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Who Absorbs the Debt-Deflation Channel? Empirical Evidence from Historical Balance Sheets and the Great Swiss Deflation

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Who Absorbs the Debt-Deflation Channel?

Empirical Evidence from Historical Balance Sheets and the Great Swiss Deflation

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February 28, 2025

Abstract

We empirically test Fisher (1933)'s debt-deflation theory using novel data on historical balance sheets of Swiss firms. Exploiting the sharp price decreases in Switzerland from 1917 until 1923, we do not find a statistically significant difference in cash holdings, inventory or profits between low- and high-leverage non-financial firms based on their initial debt ratio at the onset of deflation. In contrast, we show that non-state-owned banks with debt-to-asset ratios above the sample average reported a 1.3 to 3 percentage points lower profitability in 1921 and 1922 compared to counterparts with below-average leverage ratios. At first, all high-leverage banks issued 2.2 percentage points more new loans as a share of total assets compared to low-leverage banks as a response in 1921. State-owned banks reversed that trend in 1923, however. While firm bankruptcies indicate adverse effects on economic activity at the aggregate-level, our findings at the firm-level suggest that non-state-owned banks sheltered the real economy through an absorption of the price shock. As a policy implication, our results highlight the importance to stabilize banking systems during deflationary periods.

JEL-Classification: E31, M41, N14

Keywords: Deflation, balance sheet, leverage ratio, profitability

*Note: This manuscript is an early-stage, first draft.

1 Introduction

Fisher (1933) argues that deflation increases the real burden of nominal debt and thus financial stress of leveraged non-financial firms. As deflation progresses, liabilities grow which erodes net worth and may force firms economic to liquidate assets to service their debts. An economic downward spiral may follow as firms struggle to maintain solvency and avoid bankruptcy which may impact aggregate demand and thus real economic activity. The effect of such a deflationary shock on banks remains ambiguous, however, as an increase of the real value of assets may be counteracted by higher non-performing loan ratios. While the debt-deflation theory has been instrumental in financial economic theory (Ruoss, 1992; Shiller, 2013), empirical evidence on its mechanisms remains rather limited.

Recent work by Brunnermeier et al. (2024) examines the transmission of unexpected inflation to real economic activity through financial frictions, which amends theoretical work by (Gomes et al., 2016). In the context of Germany's price increases between 1919 to 1923, the authors find that the impact of inflation was at least partially transmitted to the real economy through a debt-inflation channel. Regarding the the debt-deflation channel, Giroud and Mueller (2017) argues that monetary effects may have been impacted firms through rigidities in their balance sheets during the Great recession, although the empirical findings remain inconclusive. We contribute to the literature by examining firms' financial performance during the Swiss deflationary period in the early-1920s which was stronger by a magnitude. Between 1920 and 1922 alone, the aggregate price level fell by nearly 40 percent. The deflation coincided with a pronounced spike in unemployment, a rapid decline of the GDP and a marked increase in firm bankruptcies. Its monetary, fiscal and macroeconomic effects were drastic (Baltensperger, 2012; Baltensperger and Schaltegger, 2023; Ruoss, 1992).

Following the high inflation of World War I, the Swiss National Bank (SNB) decreased the money supply, initiated measures to limit currency volatility and implemented policies to reduce the excessive capital flows. Aiming to reinforce the credibility of the Swiss franc in alignment with the gold standard, these policies were not only restrictive in nature, but contrasted sharply with monetary policies of Germany and Austria, among others at that time (Lopez and Mitchener, 2021; Ruoss, 1992; Schneebeli, 1932). Simultaneously, Swiss Federal Councillor Jean-Marie Musy implemented strict austerity measures to repay debt incurred during the war years, which further fuelled deflationary dynamics especially in 1921 and 1922. As both the SNB and the Swiss government announced their intentions in advance, the deflation was likely expected. We argue that such predictability of deflation provides a distinct setting for examining its impacts on bank-firm relationships, as institutions may have had time to adjust their behaviour.

