that high inflation during the World Wars heavily influenced the actual operation of income taxes. Inflation reduced the real value of tax thresholds, family allowances and bracket limits. Consequently, purely nominal increases in incomes pushed citizens into higher tax brackets and included new individuals from the bottom of the income distribution into being taxpayers. This phenomenon is known as 'bracket creep', and some calculations with both modern and historical data have shown it to have a regressive effect (e.g. Smith, 2001; Immervoll, 2005). In the same vein, we hypothesise that during the two World Wars the progressive effect of increasing top marginal tax rates was partially compensated by a regressive impact of inflation.

We study the developments in the income taxes in Sweden, the United Kingdom, and the United States during World War I and World War II, which gives us the opportunity to analyse the impact of inflation for both belligerent and neutral countries. We compile and analyse new data on tax rates, the distribution of income, and wartime inflation from tax administrations and statistical agencies. These sources have been previously used by the top incomes literature (Atkinson and Piketty, 2007, and related work), but only for a focus on the top of the income distribution, whereas we look at how taxes affected the whole population. We compare the distributive impacts of the actual operation of the income tax with alternative scenarios that assume low or null levels of inflation during wartime.

This methodological approach allows us to identify the effect exerted by inflation on the progressivity of the tax.

To the best of our knowledge, this is the first attempt to measure the fiscal impact of inflation during the two World Wars. Our results confirm the hypothesis that inflation had regressive effects by contributing to the downwards extension of income taxes to low and middle income taxpayers, and pushing middle incomes to higher income tax brackets. Marginal and effective tax rates would have been significantly lower across the income distribution in the absence of extraordinary price increases. Inflation was thus one important mechanism in the growth of income taxes during the World Wars period, which by the late 1940s already included middle and low incomes. Interestingly, this extension of the income tax also caused its redistributive effects to increase; the growth of income tax revenue due to inflation compensated the corresponding loss of progressivity.

The paper proceeds as follows. Section 2 briefly reviews the literature on progressivity and redistribution during the World Wars period. Section 3 addresses the potential role for inflation, while section 4 presents the data and methodological approach. Section 5 discusses our results, and section 6 concludes.

II Progressivity and redistribution during the two World Wars

The two World Wars fundamentally altered the tax systems of most Western countries. Even if the introduction of income taxes often preceded World War I, tax rates in most countries were initially very low and only surged during the war and in its immediate aftermath, to blow up again in the 1940s. While top rates rarely exceeded 10% before 1913, they were to be found above 60% and 70% in many OECD countries by the end of World War II. The bottom tax rates were often increased as well, but by smaller amounts (Londoño-Vélez, 2014).

That the system became more progressive in this period has been generally accepted in the literature—for example, in the United

¹ In some countries, such as the US, top marginal tax rates increased in the 1930s or the late 1920s, even if they did not reach their peak until the outbreak of World War II.

States World War I gave place to "soak the rich taxation" through progressive income and corporate taxes (Brownlee, 1996), while in the United Kingdom a fragile political equilibrium sought to increase revenue without imposing heavy consumption taxes on the working class (Daunton, 2002). Along these same lines, Sven Steinmo (2003) suggests that the institutionalization of income and corporation taxes during World War I had long-term effects for the development of fiscal policy in advanced countries, since taxes came to be understood as a valid redistributive instrument. As a result, progressive income taxation during the mid-twentieth century has been associated to a decline in income inequality in several Western countries (e.g., Piketty and Saez, 2003, 2007; Piketty, 2014).

Scheve and Stasavage (2016) have argued that very high top marginal tax rates could be imposed during the wars because of the strengh of "compensation arguments" in the midst of unprecedented manpower mobilization. Since younger and/or poorer men were contributing to the war effort by risking their lives in the battlefront, it was only fair that "the rich" funded a significant part of the needed increases in public budgets. This context made strongly progressive taxation politically viable, something which has proven challenging in other circumstances.² Other authors have emphasized revenue considerations as the driving force behind the surge in the top rates: a relatively easy way to raise taxes would be to touch on the ability to pay of the wealthy, who concentrated very significant shares of total income in this period. For example, Witte (1985) writes about the United States during World War I: "As changes in tax provisions were considered, the revenue effects were a continuous element of the debate. This does not mean that the debate neglected the issue of progressivity or that the bill had no influence on the distribution of tax burdens. However, those choices were forced on the political system by the dictates of war, and there is little evidence of an independent interest in redistributing income through the tax system" (Witte, 1985, p. 82).3 A parallel opinion is voiced about the Swedish case by Rodriguez (1981), who states that

² Several authors have also emphasized the political conflict inherent to these social changes that spread reform across the world during the two military conflicts (e.g. Kier, 2010; Obinger and Petersen, 2014; Purseigle, 2014).

