The Great Leveler According to HANK

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Abstract

Using historical data on income and wealth, we establish systematic patterns showing that war significantly reduces inequality. War persistently reduces the top-1% income share by 30% and the top-1% wealth share by 10%. It also destroys capital, reducing the capital-income share by approximately 25%. All else equal, the decline in the capital share explains, at most, half of the drop in the top income share. Therefore, we develop a Heterogeneous Agent New Keynesian (HANK) model, which endogenizes the decline in the capital share, incorporates multiple sources of capital income, and can match the empirical decline in inequality.

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JEL-Codes: F40, F50, E50

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To a large extent, it was the chaos of war, with its attendant economic and political shocks, that reduced inequality in the twentieth century. Thomas Piketty (2014)

1 Introduction

Do wars equalize the distribution of income and wealth in societies? In seminal work, Scheidel (2018) argues that war is the "Great Leveler", which has equalized society in advanced economies over the course of the 20th century. However, recent contributions challenge this view, favoring peaceful forces as the drivers of wealth equalization (Waldenström, 2024). In this paper, we adopt a macroeconomic perspective and make two contributions. First, we study systematically how both wealth and income inequality change in response to wars. Second, we calibrate the New Keynesian Heterogeneous Agent (HANK) model to match key features of the data and develop a structural account of the economic forces driving this response.

Our empirical analysis is based on granular historical data on income, wealth, and the drivers of their distribution, such as taxation and wartime destruction. Focusing on advanced economies, we find that large wars reduce the top 1% income share by up to 30% relative to its initial level, with this effect being persistent. On the other hand, the top 1% wealth share declines by 10%. Second, we find the effects are more pronounced in war-site economies compared to belligerent countries that were spared from fighting on their own soil. This suggests that physical destruction—a salient feature of war—is indeed crucial to understanding its distributional consequences.

Consistent with this, we find that during wars, capital income falls relative to labor income. Yet a simple accounting exercise in the spirit of Meade (1964) shows that the drop in the capital-income share accounts for, at most, half of the drop in the top income share. In light of this, we revisit the issue in the HANK model, calibrated to capture the dynamic adjustment of key variables in response to the war. The model allows us to endogenize the drop in the capital-income share in response to a "capital-depreciation shock". It turns out that the model can fully account for the decline in top incomes because it features pure rents or "firm profits" as well as the return on capital as distinct sources of capital income. It predicts, in particular, that firm profits—which account for a disproportionally large share of capital income at the top—drop strongly. To externally validate the model, we collect new data and show that indeed firm profits fall during and after wars: War is bad for business.

To study the impact of war on inequality, we assemble a new long-run macroeconomic dataset for what are today's advanced economies, building on the research program that has constructed data on inequality for a number of countries (Piketty, 2014). Our main focus are war sites, countries experiencing significant warfare on their territory, as defined in Federle et al. (2024). These countries experience fundamentally different economic shocks and also, as we show, outcomes for inequality. We add other series that illuminate the forces shaping income and wealth distribution over time. Here, we follow the historical literature which identifies destruction, taxation, and inflation as key drivers of wartime leveling (Scheidel, 2018). War destroys capital, and we gather data on both the amount and, in some cases, the distribution of capital destroyed in the wars we study. An alternative indicator for the situation of capitalists during wars—less prone to the challenges of directly measuring capital destruction—is the capital share, which we source from Bengtsson and Waldenström (2018). We further collect data on top marginal tax rates to account for the wartime rise in tax progressivity, as well as inflation rates and the capital stock.

We trace out the consequences of wars over a 15 year period after the start of the war, using standard macroeconometric techniques, interpreting wars as shocks in a panel local projection setting. In a first step, we quantify the effects of wars on inequality, measured by the share of total income or wealth of the top 1 percent. We find large leveling effects for *income* inequality. Relative to pre-war trends, the top percentile income share drops dramatically by up to 30%. This effect is long-lasting and persists well after the end of the war. In contrast, for *wealth* inequality, we find a decline of the top percentile share by only up to to 10%.

War is a shock with several economic dimensions. First and foremost, it destroys physical capital. Directly observable measures suggest that around 10% of the capital stock is actually destroyed in war. However, we find that, over time, the capital stock declines by about 25% for the average war site. Taken together this suggests that war also depresses investment. The capital-income share also falls sharply in wars, by a roughly similar proportion in the medium run. The rise in progressive taxation amounts to an increase of the top marginal tax rate of up to 50%. Finally, war has an important and long-lasting inflationary effect, such that the price level rises by around 100% at the 10 year horizon.

The distributional consequences of war have not only been noted in countries that are war sites themselves, but also in countries that engage in large scale warfare on foreign soil, most prominently the U.S. (Goldin and Margo, 1992).

We investigate those countries separately and find that income inequality also drops, but by much less than in war sites, suggesting that destruction is a key feature of the wartime leveling process. One dimension in which war sites and non-sites look similar is that both experience an important and long-lasting increase in tax progressivity, that is even similar in terms of size.

In a first attempt to rationalize our findings, we develop a simple accounting framework that takes the drop in the capital-income share as given and quantifies—all else equal—its impact on income and wealth inequality. As before we focus on the top shares, that is, income and wealth in the top percentile of the distribution. The direct effect of the drop in the capital-income share on the wealth distribution simply depends on composition of income and wealth. Importantly, we show that historically, the top wealth percentile and the aggregate do not differ much in terms wealth composition.[1] Hence, drop in the capital-income share will not alter wealth inequality very much, at least not directly. This is very different for income, where top earners derive a larger share of their income from capital, compared to the overall composition of income which is skewed towards labor income. We show that the change in the capital share due to war is sufficient to characterize its effects on income inequality, because a decline in capital income means that top earners lose more income than the rest. However, quantitatively, the direct effect of the decline in the capital share falls short of explaining large reductions in income inequality.
Against this background, we turn to a variant of the HANK model developed by Bayer et al. (2024). This model features households that are heterogeneous in both income and wealth, allowing us to study how inequality evolves in response to shocks. The model's New Keynesian features—monopolistic competition and infrequent price adjustments—are also crucial for addressing the issue at hand. First, under monopolistic competition, firms earn pure rents or profits in equilibrium, which they would not under perfect competition. These profits are a source of capital income for households, supplementing the return they receive for the capital they lend to firms. Second, because prices are adjusted infrequently, markups—and by extension, the capital-income share—fluctuate over time; this would not happen if prices were flexible. This enables us to model an endogenous decline in the capital share in response to a capital depreciation shock, in turn a key aspect of the war. We calibrate the model to match initial levels of income and wealth inequality and use impulse response

[1] We have compiled this data for the three hardest-hit war sites: France, Germany, and Japan.

matching to pin down key parameters.

The calibrated model is able to replicate the patterns in the data and offers new insights into the transmission of the war shock. In particular, the model explains the sharp decline in the top income share, even though the decrease in the capital-income share is no larger than what was assumed in the simpler accounting exercise. To understand this, the distinction between firm profits and returns on capital as separate sources of capital income is key. In particular, the relative importance of these income sources varies systematically across the income distribution. Profits—or monopoly rents—account for the lion's share of income at the top. And profits fall strongly in response to capital depreciation shock. In essence, the shock raises marginal costs, which are only partially passed through into prices during times of war. As a result, firms experience a significant squeeze on profit margins.

In contrast, we find a smaller role for taxation in leveling the income distribution. This is because our results on income inequality concern pre-tax income, due to data availability and consistent with the prior literature on wartime leveling. In our model, labor supply elasticities are relatively low, consistent with the data as reviewed for example in Saez et al. (2012), so that pre-tax income inequality is not affected strongly by changes in tax rates. We find that the smaller decline in wealth inequality is explained by a fall in capital returns, as well as rise in progressive taxation, which reduces the post-tax disposable income out of which the rich accumulate wealth (Piketty, 2018)[2]

Do profits decline during wars? We validate the model mechanism using newly constructed cross-country data on firm profits. In the data, we also find a large fall in profits. While there is an initial boom in profits during the military buildup in many economies, this quickly reverts during once the war turns violent.[3] In sum, as Scheidel (2018), we find that the leveling of incomes after war primarily reflects violent forces, rather than the peaceful expansion of the welfare state. In contrast, for wealth inequality, our results support explanations based on more peaceful forces as in Waldenström (2024).

The paper is organized as follows. In the remainder of the introduction, we place the paper in the context of the literature and clarify its contribution. Section 2 introduces our data set and econometric framework. We discuss our

[2]Auray et al. (2024) also find that rising markups generate increasing income inequality in France since 1980 while taxation is key role for wealth inequality in a calibrated heterogenous agent model.

[3]Importantly, profits decline more than general economic activity in most economies.

empirical results in Section 3. Section 4 outlines the HANK model which we calibrate in Section 5. Section 6 presents results from the model simulation, notably the decomposition of the leveling effect of war. A final section concludes.

Related Literature. The original contribution of our paper is to study the impact of war on inequality through the lens of a fully-specified general equilibrium model. In doing so, we bridge two important strands of research. First, we build on the pioneering work of Piketty and Saez (2014), who have brought distributional questions over the long run back to the core of economics. This literature has since studied the developments in many countries across the world in a massive data collection effort by many researchers, who have consistently highlighted the key role of wars for inequality.[4] Heldring et al. (2022) study the causal impact of bombing on wealth inequality using variation in bombing across British regions and also find small effects, consistent with our results on aggregate data. Our contribution to this literature is to comprehensively evaluate the leveling effect of war empirically and specify the its underlying causes in a state-of-the art HANK model. This allows us to assess the channels through which wars reduce inequality quantitatively for the first time.
Second, an important literature investigates the macro-economic consequences of wars and disasters focusing on many aspects such as trade, capital flows, and asset prices (Braun and McGrattan, 1993; Barro, 2006; Ursùa and Barro, 2010; Gabaix, 2012; Gourio, 2012; Nakamura et al., 2013; Farhi and Gabaix, 2016; Auray and Eyquem, 2019; Horn et al., 2020; Federle et al., 2024). Ramey and Shapiro (1998) study the macroeconomic impact of military buildups in a neoclassical two-sector model. Inequality is a key aspect of disasters that has so far been considered only by economic historians. Relative to these papers, we empirically show that disasters matter for inequality and build a model with heterogeneous agents. Song et al. (2023) find that large natural disasters reduce income inequality, corroborating our mechanism in which a shock to capital reduces inequality. Panon and Conteduca (2024) find that natural disasters reduce firm markups, consistent with the evidence we present for aggregate profits.

[4]For an incomplete list see Goldin and Margo (1992); Saez and Zucman (2016a) for the U.S., Albers et al. (2022); Bartels (2019) for Germany, Alvaredo et al. (2018) for the U.K., Garbinti et al. (2021) for France, Moriguchi and Saez (2008) for Japan, and Toussaint et al. (2022) for the Netherlands. Roine and Waldenström (2015) provide a summary.

2 Data and Econometric Framework

In order to study the distributional consequences of wars we build a new historical database, assembling data from existing studies and complementing it with several newly constructed indicators. In this section, we introduce the database and the econometric framework that we use the in subsequent analysis.

2.1 Sample and Data

In our baseline sample, we focus on major wars in advanced economies. For our baseline, we focus on countries that experience military action on their own soil, that is, on *war sites*. For this, we rely on the classification of Federle et al. (2024), who aggregate battle-level data to the country level in order to geolocate war sites.[5] We distinguish war sites and non-sites, because the war experience strongly differs across these countries, not only in terms of economic shocks, but also in terms of outcomes for inequality, as we will show later.
The focus on advanced economies means that in practice, we study nine country-war episodes which we summarize in Table 1, together with an estimate of destruction in each war site. This focus comes with three benefits. First, our sample is relatively homogeneous, compared to a sample of all historical wars which may be be part of protracted conflicts or caused by invasions of superior foreign powers. Second, for many outcome variables that we consider, such as tax rates or the capital stock, we are able to construct consistent data only for advanced economies. Lastly, we can relate our results to the insights of economic historians which have analyzed the distributional consequences of precisely these wars, although in less formal way (Piketty, 2014; Scheidel, 2018).[6]
Nevertheless, we also study an extended sample that includes other, more recent wars with available inequality data and find our main results unchanged, see Appendix B.2. Table B.5 lists the wars included in the extended sample.

Our baseline measures for inequality is the share of the top percentile in the wealth and income distribution, but we also consider the top deciles in robustness analysis below. Data is drawn primarily from the World Inequality

[5] We add Germany in World War 1, because Federle et al. (2024) consider war sites in present-day borders. However, because the historical inequality statistics for Germany do not adjust for the change in border, we consider Germany a war site as in Albers et al. (2022), due to large battles and associated destruction in (then German-Reich) East Prussia and the loss of land after the war. Our results remain unchanged when dropping individual war sites (figure B.10).

[6] Scheidel (2024) highlights the unique role of the world wars (relative to other wars) in reducing inequality.

Table 1: Large War Sites

Country	War Start	Destruction (% of pre-war Capital Stock)
Finland	1939	7.36%
France	1914	11.00%
France	1940	23.00%
Germany	1914	5.00%
Germany	1939	17.06%
Japan	1944	25.61%
Netherlands	1940	7.00%
Norway	1940	8.05%
United Kingdom	1940	5.00%

Notes: This table shows our main sample of wars in advanced economies with available inequality data. The war start year refers to the year becomes a war site. Finally, we provides estimates on the destruction in each country obtained from country-specific sources, for sources see Section C.2.

Database (WID), using pre-tax income as per the standard concept in WID.[7] The wealth data is at market prices, with underlying studies making correction for the valuation of assets which are hard to value, such as business assets. For a number of countries, we deviate slightly from the baseline WID concept and instead use different series, from other published research papers, which cover a longer historical period (for instance, Bartels, 2019; Roikonen, 2022; Moriguchi and Saez, 2008) and also refer to income before taxes, see table A.1. The baseline WID series are often available for shorter time periods, in these cases, we draw on other sources to obtain the longest available time series.[8] For the countries we consider, inequality data is usually based on income or wealth tax tabulations, which capture inequality at the top of the distribution accurately (Roine and Waldenström, 2015). Moreover, our estimation controls for country fixed effects to account for variations in the income concept between countries.

We also take up two potential caveats regarding the inequality measures we use below. First, a recent literature discusses the reliability of income and wealth inequality data, focused on the U.S. (Saez and Zucman, 2016b; Geloso et al., 2022; Smith et al., 2023). We show in Appendix A that this concerns mostly

[7]Data on post-tax income inequality is not available for most countries over a long time period. Bozio et al. (2024) argue that long-run shifts in inequality, such as the ones we are interested in largely reflect changes in pre-tax income inequality, studying France and the U.S., for which such data is available. We compare pre- and post-tax income shares in Figure A.1.

[8]The income concept in these series is usually 'fiscal income', i.e. income as report in income tax returns. By contrast, WID pre-tax income makes imputations for income not reported in tax returns, most importantly imputed rents.

the level of inequality and that war-time trends are similar across series.[9] In terms of wealth inequality, many advanced economies had wealth taxes in place throughout most of 20th century, which were only abolished towards the turn of the millennium (Saez and Zucman, 2022). Therefore, arguably, coverage of top wealth holders is as reliable as in more recent data, which often relies on top-corrected survey data or income capitalization methods to construct wealth inequality measures in the absence of wealth tax data.
Second, in some cases, there are gaps in the long-run series of top income and wealth shares, which we interpolate linearly in our baseline specification. This conservative procedure means that we may underestimate the true equalizing effects of wars, because some of the potential reduction in inequality that occurs after wars is attributed to a pre-war decline. We conduct robustness checks in Appendix B.3, including a specification in which we attribute the entirety of the decline in inequality between gaps to the war. While the response of inequality is slightly larger, the differences are small quantitatively. We further show a comparison of income and wealth inequality before and after wars in table A.3 in the appendix. Even unconditionally, we continue to find important equalizing effects, which are larger for income than for wealth inequality.

Next, we collect additional data which to study the mechanisms through which war impacts inequality. We start from existing studies and fill gaps during war years, which are usually not the focus of these papers. To measure the impact of war on capital, we use capital shares obtained from Bengtsson and Waldenström (2018) and the capital stock (Bergeaud et al., 2016), covering a host of advanced economies since 1890.[10] Importantly, we adjust the capital stock using own estimates of destruction that we construct for each country in our sample. The destruction estimates are reported in Table 1, with a discussion for each country in Appendix C.2. In the countries with the largest destruction, we also show how to account for the incidence of destruction along the distribution in Appendix C.2. To study asset prices and inflation, we rely on the macrohistory database (Jordà et al., 2017).[11]
War implies not only destruction, but also large changes in the fiscal regime. To account for these, we obtain data on top marginal tax rates from Scheve and

[9] Also, inequality trends around wars have found to be consistent in countries in which researchers have updated older studies with new methods and additional data, see for instance Bartels (2019) and Dell (2007) for Germany.

[10] We add capital shares in Japan during WW2 from the statistical yearbook (Statistics Bureau of Japan, 2023)

[11] We drop the German hyperinflation 1922–1924 from our sample.

Stasavage (2018). We estimate how these change after the start of the war and also compute a measure of tax progressivity following Heathcote et al. (2017) which maps into the HANK model, see Appendix A.2. For this purpose, we verify that the percentile at which the top marginal tax rate applies was relatively constant over time. We further construct data on government consumption during wars, for which there exists no coherent database to date. We provide details in Appendix A.2.

Before turning to our econometric framework, a general remark on the quality of our data is in order. Historical economic data was collected during a time period in which modern practices of national accounting were not yet established. Building historical accounts is hard, and even more so during times of wars. That said, our sample focuses on historical economic data in advanced countries, which has been subject to great amounts of scrutiny over time. The outcomes we consider are central economic variables such as inflation, the capital share, and top marginal tax rates that have been revisited frequently by economic historians in the respective countries. The effects we document persist long after the war itself has ended.

Also, because the government takes on an outsized role during wars, data on government activities is among the best war time data and has been studied by many economic historians. Finally, we put results regarding a core mechanism in our analysis, namely the physical destruction experienced in war sites, to further scrutiny and explicitly discuss the size of destruction from different historical sources in Appendix C.2.

2.2 Econometric framework

We investigate the consequences of wars based on impulse response functions to a 'war shock.' We conceive of a war as a multi-faceted shock, which is composed of several underlying structural shocks (e.g. capital destruction, government expenditure, taxation . . .). To identify the consequences of wars, our identification assumption is that the onset of wars is exogenous to business cycle and inequality dynamics in the war sites. The weight of historical evidence indeed suggests that this is warranted: Federle et al. (2024) offer a systematic classification of the casus belli for all wars in our sample based on a range of historical sources and find that the causes of war are generally unrelated to the current economic conditions, but rather related to broader nationalist or ideological causes. Below, we also provide additional evidence on pre-trends, as well as comparison

to non-war-participants, which corroborates the interpretation that the war triggered the subsequent inequality dynamics. This is consistent with the historical narratives outlined above.

We trace out the economic consequences of wars using panel local projections. Denoting by i the country and t the year, for any outcome variable $y_{i,t}$ we estimate the following linear specification:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \beta_h \text{War Start}_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \quad h = 0 \dots 14, \tag{1}$$

where α_i is a country fixed effect and $X_{i,t}$ is a vector of controls. Our baseline specifications control for 4 lags of the dependent variable and the regressor. Including lagged variables is important to capture trends in the outcome prior to the war, as is common in macroeconomic data. This is important, as inequality is falling in most advanced economies throughout the first half of the 20th century. Our specification isolates the effects of wars besides this trend.
In our baseline specification, we define War Start$_{i,t}$ as a dummy variable, which takes on a value of one when a country becomes a war site and is zero otherwise. Hence, our estimates capture the effect of the average war onset in our sample. The specification also accommodates wars of different duration: β_h in specification (1) measures the development of inequality in the war site h years after the start of 'average war', independently of its length.
The outcome variables are measured in changes relative to the pre-war value, so that the total effect of the shock on variables of interest can be read off directly from the β_h coefficients. Note that our specification accommodates the case where the effect of war is permanent (Stock and Watson, 2018), and indeed, we estimate impulse responses at long horizons to allow for far out effects of wars. We do so first because our sample consists mostly of wars that are fought over multiple years, so that effects likely take a few years to fully materialize. In our estimated responses, most effects of wars fully materialize at least 4-5 years after the war onset. Second and more importantly, the historical literature on the leveling effects of wars thinks of these as long-lasting shocks (Piketty, 2014; Scheidel, 2018), and we want to take into account the effects of wars at longer durations as well. Jordà et al. (2020) show that local projections, when appropriately augmented with lags as in our case, are able to detect the effects of shocks at very long horizons.[12]

[12]Local projections also form the backbone of a literature that analyzes the long-term effects of other shocks, such as taxation (Cloyne et al., 2023b,a) or pandemics (Jordà et al., 2022).

We consider a number of variations of specification (1) below and report on robustness in Section B.3. This includes a quantitative measure of wars, which is meant to capture the intensity of the war shock. To do so, we proxy the intensity of the war by the destruction to the pre-war capital stock. Moreover, in other robustness analyses, we vary the definition of the war dummy, study the effects of wars on belligerent countries which do not experience war on their own soil as well as extend our country sample to include additional wars beyond advanced economies.

3 The Distributional Impact of War

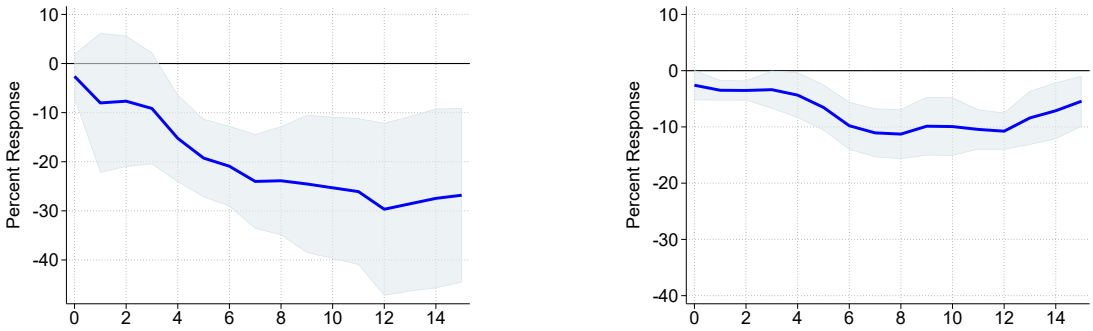
In this section, we present new evidence on the distributional impact of war and the adjustment of key indicators to inform the underlying transmission mechanism. We conclude the section by introducing a simple accounting framework to quantify the impact of destruction on income and wealth inequality.

3.1 Evidence

Figure 1 displays the response of the top income and wealth shares to the war shock. These estimates are based on specification (1), introduced above, and thus reflect the impulse responses to the start of the war in the war site. The top income/wealth shares are log-transformed so that the outcome is the percentage change relative to the pre-war trend.

The top-1 income share drops by almost 30%. The top-1 wealth share also falls, but here the effect is weaker—only a third of the decline in the top-1 income share. In both instances, however, the effect is very long-lived and there the reversal at the end of our estimation period is far from complete. The shifts in income and wealth inequality after wars, reflected in our estimates, are consistent with and offer a synthesis of the historical narrative (Scheidel, 2018). To put these results into perspective, note that the income share of the top-1 ranges between 5-20% over the 20th century, while for wealth, the top 1 share ranges from 20 to as much as 60% over the 20th century (Piketty and Saez, 2014; Roine and Waldenström, 2015). The decline in top income shares then translates into a decline of around 3 percentage points for the top-1 income share, and to about 5 percentage points for the top-1 wealth share, see Appendix B.1. However, because the level of top wealth shares is higher, in relative terms the impact of war on top wealth shares is weaker than on top income shares.