Financial institutions play a crucial role for the transmission of deflationary dynamics to the real economy, as described by Bernanke (1995). Banks whose assets are primarily composed of nominal claims face mounting defaults and declining asset values, which undermines their capital base. High-leverage banks, in particular, are more vulnerable due to their greater reliance on borrowed funds relative to equity. The reduced capacity to absorb losses leaves these banks exposed to higher risks of profitability declines, and funding crises, which undermines their ability to lend. High-leverage banks may tighten their lending standards more sharply than low-leverage banks. These dynamics exacerbate credit contractions, further restricting firms' access to financing for operations or expansion, and deepen the economic downturn.

For non-financial firms, real debt burdens adversely affect financial conditions. While low-leveraged firms may increase their holdings of cash or cash equivalents to capitalize on the increased purchasing power of cash in a deflationary environment, high-leveraged firms might be forced to sell tangible assets to meet debt obligations. In turn, high-leveraged firms may exhibit greater financial losses and thus increased risks of bankruptcy compared to low-leverage firms, as the increased real debt burden erodes financial stability.

While macroeconomic data suggest that the deflationary period had adverse effects at the aggregate level, we find no statistically significant different impact of deflation on non-financial firms based on their leverage ratio at the onset of deflation. However, we empirically show that banks with higher debt-to-asset ratios at the onset of deflation experienced lower profitability during the deflationary period compared to banks with lower leverage. Issued loans increased in the first year of deflation, however, which potentially reflects increasing financial needs by firms and households. Overall, our results highlight the heterogeneous effects of the debt-deflation channel by a firm's sector and indebtedness which supports adequate policy responses.

The remainder of the paper is organized as follows. Section 2 presents some historical background and descriptive statistics. Section 3 outlines the dataset and explains how we arrived at the structure used for our analyses, while section 4 discusses our empirical approach. Results are discussed in section 5. The paper concludes with section 6.

2 Historical Background and Descriptive Statistics

The years following World War I were marked by significant socio-political upheavals and economic turmoil in Switzerland which set the stage for a period of prolonged deflation. In November 1918, the *Landesstreik* — a nationwide strike involving 250,000 workers — erupted due to grievances over rising inflation, low wages, supply shortages, and the Spanish flu's impact on both health and economic activity. The demands for a 48-hour workweek, pension

reforms, and women's suffrage highlighted deep social unrest. While some of the demands were later met, the Swiss Federal Council at first responded by mobilizing the army to end the strike by force, leaving a polarized political landscape as a result.

Amid this political unrest, Switzerland's economy faced significant challenges, too. Post-war financial instability in Europe led to fluctuations in foreign currencies and a sell-off of Swiss securities in 1919 which reflected a widespread loss of confidence. An overestimated post-war economic boom turned into a bust which caused a sharp decline in stock prices by 1920. The situation worsened in 1921 with a proposed one-off wealth levy, which drove capital out of the country and led to panic in financial markets. To stabilize the situation, major banks formed a consortium at the end of 1921 to support industrial stock prices.

During the early 1920s, the SNB intended to support a return to the gold standard, a goal which was stated clearly at two international conferences in Brussels in 1920 and Genoa in 1922. In 1924, the Swiss franc reached pre-war parity again, setting Switzerland apart as one of the first European countries to do so after the turmoil of the war (Bordo and James, 2007; Crettol and Halbeisen, 1999). At the same time, Federal Councillor Jean-Marie Musy as sitting Minister of Finance from 1920 until 1935 implemented austerity measures to repay debt that was incurred during the First World War. These austerity measures were deemed necessary because as Switzerland still incurred non-negligible amounts of debt although it did not participate on either block in the war. A substantial increase in expenditure on national defense and, towards the end and after the war, on social programs to ease and stabilize the heated political situation following a surge in both socialist and nationalist sentiments had led to a mounting debt pile (Guex, 2012).

Governance concerns between non-financial and financial firms were present at the early-20th century, too, as the Swiss corporate sector at the time had a highly cohesive unitary elite (Rossier et al., 2022). Personal relations between members of the corporate leadership in the industrial sector and in the banking sector were wide-spread. In some cases, members of the corporate elite were even directly members of the boards of banks and vice versa. Overall, entrepreneurs from industry, finance and trade as well as their most important associations such as the Swiss Bankers Association, the Federal Council and the higher government administration, the leaders of the centre-right parties and the Governing Board of the Swiss National Bank had established a deep network of interdependencies (Guex, 2012).