³ Relatedly, Gilbert (1970, p. 87) discusses the debate of McAdoo's 1917 plan, underlining that equity considerations were normally thought with respect to future generations or returning soldiers (i.e., in contrasting taxes versus loans).

the main reason for relying on the income tax was its effectiveness in generating revenue increases.⁴

The three countries we analyse in this paper certainly experienced deep changes in their income taxes during both World Wars.⁵ Even if the United Kingdom was one of the pioneers in the implementation of a modern income tax, World War I and World War II played a fundamental role in British fiscal history. The first permanent income tax came into being in 1842 under the leadership of the conservative Prime Minister Robert Peel (Daunton, 2002). Despite of the hostility among MPs, the new tax proved to be more resilient to the political winds that the first modern income tax enacted during the Napoleonic Wars (and repealed soon thereafter). The Finance Act for the year 1909-10 brought about a qualitative change with the establishment of a "super-tax" imposed upon very high incomes (above £ 5,000). The most important changes, however, took place during the two World Wars, when top marginal tax rates soared, the tax base widened, and standard tax rates increased as never before (Broadberry and Howlett, 2005). All together, these wartime changes brought the tax to a prominent position within the British tax system for the decades to come (Steinmo, 1993).

The United States had only implemented a personal income tax in 1913, even if there were numerous precedents: a proposal during the war of 1812, a temporary income tax under the civil war, and the 1894 tax which was soon ruled unconstitutional (Mehrotra, 2013). The 1913 tax was very progressive and narrow in terms of revenue raised, but it was reformed with the Revenue Act of 1916, increasing the tax rates on the upper classes and reducing the exemption thresholds. Similar developments took place during the second War, after some tax reductions during the 1920s and new increases brought about by the New Deal. The 1941 and 1942 regulation again reduced personal

⁴ "The state's increased revenue needs – mainly for defense purposes – explain the majority of the tax expansion. Even a tax distribution issue such as the transition to progressive taxation was purely motivated by financial considerations. Progressivity became necessary mainly because it was the best way to generate new public incomes" (authors' translation of "Statens ökande behov at inkomster – huvusakligen för försvarsändamål – förklarar den största delen av skatteexpansionen. Till och med ett skattefördelningsproblem som övergången till den progressiva beskattningen motiveras av rent finansiella hänsyn. Progressiviteten blev nödvändig huvudsakligen därför att det var den bästa möjligheten att skaffa nya offentliga inkomster"; Rodriguez, 1981, p. 26).

⁵ Other taxes were affected by this wave of reforms too, for example on estates and corporate profits, especially "excess profits". The excess profits duty contributed to more than one-quarter of total government revenue in the United States during the war period (Steinmo, 1993).

exemptions and increased marginal rates, together with reinforcement in the taxation of profits. The burden was now to be extended also to the middle classes, in order to both meet the revenue needs and reduce purchasing power, thus working against inflationary trends (Brownlee, 1996). The predominance of the income tax also became a stable trait in the American tax system, which Wallis (2000) relates to new spending responsibilities and the growth of the federal share of public finances, given administrative advantages.

Even in a non-belligerent country like Sweden, income taxes rose significantly during the wars due to renewed military efforts. The Swedish income tax dated from 1902, and its progressivity had been reinforced in 1910 with the inclusion of a wealth imputation in the tax base (Stenkula, Johansson and Du Rietz, 2014; Henrekson and Stenkula, 2015). Wartimes brought about the enactment of temporary tax increases, some of which were made permanent in the aftermath of the wars (1920, 1948). The marginal tax rate for low-income earners at the end of World War II almost tripled compared to the pre-war levels, while the rates for high-income earners more than tripled in the same time span (Du Rietz, Johansson, and Stenkula 2015). The impact of the wars was, nevertheless, more moderate than in the United Kingdom or the United States, and marginal rates did not increase as much as in belligerent countries (Steinmo, 1993).

Figure 1 reflects some of these changes by displaying the spread in marginal income tax rates in the three countries from ca. 1900 to ca. 1960. As mentioned above, the two World Wars pushed the top marginal rates up to unprecedented levels, climbing above 90% in the United Kingdom and the United States during World War II. Similar raises were only experienced during the 1930s in the United States (and to a lesser extent in Sweden and the United Kingdom), which reflects the exceptional nature of such war-related transformations. Bottom marginal tax rates also increased during the two military conflicts, particularly in the United Kingdom and the United States in the 1940s, but the distance between top and bottom rates did nothing but increase in the aftermath of the period.

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

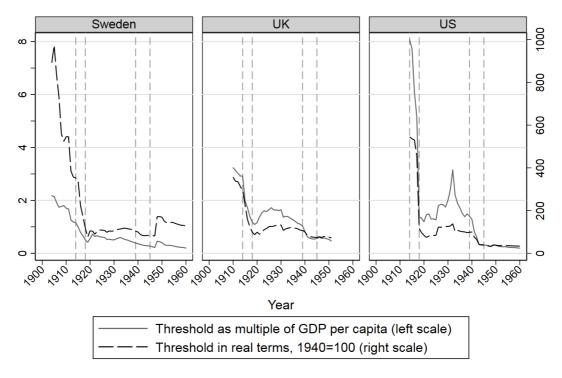
UK US Sweden 80 Marginal tax rate 9 40 20 10/0 1930 1950 1920 ,960 ,910° 1960, 1960 Year Top **Bottom**

Figure 1. Top and bottom marginal tax rates (1900-1960)

Sources: Sweden from Du Rietz et al. (2015), UK from *Report of the Commissioners*... and US from Internal Revenue Service, Historical Tables, table 23.