Figure 1: Response of Top Income and Wealth Shares to War Shock



(a) Top 1 Income Share

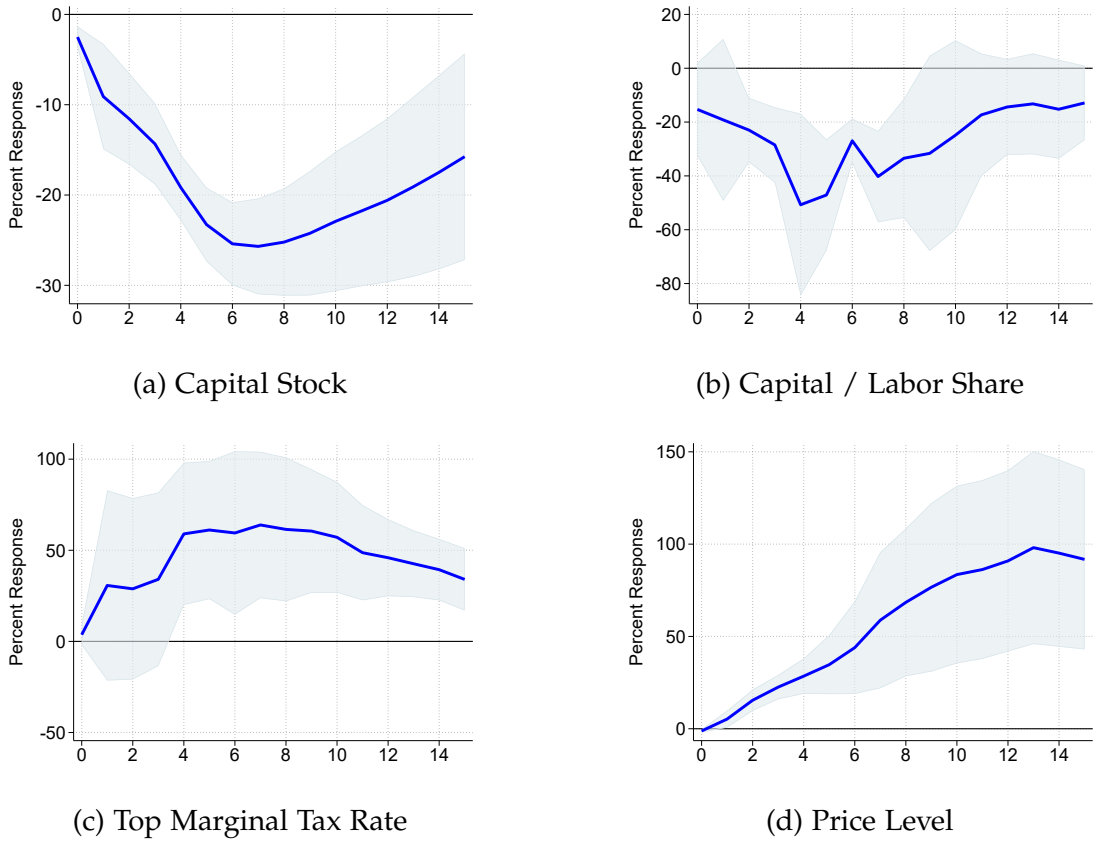
(b) Top 1 Wealth Share

Notes: Solid line shows response to war shock in war site, estimated based on specification (1); start of war as specified in table 1. Shaded areas indicate 90% confidence intervals. Horizontal (vertical) axes measure years since start of war (deviation from pre-war level in percent).

We also consider the response of the top decile, and show results in the Appendix (Figure B.4). As for the top-1 shares, we find that income shares fall more than wealth shares. The top-10 percent income share declines by around 6 percent, while we are unable to detect any movement in the top-10 percent wealth share.

The impact of war on wealth inequality is limited, even though wealth inequality has been declining strongly during the first half of the 20th century, as noted by several observers. Against this background, we find that it is important to account for the declining trend in wealth inequality via the inclusion of lags in specification (1). With no lags in the estimation, results would suggest that war caused a much stronger decline in wealth inequality, as we illustrate in Figure B.11. However, wars do not represent very large breaks in the steady decline of wealth shares for most advanced economies. Scheidel (2018) reports a decline in top wealth and top income shares shares by comparing pre and post-war wealth inequality, and does comment on systematic differences. In light of our results, we attribute the bulk of the change of wealth inequality around wars to the secular decline that is observed throughout the 20th century, rather than to the war shock. This conclusion aligns well with Waldenström (2024) who notes that wars do not constitute large breaks in inequality series and stresses other explanations for the long-run evolution of wealth inequality, such as the rise in 'popular wealth' owned by the middle class. Further, Heldring et al. (2022) show that across U.K. districts, bombing did not have a causal effect on wealth inequality on average.

Figure 2: Response of Key Indicators to War Shock



(a) Capital Stock

(b) Capital / Labor Share

(c) Top Marginal Tax Rate

(d) Price Level

Notes: Solid line shows response to war shock in war site, estimated based on specification (1); start of war as specified in table 1. Shaded areas indicate 90% confidence intervals. Horizontal (vertical) axes measure years since start of war (deviation from pre-war level in percent).

Figure 2 displays the impulse response of further variables to the war shock, offering a first insight into the economic mechanisms which drive the decline in inequality caused by the war. As before, estimates are based on specification (1). Panel (a) shows that there is a long-lasting drop in the capital stock by around 25% in response to the war; it does not recover the pre-war level by the end of our estimation period. The maximum decline exceeds the historical evidence on war destruction for most countries reported in Table 1 by a wide margin. It also clearly exceeds the cross-country average in Table 1. This suggests that the capital stock declines not only due to destruction, but because investment declines in response to the war, too (Federle et al., 2024).

Next, we turn to the functional distribution of incomes, that is, the split of income into capital and labor. Panel (b) shows the adjustment of the capital/labor ratio. In line with notion that war destroys a sizeable fraction of the capital

stock, the capital share falls strongly relatively to the labor share: the capital-labor share drops by some 40%. This shows that the wartime fall in income hits capital incomes in particular.
Panel (c) plots the response of top marginal tax rate in war sites. Wars and the associated fiscal expansions are usually financed by raising taxes and tax progressivity (Vélez, 2014). According to our estimates, the top marginal tax rates increase by up to 50% in response to war, and the tax-and transfer system remains more progressive for a considerable amount of time after the average war has ended. We discuss in Appendix A.2 how the response of the top marginal tax rate translates into the implied changes in the overall progressivity of the tax system, as considered in the model.
Finally, we consider the response of the prices in panel (d): Wars sharply increase the price level, which rises by almost 100% relative to the trend. This is consistent with the evidence in Barro (2006), who finds that war periods are generally accompanied by extremely high inflation and correspondingly low asset returns. We replicate the findings on asset returns during wars in Table B.4 and show that in particular safe assets (bonds, bills) perform worse than risky assets (housing, equity).

Additional Outcome Variables. To characterize the economic state of the countries we consider, we show a number of additional outcome variables in Figure B.6 and summarize here to economize on space. First, we find that wars lower output in the war site considerable, in line with the notion that wars are the quintessential macroeconomic disasters (Barro, 2006) (panel a)). Consistent with this, we find large declines in asset returns, for both risky and safe assets, see Table B.4. We further detail the large fiscal expansion during war times using newly constructed data on government consumption in Figure B.6, panel c). Wars lead to a large increase in government consumption (by more than 50%), to a large extent driven by the military spending, which we break out separately in panel d). However, after the war this expansion reverts and government consumption is slightly below its pre-war trend, see again Figure B.6.
Finally, we also consider two variables that are informative about how war impacts the labor market (Goldin and Margo, 1992). Specifically, we consider how the size of the population as well as total hours worked adjust in response to the war. While the population drops relatively quickly by around 3% (and only recovers slowly), hours worked rise, at least initially during the first couple of years after the start of the war, see Figure B.6, panels e) and f).

Robustness. We first consider an extended sample of countries and wars in Section B.2, which adds a number of wars in emerging economies which are also included in the World Inequality Database. The patterns we document for our baseline sample continue to persist, and the divide in the response between income and wealth inequality becomes even more apparent (Figure B.7). In particular, in the extended sample the top 1 income share now drops by around 20%, but we do not detect statistically significant effects on the top wealth share. The fact that the drop in the top 1 income share is smaller is expected because the extended sample adds a number of less destructive wars.

Next, to check the the robustness of our main results, we modify our main specification, considering both alternative independent and dependent variables. Concretely, we let the 'war shock' to refer not only to the war start but rather set the war dummy equal to one over the entire war period; furthermore we change the interpolation of missing inequality data so that all the decline in top shares between wars is attributed to the war in Figure B.8. Results remain consistent – note also that the interpolation affects mostly the short-run when inequality data is missing during the war in some countries. At the medium and long term, data is available again. Next, we consider a specification which normalizes the war shock by the destruction of the capital stock in the war site to proxy for the intensity of the war, and continue to find find sharp drops in income and wealth inequality, with the income inequality drop being more pronounced, see Figure B.9. To further test the sensitivity of results, we drop each war successively, to see if individual wars drive our results given the small sample size, see Figure B.10. Changing the sample does not influence our results, the leveling we document is broad-based across countries. Finally, we study inequality in the years before the war to study pre-war trends. As Figure B.11 shows, there are no large such movements before the wars.

We finally conduct a placebo check, in which we estimate the response of inequality in countries that are not party to the world wars (such as Switzerland). Although this is of course an imperfect check due to the international spillovers of wars, we still find that 'placebo wars' do not lower inequality, see Figure B.12.

3.2 Taking stock

According to popular accounts, the fall in inequality during wars is due to a fall in capital incomes. For example Piketty (2014, p. 275) argues that "there

is nothing surprising about the fact that the shocks endured by capital, especially private capital in the period 1914–1945 diminished the share of the upper decile (and upper centile)." In what follows, we perform a simple accounting exercise in the spirit of Meade (1964) to understand to what extent we can explain the evolution of income and wealth inequality through this mechanism quantitatively—for an exogenously given decline in the capital to labor income ratio. Importantly, in the present section, we operate under an *all-else-equal* assumption, ruling out any offsetting effect on the capital-labor ratio, such as adjustments of labor supply or changes in markups. We relax this restriction in our general-equilibrium analysis below.

In what follows K denotes wealth (including capital and other assets), and I denotes income; both may arbitrarily distributed over the population. The income share of the top-p percentile is the sum of labor and capital income:

$$sh_p^I = \frac{sh_p^L \cdot w \cdot L + sh_p^K \cdot r \cdot K}{w \cdot L + r \cdot K} \tag{2}$$

In this expression sh_p^L is the share of total labor income accruing to the top-p percentile, $w \cdot L$ is labor income, and sh_p^K is the share of capital income accruing to the top-p percentile. Capital income is the rental rate of capital r times the capital stock K. The top wealth share is given by $sh_p^K = K_p/K$, that is, the fraction of wealth owned by the top-p percentile.

We now consider an exogenous decline in the capital-labor ratio by D%, caused, for instance, directly by the physical destruction of capital, or more broadly shocks to capital and depreciation beyond this direct effect. For example, in a study right after the second world war, the U.K. government noted that "industrial and other enterprises have been compelled, by shortage of material and labour, to allow arrears of normal depreciation and obsolescence to accumulate" (British Information Services, 1945).

To the extent that D impacts wealth uniformly (we move away from this assumption below), it does not alter relative wealth shares. Yet, it changes income shares to the extent that the weight of capital income in total income differs across the income distribution. Formally, we can write the income share of the top-p percentile as a function of the shock:

$$sh_p^I(D) = \frac{sh_p^L + sh_p^K \cdot (1-D) \cdot \frac{r \cdot K}{w \cdot L}}{1 + (1-D) \cdot \frac{r \cdot K}{w \cdot L}}. \tag{3}$$

Taking the derivative shows that D lowers the income share for the top-p per-

centile, if that the share of total capital income accruing to the top-p percentile sh_p^K is greater than its labor income share sh_p^L.[13]

Importantly, D can be measured in the data such that—given data on the composition of top incomes—we can gauge its quantitative importance for the impact of war on the top-income shares. Specifically, we use data on the composition of top incomes, which is available for France, Germany, Japan and the U.K. in the pre-war period. We calibrate the top income composition and the capital-labor share to the pre-war average across those countries and vary the decline in the capital-labor ratio (D) to study its potential impact on the top-1 income share.[14] Table C.8 provides details underlying our computation.

Figure 3 shows the results. The vertical axis measures the change in the top-1 income, caused by an exogenous decline in the capital-labor share, measured along the horizontal axis. The solid vertical line represents the average empirical estimate for the response of the capital-labor ratio, see again Figure 2. On average, this ratio declines by slightly more than 25% at the 10-year horizon. We use this as our estimate of D rather than direct capital destruction, because it encompasses a wider set of shocks to the capital stock.

While a change in the capital-labor ratio of this size can generate meaningful changes in top income shares, it is ultimately insufficient to explain the observed changes in top income shares. For the top-1 share, this generates a 10% decline, less than half of the observed decline in the data (see Figure 1). Matching the observed response would require implausible declines of the capital share of around 75%. Moreover, the persistence of the decline in income inequality remains puzzling, as capital and labor shares eventually revert to pre-war levels.[15] The figure shows the average decline in the capital share. One simple prediction of the framework is that countries with larger losses of capital (measured via capital shares or destruction) in a war should see larger declines in income inequality. We confirm this in Figure C.15.

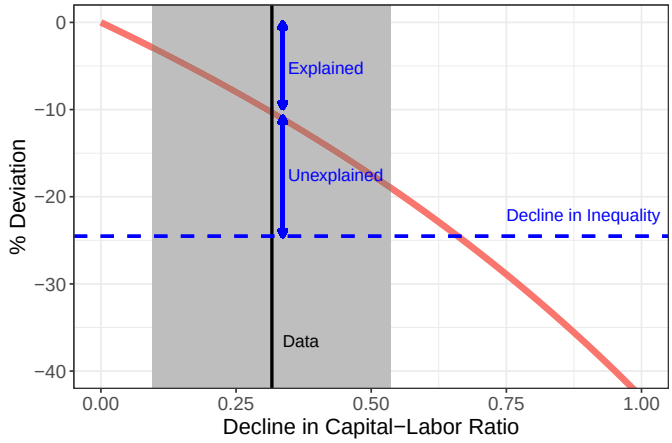
Discussion and Additional Results. The framework we have laid out shows

[13]Formally, the derivative is $\frac{\partial sh_p^I(D)}{\partial D} = \frac{\frac{rK}{wL}(sh_p^L - sh_p^K)}{(1+(1-D)\frac{rK}{wL})^2}$, which is negative iff $sh_p^L < sh_p^K$.

[14]Note that the composition of top incomes does not directly give sh_p^L, which is the share of labor (or capital) income accruing to the top fractile. However, we can compute sh_p^L directly as $sh_p^L = \frac{Y}{w \cdot L} \cdot \frac{L_p}{Y_p} \cdot \frac{Y_p}{Y}$ using income composition data on top earners, where L_P/Y_p is the labor share within the fractile.

[15]Meade (1964) and Moll et al. (2022) apply similar frameworks to study inequality in postwar U.K. and the U.S. in recent years. We show how to also apply this to the wealth distribution and find larger effects on income inequality from shifting capital shares than they do. This is because in pre-war data, the initial distribution of capital income is more unequal.

Figure 3: Top 1 Income Share as a Function of the Capital-Labor Ratio

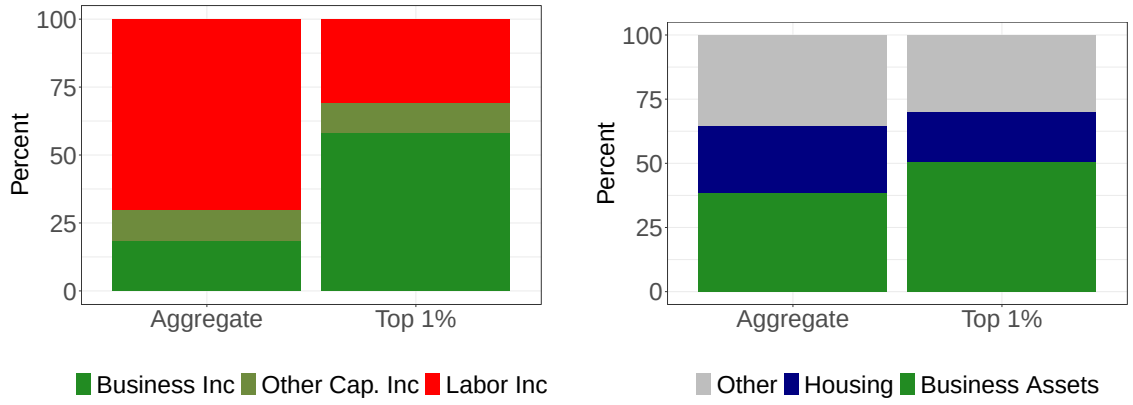


Notes: This figure illustrates the decline in income inequality as a function of the capital-labor ratio. For a given decline in this ratio on the x-axis, the red line shows the implied decline in the top income share on the y-axis. Calculations are based on the framework laid out in the text (see equation (3)). The vertical line indicates the average response at the 10-year horizon in figure 2 (with 1-sd confidence bands). The arrows indicate the decline in income inequality that can be explained by destruction through the framework in section 3.2, and the unexplained part relative to the decline in top income shares in figure 1.

how shocks to capital affect the income distribution without altering the wealth distribution—a direct implication of the assumption that D impacts wealth uniformly. As a first approximation this assumption seems warranted in light of the evidence that war impacts income inequality more strongly than wealth inequality. We now consider the more general case with multiple assets such that destruction is not wealth-neutral by construction. Even in this case, however, shocks to capital have a stronger impact on the income distribution than on the wealth distribution.

To set the stage, Figure 4 shows for France, in each panel the composition of top-1 income and wealth (left bar), as well as total holdings of income and wealth (right bar). We focus on France, because in this case we have the most complete data before World War 2, similar results for Germany are in Appendix Figure C.17. For the income composition, we distinguish labor income and two types of capital income—business income and a residual. For the wealth composition, we distinguish three asset categories, business assets, housing and other assets. What is striking is that the wealth portfolio of the top 1 and the aggregate looks relatively similar, with the portfolio of the rich only slightly tilted more towards business assets (right panel). Instead, income portfolios for the top percentile differ substantially from the aggregate (left panel). The top earn most of their income from capital, and specifically through the firms they own. Historically,

Figure 4: Income and Wealth Portfolios along the Distribution in France, 1937



(a) Income Composition

(b) Wealth Composition

Notes: This figure shows the composition of top incomes and top wealth in France in 1937. For wealth, we distinguish three asset categories in Parisian data in 1937 (Top 1 and Total): Business assets, housing and a residual. For the income composition, we distinguish business income, other capital income (real estate and interest incomes) and labor income. The precise definition of these categories is in section C.2. See figures C.17e and C.17f for an analogue for Germany.

income at the top is made up mostly of aristocratic landowners or industrialists, who live off the proceeds of their owned capital (Piketty, 2014).[16] In contrast, for the overall distribution labor income is far more important. Note that the income and wealth distribution are not linked mechanically, because labor income is to a large extent independent of the cashflow generated by wealth.

The fact that wealth composition at the top is similar to the aggregate means that shocks to specific assets, such as businesses, have only limited impacts on the wealth distribution, as measured through the top wealth share.[17] On the other hand, because the income composition at the top differs substantially from the aggregate, shocks to capital can cause sizeable changes income inequality.

Appendix C.2 develops this argument more formally for France, Germany and Japan, where we have detailed data on wealth losses due to destruction across different assets. We show that even taking into account that destruction varies along the wealth distribution, quantitatively, the impact on wealth inequality remains limited. Wealth losses concentrated at the top could also mean that the framework matches the decline in income inequality better, because more capital income is lost at the top. However, we find that even with larger losses

[16] This is different in modern data, where wages are more important at the top. This is transformation of the income-rich from 'rentiers' to 'super-managers' (Piketty, 2014).

[17] An alternative is that within an asset class, top holdings are more affected than overall holdings. In general, there is not sufficient data to study this except in the case of Germany, where this leads the top 1 share to decline by around 6% (or around 2 percentage points).

at the top, the decline in capital shares can explain less than half of the decline of the top income share, see Figure C.16.
This highlights the need for a general equilibrium model in which we can trace out the full endogenous response of shocks to capital. Figure 4 suggests that hitting business incomes is a particularly promising candidate, as these are even more concentrated at the top than overall capital incomes. In the next section, we develop a HANK model to study the distributional consequences of wars in a general equilibrium framework. Importantly, relative to equation (3), this will move the distribution of capital and labor income endogenously ($sh^I_{p,L}$ and $sh^I_{p,K}$), which were so far held fixed. It will also allow for endogenous changes in the capital-labor ratio.

4 The HANK Model

In what follows, we offer a structural interpretation of the evidence based on a HANK model. Its two distinct features—heterogeneous agents and sticky prices—are key to our analysis. First, households are heterogeneous in income and, because financial markets are incomplete, also in wealth and the model generates predictions for how the distribution of income and wealth changes in response to shocks. Specifically, we build on the HANK model by Bayer et al. (2024), which was developed to study the dynamics of inequality over the business cycle. Second, because prices are sticky, markups fluctuate over time. This, as we show below, will be a key source of income fluctuations at the top.
In what follows, we outline the model structure and explain how we calibrate it order to account for the evidence on the distributional impact of war established above. In the last part of the section, we zoom in on the underlying mechanism.

4.1 Model structure

We outline the model structure, discussing, in turn, households, firms, and the government.

Households. There is a continuum of ex-ante identical households of measure one, indexed by i. They are either employed as workers or run firms as entrepreneurs; the transition of households between both employment states follows an exogenous random process. Workers face idiosyncratic income risk, as their skill evolves randomly. Entrepreneurs do not work, but earn all pure

rents due to imperfect competition, except for the rents of unions which are equally distributed across workers.
Household labor income depends on productivity or skill, $\tilde{h}_{it}$, which switches between three states:

$$\tilde{h}_{it} = \begin{cases} \exp\left(\rho_h \log \tilde{h}_{it-1} + \epsilon^h_{it}\right) & \text{with probability } 1-\zeta \text{ if } h_{it-1} \neq 0, \\ 1 & \text{with probability } \iota \text{ if } h_{it-1} = 0, \\ 0 & \text{else.} \end{cases} \tag{4}$$

A household remains in the worker state (top line) with probability $1-\zeta$. In this case productivity depends on last period's productivity (with persistence ρ_h) and shock ϵ^h_{it}, that is normally distributed with variance $\sigma^2_{h,t}$. An entrepreneur's labor productivity is zero ($h_i = 0$); With probability ι an entrepreneur returns to the labor force. For this case, we assume median productivity; individual productivity is given by $h_{it} = \frac{\tilde{h}_{it}}{\int \tilde{h}_{it} di}$ such that $\tilde{h}_{it}$ is scaled by its cross-sectional average, $\int \tilde{h}_{it} di$, to make sure that average worker productivity is constant.

Households are infinitely lived, have time-separable preferences with discount factor β, and derive felicity from consumption c_{it} and leisure. They save via liquid nominal assets (bonds) and a less liquid asset (capital) in order to self-insure against income risk. Capital is less liquid: it can be traded only subject to the household participating in the capital market, in turn, determined by an exogenous probability.
A household's gross labor income $w_t n_{it} h_{it}$ is composed of the aggregate wage rate on raw labor, w_t, the household's hours worked, n_{it}, and its idiosyncratic labor productivity, h_{it}.
This modeling strategy serves two purposes. First and foremost, it generally solves the problem of the allocation of pure rents without distorting factor returns and without introducing another tradable asset.Second, we use the entrepreneur state in particular – a transitory state in which incomes are very high – to match the income and wealth distribution following the idea by Castaneda et al. (1998). The entrepreneur state does not change the asset returns or investment opportunities available to households. Our assumption on the distribution of pure rents implies that higher market power in the goods market leads to a higher concentration of income and higher mark-ups in the labor market leads to wage compression.[18]

[18]Boar and Midrigan (2019) use a similar structure, where entrepreneurs retain a fraction of

With respect to leisure and consumption, households have Greenwood et al. (1988) (GHH) preferences and maximize the discounted sum of felicity:

$$\mathbb{E}_0 \max_{\{c_{it}, n_{it}\}} \sum_{t=0}^{\infty} \beta^t u \left[c_{it} - G(h_{it}, n_{it}) \right]. \tag{5}$$

The maximization is subject to the budget constraints described further below. The felicity function u exhibits a constant relative risk aversion (CRRA) with risk aversion parameter $\xi > 0$,

$$u(x_{it}) = \frac{x_{it}^{1-\xi} - 1}{1 - \xi},$$

where $x_{it} = c_{it} - G(h_{it}, n_{it})$ is household i's composite demand for goods consumption c_{it} and leisure and G measures the disutility from work. Goods consumption bundles varieties j of differentiated goods according to a Dixit-Stiglitz aggregator:

$$c_{it} = \left(\int c_{ijt}^{\frac{\eta_t - 1}{\eta_t}} dj \right)^{\frac{\eta_t}{\eta_t - 1}}.$$

Each of these differentiated goods is offered at price p_{jt}, so that for the aggregate price level, $P_t = \left(\int p_{jt}^{1-\eta_t} dj \right)^{\frac{1}{1-\eta_t}}$, the demand for each of the varieties is given by

$$c_{ijt} = \left(\frac{p_{jt}}{P_t} \right)^{-\eta_t} c_{it}.$$

Assuming a (progressive) income-tax schedule (which we borrow from Benabou, 2002; Heathcote et al., 2017), a household's net labor income, y_{it}, is given by

$$y_{it} = (1 - \tau_t^L)(w_t h_{it} n_{it})^{1-\tau_t^P}, \tag{6}$$

where w_t is the aggregate wage rate and τ_t^L and τ_t^P determine the level and the progressivity of the tax code. Given net labor income, the first-order condition for labor supply is

$$\frac{\partial G(h_{it}, n_{it})}{\partial n_{it}} = (1 - \tau_t^P)(1 - \tau_t^L)(w_t h_{it})^{1-\tau_t^P} n_{it}^{-\tau_t^P} = (1 - \tau_t^P) \frac{y_{it}}{n_{it}}. \tag{7}$$

Assuming that G has a constant elasticity w.r.t. n, $\frac{\partial G(h_{it}, n_{it})}{\partial n_{it}} = (1 + \gamma) \frac{G(h_{it}, n_{it})}{n_{it}}$ with $\gamma > 0$, we can simplify the expression for the composite consumption good, x_{it},

firm profits and thus the size of markups has an impact on inequality in the economy.

making use of this first-order condition (7), and substitute $G(h_{it}, n_{it})$ out of the individual planning problem:

$$x_{it} = c_{it} - G(h_{it}, n_{it}) = c_{it} - \frac{1 - \tau_t^P}{1 + \gamma} y_{it}. \tag{8}$$

When the Frisch elasticity of labor supply is constant and the tax schedule has the form (6), the disutility of labor is always a fraction of labor income and constant across households. Therefore, in both the household's budget constraint and felicity function, only after-tax income enters and neither hours worked nor productivity appears separately.