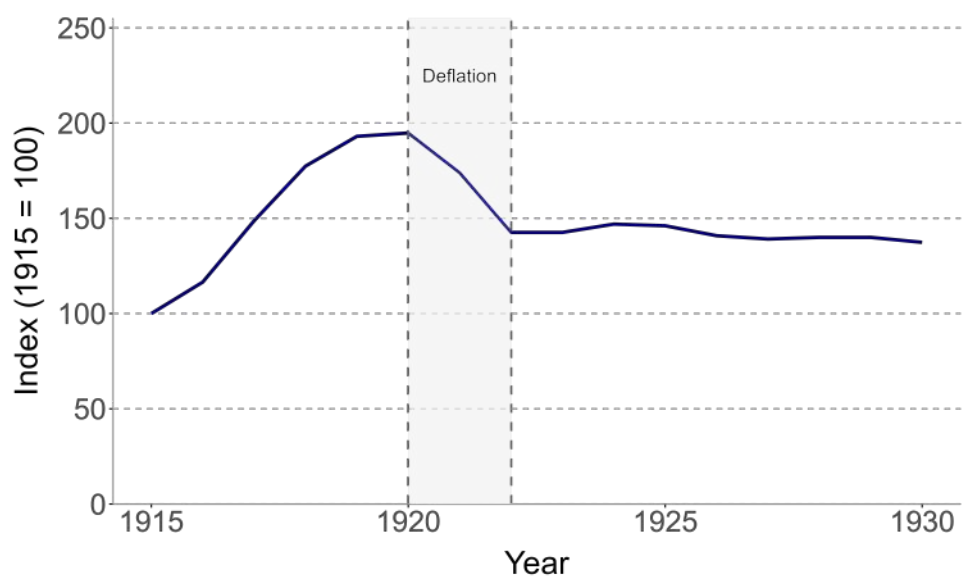
2.1 Deflation and economic activity

Figure 1 shows the annual development of the Swiss consumer price index (CPI) from 1915 to 1930. With the outbreak of World War I, the gold standard was suspended, and bank notes became legal tender in Switzerland. The confederation resorted to loans from the central bank

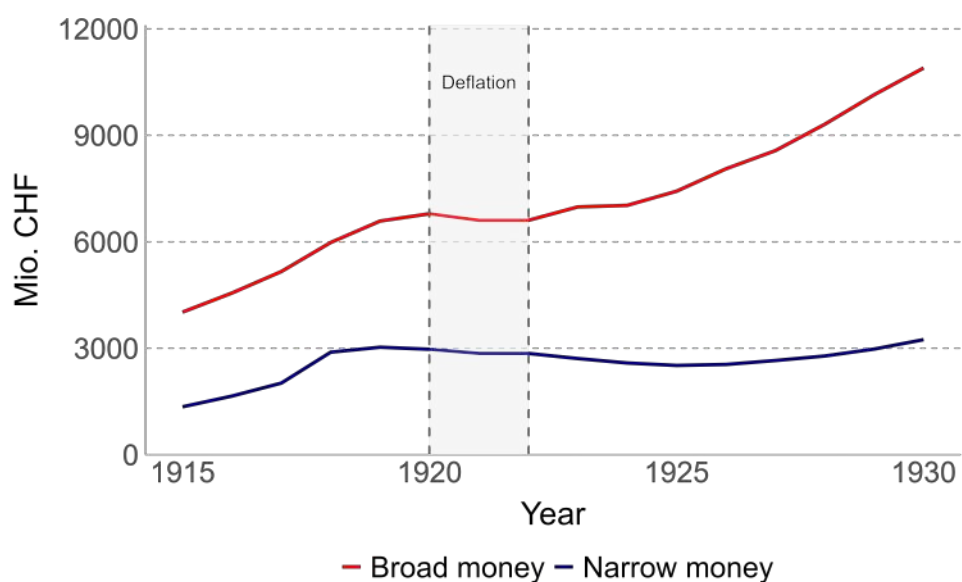
to cover the costs of national defense and the SNB greatly expanded its loans to the economy. In nominal terms, the confederation's debt increased ten-fold between 1914 and 1918, or a five-fold increase in real terms (Halbeisen and Straumann, 2012). These dynamics also led to a doubling of the amount of outstanding banknotes, as shown in Figure 2. As a consequence, the price level almost doubled between 1915 and the end of World War I, too. Nominal wages did not keep up with prices, which led to social tensions and increased criticism of the SNB's monetary policy stance (Jordan and Rossi, 2010; Straumann, 2015). Critics blamed the SNB for the expansion of the money supply and thus for the inflation of the war years (Bordo and James, 2007).