The two World Wars did not only have an impact on the marginal tax rates, but also affected profoundly the exemption limits. Figure 2 illustrates this phenomenon: the threshold in the United States, which represented approximately eight times the GDP per capita in 1914, diminished to barely 1.2 times in 1920. Even if 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. The exemption limits in Sweden and the United States diminished about 80% during World War I, while the reduction in the United Kingdom amounted to near 30%. As a result, Whiting (1990) argues that manual workers in the UK became the majority of new taxpayers in 1918-19. The erosion of the exemption limits was less pronounced during World War II, but it brought the thresholds down to the lowest levels of the period. As Sven Steinmo put it, what once was a "class tax" had been transformed in a few years into a "mass tax" (Steinmo, 2003).

Figure 2. Thresholds as percentage of GDP per capita and in real terms (1900-1960)



Sources: Sweden from Du Rietz et al. (2015), UK from *Report of the Commissioners*... and US from Internal Revenue Service, Historical Tables, table 23.

Note: in Sweden, since 1920 the basic allowance differed depending on the type of city the taxpayer lived in (to take into account differences in costs of living); we have depicted here the levels of *ortsgrupp III*, the intermediate one. This can be thought as representative, even if for 1920 it lies somewhat above the weighted average for taxpayers which we calculate for our simulation (using the distribution of taxpayers across city groups). These allowances also varied by income levels.

III A role for inflation?

The transition from a "class tax" to a "mass tax" was not solely the result of legislative changes. Higher prices translated into higher nominal wages, which pushed citizens into higher tax brackets, or directly included new individuals from the bottom of the income distribution into being taxpayers (the phenomenon known as 'bracket creep'). Hence, some citizens with low earnings started paying income taxes even when their purchasing power in real terms did not increase. Additionally, inflation reduced the real value of family allowances. The Labour MP Vernon Hartshorn put it very clear 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, 907).

Price increases were indeed acute during the two World Wars (see Figure 3). In World War I they attained very high levels, with an annual average of nearly 10% in the US and 14% in the United Kingdom for the period of 1914-19. Non-belligerent countries like Sweden also experienced high rates of inflation (19% in the same period). During World War II rates were not as extreme because of a different economic management (Broadberry and Howlett, 1998), but they still were situated around 4-5% yearly in our sample of countries, clearly above pre-war levels. Hence, price increases were a non-negligible part of the growth in nominal incomes above what has been the standard in the more recent decades, but with some parallel to the 1970s—, and arguably contributed to bring low-income households into paying the income tax and middle-income households into paying higher rates.

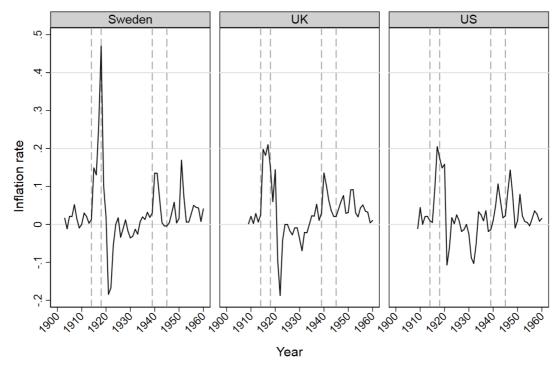


Figure 3. Yearly inflation rate (1900-1960)

Sources: Sweden from Statistics Sweden, US and UK from Measuring Worth.

In this paper we calculate the impact of inflation on the distribution of the income tax payments. Effects will take place through various channels, as inflation reduces the real value of several elements of the tax which were established in nominal terms: exemption thresholds, family allowances, and bracket limits. Reductions in the first two will push previously excluded individuals into being taxpayers, thus directly increasing the tax burden for those affected (which might be found at the top, the middle, or the bottom of the income distribution, depending on the point of departure). Allowances were deducted from gross income in order to obtain taxable income, so their effect is equivalent to that of the exemption threshold except when they were restricted to incomes below a given level, in which case their reduction will be more regressive (this was so in the UK and Sweden during World War I). Finally, the reduction in the real value of bracket limits will push taxpayers into facing higher rates (given increases in their nominal incomes), thus affecting as well those who were already paying the tax.⁷

The impact of these changes on progressivity is not clear-cut, since it depends on the income tax structure in terms of bracket thresholds and rates. On the one hand, higher taxes could fall upon low and middle incomes, which would point towards lower levels of progressivity. But, in combination with a skewed distribution of tax brackets towards the upper side of the income distribution, inflation could also increase more strongly the payments made by those with high incomes; this effect is however limited by the fact that the superrich at the top bracket do not face such potential increases.