What remains to be determined is individual and aggregate effective labor supply. Without further loss of generality, we assume $G(h_{it}, n_{it}) = h_{it}^{1-\bar{\tau}^P} \frac{n_{it}^{1+\gamma}}{1+\gamma}$, where $\bar{\tau}^P$ is the stationary equilibrium level of progressivity of the tax code. This functional form simplifies the household problem in the stationary equilibrium as h_{it} drops out from the first-order condition and all households supply the same number of hours $n_{it} = N(w_t)$. Total effective labor input, $\int n_{it} h_{it} di$, is hence also equal to $N(w_t)$ because we normalized $\int h_{it} di = 1$. When tax progressivity does not coincide with its stationary equilibrium value, individual hours worked differ across agents and are given by

$$n_{it} = \left[(1 - \tau_t^P)(1 - \tau_t^L)\right]^{\frac{1}{\gamma + \tau_t^P}} h_{it}^{\frac{\bar{\tau}^P - \tau_t^P}{\gamma + \tau_t^P}} w_t^{\frac{1 - \tau_t^P}{\gamma + \tau_t^P}}, \tag{7a}$$

such that aggregate effective hours are given by

$$N_t = \int n_{it} h_{it} = \left[(1 - \tau_t^P)(1 - \tau_t^L)\right]^{\frac{1}{\gamma + \tau_t^P}} w_t^{\frac{1 - \tau_t^P}{\gamma + \tau_t^P}} \underbrace{\int h_{it}^{\frac{\gamma + \bar{\tau}^P}{\gamma + \tau_t^P}}}_{:= H_t}. \tag{7b}$$

Here H_t measures how the tax progressivity influences the (hours-weighted) average labor productivity. Scaling of the disutility of labor by $h_{it}^{1-\bar{\tau}^P}$ is thus a normalization of H_t to one in the stationary equilibrium.

Household after-tax labor income, plugging in the optimal supply of hours, is then:

$$y_{it} = (1 - \tau_t^L)(w_t h_{it} n_{it})^{1-\tau_t^P} = (1 - \tau_t^L)^{\frac{1+\gamma}{\gamma + \tau_t^P}} (1 - \tau_t^P)^{\frac{1 - \tau_t^P}{\gamma + \tau_t^P}} w_t^{\frac{1+\gamma}{\gamma + \tau_t^P}(1 - \tau_t^P)} h_{it}^{\frac{\gamma + \bar{\tau}^P}{\gamma + \tau_t^P}(1 - \tau_t^P)}. \tag{9}$$

4.1.1 Consumption, savings, and portfolio choice

Given this labor income, households optimize intertemporally subject to their budget constraint:

$$c_{it} + b_{it+1} + q_t k_{it+1} = b_{it}\frac{R(b_{it}, R_t^b, A_t)}{\pi_t} + (q_t + r_t)k_{it} + y_{it} \\ + \mathbb{I}_{h_{it}\neq 0}(1-\tau_t)\Pi_t^U + \mathbb{I}_{h_{it}=0}(1-\tau_t^L)(\Pi_t^F)^{1-\tau_t^P}, \qquad k_{it+1} \geq 0, \quad b_{it+1} \geq \underline{B}\,,$$

where Π_t^U is union profits taxed at the average tax rate τ_t (see Equation 26), Π_t^F is firm profits, b_{it} is real bond holdings, k_{it} is the amount of illiquid assets, q_t is the price of these assets, r_t is their dividend, $\pi_t = \frac{P_t}{P_{t-1}}$ is realized inflation, and R is the nominal interest rate on bonds, which depends on the portfolio position of the household and the central bank's interest rate R_t^b, which is set one period before. All households that do not participate in the capital market ($k_{it+1} = k_{it}$) still obtain dividends and can adjust their bond holdings. Depreciated capital has to be replaced for maintenance, such that the dividend, r_t, is the net return on capital. Holdings of bonds have to be above an exogenous debt limit $\underline{B}$, and holdings of capital have to be non-negative.
Substituting the expression $c_{it} = x_{it} + \frac{1-\tau_t^P}{1+\gamma}y_{it}$ for consumption, we obtain the budget constraint for the composite leisure-consumption good:

$$x_{it} + b_{it+1} + q_t k_{it+1} = b_{it}\frac{R(b_{it}, R_t^b, A_t)}{\pi_t} + (q_t + r_t)k_{it} + \frac{\tau_t^P + \gamma}{1+\gamma}y_{it} \\ + \mathbb{I}_{h_{it}\neq 0}(1-\tau_t)\Pi_t^U + \mathbb{I}_{h_{it}=0}(1-\tau_t^L)(\Pi_t^F)^{1-\tau_t^P}, \qquad k_{it+1} \geq 0, \quad b_{it+1} \geq \underline{B}\,. \tag{10}$$

Households make their savings choices and their portfolio choice between liquid bonds and illiquid capital in light of a capital market friction that renders capital illiquid because participation in the capital market is random and i.i.d. in the sense that only a fraction, λ, of households are selected to be able to adjust their capital holdings in a given period.
What is more, we assume that there is a wasted intermediation cost that drives a wedge between the government bond yield R_t^b and the interest paid by/to households R_t. This means that we specify:

$$R(b_{it}, R_t^b, A_t) = \begin{cases} R_t^b & \text{if } b_{it} \geq 0 \\ R_t^b + \overline{R} & \text{if } b_{it} < 0. \end{cases}$$

The extra wedge for unsecured borrowing creates a mass of households with

zero unsecured credit but with the possibility to borrow, though at a penalty rate.

Since a household's saving decision—(b'_a, k') for the case of adjustment and (b'_n, k) for non-adjustment—will be some non-linear function of that household's wealth and productivity, inflation and all other prices will be functions of the joint distribution, Θ_t, of (b, k, h) in t. This makes Θ a state variable of the household's planning problem and this distribution evolves as a result of the economy's reaction to aggregate shocks. For simplicity, we summarize all effects of aggregate state variables, including the distribution of wealth and income, by writing the dynamic planning problem with time-dependent continuation values.

This leaves us with three functions that characterize the household's problem: value function V^a for the case where the household adjusts its capital holdings, the function V^n for the case in which it does not adjust, and the expected continuation value, $\mathbb{W}$, over both:

$$\begin{aligned} V_t^a(b,k,h) &= \max_{b'_a,k'} u[x(b,b'_a,k,k',h)] + \beta \mathbb{E}_t \mathbb{W}_{t+1}(b'_a,k',h') \\ V_t^n(b,k,h) &= \max_{b'_n} u[x(b,b'_n,k,k,h)] + \beta \mathbb{E}_t \mathbb{W}_{t+1}(b'_n,k,h') \\ \mathbb{W}_{t+1}(b',k',h') &= \lambda V_{t+1}^a(b',k',h') + (1-\lambda) V_{t+1}^n(b',k',h') \end{aligned} \tag{11}$$

Expectations about the continuation value are taken with respect to all stochastic processes conditional on the current states. Maximization is subject to the corresponding budget constraint.

4.2 Firm sector

The firm sector consists of four sub-sectors: (a) a labor sector composed of "unions" that differentiate raw labor and labor packers who buy differentiated labor and then sell labor services to intermediate goods producers, (b) intermediate goods producers who hire labor services and rent out capital to produce goods, (c) final goods producers who differentiate intermediate goods and then sell them to goods bundlers, who finally sell them as consumption goods to households, and to (d) capital goods producers, who turn bundled final goods into capital goods.

When profit maximization decisions in the firm sector require intertemporal decisions (i.e. in price and wage setting and in producing capital goods), we assume for tractability that they are delegated to a mass-zero group of house-

holds (managers) that are risk neutral and compensated by a share in profits.[19] They do not participate in any asset market and have the same discount factor as all other households. Since managers are a mass-zero group in the economy, their consumption does not show up in any resource constraint and all but the unions' profits go to the entrepreneur households (whose $h = 0$). Union profits go lump sum to worker households. In our baseline all profit incomes are paid out in the very period they are earned. In an extension, we introduce retained earnings such that the profit payments of unions and firms to households are smoothed over time.

4.2.1 Labor packers and unions

Worker households sell their labor services to a mass-one continuum of unions indexed by j, each of whom offers a different variety of labor to labor packers who then provide labor services to intermediate goods producers. Labor packers produce final labor services according to the production function

$$N_t = \left(\int \hat{n}_{jt}^{\frac{\zeta_t - 1}{\zeta_t}} dj \right)^{\frac{\zeta_t}{\zeta_t - 1}}, \tag{12}$$

out of labor varieties $\hat{n}_{jt}$. Cost minimization by labor packers implies that each variety of labor, each union j, faces a downward-sloping demand curve

$$\hat{n}_{jt} = \left(\frac{W_{jt}}{W_t^F} \right)^{-\zeta_t} N_t,$$

where W_{jt} is the *nominal* wage set by union j and W_t^F is the nominal wage at which labor packers sell labor services to final goods producers.

Since unions have market power, they pay the households a wage lower than the price at which they sell labor to labor packers. Given the nominal wage W_t at which they buy labor from households and given the *nominal* wage index W_t^F, unions seek to maximize their discounted stream of profits. However, they face a Calvo type (1983) of adjustment friction with indexation with the probability

[19] Since we solve the model by a first-order perturbation in aggregate shocks, the assumption of risk-neutrality only serves as a simplification in terms of writing down the model. With a first-order perturbation we have certainty equivalence and time fluctuations in stochastic discount factors become irrelevant. Of course in the cross-section, households have different stochastic discount factors depending on whether they are borrowing-constrained or not. Yet, this does not change the dynamics of the Phillips curves up to a first-order approximation beyond the steady-state non-stochastic discount factor.

λ_w to keep wages constant. They therefore maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \lambda_w^t \frac{W_t^F}{P_t} N_t \left\{ \left(\frac{W_{jt} \bar{\pi}_W^t}{W_t^F} - \frac{W_t}{W_t^F} \right) \left(\frac{W_{jt} \bar{\pi}_W^t}{W_t^F} \right)^{-\zeta_t} \right\}, \tag{13}$$

by setting W_{jt} in period t and keeping it constant except for indexation to $\bar{\pi}_W$, the steady-state wage inflation rate.
Since all unions are symmetric, we focus on a symmetric equilibrium and obtain the linearized wage Phillips curve from the corresponding first-order condition as follows, leaving out all terms irrelevant at a first-order approximation around the stationary equilibrium:

$$\log \left(\frac{\pi_t^W}{\bar{\pi}_W} \right) = \beta \mathbb{E}_t \log \left(\frac{\pi_{t+1}^W}{\bar{\pi}_W} \right) + \kappa_w \left(mc_t^w - \frac{1}{\mu_t^W} \right), \tag{14}$$

with $\pi_t^W := \frac{W_t^F}{W_{t-1}^F} = \frac{w_t^F}{w_{t-1}^F} \pi_t^Y$ being wage inflation, w_t and w_t^F being the respective *real* wages for households and firms, $mc_t^w = \frac{w_t}{w_t^F}$ is the actual and $\frac{1}{\mu_t^W} = \frac{\zeta - 1}{\zeta}$ being the target mark-down of wages the unions pay to households, W_t, relative to the wages charged to firms, W_t^F and $\kappa_w = \frac{(1-\lambda_w)(1-\lambda_w \beta)}{\lambda_w}$. In our baseline, profits paid to households therefore are $\Pi_t^U = (w_t^F - w_t) N_t$.

4.2.2 Final goods producers

Similar to unions, final goods producers differentiate a homogeneous intermediate good and set prices. They face a downward-sloping demand curve

$$y_{jt} = \left(p_{jt} / P_t \right)^{-\eta_t} Y_t$$

for each good j and buy the intermediate good at the nominal price MC_t. As we do for unions, we assume price adjustment frictions à la Calvo (1983) with indexation.
Under this assumption, the firms' managers maximize the present value of real profits given this price adjustment friction, i.e., they maximize:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \lambda_Y^t (1 - \tau_t^L) Y_t^{1-\tau_t^P} \left\{ \left(\frac{p_{jt} \bar{\pi}_Y^t}{P_t} - \frac{MC_t}{P_t} \right) \left(\frac{p_{jt} \bar{\pi}^t}{P_t} \right)^{-\eta_t} \right\}^{1-\tau_t^P}, \tag{15}$$

with a time-constant discount factor.
The corresponding first-order condition for price setting implies a Phillips curve:

$$\log\left(\frac{\pi_t}{\bar{\pi}}\right) = \beta \mathbb{E}_t \log\left(\frac{\pi_{t+1}}{\bar{\pi}}\right) + \kappa_Y \left(mc_t - \frac{1}{\mu_t^Y}\right), \tag{16}$$

where we again dropped all terms irrelevant for a first-order approximation and have $\kappa_Y = \frac{(1-\lambda_Y)(1-\lambda_Y\beta)}{\lambda_Y}$. Here, π_t is the gross inflation rate of final goods, $\pi_t := \frac{P_t}{P_{t-1}}$, $mc_t := \frac{MC_t}{P_t}$ is the real marginal costs, $\bar{\pi}$ is steady-state inflation, and $\mu_t^Y = \frac{\eta}{\eta - 1}$ is the target markup. In our baseline, profits paid to households therefore are $\Pi_t^F = (1 - mc_t)Y_t$.

4.2.3 Intermediate goods producers

Intermediate goods are produced with a constant returns to scale production function:

$$Y_t = N_t^{\alpha}(u_t K_t)^{(1-\alpha)},$$

where $u_t K_t$ is the effective capital stock taking into account utilization u_t, i.e., the intensity with which the existing capital stock is used. Using capital with an intensity higher than normal results in increased depreciation of capital according to $\delta(u_t) = \delta_0 + \delta_1(u_t - 1) + \delta_2/2(u_t - 1)^2 + \epsilon^D$, which, assuming $\delta_1, \delta_2 > 0$, is an increasing and convex function of utilization. Without loss of generality, capital utilization in the steady state is normalized to 1, so that δ_0 denotes the steady-state depreciation rate of capital goods. ϵ^D are capital depreciation shocks that follow an autoregressive process of order 2.
Let mc_t be the relative price at which the intermediate good is sold to final goods producers. The intermediate goods producer maximizes profits,

$$mc_t Z_t Y_t - w_t^F N_t - [r_t + q_t \delta(u_t)] K_t,$$

where r_t^F and q_t are the rental rate of firms and the (producer) price of capital goods respectively. The intermediate goods producer operates in perfectly competitive markets, such that the real wage and the user costs of capital are given

by the marginal products of labor and effective capital:

$$w_t^F = \alpha mc_t Z_t \left(\frac{u_t K_t}{N_t}\right)^{1-\alpha}, \tag{17}$$

$$r_t + q_t \delta(u_t) = u_t(1-\alpha) mc_t Z_t \left(\frac{N_t}{u_t K_t}\right)^{\alpha}. \tag{18}$$

We assume that utilization is decided by the owners of the capital goods, taking the aggregate supply of capital services as given. The optimality condition for utilization is given by

$$q_t \left[\delta_1 + \delta_2(u_t - 1)\right] = (1-\alpha) mc_t Z_t \left(\frac{N_t}{u_t K_t}\right)^{\alpha}, \tag{19}$$

i.e., capital owners increase utilization until the marginal maintenance costs equal the marginal product of capital services.

4.2.4 Capital goods producers

Capital goods producers take the relative price of capital goods, q_t, as given in deciding about their output, i.e., they maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t I_t \left\{ q_t \left[1 - \frac{\phi}{2} \left(\log \frac{I_t}{I_{t-1}} \right)^2 \right] - 1 \right\}. \tag{20}$$

Optimality of the capital goods production requires (again dropping all terms irrelevant up to first order)

$$q_t \left[1 - \phi \log \frac{I_t}{I_{t-1}} \right] = 1 - \beta \mathbb{E}_t \left[q_{t+1} \phi \log \left(\frac{I_{t+1}}{I_t} \right) \right], \tag{21}$$

and each capital goods producer will adjust its production until (21) is fulfilled. Since all capital goods producers are symmetric, we obtain as the law of motion for aggregate capital

$$K_t - (1 - \delta(u_t)) K_{t-1} = \Upsilon_t \left[1 - \frac{\phi}{2} \left(\log \frac{I_t}{I_{t-1}} \right)^2 \right] I_t. \tag{22}$$

The functional form assumption implies that investment adjustment costs are minimized and equal to 0 in the steady state.

4.3 Government

The government operates a monetary and a fiscal authority. The monetary authority controls the nominal interest rate on liquid assets, while the fiscal authority issues government bonds to finance deficits, chooses both the average tax rate in the economy and the tax progressivity, and makes expenditures.
We assume that monetary policy sets the nominal interest rate following a Taylor-type (1993) rule with interest rate smoothing:

$$\frac{R^b_{t+1}}{\bar{R}^b} = \left(\frac{R^b_t}{\bar{R}^b}\right)^{\rho_R} \left(\frac{\pi_t}{\bar{\pi}}\right)^{(1-\rho_R)\theta_\pi} \left(\frac{Y_t}{Y^*_t}\right)^{(1-\rho_R)\theta_Y} \epsilon^R_t. \tag{23}$$

The coefficient $\bar{R}^b \geq 0$ determines the nominal interest rate in the steady state. The coefficients $\theta_\pi, \theta_Y \geq 0$ govern the extent to which the central bank attempts to stabilize inflation and the output gap, where the gap, $\frac{Y_t}{Y^*_t}$, is defined relative to what output would be at stationary equilibrium markups, Y^*_t. $\rho_R \geq 0$ captures interest rate smoothing.
The government follows a simple rule for government spending that reacts to government debt and output deviations from steady-state:

$$\frac{G_t}{\bar{G}} = \left(\frac{G_{t-1}}{\bar{G}}\right)^{\rho_G} \left(\frac{B_t}{\bar{B}}\right)^{(1-\rho_G)\theta_{GB}} \left(\frac{Y_t}{\bar{Y}}\right)^{(1-\rho_G)\theta_{GY}} \epsilon^G_t. \tag{24}$$

Besides issuing bonds, the government uses tax revenues T_t, defined below, to finance government consumption, G_t, and interest on debt.
The government sets the average tax rate in the economy according to a similar rule

$$\frac{\tau_t}{\bar{\tau}} = \left(\frac{\tau_{t-1}}{\bar{\tau}}\right)^{\rho_\tau} \left(\frac{B_t}{\bar{B}}\right)^{(1-\rho_\tau)\gamma^\tau_B} \left(\frac{Y_t}{Y^*_t}\right)^{(1-\rho_\tau)\gamma^\tau_Y}. \tag{25}$$

The level parameter of the tax code τ^L_t adjusts such that the average tax rate on income equals this target level:

$$\tau_t = \frac{\mathbb{E}_t\left(w_t n_{it} h_{it} + \mathbb{I}_{h_{it}=0}\Pi^F_t\right) - \tau^L_t \mathbb{E}_t\left(w_t n_{it} h_{it} + \mathbb{I}_{h_{it}=0}\Pi^F_t\right)^{\tau^P_t}}{\mathbb{E}_t\left(w_t n_{it} h_{it} + \mathbb{I}_{h_{it}=0}\Pi^F_t\right)}, \tag{26}$$

where $\mathbb{E}_t$ is the expectation operator, which here gives the cross-sectional average.
The parameter τ^P_t governs the progressivity of the tax schedule evolves accord-

ing to an autoregressive process of order 2:

$$\frac{\tau_t^P}{\bar{\tau}^P} = \left(\frac{\tau_{t-1}^P}{\bar{\tau}^P}\right)^{\rho_{P_1}} \left(\frac{\tau_{t-2}^P}{\bar{\tau}^P}\right)^{\rho_{P_2}} \epsilon_t^P, \tag{27}$$

where ϵ_t^P are shocks to tax progressivity.
Total government tax revenues T_t are then

$$T_t = \tau_t \left(w_t n_{it} h_{it} + \mathbb{I}_{h_{it}\neq 0}\Pi_t^U + \mathbb{I}_{h_{it}=0}\Pi_t^F\right)$$

and the government budget constraint determines government deficits residually.

4.4 Goods, bonds, capital, and labor market clearing

The labor market clears at the competitive wage given in (17). The bond market clears whenever the following equation holds:

$$B_{t+1} = B^d(R_t^b, A_t, r_t, q_t, \Pi_t^F, \Pi_t^U, w_t, \pi_t, \tau_t, \tau_t^P, \tau_t^L, \Theta_t, \mathbb{W}_{t+1}) := \mathbb{E}_t\left[\lambda b_{a,t}^* + (1-\lambda) b_{n,t}^*\right], \tag{28}$$

where $b_{a,t}^*, b_{n,t}^*$ are functions of the states (b, k, h), and depend on how households value asset holdings in the future, $\mathbb{W}_{t+1}(b, k, h)$, and the current set of prices (and tax rates) $(R_t^b, A_t, r_t, q_t, \Pi_t^F, \Pi_t^U, w_t, \pi_t, \tau_t, \tau_t^P, \tau_t^L)$. Future prices do not show up because we can express the value functions such that they summarize all relevant information on the expected future price paths. Expectations in the right-hand-side expression are taken w.r.t. the distribution $\Theta_t(b, k, h)$. Equilibrium requires the total *net* amount of bonds the household sector demands, B^d, to equal the supply of government bonds. In gross terms there are more liquid assets in circulation as some households borrow up to $\underline{B}$.
Last, the market for capital has to clear:

$$K_{t+1} = K^d(\cdot) := \mathbb{E}_t[\lambda k_t{}^* + (1-\lambda)k], \tag{29}$$

this defines the aggregate supply of funds from households—both those that trade capital, λk_t^*, and those that do not, $(1-\lambda)k$. Again k_t^* is a function of the current prices and continuation values. The goods market then clears due to Walras' law, whenever labor, bonds, and capital markets clear.

4.5 Equilibrium

A *sequential equilibrium with recursive planning* in our model is a sequence of policy functions $\{x^*_{a,t}, x^*_{n,t}, b^*_{a,t}, b^*_{n,t}, k^*_t\}$, a sequence of value functions $\{V^a_t, V^n_t\}$, a sequence of prices $\{w_t, w^F_t, \Pi^F_t, \Pi^U_t, q_t, r_t, R^b_t, \pi_t, \pi^W_t, \tau_t, \tau^P_t, \tau^L_t\}$, a sequence of shocks $\epsilon^D_t, \epsilon^P_t$, aggregate capital and labor supplies $\{K_t, N_t\}$, distributions Θ_t over individual asset holdings and productivity, and expectations Γ for the distribution of future prices, such that

1. Given the functionals $\mathbb{E}_t \mathbb{W}_{t+1}$ for the continuation value and period-t prices, policy functions $\{x^*_{a,t}, x^*_{n,t}, b^*_{a,t}, b^*_{n,t}, k^*_t\}$ solve the households' planning problem; and given the policy functions $\{x^*_{a,t}, x^*_{n,t}, b^*_{a,t}, b^*_{n,t}, k^*_t\}$ and prices, the value functions $\{V^a_t, V^n_t\}$ are a solution to the Bellman equation (11).

2. Distributions of wealth and income evolve according to households' policy functions.

3. The labor, the final goods, the bond, the capital, and the intermediate goods markets clear in every period, interest rates on bonds are set according to the central bank's Taylor rule, fiscal policies are set according to the fiscal rules, and stochastic processes evolve according to their law of motion.

4. Expectations are model consistent.

5 Calibration and Estimation

The estimation of the model follows a two-step procedure: First, we calibrate all parameters that affect the steady state of the model. Second, we estimate by Bayesian limited-information methods (concretely, this is by IRF matching, see Christiano et al., 2010) all parameters that only matter for the dynamics of the model, i.e., the shocks to aggregate capital destruction and tax progressivity, as well as real and nominal frictions, and policy rules. Table 2 summarizes the calibrated parameters and the calibration targets, and Table 3 lists the estimated parameters. One period in the model refers to a year and Section 2.1 describes our sample.

Following the literature on the history of wars and inequality, we view war as a composite of very persistent underlying economic shocks, from which the economy recovers only very slowly (Piketty, 2014; Scheidel, 2018). We estimate the model to uncover the underlying economic shocks.