Restrictive fiscal and monetary policies implemented to stabilize the economy and return the Swiss franc to pre-war parity were announced by the SNB, for example at an international conference in Brussels in 1920 (Ruoss, 1992; Schneebeli, 1932). A sharp decline of the CPI followed, falling from 195 index points in 1920 to 143 in 1922. As the gold standard was seen as an indispensable prerequisite for growth and prosperity, political parties and associations were certain that monetary policy should aim to restore convertibility and revalue the Swiss franc to the pre-war parity level. The main differences were not on the question if but on how quickly the Swiss franc should reach pre-war parity again. Political support thus even remained intact during the deflationary period, when the real exchange rate of the Swiss franc skyrocketed. Post-war deflation was more or less seen as a natural consequence of war-related inflation (Bordo and James, 2007; Halbeisen and Straumann, 2012).

At the same time, the post-war monetary tightening in Switzerland aligned with the debt-deflation mechanism outlined by Lin et al. (2015). Their model shows that when central banks reduce the money supply, the real burden of nominal debt can rise abruptly, leading to defaults and inefficiencies in production. This is also in line with more general evidence which highlight that firms clearly react to monetary policy changes (Durante et al., 2022; Gertler and Gilchrist, 1994; Ottonello and Winberry, 2020). Although Switzerland's deflationary policies sought to restore pre-war monetary stability, the contraction in liquidity likely added to firms' vulnerabilities by increasing the real value of their debts. After the fast decline in the price level, it stabilized with only very moderate fluctuations in the following years.

Figure 1: Swiss CPI 1915-1930 (1915 = 100)

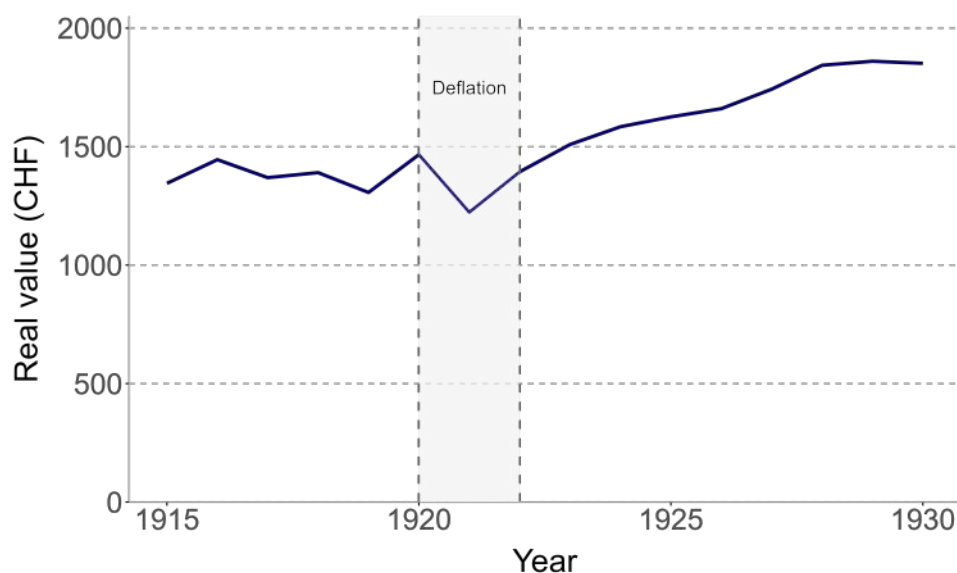
Data source: Jordà et al. (2017)

Figure 2: Swiss narrow and broad money 1915-1930

Data source: Jordà et al. (2017)