We expect the regressive effects to prevail based on the results of previous literature on other contexts with both modern and historical data. 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 the context of an unchanged tax rate schedule. In this regard, the Australian Committee of Inquiry into Inflation and Taxation lamented in 1975 that "inflation results in a violation of legislated horizontal and vertical equity prescriptions... it is unlikely that the personal tax redistributions caused by inflation are those intended or preferred by society" (quoted in Smith, 2001, p. 274).

⁷ We take gross incomes 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.

Immervoll (2005) reaches similar conclusions when simulating a range of inflation scenarios for Germany, the Netherlands and the United Kingdom based on a multi-country tax-benefit model for a baseline year (1998). Even if the inflation-induced erosion of certain deductions might affect high-income taxpayers, the overall impact appears to be clearly regressive (mainly due to the erosion of tax-bracket limits and the ensuing effect of pushing low-income tax units who did not pay taxes before inflation—into paying the tax).

Bracket creep will also potentially have an impact on the redistributive effects of the income tax, i.e. on the difference between before and after-tax Gini coefficients. For instance, Steiner and Haan (2004) find that the German fiscal reform of 2000 would have exerted a lower negative redistributive impact if the government had adjusted the income tax for bracket creep; similarly Immervoll (2005) concludes that the growth in the size of the tax after inflation in his sample of countries was large enough to offset the aforementioned regressive tax effect. Even if inflation reduces the progressivity of the income tax, the growth in the size of the tax increases its overall redistributive impact.

In the light of these previous studies, we hypothesise that during the two World Wars inflation had a regressive 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 lower real exemption limits and higher effective tax rates for low and middle income groups, reinforcing regulatory changes in the same direction. Even if we do not dispute the overall progressive impact of the normative changes affecting the top of the distribution, we argue that the often overlooked effect of inflation needs to be taken into account in order to assess the real impact of wartime fiscal policies. The fiscal history of the two World Wars has already acknowledged the impact of inflation on the tax systems; for instance, Broadberry and Howlett (1998, 2005) mention its role in expanding the British number of taxpayers during the two World Wars, while Brownlee (1996, p. 147) alludes to wartime inflation as one of the factors leading to increases in effective tax rates in the United States during the 1940s.8 To the best of our knowledge,

⁸ "Income tax revenue was boosted by raising the rate of tax and by pulling more people into the tax net, either directly by lowering the exemption limit or indirectly via inflation" (Broadberry and Howlett, 2005,

however, the topic has not yet been approached empirically, nor with consideration of the impacts of inflation on progressivity and redistribution.

IV Data and methods

We study the operation of the income tax in three Western countries, two involved in the World Wars (United Kingdom and United States) and one neutral (Sweden). We quantify the consequences of bracket creep in terms of the additional number of taxpayers and revenue brought into the tax system, differentiating the shares paid by new and old taxpayers in this additional revenue. We additionally decompose the results by isolating the impact of inflation from the impact of legislative changes. Finally, we calculate the effective tax rates by percentiles of the income distribution and synthetic measures of tax progressivity and redistribution under different inflation scenarios.

We follow the methodology developed by Torregrosa-Hetland and Sabaté (2019) to calculate effective tax rates by percentiles of the income distribution based on the tax statistics compiled by tax administrations and statistical agencies. The original data provide us with the distributions of taxpayers, reported income and tax paid for selected years. This information is grouped by specific income levels that generally do not coincide with those of the brackets in the tax schedules, and also change over the years. In order to make calculations comparable across countries and over time we adapt these numbers to a permille distribution following the method and software provided by Blanchet et al. (2017). The resulting synthetic sample is consistent in mean and distribution with the original grouped information.

Once the synthetic sample has been generated, we estimate the tax payments and effective tax rates corresponding to each permille, following Piketty (2001, annex B.3) in micro-simulating the tax regulations. To do so we first deduct family allowances (basic deductions for the taxpayer, and his spouse and children when

p. 217). The chapter on World War II also mentions the inflation mechanism when referring to the extension of the British income tax in 1940-41.

present) from gross income, thus obtaining taxable income. Since these allowances depend on the family circumstances, we generate eight synthetic taxpayers for each income permille: singles and couples with zero, one, two, or three children. After this, we apply the corresponding marginal tax rates to each synthetic taxpayer type. When we have obtained the tax due paid by each of them, we calculate the tax due for each permille as a weighted average (using the distribution over family types). Average effective tax rates are then obtained by dividing the tax due over gross income.⁹

With this information we can calculate progressivity and redistribution indices using the 'progres' stata module developed by Peichl and van Kerm (2007). For progressivity we use the Kakwani index, 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 o 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):

$$RS = G_Y - G_{YT} \tag{2}$$

A tax is redistributive if RS > 0.

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

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

⁹ The methodology is described in greater detail in the methodological appendix of Torregrosa-Hetland and Sabaté (2019), where we also go through some country-specific calculations. This document is available in the authors' webpages.

where RR is the effect of re-ranking between tax units. Redistribution by the income tax is thus positively affected both by progressivity (K) and the average effective tax rate (aetr).