Table 2: Calibration (Annual Frequency)

Parameter	Value	Description	Target
Households: Income Process			
ρ_h	0.90	Persistence labor income	Storesletten et al. (2004)
σ_h	0.10	STD labor income	Storesletten et al. (2004)
ι	25.00%	Trans.prob. from E. to W.	Guvenen et al. (2014)
ζ	0.11%	Trans.prob. from W. to E.	Top 1% wealth share, 27%
Households: Preferences			
ξ	2.00	Relative risk aversion	Standard value
γ	2.00	Inverse of Frisch elasticity	Chetty et al. (2011)
β	0.96	Discount factor	Capital to output, $K/Y = 3.23$
λ	8.00%	Portfolio adj. prob.	Public debt, $B/Y = 0.56$
$\bar{R}$	8.00%	Borrowing penalty	Private debt $IOUs/Y = 0.21$
Firms			
α	0.66	Share of labor	Standard value
δ_0	7.50%	Depreciation rate	Standard value
$\bar{\eta}$	11	Elasticity of substitution	Price markup 10%
$\bar{\zeta}$	40	Elasticity of substitution	Wage markup 2.5%
Government			
τ	0.33	Tax rate level	Gov.'t expend. share, $G/Y = 22\%$
$\bar{R^b}$	1.00	Nominal rate	Growth $\approx$ interest rate,
$\bar{\pi}$	1.00	Inflation	Indexation

5.1 Calibration

For the steady state, we match 4 targets (relative to annual output): (1) average illiquid assets ($K/Y = 3.2$), (2) public liquidity ($B/Y = 0.56$), (3) private liquidity ($IOU/Y = 0.21$), and (4) the average top 1 percent share of wealth, which is 27 percent. This yields a discount factor of 0.96, a portfolio adjustment probability of 8.0 percent, a borrowing penalty of 8.0 percent (given a borrowing limit of one-time average annual income), and a transition probability from worker to entrepreneur of 0.11 percent.

We fix the other steady-state parameters following the literature; see Table 2. For the household side, the relative risk aversion is set to 2. The Frisch elasticity is set to 0.5; see Chetty et al. (2011). We take estimates for idiosyncratic income risk from Storesletten et al. (2004), and set $\rho_h = 0.9$ and $\sigma_h = 0.1$. Guvenen et al. (2014) provide the probability that a household will fall out of the top 1 percent of the income distribution in a given year, which represents the transition probability

from entrepreneur to worker, $\iota = 25$ percent.
For the firm side, we use standard values. The labor share in production, α, is set to 66 percent, The depreciation rate is 7.5 percent per year. An elasticity of substitution between differentiated goods of 11 yields a markup of 10 percent. The elasticity of substitution between labor varieties is set to 40, yielding a wage markup of 2.5 percent.
The tax rate, τ, is set to clear the government budget constraint that corresponds to a government share of $G/Y = 22$ percent. Steady-state inflation is set to zero as there is indexation to it in the Phillips curves. The steady-state net interest rate on bonds is set to 0.0 percent to capture the average federal funds rate relative to nominal output growth over 1947 – 2019.

5.2 Estimation

We follow Christiano et al. (2010) in employing a Bayesian variant of the Christiano et al. (2005)-type impulse response matching approach. The idea is to treat the empirical impulse responses $\hat{\psi}$ as "data" and to choose parameters ϑ to make the model impulse responses $\psi(\vartheta)$ as close as possible to $\hat{\psi}$. Christiano et al. (2010) refer to this strategy as a "limited information Bayesian approach". The Bayesian log posterior is then given by

$$\log f(\vartheta|\psi) \propto -\frac{1}{2}\left(\hat{\psi} - \psi(\vartheta)\right)' W \left(\hat{\psi} - \psi(\vartheta)\right)' + \log p(\vartheta) \,, \tag{30}$$

where W is a weighting matrix and $p(\vartheta)$ denotes the priors on ϑ.
The vector $\hat{\psi}$ stacks a selection of the empirical impulse responses at all horizons shown in Figure 1 and 2. Following common practice in the impulse-response-matching literature (Christiano et al., 2005, 2010), we use a diagonal weighting matrix W, where the diagonal entries are 1 divided by the squared standard error of the respective empirical impulse response.

6 Simulation Results

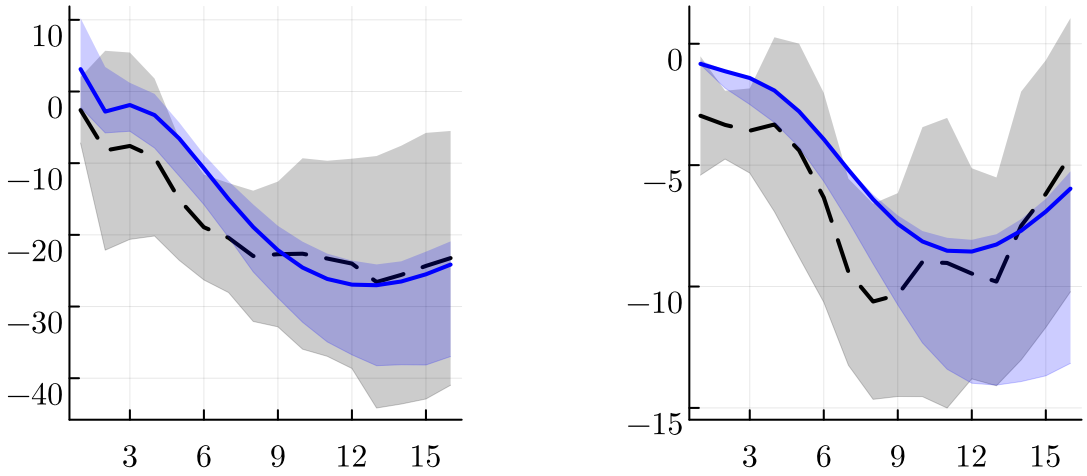
This section examines the aggregate and distributional effects of wars through the lens of our HANK model. First, we show that the estimated model is consistent with the target evidence from the local projections in section 3. We then use the model to examine the transmission channels and conduct counterfactual analysis.

Table 3: Prior and Posterior Distributions of Estimated Parameters

Parameter		Prior		Posterior			
	Distribution	Mean	Std. Dev.	Mean	Std. Dev.	5 %	95 %
Capital Destruction Shock							
ρ_{D*}	Beta	0.50	0.20	0.97	0.01	0.95	0.98
ρ_{D2}	Normal	0.00	0.50	-0.95	0.03	-0.99	-0.90
σ_D	Inv.-Gamma	1.00	2.00	4.04	0.46	3.43	4.97
Tax Progressivity Shock							
ρ_{P*}	Beta	0.50	0.20	0.94	0.02	0.91	0.98
ρ_{P2}	Normal	0.00	0.50	-0.76	0.09	-0.92	-0.62
σ_P	Inv.-Gamma	1.00	2.00	23.85	9.65	9.36	40.72
Real and Nominal Frictions							
δ_s	Gamma	5.00	2.00	0.37	0.11	0.20	0.57
ϕ	Gamma	4.00	2.00	3.77	0.81	2.57	5.38
κ	Gamma	0.10	0.02	0.19	0.03	0.12	0.24
κ_w	Gamma	0.10	0.02	0.09	0.02	0.05	0.12
$SHIFT_\pi$	Beta	0.00	0.50	0.45	0.16	0.18	0.71
Monetary and Fiscal Policy Rules							
ρ_R	Beta	0.75	0.20	0.93	0.02	0.90	0.96
θ_π	Normal	1.70	0.30	1.53	0.10	1.31	1.68
θ_Y	Normal	0.13	0.05	0.16	0.04	0.09	0.24
ρ_G	Beta	0.5	0.20	0.54	0.20	0.19	0.85
γ_{YG}	Normal	0.00	1.00	0.04	0.33	-0.48	0.57
γ_{BG}	Normal	0.00	1.00	0.09	0.04	0.04	0.16
ρ_τ	Beta	0.5	0.20	0.56	0.18	0.21	0.82
$\gamma_{Y\tau}$	Normal	0.00	1.00	-0.23	0.16	-0.48	0.08
$\gamma_{B\tau}$	Normal	0.00	1.00	0.61	0.28	0.22	1.15

Notes: To estimate the AR(2)-processes for shocks to capital depreciation and tax progressivity, we estimate $\rho_{D*/P*} = \rho_{D1/P1} + \rho_{D2/P2}$ in addition to $\rho_{D2/P2}$. The standard deviation of both shocks is expressed in percent.

Figure 5: Local Projection vs. Model: Inequality



(a) Top 1 Income Share

(b) Top 1 Wealth Share

Notes: IRFs from the estimated model. Blue solid line: Baseline model estimated via IRF-matching, HANK-2. Black dashed line: Local-projection estimates. Gray shaded areas: 90 percent confidence bounds based on Newey and West (1987)-standard errors; blue shaded areas: 90 percent bands based on simulating 10,000 sets of IRFs using posterior draws. Y-axis: Percent deviation from steady state. X-axis: Years.

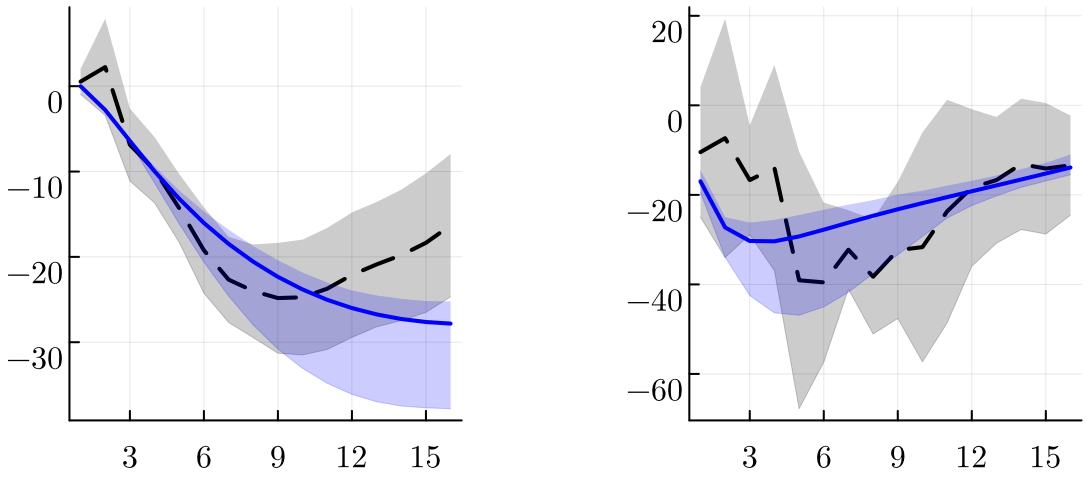
Figure 6 (blue solid lines) shows the impulse responses to a capital destruction and tax progressivity shock in the estimated model along with the six local projection IRFs to which the model is matched (black dashed lines): capital stock, top marginal tax rate, inflation, output, top 1 wealth and income shares. The estimates follow reasonably closely the responses estimated from the local projections in Section 3. In particular, the model can reproduce the large and persistent decline in income inequality and the simultaneous small response of wealth inequality. The two exogenous shocks are disciplined by our measures of capital destruction and increases in top marginal tax rates.

We can study the transmission channels in the model with heterogeneous households by writing aggregate outcomes as functions of a sequence of household policy functions induced by equilibrium prices $\{\Omega_t\}_{t\geq 0}$, with $\Omega_t = \{R_t^b/\pi_t, q_t, r_t, w_t, \Pi_t^U, \Pi_t^F, \tau_t, \tau_t^P\}$:

$$B_t(\{\Omega_t\}_{t\geq 0}) = \int [\nu b_t^a(b,k,h;\{\Omega_t\}_{t\geq 0}) + (1-\nu) b_t^n(b,k,h;\{\Omega_t\}_{t\geq 0})] d\Theta_t,$$

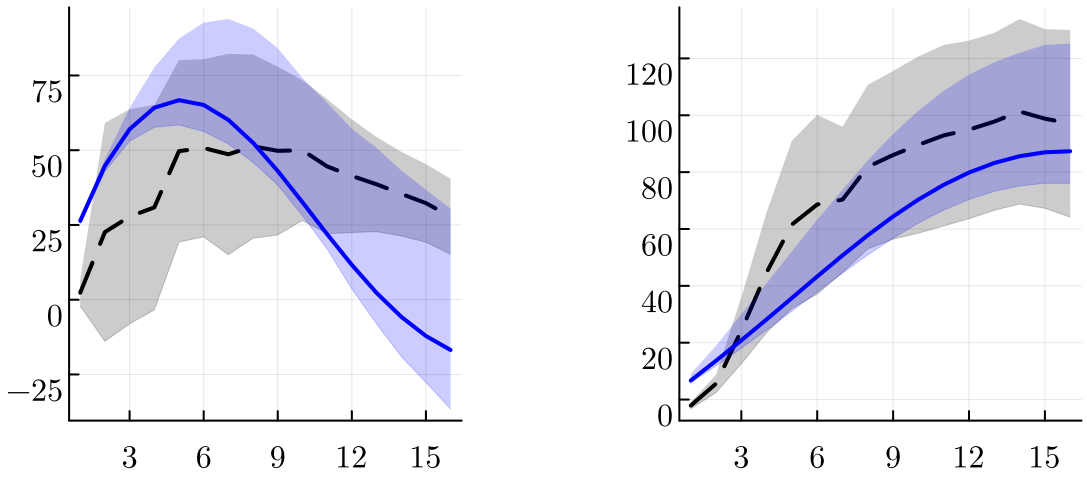
$$K_t(\{\Omega_t\}_{t\geq 0}) = \int [\nu k_t^a(b,k,h;\{\Omega_t\}_{t\geq 0}) + (1-\nu) k^n(b,k,h)] d\Theta_t,$$

Figure 6: Local Projection vs. Model: Driving Forces



(a) Capital Stock

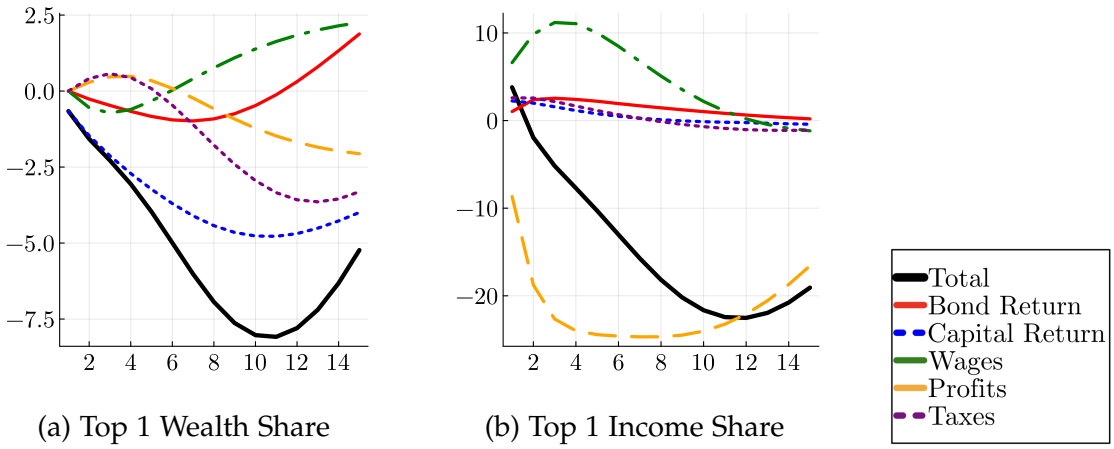
(b) Capital to Labor Share



(c) Top Marginal Tax Rate

(d) Price Level

Notes: IRFs from the estimated model. Blue solid line: Baseline model estimated via IRF-matching, HANK-2. Black dashed line: Local-projection estimates. Gray shaded areas: 90 percent confidence bounds based on Newey and West (1987)-standard errors; blue shaded areas: 90 percent bands based on simulating 10,000 sets of IRFs using posterior draws. Y-axis: Percent deviation from steady state. X-axis: Years.



(a) Top 1 Wealth Share (b) Top 1 Income Share

Figure 7: Inequality Decomposition

Notes: IRFs from estimated model. Y-axis: Percent deviation from steady state. X-axis: Years.

where $\Theta_t(db, dk, dh; \{\Omega_t\}_{t\geq 0})$ is the joint distribution of liquid and illiquid assets and idiosyncratic income. Totally differentiating both functions decomposes the total response to exogenous shocks into the parts explained by each of the prices; see Auclert (2019) and Kaplan et al. (2018).

Figure 7 shows the decomposition of the distributional consequences of wars into equilibrium prices and price responses. The large and persistent decline in the top-1 income share is driven by a persistent decline in corporate profits by some 40%, an important source of income for top income earners. In terms of underlying mechanism, note that profits decline because firms' markups decline—the model generates a pro-cyclical markup response to the capital depreciation shocks, consistent with observations by Nekarda and Ramey (2020).[20] This effect is amplified in the present model because wages are less sticky than prices and, hence, increase more strongly in response to the shock. This, too, is consistent with the response of prices and wages to the war shock (Figure D.19a), even though we have not used it to calibrate the model (external validation). Anecdotal evidence Okazaki (1992), who studies price controls in Japan, shows that this was often a goal of wartime price controls that were introduced for *'making producers bear sacrifices to cover the rise in production costs'*.[21] We also show directly that profits decline after wars below. In modern data, Auray et al. (2024) similarly find that the rise in markups in France since 1980 generate rising

[20] In particular, they provide evidence for a procyclical response of markups to a TFP shock, consistent with the basic New Keynesian model. They stress however, that this model predicts a countercyclical markup response to demand shocks which is at odds with the evidence.

[21] Similarly, the goal of the U.K.'s prices of goods act was to *'freeze sellers net pre-war income'* (Earley and Lacy, 1942, p. 166).

top 1 pre-tax income shares (taking markups as exogenous).
As we estimate in the data, top wealth shares fall less than top income shares. The driving force for the top wealth shares however differs markedly from the top income share. The model identifies capital returns as well as taxation to be key for the decline in top wealth shares. Low capital returns are a key feature of macroeconomic disasters, such as wars (see table B.4 for asset returns in the wars in our sample). These hit primarily the owners of capital. On the other hand, taxes also contribute by reducing the post-tax income out of which the wealthy accumulate their fortunes. This mechanism is outlined in Piketty (2003), we show here that it also exists in our quantitative macroeconomic model.

6.1 External Validation of the Model Mechanism

The HANK model suggests that falling profits are a key source of the decline in inequality. Do profits decline in wartime? During wars, many contemporaries condemned war profiteering based on examples of large profits in individual corporations. However, little is known whether war decreases profits in general. To answer this, we construct historical data on war profits for the countries in our sample. We show that systematically war *decreases* firm profits.
Our investigation builds on important efforts by historians who have studied the question of war profiteering during specific wars (for instance, Baten and Schulz (2005) and Spoerer (1996) for Germany). In some cases, we can rely on those existing series, while in other cases we construct data on profits directly from primary sources. The data we construct is detailed in section D.1, which includes the full profit series for each country. When constructing profits, we aim to maximize our coverage of companies.[22] However, this is not possible in all cases, so in some countries we are only able to cover a subset of firms, such as listed corporations. Table 4 shows real profits in the sample of war sites that we cover. Because the time series is considerably shorter and profit concepts are not always comparable across countries, we do not estimate local projections but normalize real profits to 100 in an initial year and show the evolution of real profits over time. For the sake of clarity, we set the initial year to be the same across countries, note however that our estimation in section 3 starts when the country becomes a war site.
Before the start of the war, there is some evidence of rising profits during the military buildups (Spoerer, 1996). However, this is quickly reversed, so that in

[22]When available, we use profits after taxes, as only income after the corporate tax is recorded in income tax tabulations.

Table 4: Index of Profits and Profits relative to GDP

WW2	1935	1938	1941	1944	1949	1952
Finland	67.4	100.0	94.5	64.3	56.1	51.9
over GDP	*87.3*	*100.0*	*98.0*	*53.0*	*39.0*	*26.0*
France	75.6	100.0	61.1	–8.3	115.5	124.6
over GDP	*99.8*	*100.0*	*87.3*	*–16.4*	*88.5*	*80.9*
Germany	61.2	100.0	81.3		2.1	15.8
over GDP	*82.8*	*100.0*	*58.1*		*3.2*	*16.1*
Japan	59.3	100.0	149.3	186.0	33.9	94.2
over GDP	*73.7*	*100.0*	*119.0*	*131.7*	*55.1*	*96.0*
Netherlands		100.0	138.0	16.0		
over GDP		*100.0*	*202.6*	*44.9*		
UK	68.7	100.0	95.4	71.6	96.3	110.6
over GDP	*75.6*	*100.0*	*80.7*	*58.6*	*78.8*	*89.0*
WW1	1911	1913	1915	1917	1919	1919
France	71.1	100.0	21.7	59.6	58.2	65.2
over GDP	*78.2*	*100.0*	*23.9*	*73.6*	*77.3*	*76.9*
Germany		100.0	76.0	41.0		
over GDP		*100.0*	*89.6*	*51.9*		

Notes: This table shows real profits during the wars in our sample. For each war, we construct an index of real profits that is equal to 100 in the year given in the table. Then, in the next rows, we show the respective indices when dividing by an index of real GDP, so that profits are falling relative to GDP if the figure is lower than 100. Details on the data are in section D.1. Note that in Germany we cannot construct an index of real profits in WW2, so instead we show an index for the return on equity. For WW1 in Germany, we show 'medium war-related industries' in the data of Baten and Schulz (2005).

all countries in our sample, real profits fall strongly during the wars and their immediate aftermaths. This decline is pronounced, in most economies profits drop by more than 25% of their initial level. The largest drops are found in France, Germany and Japan after World War 2, when profits decline by more than 50%, and even turn negative in the case of France. Importantly, this is not just a function of the general decline in economic activity during wars. We divide each index of profits by an index of real GDP to show that profits fall by a greater extent than general economic activity. In many countries (such as the U.K. or France), the decline in profits becomes even larger when measured against general economic activity.

In practice, in wars, input costs of firms increased starkly due to a shortage of raw materials and labor. Governments then intervened in private markets

to keep rising profits in check, often through price controls, which our model captures through the stickiness of prices.[23] An alternative way of validating this mechanism is by studying dividends of listed firms. If all firm earnings are payed out to shareholders, these coincide with profits. We construct the real dividend flow to shareholders across countries and show the impulse response in Figure D.19b. Real dividends also fall strongly, by up to 150%, after wars. Together, this evidence suggests that wars markedly reduce firm profits, validating the key mechanism in our quantitative model.

7 Conclusion

This paper provides a comprehensive analysis of the distributional impacts of war, covering both income and wealth inequality. We show that war is indeed a great leveler, but mostly when it comes to income inequality in war sites. For wealth inequality, the impact of wars are less apparent.

We study these facts jointly, both through a partial equilibrium framework, in which we can characterize the impact of wars on income and wealth inequality analytically as well as in general-equilibrium HANK model. Our analysis highlights the role of capital destruction, which wiped out a large source of earnings for the top of the distribution. On the other, hand, wealth inequality remains relatively less affected, as the differential destruction of wealth across the distribution is limited.

War is now back on the international agenda, with the Russian full scale invasion of Ukraine dominating headlines since 2022. While the long-run impact on inequality is not yet clear, preliminary studies find that in both countries, one consequence has been a reduction in the economic standing of 'oligarchs'. The mechanisms we outline continue to be at play more than 70 years after the world wars: Several Ukrainian oligarchs have seen their assets destroyed, wages are rising strongly, and a governments in both countries enacting policies to curtail corporate profits[24]– indeed it appears that war continues to have large effects on top business owners, even in the 21st century.

[23] See Banken (2018); Okazaki (1992); Howlett (2004) for case studies of Germany, Japan and the U.K.. Piketty and Saez (2003) also find a large reduction in business income in the U.S. in World War 2.

[24] For sources see here, here and here.

References

Aaberge, R. and A. B. Atkinson (2010). Top incomes in norway. *Top incomes: A global perspective 2*, 448–480.

Albers, T., C. Bartels, and M. Schularick (2022). Wealth and its distribution in germany, 1895-2018. *CEPR Discussion Paper No. 17269*.

Alvaredo, F., A. B. Atkinson, and S. Morelli (2018). Top wealth shares in the uk over more than a century. *Journal of Public Economics 162*, 26–47.

Atkinson, A. B. (2007). The distribution of top incomes in the united kingdom 1908-2000. In A. B. Atkinson and T. Piketty (Eds.), *Top Incomes over the Twentieth Century. A Contrast Between Continental European and English-Speaking Countries*, Chapter 4. Oxford University Press.

Auclert, A. (2019). Monetary policy and the redistribution channel. *American Economic Review 109*(6), 2333–67.

Auray, S. and A. Eyquem (2019, August). Episodes of war and peace in an estimated open economy model. *Journal of Economic Dynamics and Control 105*, 203–249.

Auray, S., A. Eyquem, B. Garbinti, and J. Goupille-Lebret (2024). Markups, Taxes, and Rising Inequality.

Banken, R. (2018). *Hitlers Steuerstaat: Die Steuerpolitik im Dritten Reich*. Walter de Gruyter GmbH & Co KG.

Barkai, S. (2020). Declining labor and capital shares. *The Journal of Finance 75*(5), 2421–2463.

Barro, R. J. (2006). Rare Disasters and Asset Markets in the Twentieth Century. *The Quarterly Journal of Economics 121*(3), 823–866.

Bartels, C. (2019). Top incomes in germany, 1871–2014. *The Journal of Economic History 79*(3), 669–707.

Baten, J. and R. Schulz (2005). Making profits in wartime: corporate profits, inequality, and gdp in germany during the first world war 1. *The Economic History Review 58*(1), 34–56.

Bayer, C., B. Born, and R. Luetticke (2024). Shocks, frictions, and inequality in us business cycles. *American Economic Review 114*(5), 1211–1247.