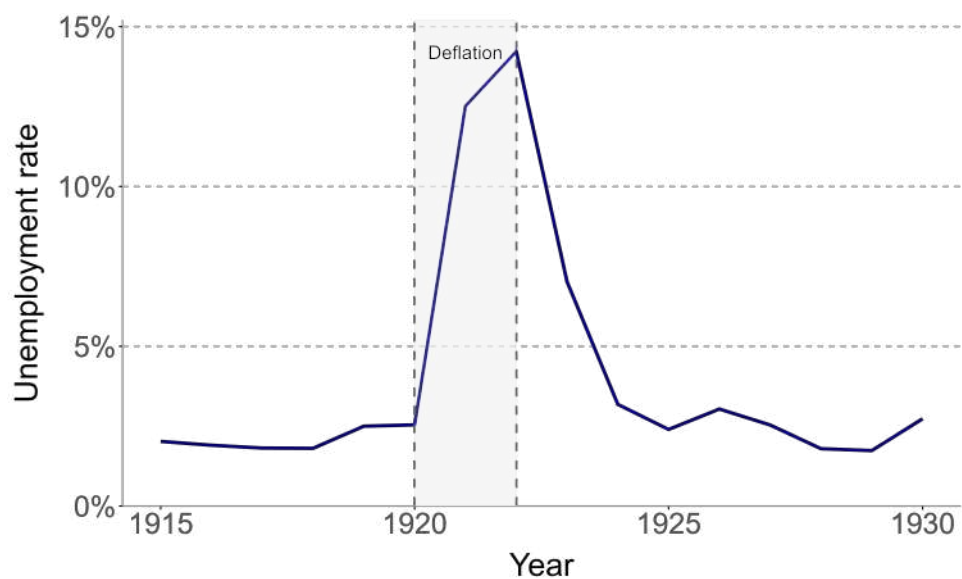
Such monetary shocks may lead to output fluctuations as shown by (Cordoba and Ripoll, 2004). Likewise, economic models with binding collateral constraints predict how sudden declines in asset prices or deflationary shocks can amplify real debt burdens and trigger large output drops (Mendoza, 2010). Similarly, Eichengreen and Grossman (1997) show that periods of deflation can coincide with heightened banking instability, as falling prices increase the real burden of debt and erode borrower collateral. In Switzerland's post-World War I setting, the combination of heavy debts and strained financial institutions likely reinforced the contraction in economic activity. Accordingly, the Swiss deflation caused a sharp decline in production and considerable unemployment (Ruoss, 1992). Figure 3 illustrates Swiss real GDP per capita from 1915 to 1930. From 1920 to 1921, the first deflation year, GDP per capita fell by over 15 percent. GDP per capita already partially recovered by 1922 with an increase of around 14 percent.

Figure 3: Swiss real CPI-deflated GDP per capita 1915-1930, base year 1915

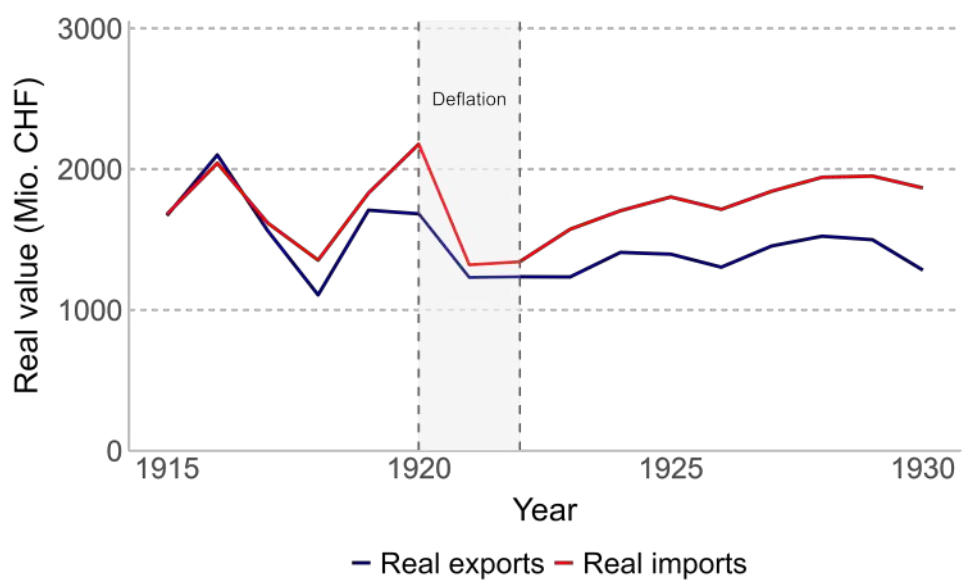


Data source: Jordà et al. (2017)