We estimate the aforementioned effective tax rates and indices of progressivity and redistribution for the first post-war year where data is available. 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), whereas scenario 2 considers what would have happened if yearly inflation during wartimes would have been situated at the level of its average in the five preceding years (1909-13 and 1934-38 respectively). These two scenarios allow us to estimate the tax that each permille of the income distribution would have paid if we took out purely nominal growth in incomes.

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:

$$PD_{-}WWI_{t} = PD_{-}WWI_{t-1} * (I_{t} + 1)$$

$$PD_{-}WWII_{t} = PD_{-}WWII_{t-1} * (I_{t} + 1)$$
(4)

where *PD_WWIt* stands for "price deflator for World War I" at time t, *PD_WWIt-1* represents the same deflator at time t-1, and *It* stands for inflation at time t, with *PD_WWI1913* equal to 1 (the same applies to *PD_WWIIt*, with *PD_WWI11938* equal to 1). We then use this price index to adjust nominal incomes to their 1913 values:

$$RGI_t = GI_t/PD_WWI_t (6)$$

$$RGI_t = GI_t/PD_WWII_t (7)$$

¹⁰ We use 1919 for World War I in the United Kingdom and the United States, but 1920 for Sweden. Regarding World War II, 1946 for Sweden and the United States but 1949 in the United Kingdom. In this last case, similar data was available in 1948, but we deem the 1949 benchmark more reliable due to the *Survey of Personal Incomes* conducted that year. Additionally, Scott and Walker (2018) provide some corrections to the original income distribution based on posterior official sources which improve the overall accuracy of the exercise.

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":

$$EPD_{-}WWI_{t} = EPD_{-}WWI_{t-1} * (I_{t} - PWWI + 1)$$

$$EPD_{-}WWII_{t} = EPD_{-}WWII_{t-1} * (I_{t} - PWWII + 1)$$
(8)

where *EPD_WWIt* stands for "excess price deflator for World War I" at time t, *EPD_WWIt-1* represents the same deflator at time t-1, *It* stands for inflation at time t, and *PWWI* reflects the average pre-war inflation (1909-1913), with *EPD_WWI1913* equal to 1. The same applies to equation (9), with the pre-war inflation based on the period 1934-1938 and *EPD_WWII1938* equal to 1.

V Results

Effects on number of taxpayers and income tax revenue

Inflation was a powerful mechanism for the downward extension of the tax. Our calculations show that, in 1919, 28.2% of US taxpayers would not have come into the rolls in absence of inflation (see Table 1). The corresponding number for 1946 is 6.9%, which amounts to 3.1 million new taxpayers, versus 1.25 in World War I. The incorporation of new taxpayers, together with bracket creeping, had a significant impact on revenue. In 1919, as much as 66% of the total income tax revenue can be attributed to the effect of cumulative inflation since 1913. At the end of World War II, in 1946, the corresponding figure is 42% (referring to cumulative inflation since 1938). 11 Similarly, 66% of Swedish taxpayers in 1920 fell under the income tax due to the bracket creep (accounting for about 988,000 additional taxpayers), while the impact of inflation on revenue summed 82%. These impacts were considerably lower during World War II, with 5% of additional taxpayers (155,000) and 44% of revenue. In the United Kingdom, our data for 1949 point to 33 percent of taxpayers brought in by inflation,

¹¹ In our second scenario, if the point of comparison is the pre-war inflation level, the numbers would be 61 and 28% respectively.

and an effect on revenue of 68% but in this case we are three years further from the pre-war point of reference because of data availability. In all these senses, the effects of inflation on the income tax were far from negligible.¹²

Table 1. Additional taxpayers and income tax revenue brought in by inflation

	Year	Scenario	Inflation taxpayers		Inflation tax revenue	
Country			Absolute number	Percent	Absolute number	Percent
	1920	1	988,185	65.8%	175	82%
Couradan	1920	2	910,252	60.7%	171	81%
Sweden	1946	1	155,447	5.1%	584	44%
	1946	2	81,425	2.7%	389	29%
United Kingdom	1919	1	6,568,778	84.2%	220	69%
	1919	2	6,545,064	82.4%	209	66%
	1949a	1	6,656,300	32.6%	873	68%
	1949a	2	3,626,000	17.8%	640	50%
United States	1919	1	1,253,981	28.2%	763	66%
	1919	2	1,051,726	23.6%	698	60%
	1946	1	3,126,841	6.9%	8 620	42%
	1946	2	1,769,910	3.9%	5 620	27%

Source: authors' calculations with tax data from Taxeringen till inkomst..., Skattetaxeringarna..., Report of the Commissioners..., Statistics of Income...; inflation from Measuring Worth and Statistics Sweden; and total income controls from Atkinson (2007), Piketty and Saez (2007b), and Roine and Waldenström (2010).

Notes: inflation tax revenue is given in millions of current krs / \$ / \$. a) The inflation tax revenue brought in by the bracket creep is calculated taking into account the original income tax due reported in the original sources (Inland Revenue, 1952), whereas the number of inflation taxpayers uses the extension provided by Scott and Walker (2018).