Benabou, R. (2002). Tax and education policy in a heterogeneous-agent economy: What levels of redistribution maximize growth and efficiency? *Econometrica 70*(2), 481–517.

Bengtsson, E. and D. Waldenström (2018). Capital shares and income inequality: Evidence from the long run. *The Journal of Economic History 78*(3), 712–743.

Bergeaud, A., G. Cette, and R. Lecat (2016). Productivity trends in advanced countries between 1890 and 2012. *Review of Income and Wealth 62*(3), 420–444.

Blanchet, T., J. Fournier, and T. Piketty (2022). Generalized pareto curves: theory and applications. *Review of Income and Wealth 68*(1), 263–288.

Boar, C. and V. Midrigan (2019). Markups and inequality.

Bolt, J., R. Inklaar, H. De Jong, and J. L. Van Zanden (2018). Rebasing 'maddison': new income comparisons and the shape of long-run economic development. *GGDC Research Memorandum 174*, 1–67.

Bozio, A., B. Garbinti, J. Goupille-Lebret, M. Guillot, and T. Piketty (2024, April). Predistribution versus redistribution: Evidence from france and the united states. *American Economic Journal: Applied Economics 16*(2), 31–65.

Braun, R. A. and E. R. McGrattan (1993). The macroeconomics of war and peace. *NBER macroeconomics annual 8*, 197–247.

British Information Services (1945). Statistical material presented during the washington negotiations, cmd 6707.

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics 12*(3), 383–398.

Castaneda, A., J. Diaz-Gimenez, and J.-V. Rios-Rull (1998). Exploring the income distribution business cycle dynamics. *Journal of Monetary Economics 42*(1), 93 – 130.

Chetty, R., A. Guren, D. Manoli, and A. Weber (2011). Are micro and macro labor supply elasticities consistent? A review of evidence on the intensive and extensive margins. *The American Economic Review 101*(3), 471–475.

Christiano, L. J., M. Eichenbaum, and C. L. Evans (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy 113*(1), 1–45.

Christiano, L. J., M. Trabandt, and K. Walentin (2010). DSGE models for monetary policy analysis. In B. M. Friedman and M. Woodford (Eds.), *Handbook of Monetary Economics*, Volume 3 of *Handbook of Monetary Economics*, Chapter 7, pp. 285–367. Elsevier.

Cloyne, J., J. Martinez, H. Mumtaz, and P. Surico (2023a). Do tax increases tame inflation? In *AEA Papers and Proceedings*, Volume 113, pp. 377–381. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Cloyne, J., J. Martinez, H. Mumtaz, and P. Surico (2023b). The dynamic effects of income tax changes in a world of ideas. Technical report, Working Paper.

Dell, F. (2007). Top incomes in germany throughout the twentieth century: 1891–1998. *Top Incomes over the Twentieth Century: A Contrast Between Continental European and English Speaking Countries*, 365–425.

Driscoll, J. C. and A. C. Kraay (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics 80*(4), 549–560.

Earley, J. S. and W. S. Lacy (1942). British wartime control of prices. *Law and Contemporary Problems*, 160–172.

Farhi, E. and X. Gabaix (2016). Rare disasters and exchange rates. *The Quarterly Journal of Economics 131*(1), 1–52.

Federle, J., A. Meier, G. J. Müller, W. Mutschler, and M. Schularick (2024). The price of war. Technical report, Kiel Working Paper.

Flora, P. (1983). State, economy, and society in western europe, 1815-1975: a data handbook in two volumes. *(No Title)*.

Gabaix, X. (2012). Variable rare disasters: An exactly solved framework for ten puzzles in macro-finance. *The Quarterly journal of economics 127*(2), 645–700.

Garbinti, B., J. Goupille-Lebret, and T. Piketty (2021). Accounting for wealth inequality dynamics: Methods, estimates and simulations for france. *Journal of the European Economic Association 19*(1), 620–663.

Geloso, V. and P. Magness (2023). A methodologically consistent measure of income inequality in the united states, 1917 to 2020. *Available at SSRN 4532761*.

Geloso, V. J., P. Magness, J. Moore, and P. Schlosser (2022). How pronounced is the u-curve? revisiting income inequality in the united states, 1917–60. *The Economic Journal 132*(647), 2366–2391.

Goldin, C. and R. A. Margo (1992). The great compression: The wage structure in the united states at mid-century. *The Quarterly Journal of Economics 107*(1), 1–34.

Gourio, F. (2012, May). Disaster risk and business cycles. *American Economic Review 102*(6), 2734–2766.

Greenwood, J., Z. Hercowitz, and G. W. Huffman (1988, 06). Investment, capacity utilization, and the real business cycle. *American Economic Review 78*(3), 402–417.

Groote, P., R. Albers, and H. De Jong (1996). A standardised time series of the stock of fixed capital in the netherlands, 1900-1995.

Grytten, O. H. (2004). The gross domestic product for norway, 1830'2003. *Norges Bank: Occasional Papers 1*, 241.

Gutierrez, G. (2017). Investigating global labor and profit shares. *Unpublished Working Paper, SSRN*.

Guvenen, F., G. Kaplan, and J. Song (2014). How risky are recessions for top earners? *The American Economic Review 104*(5), 148–153.

Haffert, L. (2019). War mobilization or war destruction? the unequal rise of progressive taxation revisited. *The Review of International Organizations 14*(1), 59–82.

Harrison, M. (2000). *The economics of World War II: six great powers in international comparison*. Cambridge University Press.

Heathcote, J., K. Storesletten, and G. L. Violante (2017, 06). Optimal Tax Progressivity: An Analytical Framework. *The Quarterly Journal of Economics 132*(4), 1693–1754.

Heldring, L., J. A. Robinson, and P. Whitfill (2022). The second world war, inequality and the social contract in britain. *Economica 89*, S137–S159.

Hjerppe, R. et al. (1989). *The Finnish economy 1860-1985: Growth and structural change*.

Horn, S., C. M. Reinhart, and C. Trebesch (2020). Coping with disasters: two centuries of international official lending. Technical report, National Bureau of Economic Research.

Howlett, P. (2004). The war-time economy, 1939–1945. In R. Floud and P. Johnson (Eds.), *The Cambridge Economic History of Modern Britain, Volume 3: Structural Change and Growth, 1939–2000*, pp. 1–26. Cambridge University Press.

Jordà, Ò., K. Knoll, D. Kuvshinov, M. Schularick, and A. M. Taylor (2019). The rate of return on everything, 1870–2015. *The Quarterly Journal of Economics 134*(3), 1225–1298.

Jordà, Ò., M. Schularick, and A. M. Taylor (2017). Macrofinancial history and the new business cycle facts. *NBER macroeconomics annual 31*(1), 213–263.

Jordà, Ò., S. R. Singh, and A. M. Taylor (2020). The long-run effects of monetary policy. Technical report, National Bureau of Economic Research.

Jordà, Ò., S. R. Singh, and A. M. Taylor (2022). Longer-run economic consequences of pandemics. *Review of Economics and Statistics 104*(1), 166–175.

Kaplan, G., B. Moll, and G. L. Violante (2018). Monetary policy according to hank. *American Economic Review 108*(3), 697–743.

Klemann, H. A. (2002). *Nederland 1938-1948: economie en samenleving in jaren van oorlog en bezetting*. Boom Koninklijke Uitgevers.

Kuvshinov, D. and K. Zimmermann (2022). The big bang: Stock market capitalization in the long run. *Journal of Financial Economics 145*(2, Part B), 527–552.

Mauro, P., R. Romeu, A. Binder, and A. Zaman (2015). A modern history of fiscal prudence and profligacy. *Journal of Monetary Economics 76*, 55–70.

Meade, J. E. (1964). *Efficiency, Equality and the Ownership of Property*. George Allen & Unwin.

Mitchell, B. R. (1988). *British Historical Statistics*. Cambridge University Press.

Moll, B., L. Rachel, and P. Restrepo (2022). Uneven growth: automation's impact on income and wealth inequality. *Econometrica 90*(6), 2645–2683.

Montiel Olea, J. L. and M. Plagborg-Møller (2021). Local projection inference is simpler and more robust than you think. *Econometrica 89*(4), 1789–1823.

Moriguchi, C. and E. Saez (2008). The evolution of income concentration in japan, 1886–2005: evidence from income tax statistics. *The Review of Economics and Statistics 90*(4), 713–734.

Nakamura, E., J. Steinsson, R. Barro, and J. Ursúa (2013, July). Crises and recoveries in an empirical model of consumption disasters. *American Economic Journal: Macroeconomics 5*(3), 35–74.

Nekarda, Christopher, J. and V. A. Ramey (2020). The cyclical behavior of the price-cost markup. *Journal of Money, Credit and Banking 52*(S2), 319–353.

Newey, W. K. and K. D. West (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica 55*(3), 703–708.

Nummela, I. (1993). *Inter arma silent revisores rationum: toisen maailmansodan aiheuttama taloudellinen rasitus Suomessa vuosina 1939-1952*. Number 46. Jyväskylän yliopisto.

Ohkawa, K., M. Shinohara, and M. Umemura (Eds.) (1965–88). *Chōki Keizai Tōkei (Estimates of Long-Term Economic Statistics of Japan)*. Tokyo: Tōyō Keizai Shimpōsha.

Okazaki, T. (1992). *The Japanese firm under the wartime planned economy*. Faculty of Economics, University of Tokyo.

Panon, L. and F. P. Conteduca (2024). Natural disasters and markups. *Available at SSRN*.

Piketty, T. (2003). Income inequality in france, 1901–1998. *Journal of political economy 111*(5), 1004–1042.

Piketty, T. (2011). On the long-run evolution of inheritance: France 1820–2050. *The quarterly journal of economics 126*(3), 1071–1131.

Piketty, T. (2014). *Capital in the twenty-first century*. Harvard University Press.

Piketty, T. (2018). *Top incomes in France in the twentieth century: Inequality and redistribution, 1901–1998*. Harvard University Press.

Piketty, T. and E. Saez (2003). Income inequality in the united states, 1913–1998. *The Quarterly journal of economics 118*(1), 1–41.

Piketty, T. and E. Saez (2014). Inequality in the long run. *Science 344*(6186), 838–843.

Piketty, T. and G. Zucman (2014). Capital is back: Wealth-income ratios in rich countries 1700–2010. *The Quarterly journal of economics 129*(3), 1255–1310.

Ramey, V. A. and M. D. Shapiro (1998, June). Costly capital reallocation and the effects of government spending. *Carnegie-Rochester Conference Series on Public Policy 48*, 145–194.

Ramey, V. A. and S. Zubairy (2018). Government spending multipliers in good times and in bad: evidence from us historical data. *Journal of political economy 126*(2), 850–901.

Roikonen, P. (2022). Income inequality in finland, 1865–2019. *Scandinavian Economic History Review 70*(3), 234–251.

Roine, J. and D. Waldenström (2015). Long-run trends in the distribution of income and wealth. *Handbook of income distribution 2*, 469–592.

Ryland, T. and N. Dimsdale (2017). A millennium of macroeconomic data. bank of england research dataset.

Saez, E., J. Slemrod, and S. H. Giertz (2012). The elasticity of taxable income with respect to marginal tax rates: A critical review. *Journal of economic literature 50*(1), 3–50.

Saez, E. and G. Zucman (2016a). Wealth inequality in the united states since 1913: Evidence from capitalized income tax data. *The Quarterly Journal of Economics 131*(2), 519–578.

Saez, E. and G. Zucman (2016b). Wealth inequality in the united states since 1913: Evidence from capitalized income tax data. *The Quarterly Journal of Economics 131*(2), 519–578.

Saez, E. and G. Zucman (2022). Wealth taxation: lessons from history and recent developments. In *AEA Papers and Proceedings*, Volume 112, pp. 58–62. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Salverda, W. and A. B. Atkinson (2007). Top incomes in the netherlands over the twentieth century. In A. B. Atkinson and T. Piketty (Eds.), *Top Incomes over the Twentieth Century. A Contrast Between Continental European and English-Speaking Countries*, Chapter 10. Oxford University Press.

Scheidel, W. (2018). *The Great Leveler*. Princeton University Press.

Scheidel, W. (2024). Inequality reduction between tragedy and progress: The great leveler and recent scholarship, 2017-2024.

Scheve, K. and D. Stasavage (2018). *Taxing the Rich*. Princeton University Press.

Sentralbyrå, S. (1949). *Statistiske oversikter 1948: Statistical Survey 1948*. Oslo: Statistics Norway.

Smith, M., O. Zidar, and E. Zwick (2023). Top wealth in america: New estimates under heterogeneous returns. *The Quarterly Journal of Economics 138*(1), 515–573.

Song, Z., G. Hochman, and G. Timilsina (2023). Natural disaster, infrastructure, and income distribution. *Development Research*.

Spoerer, M. (1996). *Von Scheingewinnen zum Rüstungsboom*. Franz Steiner Verlag.

Statistics Bureau of Japan (1949 – 2023). *Japan Statistical Yearbook*. Statistics Bureau of Japan.

Statistics Finland (1900 –). *Statistical Yearbook of Finland*. Statistics Finland.

Statistisches Bundesamt (1949-55). *Die Abschlüsse der Aktiengesellschaften*. Stuttgart: Kohlhammer.

Stock, J. H. and M. W. Watson (2018, May). Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments. *The Economic Journal 128*(610), 917–948.

Storesletten, K., C. I. Telmer, and A. Yaron (2004, June). Cyclical dynamics in idiosyncratic labor market risk. *Journal of Political Economy 112*(3), 695–717.

Taylor, J. B. (1993). Discretion versus policy rules in practice. In *Carnegie-Rochester Conference Series on Public Policy*, Volume 39, pp. 195–214. Elsevier.

Toussaint, S., A. de Vicq de Cumptich, M. Moatsos, and T. van der Valk (2022). Household wealth and its distribution in the netherlands, 1854-2019. *World Inequality Lab Working Paper 19*.

Ursùa, J. F. and R. J. Barro (2010). Barro-ursua macroeconomic data.

Vélez, J. L. (2014). War and progressive income taxation in the 20th century. *University of California, Berkeley Working Paper*.

Villa, P. (1994). *Un siècle de données macroéconomiques*, Volume 303-304 of *Insee Résultats*. Insee.

Waldenström, D. (2024). *Richer and More Equal: A New History of Wealth in the West*. Polity.

Wolff, E. N. (1991). Capital formation and productivity convergence over the long term. *The American Economic Review*, 565–579.

A Appendix: Data and Methodology

In this section, we describe in detail the data sources used in the paper.

A.1 Inequality Data

Table A.1 provides a list of instances where we use a series other than the WID baseline series. As explained in the text, this is done to make use of historical series that cover a longer time horizon in some countries.

Table A.1: Summary of Top Income Data

Country	Source	Variable	Period	Unit	Concept
UK	Atkinson (2007)	Top 10, 1	1918-2009	Family -1989, Individuals age 15+ post 1989	Fiscal Inc
Netherlands	Salverda and Atkinson (2007)	Top 10, 1	1914-2012	Tax Unit	Fiscal Inc
Germany	Bartels (2019)	Top 10, 1	1871-2014	Tax Unit	Fiscal Inc
Japan	Moriguchi and Saez (2008)	Top 10, 1	1886-2005	Individuals	Fiscal Inc
Finland	Roikonen (2022)	Top 1	1865-2017	Tax Unit	Fiscal Inc
Norway	Aaberge and Atkinson (2010)	Top 1	1875-2017	Individuals	Fiscal Inc

Notes: This table presents every country in which we deviate from the baseline WID income concept, alongside with the period the series covers, the unit of observation (Individual, Tax unit etc.) and the income concept as denoted in WID. The reason for the deviation is that using a different income concept allows us to cover a longer time horizon in these countries.

Due to data availability, we can only present results on pre-tax income inequality. In the U.S. and France, for which long-run data on post-tax inequality is available, pre- and post-tax inequality has evolved similarly after large wars. In figure A.1 we plot pre and post-tax top income shares for these countries. In France, the evolution of pre- and post-tax top income shares in the aftermath of wars, while in the U.S. post-tax top shares drop considerably more than pre-tax top shares. This is likely a function of the larger increase in tax progressivity in the U.S., which did not experience war on its own soil (Haffert, 2019).
Recently, Smith et al. (2023) and Geloso et al. (2022) raise concerns about the measurement of top income and wealth shares in the U.S.. We show below that

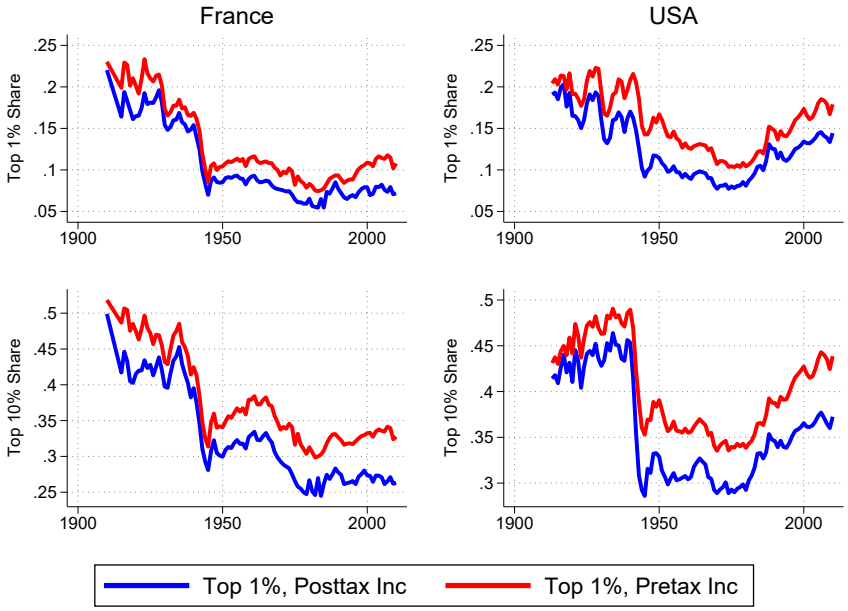


Figure A.1: Pre-and Post Tax Top income shares in France and the U.S.

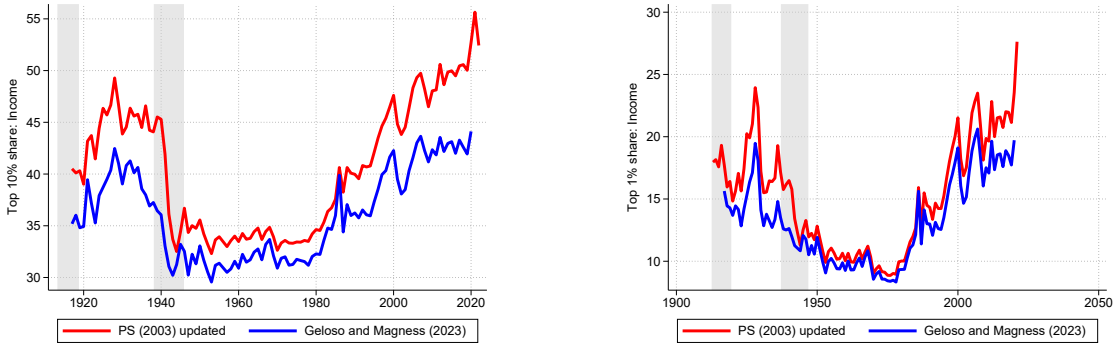
Notes: This figure shows pre- and post-tax top income shares for the U.S. and France. Data is from the World Inequality Database.

these concerns do not affect our result that wars have an important equalizing impact on the income distribution. For the wealth distribution, Smith et al. (2023) only provide a post-war series; moreover the top wealth shares of Smith et al. (2023) and Saez and Zucman (2016b) align closely up to the top 1%, with major differences only at even higher percentiles.
Figure A.2 compares the data of Geloso et al. (2022) with the updated series of Piketty and Saez (2003), which are most comparable in terms of income concept. The main difference between is in the level, with the PS series showing a consistently higher level of inequality. The trends in inequality, which are the primary concern of this paper are relatively similar. The top decile income share drops by around 10pp from 45% to 35% in the PS data and from around 37% to 32% in the GM data, a pronounced fall in both cases. For the top percentile share, a similar smaller wartime leveling is in the GM data.

A.2 Fiscal Data

Tax Progressivity. We approximate the tax-system using the non-linear tax function of Heathcote et al. (2017) and Benabou (2002), which provides a good fit to progressive income tax schedules. Explicitly, household post-tax income y_{post} is calculated from pre-tax income y_{pre} using

$$y_{\text{post}} = (1 - \tau_t^L) y_{\text{pre}}^{1-\tau_t^p}, \tag{31}$$



(a) Top 10 Income Shares

(b) Top 1 Income Shares

Figure A.2: Top Percentile Shares across Data Sources

Notes: This figure compares the evolution of top income shares across data sources. The red line corresponds to the data of Piketty and Saez (2003) (updated to the present) while the blue line corresponds to the data of Geloso and Magness (2023).

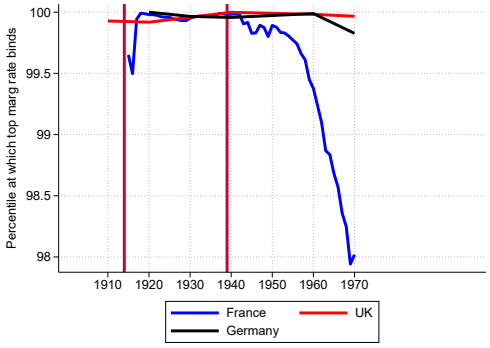
where τ_t^L and τ_t^P determine the level and progressivity of the tax code. In particular, for the top marginal tax rate, this means that the top marginal tax rate is given by

$$(1-\tau_t^P)y^{-\tau_t^P} = \frac{\text{Top MTR}_t - 1}{\tau_t^L}.$$

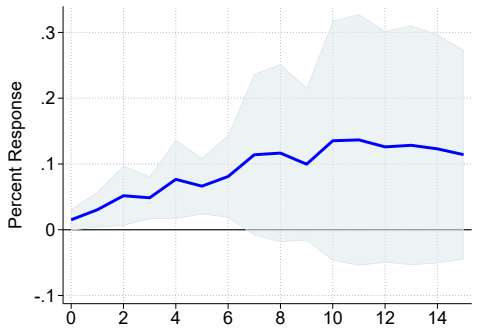
Because historical data on post and pre-tax incomes is limited, we compute the change in tax progressivity directly in the model. To do so, we solve equation 31 for τ_t^P at the top income state in the model.

Implicitly, this assumes that the percentile at which the top marginal tax rate binds is constant before and after wars. We can check this assumption for a few countries. Specifically, we have information on (i) the amount of income at which the top marginal tax rate binds and (ii) various quantiles of the pre-tax income distribution. We apply generalized pareto interpolation (Blanchet et al., 2022) to estimate the quantile of the income distribution at which the top marginal tax rate binds. We find that historically, top marginal tax rates only bind at the very top of the income distribution, so that only the top 0.1 really are affected by this rate. This is consistent with the narrative in Scheve and Stasavage (2018), who characterize historical income tax system and find that they have extremely high top marginal tax rates, which are however only paid by a tiny fraction of the population. Importantly, this fact is unchanged by wars. Figure A.3 shows this explicitly in two ways: First, we show for a number of countries the percentile of the income distribution at which the top marginal tax rate binds. Second, we estimate local projections in which we study how this more formally and also find a small response of the percentile at which the top rate binds to war shocks.

Government Consumption. War implies large increases in government consumption. To capture these accurately, we construct historical data on government consumption across country. This overcomes limitations with existing data



(a) Percentile at which top MTR binds



(b) Response to War Shocks

Figure A.3: Top Marginal Tax Rates along the Distribution

Notes: This figure provides additional information on historical tax schedules. Panel (a) shows the percentile of the income distribution at which the top marginal tax rate binds in three countries in which we have details on the distribution at the top. Panel (b) shows the response of this percentile to war shocks computed using specification 1. The fact that top marginal tax rates bind at a relatively constant percentile around wars means that we can compute tax progressivity well using equation 31.

sources, which only cover government expenditures (Mauro et al., 2015). This includes a number of expenditures that do not directly map into our model, such as interest payments or pension payments.
We construct this data from Flora (1983), who provide more granular data on the composition of public spending. We classify the categories 'defense' and 'Economy and Transport' as government consumption and use this to obtain data on government consumption.[25]

Table A.2: Summary of Government Consumption Data

Country	**Source**	**Notes**
Denmark	Atkinson (2007)	Top 10, 1; 1918–2009
Finland	Hjerppe et al. (1989)	Updated to present
France	Piketty and Zucman (2014)	Top 10, 1
Japan	Ohkawa et al. (88)	Updated to present
Germany	Piketty and Zucman (2014)	
Netherlands	XXX	XXX
Norway	Grytten (2004)	Updated to present
United Kingdom	Ryland and Dimsdale (2017)	

Notes: This table presents the sources for the data on government consumption.

[25]In Finland, France, Japan and the U.K. we use country-specific series providing more detailed coverage by Hjerppe et al. (1989), Villa (1994) and .