This unfavorable economic development was reflected in a rise in the unemployment rate in 1921, followed by a smaller increase in 1922 (see Figure 4). The rise in unemployment was driven by export-dependent industries, particularly watches, metals and machinery, and textiles (Baltensperger, 2012; Ruoss, 1992). Nearly all foreign trade was based on compensation deals and export credits during World War I. Although the Entente severely restricted imports into the country, Switzerland was still able to import the most important raw materials and food. Nevertheless, international transportation routes became increasingly insecure in the later stages of the war (Halbeisen and Straumann, 2012). After the war, foreign trade initially nearly bounced back to pre-war levels, but international trade almost immediately ran into new difficulties due to deflation, as illustrated by Figure 5.

Figure 4: Swiss unemployment rate 1915-1930

Data source: Jordà et al. (2017)

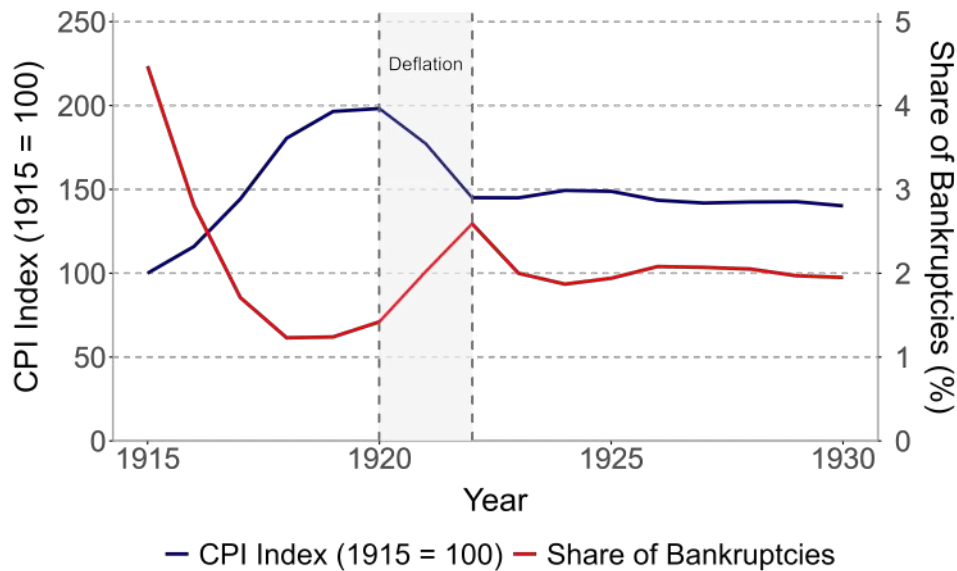
Figure 5: Swiss real CPI-deflated international trade 1915-1930, base year 1915

Data source: Jordà et al. (2017)

2.2 Deflation and firm bankruptcies

As deflation and deflation expectations lead to an increase in the real value of debt, it should translate to financial distress and higher firm bankruptcies for leveraged firms (Bhamra et al., 2011; DeLong and Sims, 1999; Fisher, 1933). Figure 6 shows the Swiss CPI and the bankruptcies of companies registered in the commercial register as a share of all registered firms. During the First World War, bankruptcies were particularly high. After the war, they initially declined again. As prices fell sharply from 1921 to 1922, bankruptcies increased again, however, from around 1.5 percent to approximately 2.5 percent of all companies registered in the commercial register. The decline in bankruptcies immediately in 1923 and its stabilization at around 2 percent afterwards suggests that as deflationary pressures subsided, bankruptcies were less frequent.