At the same time as inflation was making nominal incomes soar, the three countries enacted tax reforms meant to increase revenue. How important was the impact of the legislative changes compared to that of inflation? We should start by saying that both elements reinforced each other. The effect of inflation was bigger under the new legislation than it would have been if the states had kept the regulations from 1913; increased marginal tax rates and a higher

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 $^{^{12}}$ If we consider total tax revenue as a reference (and not just income tax revenue), the additional tax revenue brought in by inflation represented 14% in the US, around 10% in Sweden, and around 15% in the UK, in all cases at similar levels in both wars. These numbers correspond to scenario 2, that with "normal inflation".

number of tax brackets intensified the impact that bracket creep had on the revenue collected through the income tax. Similarly, the revenue effect of, for example, reducing the exemption limit, was higher when combined with generalized income growth pushed by war inflation.

Having this in mind, we have estimated the impact of the legislative changes by calculating how much the income tax would have risen in each country if the pre-war regulations had been kept in place (1913 and 1938 respectively for the two wars). The difference with the actual personal income tax revenue, expressed as a percentage of the latter, gives us the effect of legislative change. This effect is estimated leaving other aspects unchanged, and thus includes extraordinary inflation: in other words, the impacts of inflation and legislative change are not the result of decomposing the overall effects of the two wars (and therefore sum more than 100 percent).

In most cases the revenue effects of tax reform were higher than those of inflation: in the US wartime legislative changes accounted for 94% of the total income tax revenue in 1919 and 82% in 1946, which clearly exceeded the corresponding 66% and 43% associated with bracket creep. 61% in Sweden in 1946 and 80% in UK in 1919 also stand out as particularly relevant effects. Sweden in 1920 was an exception, since inflation attained extraordinary levels and the tax reform included increased personal and family allowances: here, without regulation changes the income tax revenue would have been 36% lower (versus 81% if inflation was taken out), which is nonetheless very significant.

We can also go one step further: apart from identifying how important bracket creep was in general terms, we can explore who paid this inflation-related income tax revenue. Was the majority of the additional tax paid by the new taxpayers, who wouldn't have paid anything in the absence of (extraordinary) inflation? Or was it mostly those who already were on the rolls? And which percentiles of the income distribution were bearing most of the cost? The answer to these questions can be seen in table 2. The majority of this inflation-related revenue (always over 90%) was borne by those who were already paying the tax before, and who saw their tax dues increase due to bracket creep. The episodes where new taxpayers paid the highest share are found in the United Kingdom and Sweden in World War I, when a huge downward extension of the tax took place.

The opposite case is found in Sweden during World War II, when the new taxpayers were almost completely exempted from paying the tax due to the operation of allowances. In any case, and unsurprisingly given the progressive tax schedules in place, most of the increase in absolute tax revenue (due to inflation) fell on the top percentiles of the population. This effect was particularly acute in the United States during World War I, when the income tax was mostly paid by the highest incomes (see below, and also Torregrosa-Hetland and Sabaté, 2019). The rich paid the majority of this "inflation tax", even if for the lower-middle incomes the proportional change in tax rates—and the qualitative change of becoming taxpayers—were undoubtedly meaningful.

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

Country	Year	Scenario	Inflation taxpayers	Rest of taxpayers	Top 10%	Top 1%
	1920	1	11.07	88.93	79.6	49.7
Sweden	1920	2	8.63	91.37	79.3	49.4
Sweden	1946	1	0.07	99.93	56.7	27.0
	1946	2	0.02	99.98	56.5	26.6
	1919	1	8.94	91.06	95.4	74.6
United	1919	2	8.54	91.46	95.2	74.0
Kingdom	1949	1	2.92	97.08	64.0	31.3
	1949	2	0.98	99.02	62.0	30.3
	1919	1	1.32	98.68	99.9	78.8
United	1919	2	0.97	99.03	99.9	78.6
States	1946	1	0.27	99.73	54.4	30.6
	1946	2	0.13	99.87	54.0	30.5

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

Notes: quantiles are defined over the whole population of tax units (not only taxpayers). The taxpayer groups are defined in permilles. "Inflation taxpayers" refers to taxpayers that would not have paid income tax in the absence of inflation (scenario 1) or above pre-war average inflation (scenario 2).

Distribution of the income tax burden

In this section we discuss the impact of inflation on the distribution of the tax burden. To do so we look at the effective tax rates by percentiles of the income distribution and the aforementioned indices of progressivity and redistribution under the two inflation scenarios. We compare these estimations with the actual operation of income taxes to isolate the impact of nominal prices. The results of the actual operation of income taxes ("baseline" estimation) come from Torregrosa-Hetland and Sabaté (2019).

Table 3 displays the average effective tax rates under the three alternatives. The baseline estimation shows how top marginal 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 US (moving from 9.1% to 37.7% in the highest percentile). Top effective tax rates attained the highest level in the UK in 1949 (41.2%), although the World War I levels were already above those of Sweden and the US (26.1% in the UK compared to 5.7% in Sweden and 9.1% in the US). The income tax also expanded downwards along the income distribution, with percentile 25 falling under the income tax system in the three countries after World War II. Effective tax rates, however, remained fairly low for low and middle incomes even in the aftermath of the military conflicts.