A.3 Summary Statistics: Pre and Post War Inequality

This section presents summary statistics on the level of top income and wealth shares pre- and post wars. Table A.3 presents the top shares before and after the wars in our sample. For each war, we show the level of the top shares averaged across the 10 years pre and post-war, together with the changes (in percent and in levels). We further show the average change in the top 1 income and wealth share. As is suggested by our empirical findings, income inequality declines stronger than wealth inequality on average.

Table A.3: Top 1 Shares Pre- and Post-War

		Top 1 Income				**Top 1 Wealth**			
Country	War	Pre	Post	%Change	Delta	Pre	Post	%Change	Delta
Average				**32.41**				**24.52**	
Finland	WW 2	12.50	7.43	40.54	5.07				
France	WW 1	23.02	21.00	8.78	2.02	55.29	48.61	12.08	6.68
France	WW 2	17.25	10.54	38.92	6.71	42.93	31.94	25.60	10.99
Germany	WW 1	18.10	13.09	27.67	5.01	51.42	38.79	24.57	12.63
Germany	WW 2	12.61	9.75	22.68	2.86	35.96	22.01	38.79	13.95
Japan	WW 2	18.22	7.39	59.46	10.83				
Netherlands	WW 2	16.20	13.21	18.43	2.98	39.44	28.71	27.20	10.73
Norway	WW 2	13.62	8.81	35.32	4.81				
UK	WW 2	16.61	9.98	39.88	6.62	55.67	45.16	18.89	10.51

Notes: This table shows the pre- and post war levels of top 1 income and wealth shares for the countries in our sample. For each country, it displays the average top 1 share in the 10 years before and 10 years after the war. Further, it shows the percentage change in the top share as well as the change in the level of the top share. The first row presents the (unweighted) average.

B Appendix: Results

This Appendix supports the results we document in section 3. We provide robustness checks as well as additional results supporting the main text.

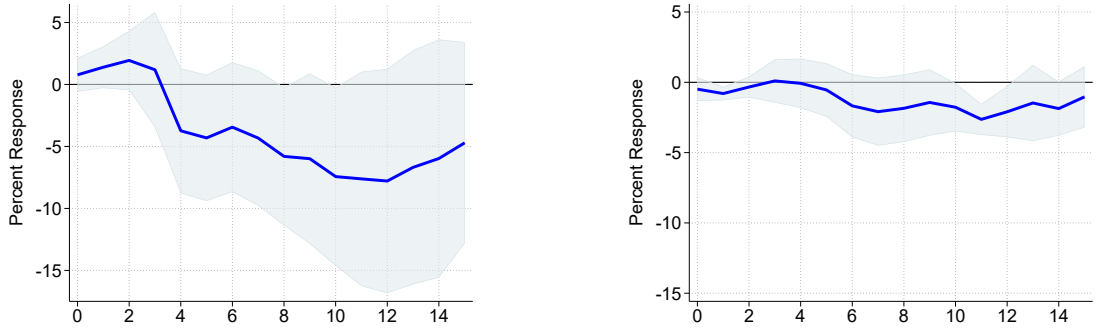
B.1 Additional Outcomes

This section reports a number of additional outcomes to the war shock considered in section 3.

Inequality. In the main text, we focus on inequality as measured using the share of income or wealth that accrues to the top percentile. This is a classic inequality considered for instance in Scheidel (2018) and Piketty (2014). For a number of other countries, we are also able to study inequality not only at the very top but also for the entire upper class.[26] In particular, figure B.4 reports the response of the top *decile* share of income and wealth to the war shock. We

[26]Doing so shrinks our sample slightly, because there are a few countries, for which we only have top 1 shares.

find a similar picture to the top percentile when comparing income and wealth: Income inequality drops following the war shock, but wealth inequality remains insulated.



(a) Top 10 Income

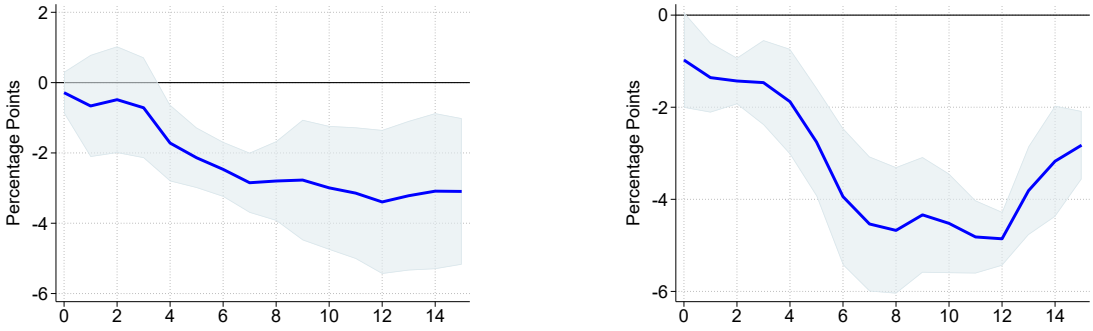
(b) Top 10 Wealth

Figure B.4: Response of Top Ten Income and Wealth Shares

Notes: This figure displays the response of the top 10 income and wealth share to the onset of war. Impulse responses are computed using specification 1 using the start of war as in table 1 as a shock in specification 1. Shaded areas indicate 90% confidence intervals.

Next, in figure B.5, we report the response of top income and wealth shares measured in percentage points. Our findings confirm those from the main text. Top income shares decline, by up to 3pp for the top 1 income share and around 2pp for the top 10 income share. For the top 10 wealth share we find a decline of also around 2 pp, while the top 1 wealth share declines by around 5pp. The effects reported in the main text for the top 1 shares are stronger for income than for wealth. The reason is that in levels, top wealth shares are much higher than top income shares – historically, the top 1 wealth share is more than twice as large the top 1 income share, and often even around 3-4 times as large (Roine and Waldenström, 2015). Top percentile wealth shares range from 20 to up to 60% (historically) across countries, while top percentile income shares range from 5-15%. Therefore, a given decline (in percentage points) in top income shares corresponds to a larger decline in inequality than a decline to the same extent in the top wealth share.

Macroeconomic Aggregates and Asset Prices. We first focus on the response of asset returns, which also drop sharply during wars (Barro, 2006; Jordà et al., 2019). Both safe and risky assets perform poorly and earn negative returns during war times. Perhaps surprisingly, safe assets (bills and bonds) perform worse than risky assets (equity and housing). This is due to wartime inflation, which erodes the value of safe and nominal assets. However, for both asset classes, wartime returns are far below their long-run average of 1-3 % (safe assets) (resp. 7-8% on risky assets). The fact that equity returns are low is consistent with our channel of falling profits during war times. The fact that equity returns are low is consistent with our channel of falling profits during war times.



(a) Top 1 Income Share, P.P

(b) Top 1 Wealth Share, P.P

Figure B.5: Top 1 Income and Wealth Share in Percentage Points

Notes: This figure displays the response of top income and wealth shares in percentage points (i.e. not log-transformed) to the onset of war. Impulse responses are computed using specification 1 using the start of war as in table 1 as a shock in specification 1. Shaded areas indicate 90% confidence intervals.

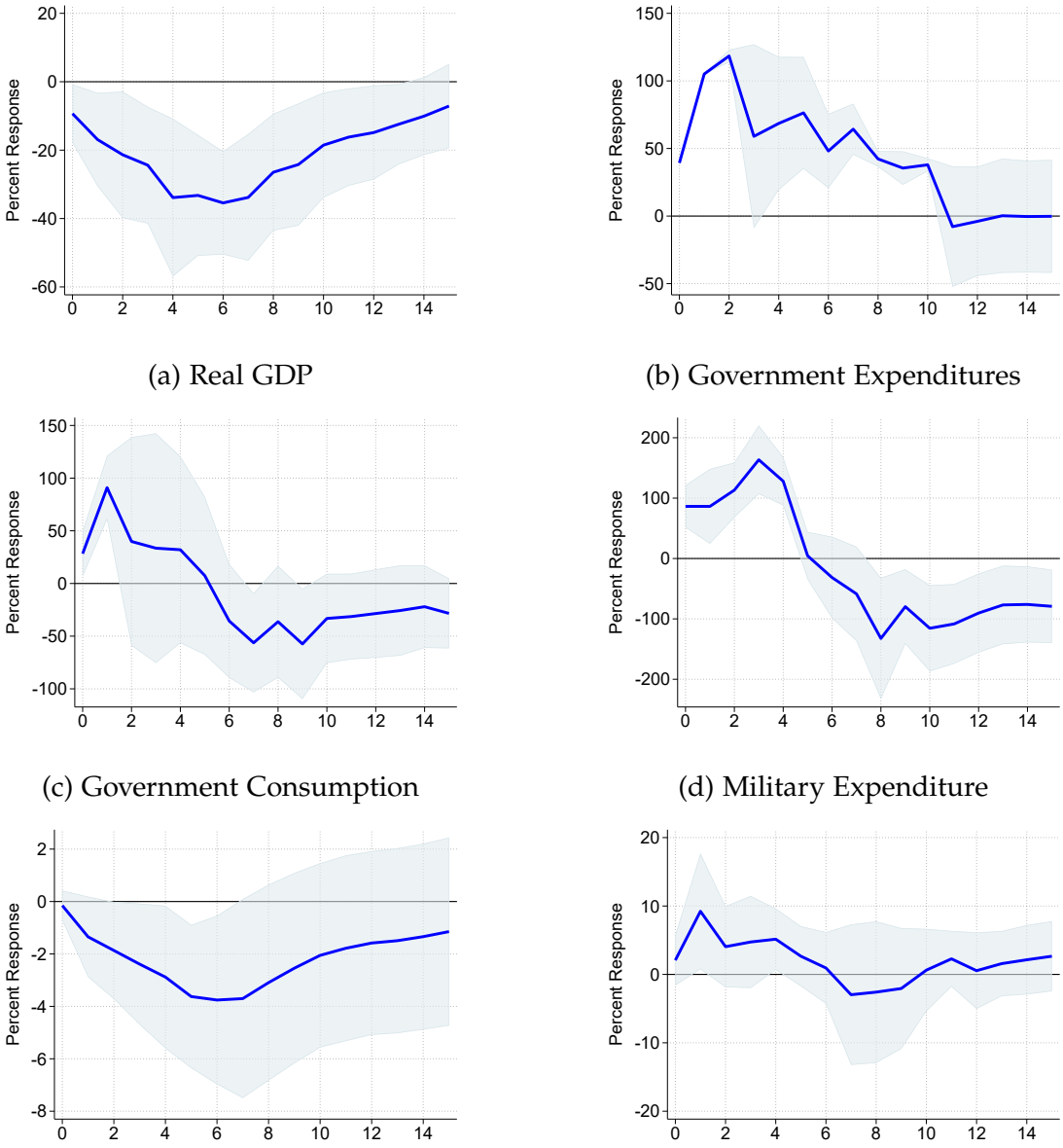
Table B.4: Asset Returns in War Sites

	Arithmetic Mean		Geometric Mean	
Asset	Real Returns	Nominal Returns	Real Returns	Nominal Returns
Bills	–11.75	2.82	–15.44	2.81
Bonds	–11.06	4.32	–14.54	3.90
Equity	–2.91	14.62	–8.11	11.01
Housing	0.14	13.18	–0.86	12.28

Notes: This table presents real and nominal asset returns on various assets during wars. Asset returns in the sample of war sites, we do not impute missing asset returns. Therefore implied inflation rates from the real and nominal returns differ slightly across assets.

Finally, in figure B.6 we consider further economic outcomes. Wars are quintessential macroeconomic disasters, and go hand-in-hand with a large drop in output (panel (a)). However, the government also takes on an outsized role during wars as there are large increases in spending. We first show the response of all government expenditures, obtained from Mauro et al. (2015) in panel (b). However, this indicator includes a number of expenditures (such as interest payments on debt), that do not directly map into the model we consider in section 4. Therefore, we construct additional data on government consumption, as detailed in section A.2. Panel (c) displays the response of government consumption. This increases strongly in the initial years of the war. However, after around 4-5 years, when the wars in our sample end, government consumption reverts below trend. This is because at this point, with the large losses in output, governments cut back on the spending they were doing relative to the pre-war

period. Similarly, when we look at military expenditure in panel (d) (obtained from the Correlates of War), which is a large sub component of government consumption at this time, we find an initial increase and then a drop below the pre-war trend after the war has ended.
Finally, panels e) and f) study the human losses of wars. There is a decline in population around the wars we study relative to the pre-war trend by around 4% in the immediate years after the war, but population reverts back to trend in the long run. On the other hand, the number of total hours worked to display a non-monotonic behavior. Initially, there appears to be a slight increase in the amount of total hours worked, perhaps due to hightened wartime patriotism Ramey and Zubairy (2018) as well as the inclusion of women in the labor force (Goldin and Margo, 1992). Afterwards, total hours worked fall by up to 10% but then recover in the long run.



(a) Real GDP

(b) Government Expenditures

(c) Government Consumption

(d) Military Expenditure

(e) Population

(f) Total Hours Worked

Figure B.6: Additional Outcomes following War Shock

Notes: This figure displays the response of additional outcomes to the onset of war. Impulse responses are computed using specification 1 using the start of war as in table 1 as a shock in specification 1. All quantitities are in real terms. Data on population is from Bolt et al. (2018), total hours worked are from Bergeaud et al. (2016). Shaded areas indicate 90% confidence intervals.

B.2 Larger Sample

In the main text, we consider a sample of advanced economies. In this section, we extend our sample to the larger historical set of wars. The classification of war sites is based on Federle et al. (2024). A key limitation is that wealth and income inequality measures are not available consistently across countries in the larger sample, so that that effective estimation sample on which we estimate impulse responses varies across responses. Moreover, there is large heterogeneity between the wars fought in this sample. The sample of large war sites with available data on inequality over the course of the wars is in table B.5.

Table B.5: All War Sites

Country	Year	Casualties	Country	Year	Casualties
Germany	1914	2589	India	1965	2791
France	1914	6578999	India	1971	12144
United Kingdom	1915	190	Tunisia	1985	73
Finland	1939	240510	Israel	1991	78
Poland	1939	2795609	Bosnia and Herzegovina	1992	35895
Germany	1939	2267118	Argentina	1992	315
Denmark	1940	1392	Ecuador	1995	30
United Kingdom	1940	88988	Peru	1995	30
Norway	1940	28131	Israel	1996	70
France	1940	704768	Albania	1998	2
Netherlands	1940	63372	India	1999	2441
Japan	1944	432319	Pakistan	1999	2441
India	1944	77310	Afghanistan	2001	15029
India	1947	2738	Iraq	2003	69561
South Korea	1950	757649	Turkey	2007	100
India	1962	10846	Pakistan	2009	5753

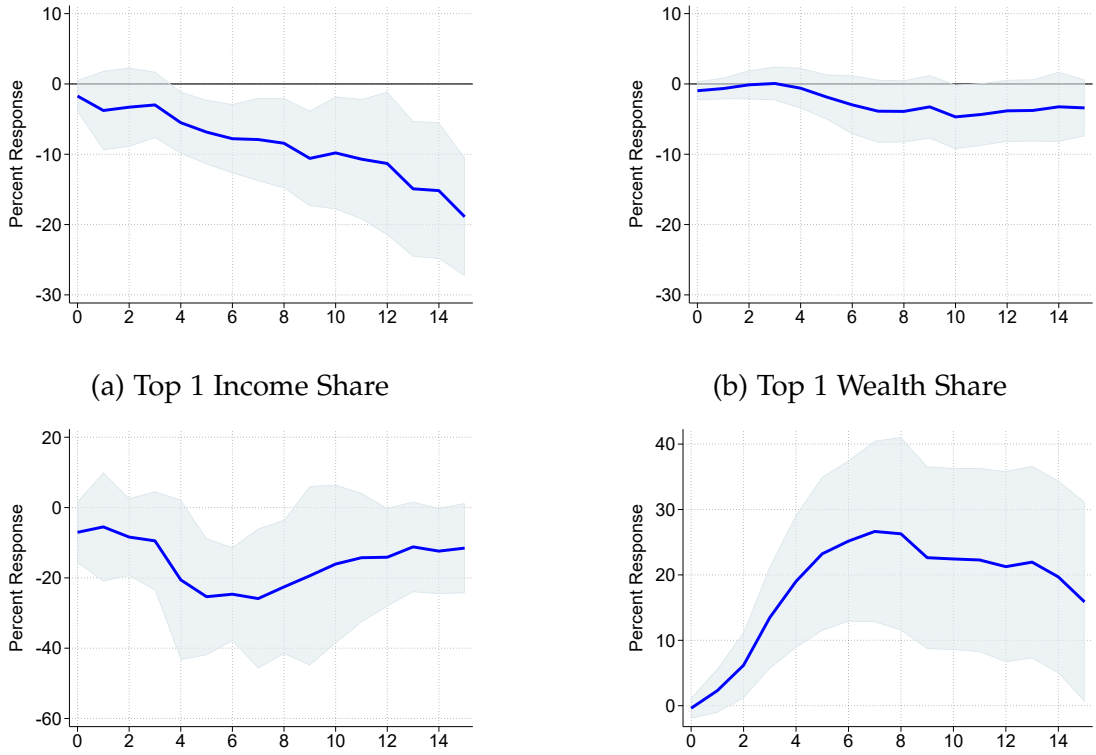
Notes: This table show summary statistics on war sites with available inequality data. The year refers to the year in which a country becomes a war site in, casualties in the war site are from Federle et al. (2024). Additionally, we show the number of casualties in each war site.

Using the extended sample, we estimate local projections using specification 1. Figure B.7 plots the results we obtain for the same outcomes as those in the main text. We obtain similar results to those reported in section 3 the main text, as we describe below. The most important difference is that results are more attenuated in terms of inequality, particularly for wealth inequality.[27]

Top income shares fall strongly, with the top percentile share falling more than the top decile share. In magnitude, the decline in inequality is slightly attenuated relative to the baseline sample in the main text. The top 1 income share drops by roughly 20%, and by almost 30% in the baseline sample. Wealth in-

[27] Because we do not have data on the top marginal tax rate and the capital stock for a sample that includes emerging economies, we omit those from the results

equality remains less affected, and we are unable to detect significant effects for it. The fact that the inequality results are attenuated relative to our baseline sample is consistent with the fact that the wars added in the extended sample are less destructive than the world wars in advanced economies. For the dynamics of capital and labor shares, key to the calibration of the framework laid out in section 3.2, we also find similar results. The capital share declines by around 20%, the price level also rises, but by a smaller magnitude.



(a) Top 1 Income Share

(b) Top 1 Wealth Share

(c) Capital to Labor Share

(d) Price Level

Figure B.7: Outcomes in War Sites, Larger Sample of Countries

Notes: This figure displays the response of various outcomes to the onset of war for war sites, defined as in Federle et al. (2024). Shaded areas indicate 90% confidence intervals. This figure considers the full sample employed in Federle et al. (2024).

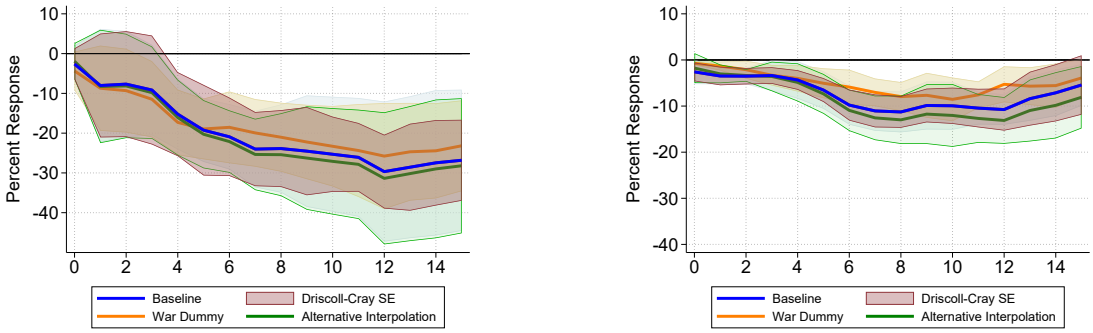
B.3 Robustness

In this section we provide a number of checks to assess the robustness of the results in section 3. We first focus on the results on income and wealth inequality.

Alternative Specifications. We consider alterations to the baseline specification in our baseline regression 1. In particular, we vary both the construction of the dependent and independent variable. The results are in figure B.8.

First, the figure shows the baseline regression, now also using Driscoll and Kraay (1998)-robust standard errors (rather than robust standard errors). Next, we vary the independent variable to be a dummy variable equal to one during the entire duration of the war (and not only on the war onset). Finally, we change the interpolation of inequality so that the entire change in inequality between missing years is attributed war years. These changes do not affect the results in the main text – this is because the wars represent large and important shifts in inequality that are clearly visibly in the time series in most countries.

Figure B.8: Response of top income and wealth shares, Robustness Checks



(a) Top 1 Income Share

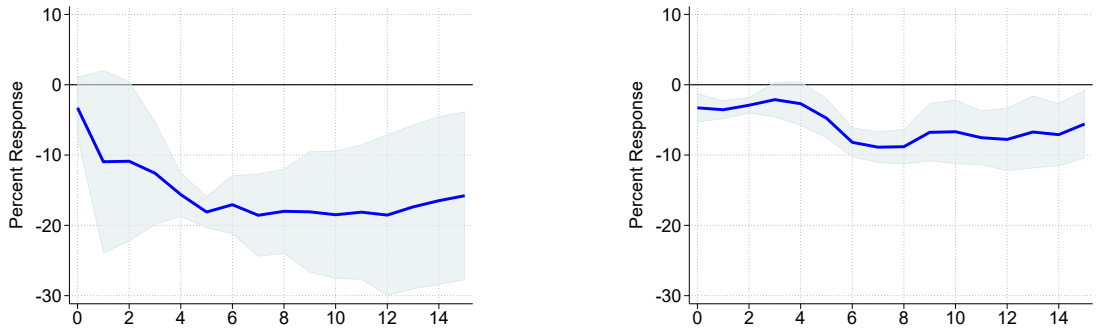
(b) Top 1 Wealth Share

Notes: This figure displays robustness to the main results on top percentile income and wealth shares in figure 1 in the main text. Variables are log-transformed so that the outcome refers to the percent change in inequality. The blue line shows the effects as computed in the main text. Next, the red shaded areas provide Driscoll and Kraay (1998)–standard errors. The yellow line corresponds to a specification with a dummy equal to one during the entire war, and the red line varies the interpolation of inequality during missing years. Shaded areas indicate 90% confidence intervals. For details see text.

Quantitative War Shock. Finally, we use a quantitative measure of the size of the war shock. Concretely, we normalize the war shock we consider in the main text by the share of the capital stock that is destroyed in the war. The sources for our estimates of destruction are given in C.2, together with a small narrative for each country. We then normalize the war shock so that it corresponds to a destruction of 10% of the capital stock in the war site economy. Figure B.9 plots the impulse responses obtained this way. We find results consistent with the main text: Income inequality drops sharply, but wealth inequality is relatively insulated. Intuitively, this is because the most destructive wars also saw the largest declines in inequality, which we show explicitly in figure C.15.

The impact of individual wars. We check for the impact of individual wars on our results. Figure B.10 reports the impact individual wars have on our results, by showing impulse response functions computed by dropping each war successively from our sample. Doing so results in a decline in inequality that is very similar across samples, because the fall in inequality was a very common

Figure B.9: Response of top shares to war shock, quantitative measure

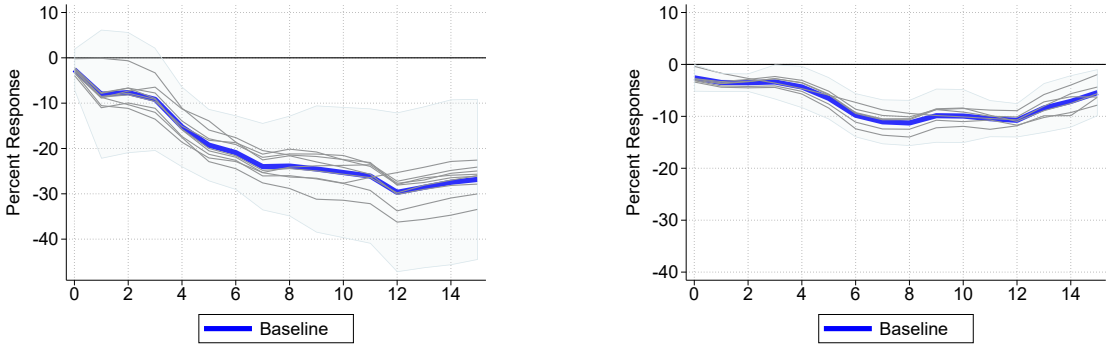


(a) Top 1 Income Share

(b) Top 1 Wealth Share

Notes: This figure displays the response to the onset of war for top income and wealth shares. Variables are log-transformed so that the outcome refers to the percent change in inequality. Figures are computed using specification 1 using the war onset, normalized to one when 10% of the capital stock is destroyed, as a shock. Shaded areas indicate 90% confidence intervals.

experience across the countries in our sample. This means our results are not driven by individual wars and their leveling effects.



(a) Top 1 Income Share

(b) Top 1 Wealth Share

Figure B.10: Response of top income and wealth shares, dropping successive wars

Notes: This figure displays the response to the onset of war for top income and wealth shares. Variables are log-transformed so that the outcome refers to the percent change in inequality. Impulse responses are computed using specification 1 using the start of war as in table 1 as a shock in specification 1. Shaded areas indicate 90% confidence intervals. Gray lines indicate specifications in which individual wars are dropped from the sample successively.