The deflated scenarios confirm our expectations: the two of them 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 tax rate imposed upon the top percentile in the United States would have been 15% lower in the absence of inflation during World War II, whereas the relative difference found in the median of the income distribution reached 35%. These results tell us, first of all, that inflation pushed the overall effect of the tax system up, since tax rates in the absence of nominal price growth would have been lower across the board. Secondly, low and middle incomes were more severely hit by the inflation-related growth of the income tax system than the highest incomes. Even if 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.

¹³ It should be noted that, in the case of Sweden, additional income taxes enacted during the war were in effect in 1919 but not longer in 1920, so these estimates do not represent the maximum progressivity reached in wartime.

Table 3. The impact of inflation on average effective tax rates

Sweden, 1920							
Percentile	Baseline	No	Pre-war	Rel. Diff.	Rel. Diff.		
		inflation	inflation	No inflation	Pre-war inflation		
60	0.3%	0.0%	0.0%	100%	100%		
75	1.0%	0.0%	0.0%	100%	100%		
90	2.2%	0.3%	0.3%	88%	85%		
95	2.7%	0.6%	0.7%	78%	75%		
100	5.7%	3.8%	3.9%	31%	30%		
			Sweden, 1946	•	l		
D (21	D 1:	No	Pre-war	Rel. Diff.	Rel. Diff.		
Percentile	Baseline	inflation	inflation	No inflation	Pre-war inflation		
25	1.0%	0.2%	0.5%	79%	51%		
50	5.0%	3.2%	3.9%	37%	21%		
75	7.7%	6.0%	6.6%	23%	14%		
90	10.1%	8.0%	8.8%	20%	12%		
95	11.8%	9.6%	10.4%	18%	12%		
100	25.7%	21.4%	23.1%	17%	10%		
			UK, 1919				
Percentile	Baseline	No	Pre-war	Rel. Diff.	Rel. Diff.		
		inflation	inflation	No inflation	Pre-war inflation		
75	0.7%	0.0%	0.0%	100%	100%		
90	2.4%	0.0%	0.0%	100%	100%		
95	4.8%	0.7%	0.8%	85%	83%		
100	26.1%	17.6%	18.6%	33%	29%		
			UK, 1949				
Percentile	Baseline	No	Pre-war	Rel. Diff.	Rel. Diff.		
Percentile		inflation	inflation	No inflation	Pre-war inflation		
25	0.6%	0.0%	0.0%	100%	100%		
50	4.3%	0.2%	1.3%	95%	70%		
75	8.8%	2.3%	4.6%	74%	48%		
90	14.5%	6.2%	8.9%	57.2%	38.6%		
95	19.8%	9.8%	13.3%	50.5%	32.8%		
100	41.2%	33.4%	36.2%	19%	12%		
US, 1919							
Percentile	Baseline	No	Pre-war	Rel. Diff.	Rel. Diff.		
rercentile	Daseille	inflation	inflation	No inflation	Pre-war inflation		
90	0.2%	0.0%	0.0%	100%	100%		
95	1.6%	0.5%	0.6%	70%	62%		
100	9.1%	5.7%	6.1%	37%	33%		
US, 1946							
Percentile	Baseline	No	Pre-war	Rel. Diff.	Rel. Diff.		
1 ercennie		inflation	inflation	No inflation	Pre-war inflation		
25	0.8%	0.0%	0.0%	100%	100%		
50	7.8%	5.1%	6.2%	35%	20%		

75	12.9%	9.7%	11.0%	25%	15%
90	16.2%	13.1%	14.4%	19%	11%
95	17.8%	15.1%	16.2%	15%	9%
100	37.7%	32.2%	34.3%	15%	9%

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

The corresponding estimated indices of progressivity and redistribution under the three aforementioned scenarios can be seen in Table 4. In line with our previous results—which pointed towards a regressive impact of inflation—the Kakwani index increases in the two alternative scenarios compared to the actual operation of the tax. The effect is particularly relevant in Sweden during World War I, with 19% progressivity loss in the baseline compared to the alternative scenarios, and in the United Kingdom for World War II inflation (21 and 14% with respect to 'no inflation' and 'pre-war inflation' respectively). 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 relatively high exemption limits, which constrained the regressive effect exerted by inflationary pressures.