The reaction of wealth inequality. We now offer additional details on the results concerning the response of wealth inequality. In our baseline findings, as for instance reported in figure 1, we find only a small reaction of wealth inequality. Figure B.11 provides further insights on this. We show that controlling for

lags of the dependent variable, as is standard in the macroeconometric literature and recommended e.g. in Montiel Olea and Plagborg-Møller (2021) generates the muted response of wealth inequality. Intuitively, adding lags means that we are controlling for trends in wealth inequality prior to the war. As we move towards a higher amount of lags, the effect of wars on wealth inequality increasingly declines. If we add no lags at all, we would find a larger equalizing effects in terms of wealth inequality, as in Scheidel (2018), where the unconditional comparison of wealth shares before and after wars is reported.[28]

We also also show data on top wealth shares for four prototypical countries – indeed wealth inequality is falling in all economies already prior to the world wars, with the wars having relatively small effects in visual terms. Consistent with the lack of visual evidence, our macroeconometric method finds a small reaction of wealth inequality.

Moreover, in this figure we also show the evolution inequality prior to the wars, both for income and wealth. In our baseline specification, we control for 4 lags of the outcome, so that there are no pre-trends in the 4 years before by construction. Figure B.11 shows that the there are no important pre-trends in prior years, even when controlling for less lags. The fact that there are no large movements in inequality prior to wars strengthens the interpretation of war as the ultimate cause of movements in inequality.

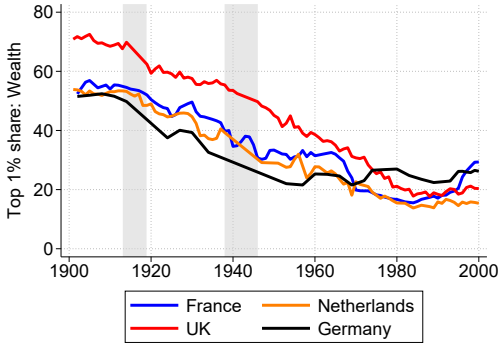
Placebo Check. We conduct a Placebo exercise to test the robustness of our findings. In particular, our methodology might mechanically find important leveling effects of wars because it is hard to separate the effects of war shocks from the underlying trends in inequality. We use countries, which have long series of inequality available pre and post war, but were not part of the war (either directly or indirectly via colonial linkages) as a control to see if we are able to find effects from placebo war shocks in 1914 and 1939. The countries included are listed in table B.6.

Country Name	Year
Argentina	1939
Denmark	1914
Finland	1914
Norway	1914
Switzerland	1939
Sweden	1914
Sweden	1939

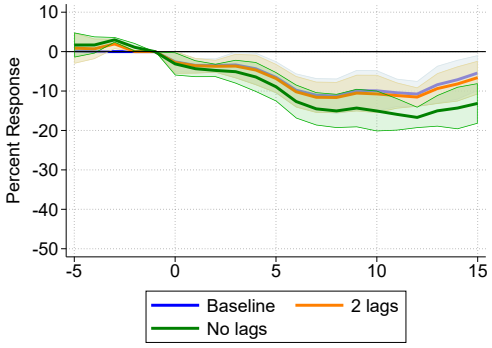
Table B.6: Countries and Years for Placebo War Assignment

Notes: This table shows the country and war years considered in the placebo sample.

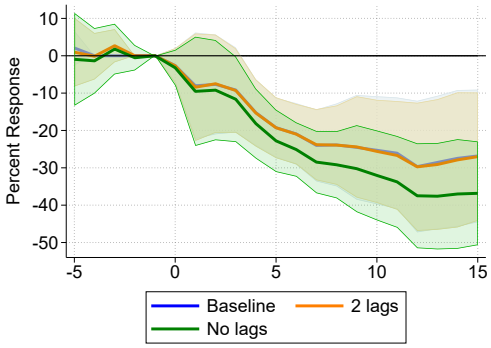
[28]The impact of adding lags to the results on income inequality are smaller, as wars represent sharper breaks in the income inequality series.



(a) Top Wealth Share in select countries



(b) Top 1 Wealth share; different lags



(c) Top 1 Income share; different lags

Figure B.11: Response of top shares to war shock, changing amount of lagged outcomes in control

Notes: This figure shows the impact that controlling for lagged outcomes has for our empirical results. Panel (a) shows the raw data on the top wealth share for four prototypical economies. Panel (b) displays the response of the top 1 wealth share to the onset of war, panel (c) shows the top 1 income share. The amount of lags of Impulse responses estimated based on specification (1); start of war as specified in table 1. Shaded areas indicate 90% confidence intervals.

Of course, this is an imperfect check given the important spillovers war has on other economies, but it gives an idea whether the leveling we document happened also absent the war shocks. Due to data limitations, we are only look at the top 1 income share. We then estimate specification 1 on this sample of placebo wars, the resulting impulse response is given in figure B.12. Unlike for war sites, or even war participants, we are unable to effect large leveling effects, if anything there appears to be a slight increase in inequality in the beginning.[29]

B.4 Wars in Non-Sites

The leveling effects of wars have not only been discussed for war sites, but also for non-sites, most prominently in the case of the U.S. (Scheidel, 2018). We investigate war sites and non-sites separately, as the underlying shocks are likely

[29]This can be seen as a formalization of arguments in Scheidel (2018), who argues that a leveling of inequality was absent Latin America and Switzerland

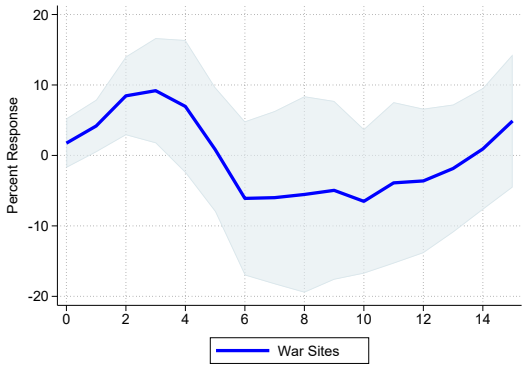


Figure B.12: Top 1 Income Share, Placebo Sample

Notes: This figure studies the distributional impact of wars in a 'placebo sample'. Specifically, we estimate specification 1 using the placebo war sample in table B.6.

Table B.7: Large Non Sites

Country	Year	Deaths (% Pop)	Country	Year	Deaths (% Pop)
Australia	1914	1.25%	New Zealand	1939	0.75%
Australia	1940	0.48%	U.K.	1914	1.97%
Canada	1914	0.83%	U.S.	1917	0.11%
Canada	1939	0.36%	U.S.	1941	0.30%
Japan	1904	0.17%	U.S.	1950	0.04%
New Zealand	1914	1.46%	U.S.	1965	0.03%

Notes: This table show summary statistics on the large wars in non-sites in our sample. In particular, we show the year the war starts and number of casualties (as a percentage of initial population of the country).

very different. We know that non-sites experience markedly smaller declines in GDP (Federle et al., 2024), no capital destruction (Auray and Eyquem, 2019) and a larger increase in tax progressivity (Haffert, 2019). In this section, we study the outcomes discussed above for non-sites. We consider a sample of non-war sites with more than 10K casualties in a war, so that we only consider wars fought on foreign soil that leave an important mark on the country itself. The list of countries is given in table B.7. In practice, this again leaves us with a sample of world wars, and two additional wars in the U.S. which reached a sufficient size (Vietnam and Korea).

In terms of income and wealth inequality inequality, we find that income inequality declines less in non-sites than in war sites than in non-sites (panel (a)), and estimates are noisier for non-sites. This suggests that destruction is key in the leveling process during wars. In terms of wealth inequality, the two look more similar, and we find a slight decline in wealth inequality both for war sites

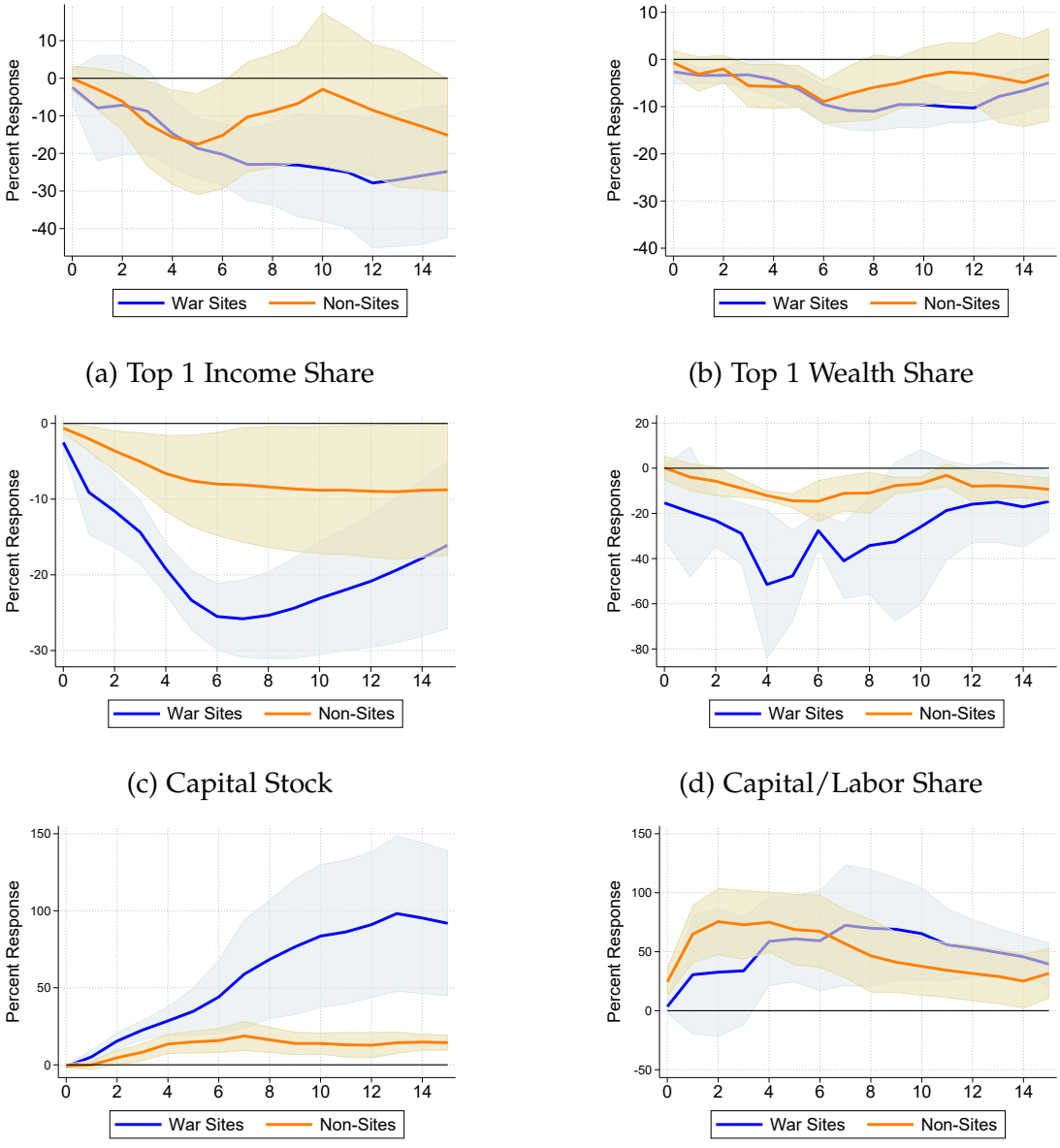
and for non-sites.[30]

Turning to the channels, non-sites do not experience wartime destruction by definition, so the capital stock remains relatively unaffected. There is a small decline, due to reduced investment also in non-sites, but the magnitude is much smaller than in war sites. This can be also seen in the capital share, in panel (d). On the other hand, we still see large expansions in fiscal spending and debt. In terms of inflation, non-sites also remain much more insulated than war sites, so that the increase in inflation is much smaller. Finally, we observe a somewhat stronger increase in tax progressivity in non-sites than in war sites. This is consistent with the narrative in Haffert (2019), who argues that after the second world war, the U.S. found it easier to institute highly progressive taxation than European countries, which had to rebuild their destroyed capital stock.

Taking stock, the nature of wars is fundamentally different in war sites and non-sites. Whereas wars cast a long shadow in terms of economic performance in war sites, non-sites emerge relatively unscathed. In these countries, an increase in progressive taxation to finance the military effort emerges as a main legacy of wars.

Winners and Losers. We can similarly compare winners and losers of wars and how they differ in terms of inequality outcomes. Of course, classifying winners and losers is not always straightforward. Our baseline classification follows the Correlates of War. Concretely, we classify all war sites as losers, except France in both world wars and the U.K. in world war 2. All other belligerent countries (non-sites) in table B.7 are classified as winners. Figure B.14, compares inequality outcomes of winners and losers. We use the top 1 income share, as this is consistently available across countries. We find that winners see smaller declines in inequality than losers, consistent with the fact that losers of wars tend to face larger destruction in their own country (see table 1).

[30] We do not report data on the top decile income share, because here we only have data on the U.S. in our sample of non-sites.



(a) Top 1 Income Share

(b) Top 1 Wealth Share

(c) Capital Stock

(d) Capital/Labor Share

(e) Price Level

(f) Top Marginal Tax Rate

Figure B.13: War Sites vs non-Sites

Notes: This figure displays the response of various outcomes to the onset of war for non war sites, defined as countries with more than 10K casualties in a war that does not occur on their soil. Shaded areas indicate 90% confidence intervals.

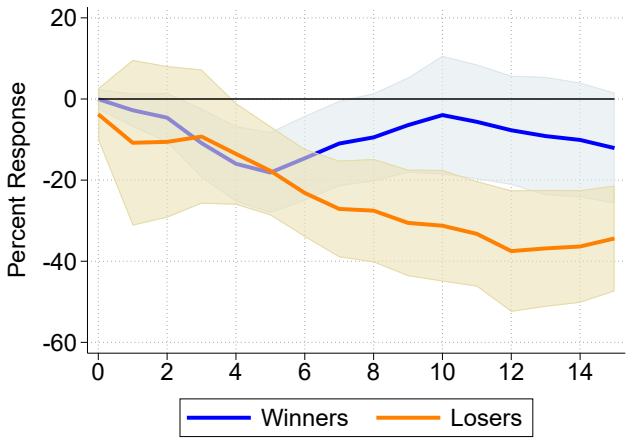


Figure B.14: Top 1 Income Share: Winners vs. Losers

Notes: This figure compares the outcomes for inequality of war for winners and losers, both in terms of the top 1 income share. For the classification of winners and losers see the text.

Table C.8: Summary Statistics: Simple Framework

Country	Top 1 Income Share	$sh^I_{1,L}$	$sh^I_{1,W}$	Capital Share	Labor Share	Capital / Labor Share
France	0.17	7.83	40.88	29.73	70.27	0.42
Germany	0.13	8.87	19.73	37.57	62.43	0.60
Japan	0.28	16.79	57.30	26.76	73.24	0.37
U.K.	0.17	10.25	30.13	31.39	68.61	0.46
Average	0.19	10.93	37.01	31.36	68.64	0.46

Notes: This table displays the initial calibration for the stylized framework as presented in section 3.2. 'Average' corresponds to an unweighted average of France, Germany, Japan and the U.K., which we use to produce the simulations in section 3.2.

C Appendix: Stylized Framework

In this section, we provide additional details and results on the framework laid out in section 3.2.

C.1 Calibration and Further Results

Calibration. We calibrate the framework to those economies for which we have data on the composition of top incomes before wars. Due to data limitations this restricts our sample to four economies before world war II. We summarize the calibration, which averages over the period 1930-1938 in table C.8.

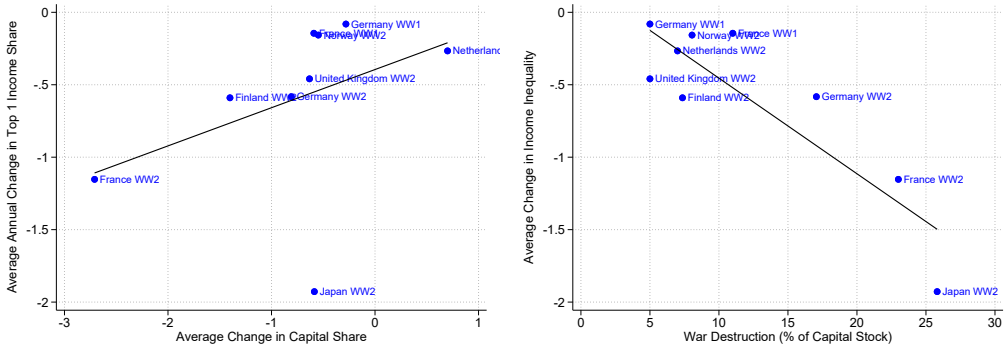
Destruction and the Fall in Inequality. The framework offers a simple empirical prediction: In wars that see larger declines in capital shares, income inequality should fall more. We test this prediction empirically in figure C.15, which compares the evolution of overall income inequality and the capital share. Concretely, we compute the average annual decline in inequality during the wars and correlate it the the average annual decline in capital shares, as well as the share of the capital stock that is physically destroyed in each war.[31] Figure C.15 plots this correlation for the wars in our sample. Although there is consistent decline in income inequality during war years, income inequality declines more for countries with larger declines in the capital share. The correlation with the destruction of the capital stock similarly shows that countries which experienced larger capital destruction due to wars saw larger declines in inequality.

Income Inequality with Differential Destruction. Finally, we can calibrate the framework to a higher loss of capital for the top 1 than for the whole economy. This generates a larger decline in top income shares for a given loss in wealth, because the rich are hit more by the shock. Concretely, we consider that the rate of destruction D_1 for the top 1% can be computed from the decline in the top percentile wealth share as follows

$$sh^{post}_{1,W} = \frac{(1-D_1)W^{pre}_1}{(1-D)W^{pre}} \quad \text{so that} \quad \frac{sh^{post}_{1,W}}{sh^{pre}_{1,W}} = \frac{1-D_1}{1-D} \approx 1 + D - D_1$$

[31] We define the periods as 1914-1920 for WW1 and 1939-1950 for WW2, to allow for the effects of wars to level out. The choice of periods does not affect our results.

Figure C.15: Correlation: Change in Inequality, Capital Shares and Destruction



(a) Inequality and Capital Shares (b) Inequality and Destruction

Notes: This figure shows the correlation between the change in inequality and both the decline in capital shares and wartime destruction. In both plots, the y-axis shows the average annual change in inequality. Panel (a) shows the average annual change in the capital share on the x-axis, Panel (b) provides instead uses the estimates of capital destruction from table 1.

where $sh_{1,W}^{post}$ is the top 1 wealth share after the war, W_1^{pre} is the wealth of the top 1% and W^{pre} is total wealth (measured before the war). Using decline in top wealth shares, the differential loss of wealth comes out to $D_1 = D - \Delta \log sh_{1,W}$. To calibrate the framework with differential destruction, we then compute

$$sh_p^I = \frac{sh_{p,L}^I + sh_{p,K}^I \cdot (1 - D_1) \cdot \frac{r \cdot K}{w \cdot L}}{1 + (1 - D) \cdot \frac{r \cdot K}{w \cdot L}}, \tag{32}$$

with D_1 computed as above. Figure C.16 shows the implied decline in the top 1 income share when taking into account differential destruction of capital. It plots the aggregate rate of destruction D against the explained decline in the top 1 share, when fixing D_1 using the decline in the top wealth share at the 10-year horizon. While potentially, larger losses of wealth at the top of the distribution could account for the fall in income inequality with a lower decline of the capital-labor ratio, quantitatively the decline in the top 1 wealth share is relatively small, such that the resulting simulation is close to the benchmark with proportional losses.

C.2 Empirical Evidence on Differential Destruction

We provide additional empirical evidence on war destruction, and in particular on the indidence of destruction along the distribution. To do so, we construct estimates of destruction at the asset class level for a number of economies. We then use a version of the framework with multiple assets to understand the impact that differential destruction may have on top wealth shares. Although there is some uncertainty around the wealth lost in wars, we find little evidence for wealth losses that are very disproportional along the the distribution.

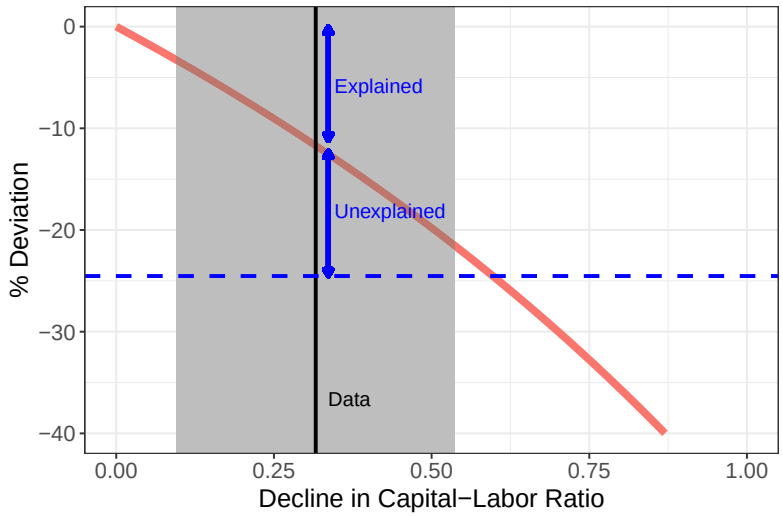


Figure C.16: Framework Simulation Accounting for Differential Wealth Losses

Notes: This figure shows simulations of the top 1 income share for a given decline in the capital-labor ratio using equation (32). The red line indicates the decline in the top income share as a function of the decline in the capital-labor ratio. The vertical line indicates the average decline in the data at the 10-year horizon. The blue line indicates the observed decline in the top 1 income share.

The Impact of Destruction in the Simple Framework. To fix ideas, consider an economy with two types of assets, housing H and the rest of the wealth stock R. Then the top percentile wealth share is the composite of both assets,

$$sh_1^W = \frac{W_1}{W} = \frac{H_1 + R_1}{H + R},$$

where H_1 and R_1 are the wealth holdings of housing and the other asset of the top 1 of the wealth distribution. Then we consider a shock D that destroys parts of the housing stock. After the shock, we have that the top 1 share comes out to

$$sh_1^W(D) = \frac{(1-D)H_1 + R_1}{(1-D)H + R}. \tag{33}$$

The top wealth share falls in the degree of wealth destruction if and only if

$$sh_1^{W'}(D) = \frac{HR_1 - H_1R}{((1-D)H + R)^2} < 0 \Leftrightarrow \frac{H_1}{R_1} > \frac{H}{R}$$

i.e. if the portfolio of the top wealth holders is more tilted towards housing, the asset destroyed in this case, than the aggregate portfolio.
The decomposition is straightforward to extend to multiple assets, for which we each know the rate of destruction. The coverage of asset classes varies by country, and is given in the table. Generally, we are able to consider three types of asset holdings; Housing, Business (and equity claims) and a residual asset category, which is in practice made up mostly of safe asset holdings. For each asset category, we compute a rate of destruction and apply it to wealth

Table C.9: Simulation of Destruction Effects on Top 1 Wealth Share

Country	Pre-War	Post-War (Simulation)	Delta	Percent Change	Post-War (Data)
France WW1	55	55	0	-0.1	50.6
France WW2	42.8	42.2	-0.6	-1.5	32
Germany WW1	50.7	50.4	-0.3	-0.6	37.5
Germany WW2	32.6	30.4	-2.2	-6.7	22
Japan WW2	*40*	*38.7*	*-1.3*	-3.1	

Notes: This table shows the impact of destruction on the top 1 wealth share, taking into account the effect of differential destruction across asset classes. The 'Pre-War' column shows the top 1 wealth share before the war, while the 'Post-War (Simulation)' column shows the top 1 wealth share after the war in the simulation, accounting for differential destruction across asset classes. The next two columns show the implied impact on the top wealth share, both in percentage points (Change in Share), and in percent (Percent Change). The 'Post-War (Data)' column shows the top 1 wealth share after the war in the data. Note that for Japan, we do not have data on the pre-war top wealth share, instead we use a value of 40%. The resulting change in percent is invariant to this choice (see footnote 35), the absolute change in share is not.

holdings to calculate the impact of destruction on the wealth distribution in a more granular way. The results of this exercise are shown in table C.9, we give precise details on the calculations below.
The direct effects of destruction on wealth inequality through these simulations is limited. Concretely, we find that destruction directly lowers wealth inequality by around 7% in Germany in World War 2, and by less in the other wars. For France we find barely any potential reduction of wealth inequality in world war 1, and around 1.5% in world War 2. For Japan, we find a somewhat intermediate result, with a decline in inequality of a bit more than 3%.
The muted effect of destruction is a result of portfolio composition: Differences in the wealth portfolio of the top 1 and the aggregate portfolio are small historically. Figure C.17 illustrates this by comparing the wealth portfolio of the top 1 to the aggregate portfolio for a number of countries with detailed data available. In the historical sample, wealth is more concentrated than in modern data, so that there is not as much space for the aggregate wealth portfolio to deviate from the top 1 wealth portfolio. The pre-world war 1 portfolio in France is a case in point: The top 1 portfolio looks very similar to the aggregate portfolio and top 1 wealth shares stand at 55% (top decile shares at 80%).

France. For France, we take portfolio data from Piketty (2011), who provides data both on the top portfolio as well as the aggregate wealth portfolio based on data from the (universal) estate tax in Paris. We use the portfolios for the top 1 of decedents as well as for all decedents in the years 1912 and 1937. In particular, we distinguish three asset categories that are consistently available; real estate, business assets (including equity) and a residual category. We show the portfolios in figures C.17a and C.17b. Notably, before the wars, the aggregate portfolio of decedents looks very similar to the portfolio of the top 1.[32] For the composition of income in figure 4, we use data from (Piketty, 2018) and classify

[32]Further examining the data of Piketty (2011) shows that this is a function of the fact that the portfolio of the "next nine" looks very similar to the top 1 portfolio. Only for the middle 40 do portfolios start to look meaningfully different.

'investment income', 'agricultural income', 'industrial and commercial profits' and noncommercial profits' as business income, 'payments, wages, retirement pensions and annuities' as labor income and the residual as other capital income.
Then, we compute top percentile shares when applying destruction rates to both the stock of real estate as well as business assets. For World War 1, we use a destruction rate of around 11% for business assets as well as real estate following the estimate of Piketty and Zucman (2014).[33] For world war 2, we use the same sources to estimate a 23% for real assets. Unfortunately, no consistent breakdown of war destruction across businesses and housing is available. However, given the limited difference of the top 1 portfolio from the aggregate wealth portfolio (figure C.17), having destruction differ by asset class would not generate meaningful shifts in the wealth distribution. To compute the capital stock, we assume evenly spaced destruction during the years of world war 1 and world war 2.

Japan. For Japan, we take information on the portfolio of top estates in 1935 from Moriguchi and Saez (2008). Information on the aggregate wealth portfolio is from the Japan historical statistical yearbook (Statistics Bureau of Japan, 2023, Table 591; Statistical Yearbook 1949), which contains the composition of aggregate wealth as well as an estimate for direct destruction for each component of aggregate wealth. In both sources, we classify components into business assets, housing and other.[34] Figure C.17c shows the portfolio of the top estates as well as the aggregate wealth portfolio. While the rich are slightly tilted more towards business assets, they are not too different than the aggregate wealth portfolio. We then apply the destruction rates from the Statistical Yearbook of Japan, i.e. 22% of housing, 31% of business assets and 22% of other. For the total wealth stock, this yields a rate of destruction of 25.61%, consistent with Wolff (1991) and Harrison (2000) who find similar values. To compute the capital stock, we assume that the full destruction happens in 1945.
Note that for Japan, we do not have data on the top wealth share (or even the top estate share). However, we can carry out simulations for differential destruction using data on just the portfolios of the bottom and the top of the wealth distribution, and assuming a value for the top wealth share. We assume a value of 40%, in line with the evidence for France and Germany pre-WW2 and higher than the top income share of 35%; changing this assumption leaves the resulting decline in top wealth shares unchanged in percent terms.[35] Doing this results

[33] Piketty and Zucman (2014) often mention a rate of destruction of 22%, but explain that half of this are losses on foreign bond holdings in France.

[34] Concretely, in Moriguchi and Saez (2008) we classify stocks, Agricultural land and businesses as business assets; residential land and houses and structures as housing and the residual as other. In Statistics Bureau of Japan (2023, Table 591; Statistical Yearbook 1949), we classify "Building" as Housing, "Machinery and Equipment for Industry", "Industrial Facilities" (Electricity, Waterworks,...) and "Products" as Business Assets and all other assets as Other. We have experimented with other classifications, which yield similar results in terms of differential destruction.

[35] To see this, note that we can rewrite (32) as $sh_1^W(D) = \frac{(1-D)H_1+R_1}{(1-D)H+R} = \frac{W_1}{W}\frac{(1-D)H_1/W_1+R_1/W_1}{(1-D)H/W+R/W}$, i.e.

in a decrease of 3.1 % (1.3 percentage points).

Germany. Data on the portfolios and the destruction simulations is taken from Albers et al. (2022). In particular, the authors simulate the effects of destruction historically for both wars, taking into account the asset classes destroyed in both wars. Moreover, they make an adjustment for differential destruction along the distribution, to take into account that within an asset class.[36] In numbers, the authors estimate a 5% loss of wealth due to territorial losses after the first world war (this is taken into account, because pre-war data refers to pre-1914 borders), and destruction of 17.5% of the capital stock in world war 2. For the calculation of the capital stock, we apply the losses at the end of world war 1 and evenly spaced in world war 2.
Figures C.17d and C.17e compare the top 1 portfolio and the rest of the distribution. In Germany, we are able to break out agriculture and industry separately. However, one drawback is that equity claims are not broken out separately, so that a fraction of "other" likely represents claims on business assets as well. Before both wars, the top 1 portfolio is relatively well aligned with the aggregate wealth portfolio.[37]
For Germany before WW2, we can also compare both the income and the wealth portfolio of the top 1 and the aggregate, as we do for France in figure 4. Figure C.17f shows the resulting income portfolio in Germany in 1938.[38] Note that we cannot break out business income and other capital income for the 'total income' portfolio. The resulting picture is similar to France: The top and the aggregate differ very strongly in their income composition, with the top much more tilted towards business income.
Overall, both wars contribute to a reduction in wealth inequality through destruction, but only mildly. For World War 1, the estimated reduction in the top 1 wealth share is only around -0.6 percent, for world war 2 it is higher at 6.7 %.

Destruction Estimates for Other Countries

We now provide the sources for our estimates of destruction for the other countries in our sample, in addition to the data on France, Germany and Japan discussed in section C.2. Of course, the fog of war means that these estimates are surrounded with some uncertainty, which we discuss for each country.

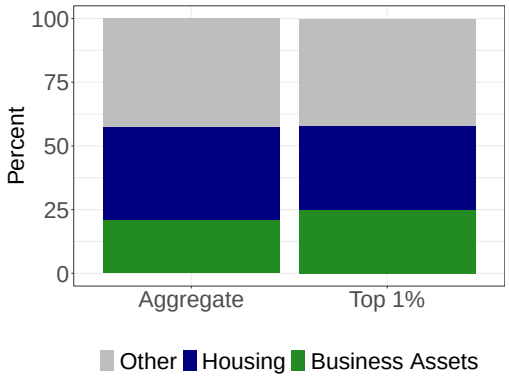
Finland. Finland suffered repeated war destructions during a series of battles and bombings in the second world war, first during the 'Winter War' in 1939-

separating the top wealth shares and the top wealth portfolio.

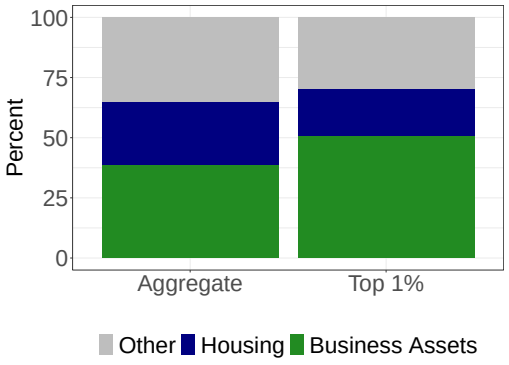
[36] We do not have sufficient data to make this adjustment for other countries.

[37] The share of "Industry" in the portfolio may appear low, especially before the second world war. This is because the portfolios for the second world war come from the year 1934, which is still heavily affected by the great depression.

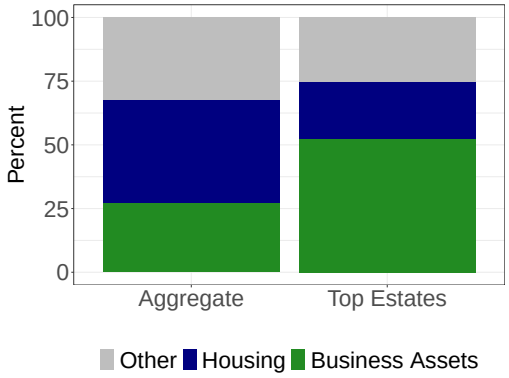
[38] In Germany, we use the data of Dell (2007) and classify Agricultural income, Industrial income and 2/3 of self-employment income as 'business income'.



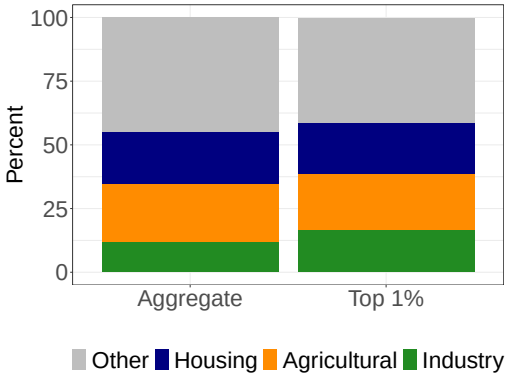
(a) Asset Composition France WW1



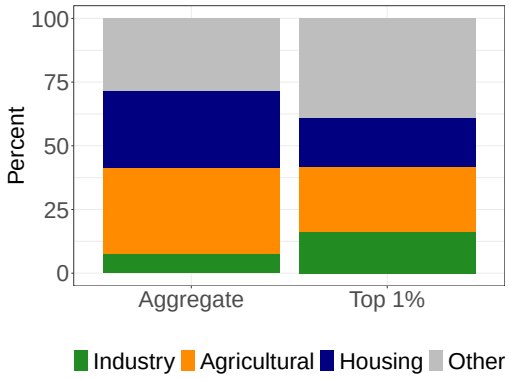
(b) Asset Composition France WW2



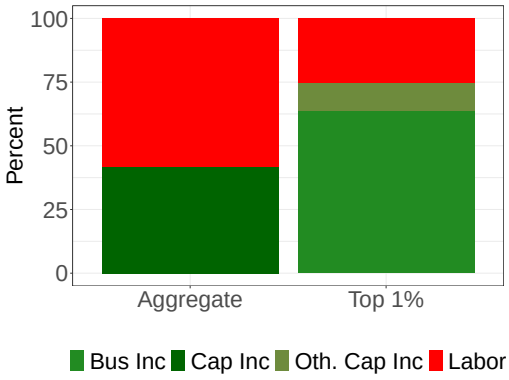
(c) Asset Composition Japan WW2



(d) Asset Comp. Germany WW1



(e) Asset Comp. Germany WW2



(f) Income Comp. Germany WW2

Figure C.17: Historical Wealth and Income Composition

Notes: This figure shows the composition of top incomes and wealth as well as the aggregate wealth or income composition prior to the wars. Panel C.17f shows the income composition for Germany, both for the top 1% and the aggregate. For details see the text.

40 and then through German destruction at the end of the war. We base our analysis on the work of Finnish economic historian Nummela (1993)'s analysis of the Economics of the world war in Finland. It is hard to exactly quantify the extent of destruction in Finland in general. In terms of dwellings, 13.27% of the total housing stock was destroyed in Finland during the Winter War (Nummela, 1993, page 123). The exact value of the destroyed housing stock is not known, however we know the extent to which different kinds of buildings were destroyed (fully destroyed, more than half, less than half) (Nummela, 1993, Table 24). Factoring this in leads to an estimate on the lower bound of 7.36% of the total dwelling stock.[39] This yields a lower rate of destruction of 7.36% of the total dwelling stock. We assume the same for industrial assets and use this figure in our calculations. In calculating the capital stock, we assume even destruction across the years 1939, 1940 and 1945. Note that this does not factor in the loss of territories in Karelia or war reparations paid to the Soviet Union in terms of Machinery.

Netherlands. The Netherlands experienced war destruction as well as German plunder in the second world war, especially towards the end of the war in 1943-45. Our baseline estimate accounts for only destruction and is 7% of the initial capital stock, taken from Groote et al. (1996, page 8). As noted there, this estimate is on the low end compared to immediate post-war reactions, which were put at up 28%. However, given the limited fighting on dutch soil, we find the estimate of Groote et al. (1996), who carefully survey the post-war data more plausible. We apply the destruction evenly to the 1943-45 period when computing the capital stock.

Norway. During the German occupation of Norway, there were repeated allied raids on Norwegian territory to sabotage the military and industrial capacity of the German military. Moreover, at the end of the war, Norway experienced destruction through the scorched earth policy in the area of Finnmark. The Norwegian administration quantified the capital losses during the war in a statistical publication in 1946 (Sentralbyrå, 1949). The data provides an estimate of the losses due to the war as well as the pre-war capital stock. We take those numbers directly from the publication and thus arrive at an estimate of destruction around 8.05 % of the capital stock.[40] Because war destruction is not broken out separately, this figure should be considered an upper bound for the total destruction of the Norwegian capital stock. In computing the capital stock, we apply this evenly from 1940 and 1944-45, when allied raids as well as destruction by German forces was concentrated.

United Kindom. Harrison (2000) surveys the war damages in the United Kingdom during the second world war. Although war damages in the U.K.

[39]Concretely, we weight houses fully destroyed by 1, those destroyed 'more than half' by 0.75, and those destroyed by 'less than half' by 0.25.

[40]We include capital destruction in land, buildings, and machinery (and exclude destruction in boats and durable goods).

were more limited, the U.K. was subject to aerial attacks on its territory through German bombings, which killed more than 40,000 people and injured many more. Harrison (2000) puts the figure of destruction for the U.K. economy at 5% of the capital stock. This does not account for the large wartime 'disinvestments' (foregone investment due to the war), which are argued to have lowered the capital stock even more. To compute the capital stock, we assume that this happens evenly throughout the period 1941-42 as well as 1944-45, when allied raids were concentrated.

D Appendix: HANK Model

D.1 Evidence on Profits

A key channel for the leveling in our estimated HANK is a decline in firm profits. We provide evidence on declining profits during war times in section 6.1. Here, we describe the data used to construct firm profits. When constructing profits, we aim to maximize our coverage of companies. Therefore, when possible, we take profits from national accounts. However, this is not possible in many cases, in which we are can only cover a subset of companies (for example, listed firms). When possible, we subtract profit taxes levied during the wars.[41] There are numerous issues related to the measurement of economic profits (see e.g. Barkai (2020); Gutierrez (2017)). We make no attempt to correct for these. Instead, we directly show profits as reported in the source material, with no further computations or corrections. The concept of profits we use is consistent over time within countries around each war.

France. Data for profits in France come from Piketty and Zucman (2014), who source data from Villa (1994). We define profits as the sum of net of depreciation corporate profits and self-employment capital income and subtract the corporate tax. Figure D.18a shows each component of the calculation. In the first world war, there is a initial rise and then small decline in profits in France. Note that we do not have data on the corporate profit tax imposed in world war 1. However, the fact that profits do not decline much in world war 1 is consistent with a relatively flat top income share. In world war 2, corporate profits in France fall sharply at the start of the war and even turn negative. They then continue to remain low into the 1950's.

Germany. In Germany, we start from two comprehensive works on 'war profiteering' during world wars by economic historians; Baten and Schulz (2005) for world war 1 and Spoerer (1996) for the second world war. We extend these to the post-war period periods using the balance sheet of listed corporations.
Specifically, for WW1 we use the profit indices from Baten and Schulz (2005, Table 4), who track rates of real profits for a sample of large firms. They classify

[41] Although the data on income inequality is pre-tax, income taxes are levied on the payouts to firm owners after they pay corporate taxes.

firms by their relatedness to wars (e.g. heavy industry is classified as very war related). The indices are normalized to 100 in 1913, as a comparison, we also report GDP. For World War 2, we use the return on equity from Spoerer (1996, Page 147, Table 34) up to 1942.[42] After World War 2, we use data on the profits of non-financial firms from Statistisches Bundesamt (9 55). This annual publication reports the consolidated balance sheet of German listed firms and is the post-war continuation of the pre-war data. We take profits directly from the tables ('Gewinne und Verluste der Aktiengesellschaften nach Gewerbegruppen'). We divide profits by shareholder equity, which is reported in the same tables. We cannot compute an index of real profits, but only of the return on equity because only the second is available in the pre-war period.
The data leave us with a from 1943–48 during which we have no information on profits. It is likely that profits were extremely low during this time period, both because of very high profit taxes of up to 80% by the Nazi regime at the end of the war (Banken, 2018), and the general economic depression in the post-war period.
Figures D.18b and D.18c reports profit rates for both wars. In both wars profits decline sharply. In World War 1, profits drop by more than 40% for the industries not directly related to wars. In the second world war, there is an initial boom in corporate profits during the military buildup. However, after the destruction of the war has set in, profits after the second world war are extremely low abd do not catch up to their pre-war levels for a while.

Japan. For Japan, we collect data on the national accounts from the Japanese Statistical Yearbook (Statistics Bureau of Japan, 2023, Table: National Income by Distributive Shares). We use the series on corporate profits and subtract the series on the corporation tax. Figure D.18d plots profits in Japan, expressed as a share of GDP, before and after taxes. While initially corporate profits are high during the war (similar to Germany), profits decline steeply at the end of the war years and almost turn negative post-tax.

United Kingdom. We take data on Profits from Piketty and Zucman (2014) ('Gross operating surplus of private non-financial companies'), who in turn rely on data from Mitchell (1988). For profit taxes, we take data from Ryland and Dimsdale (2017, Sheet A.27) ('Profit Taxes'). This allows us to calculate profits of U.K. nonfinancial firms as a percentage of GDP. We show profits before and after the profit tax in figure D.18e. After the wartime profit tax, corporate profits decline significantly during the war and the immediate aftermath.

Netherlands. Data on profits during world war 1 come from the work of dutch

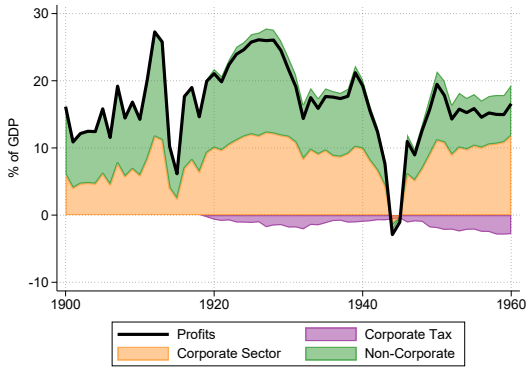
[42]Spoerer (1996) reports the return on equity from the balance sheet both for the entire economy, and for a sample of companies for which he also collects profits as reported in corporate income tax statistics. We use balance sheet profits, consistent with what is available post-war. In 1940-41, we use the balance sheet profits for the firms in the smaller sample, as there is no balance sheet covering the entire corporate sector. As explained in Spoerer (1996), balance sheet profits are similar in his sample and the full corporate sector before 1940.

economic historian Klemann (2002). He constructs profits for a large sample of dutch listed firms from corporate balance sheets and provides an index of aggregate profits from 1938 to 1948. Figure D.18f plots the index of profits together with an index of real GDP that is normalized to 100 in 1938 as well.

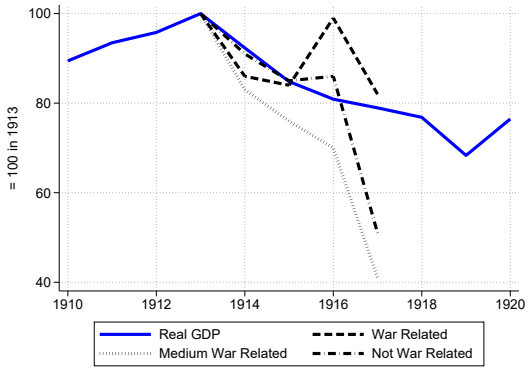
Finland We collect data for profits of cooperatives in Finland from the Finnish statistical yearbook (Statistics Finland, 0 , Table 139). Profits are available for Cooperatives, a form of privately held businesses owned by multiple partners. We use the net surplus of cooperatives without further adjustment. Figure D.18g reports profits as a percentage of sales, which are also available in the same table.

D.2 Additional Validation: Prices, Wages and Dividends

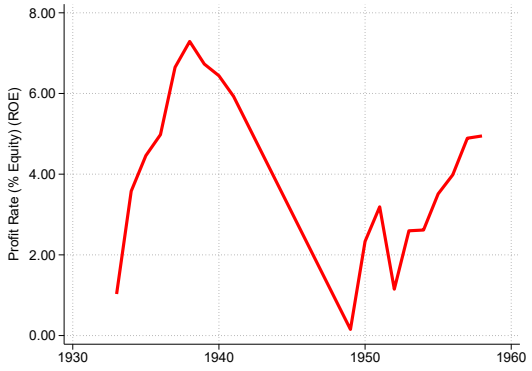
In the model, a key mechanism for the decline in income inequality is a decline in firm profits, which constitute the majority of income for the top earners. Figure D.19a shows impulse responses of the price and wage level (from Jordà et al. (2017)) using specification 1. Indeed, we find that in the data wages also rise faster than prices.
Second, in addition to the profit data, we also construct data on real dividends across countries. We compute real dividends by multiplying stock market capitalization from Kuvshinov and Zimmermann (2022) with the price-dividend ratio from Jordà et al. (2019). Figure D.19b shows the estimated response of real dividends (log-transformed) to the wars using specification 1 in our sample. We find that war decreases dividend payouts sharply, by up to 150%. The decline in dividends far exceeds the decline in output (see figure B.6), so that dividends decline by more than overall income.



(a) France World War 2



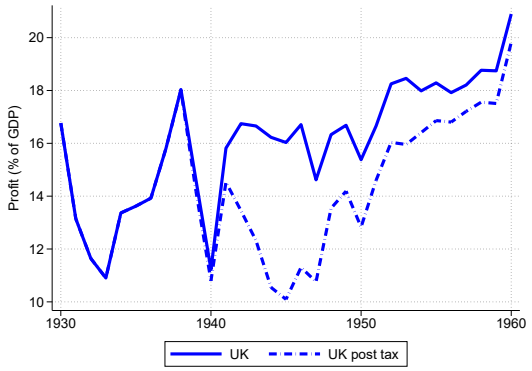
(b) Germany World War 1



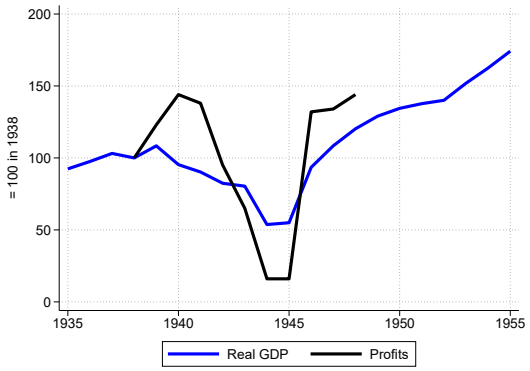
(c) Germany World War 2



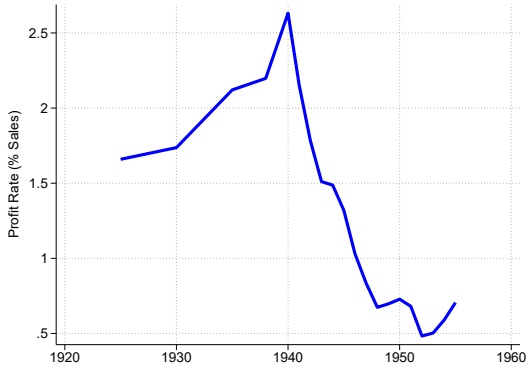
(d) Japan World War 2



(e) United Kingdom World War 2



(f) Netherlands World War 2

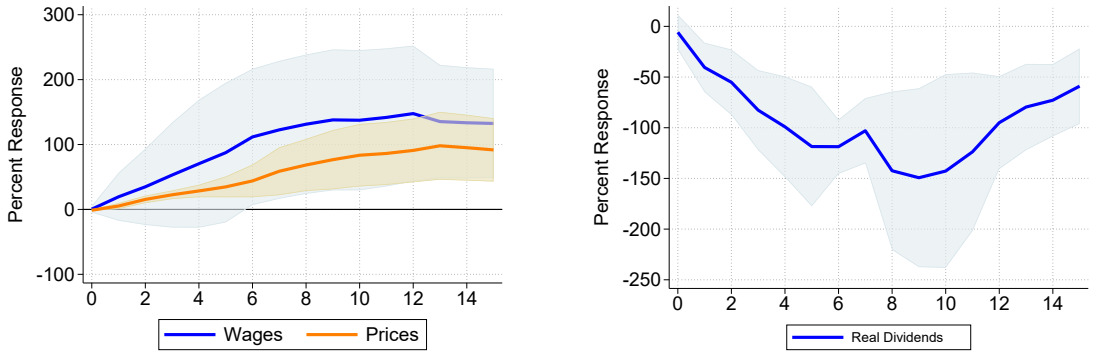


(g) Finland World War 2

Figure D.18: Comparison of Corporate Profits during Wars

Notes: This figure shows profits during war for the countries in our sample. For details see text.

Figure D.19: Response of Prices, Wages and Dividends



(a) Response of Wages and Prices

(b) Response of Real Dividends

Notes: Panel a) the response of wages and prices in the data of Jordà et al. (2017) to the war shock computed using specification 1. Next, panel b) shows the response of real dividends to the war shock. For the data on dividends, see section D.2.