Table 4. Progressivity and redistribution under the alternative scenarios

Sweden, 1920							
	Baseline	No inflation	Pre-war inflation				
Redistribution	0.86	0.50	0.52				
Progressivity	30.75	38.06	37.81				
Average effective tax rate	2.72	1.31	1.36				
Sweden, 1946							
	Baseline	No inflation	Pre-war inflation				
Redistribution	2.83	2.43	2.58				
Progressivity	24.17	26.94	25.73				
Average effective tax rate	10.48	8.28	9.13				
UK, 1919							
	Baseline	No inflation	Pre-war inflation				
Redistribution	5.18	3.45	3.60				
Progressivity	54.90	56.76	56.72				
Average effective tax rate	8.63	5.72	5.96				
UK, 1949							
	Baseline	No inflation	Pre-war inflation				
Redistribution	6.71	4.63	5.42				
Progressivity	38.63	48.89	45.09				
Average effective tax rate	14.79	8.64	10.73				
	US, 1919	ı					
	Baseline	No inflation	Pre-war inflation				
Redistribution	1.76	1.08	1.16				
Progressivity	68.84	69.49	69.40				
Average effective tax rate	2.49	1.53	1.64				
US, 1946							
	Baseline	No inflation	Pre-war inflation				
Redistribution	4.82	4.23	4.48				
Progressivity	23.68	26.67	25.40				
Average effective tax rate	16.92	13.70	14.98				

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.

Interestingly, the Reynolds-Smolensky index shows how the impact on redistribution was actually positive, since the increase in the average effective tax rate overcame the loss of progressivity. For instance, the US income tax reduced inequality by a modest amount in 1919 below 2 Gini points , and no less than 39% of this effect was caused by accumulated inflation since 1913. By 1946, the tax had become much more redistributive, reducing inequality in near 5 Gini points, of which 14% were the result of accumulated inflation since

1938. The mechanism in play is the increase of tax revenue, which places more income into the redistributive channel.¹⁴

All in all, we have shown inflation to have ample effects on both the low/middle- and high-income segments of the population. The better off faced increasing rates, partly due to bracket creep, and assumed most of the income tax burden brought in by wartime inflation. Growth in revenue led to reinforced redistribution, both directly through the income tax (as net incomes were increasingly made more equal than gross incomes), and indirectly through the potential effects of social spending, which became more feasible to fund after the war.

The low-middle classes paid a small share of the income tax revenue during the world wars, but they experienced the very significant qualitative change of becoming taxpayers (in this tax!). In this way, their tax burden increased relatively more. The importance of this episode of downward extension of the income tax, and the contribution of inflation to it, also lies in administrative considerations: these taxpayers were already incorporated into the fiscal net for later periods, when they would be asked to shoulder greater burdens.

VI Conclusions

Major warfare and mass mobilization during the two World Wars were associated to increasing top rates in income taxes in most Western countries, which points towards increases in the progressivity of the tax systems. We argue that this war-related effect is less clear-cut than previously thought, as wartime inflation exerted a counteracting impact by pushing citizens into higher tax brackets or including new individuals from the bottom of the income distribution into being taxpayers. In order to address this hypothesis, we study the operation of the income taxes in three countries, two of them involved during World War I and World War II and one neutral: Sweden, the United Kingdom, and the United States. We do so by compiling and analysing new data on tax rates, the distribution

¹⁴ The conceptual distinction between 'progressivity' and 'redistribution' is an important one to keep in mind. Recall the definitions in page 9.

of income, and wartime inflation, based on the original tax statistics compiled by tax administrations and statistical agencies.

Our results show that inflation partially compensated the progressive effect of increases in top marginal tax rates, by reducing the real value of the thresholds, family allowances, and bracket limits in place. The exemption limits were in this way made less restrictive over time (often reinforcing legislative reforms in the same direction), which caused a substantial expansion in the number of taxpayers. As a result, citizens previously relieved from taxation owing to their low incomes started paying the tax. On the other hand, inflation also pushed middle incomes to higher income tax brackets, even without real increases in their purchasing power. According to our estimates, tax rates would have been significantly lower across the whole distribution of income but particularly for low and middle incomes if inflation during the wars had been at similar levels than in the pre-war years. These two effects shifted the burden of the income tax from the very top of the income distribution to a broader segment of the population which, by the end of World War II, included middle and low incomes. Consequently, inflation is found to have exerted a negative impact on the progressivity of the income tax. Interestingly, though, it had the opposite effect on redistribution, due to the extension of revenues that it entailed.

Bracket creeping had allegedly other long-term indirect effects: as new taxpayers were brought into the income tax system, the states gained the administrative capacity to extract public revenue from most of their populations (including the large segments of low and middle incomes). Similarly, the highest effective tax rates resulting from the combination of wartime inflation and legislative changes gave governments the opportunity to maintain an unprecedented level of fiscal revenue by historical standards. Even if progressive taxation was attenuated soon after the end of the two military conflicts (e.g., the top marginal rate in the United States decreased significantly during the 1920s), the two World Wars expanded the scale and scope of the income tax irreversibly. As has been already described elsewhere (e.g., Peacock and Wiseman, 1961; Rasler and Thompson, 1985; Sabaté, 2016), the ensuing public revenues did not return to pre-war levels in the aftermath of the two military conflicts.

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 took these effects into account 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, as mentioned above, a great deal of research explains the fiscal reforms of the two World Wars as based on the governments' need to compensate the war efforts of the poorer social groups by taxing the rich, but this literature has been mostly based on the evolution of marginal tax rates, and especially at the top. Our research agenda includes calculating how the increases in the overall tax burden where apportioned during wartime, and therefore ultimately establish the contribution of high, middle and low income classes to the war effort.

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