Figure 6: Swiss CPI 1915-1930 (1915 = 100) and share of firm bankruptcies



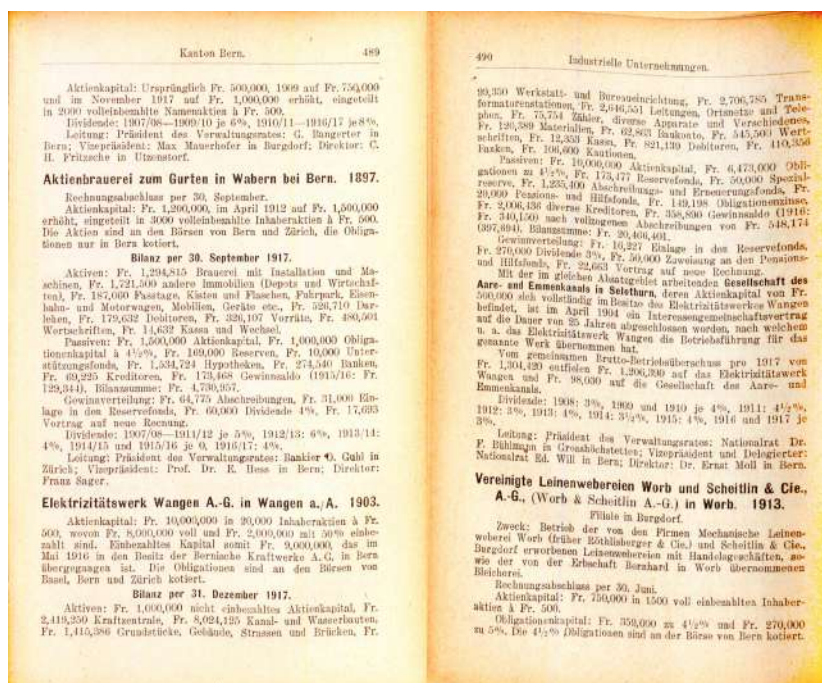
Data source: HSSO (2012a,b); Jordà et al. (2017)

3 Data

We compile novel data on balance sheet information for non-financial firms and banks as reported in various editions of the *Schweizerisches Finanz-Jahrbuch*, an annual publication that provides detailed data on numerous such companies (Steiger, 1918, 1919, 1920, 1921, 1922, 1923, 1924). The data spans from 1917 to 1923, which corresponds to the *Schweizerisches Finanz-Jahrbuch* editions published between 1918 to 1924 and thus covers the period from the end of World War I to the end of the deflationary episode.

The balance sheets have been digitized from copies of the original books. We have verified entries for accuracy, and flagged instances where accounting identities failed to hold due to inaccuracies in the original reports. After data cleaning, 610 observations in our non-financial firm ("firm") dataset and around 540 observations in our financial firm ("bank") dataset remain. As shown in Figure 7, the balance sheet items are not consistently reported. We adopt a general financial statement structure following the International Financial Reporting Standards (IFRS). Table 1 presents the top-level structure used for non-financial firms, while a partially modified structure was applied to bank balance sheets to account for industry-specific entries. In most cases, these definitions have several sub-categories. Where applicable, we categorized balance sheet items using sub-categories within this framework.

Figure 7: Example Pages of the *Schweizerisches Finanz-Jahrbuch*, 1918



Data source: Steiger (1918)

Table 1: Balance Sheet Structure based on International Financial Reporting Standards

Assets	Equity
Property, Plant, and Equipment	Total Equity attributable
Investment Property	to Owners of Parent
Goodwill	Retained Earnings
Intangible Assets	Other Reserves
Other Financial Assets	Other Equity Items
Inventories	Non-controlling Interests
Accruals and Additional Assets	Liabilities
Receivable and Contracts	Trade and Other Payables
Tax Assets	Provisions
Agricultural (Biological) Assets	Other Financial Liabilities
Cash and Cash Equivalents	Accruals, Deferrals and Additional Liabilities

Similarly as Brunnermeier et al. (2024), it is likely not the case that deflation was fully dealt with in firms' accounting practices, as specialised inflation accounting techniques did not exist at the time. This was an issue in particular during the hyperinflations in other European countries (Sweeney, 1934). In our setting with pronounced deflation, this implies that real accounting items such as fixed assets could become overvalued relative to nominal items such as cash holdings. Where applicable, we follow the approach of Brunnermeier et al. (2024) to address these issues. On the one hand, we rely on balance sheet data before the onset of deflation to categorize our firms and banks according to their leverage ratios and provide estimates up to the year after the deflation. Our analysis thus sorts firms based on their balance sheet exposure to deflation before the start of the deflation. On the other hand, we use ratios instead of absolute or log values, which should mitigate part of the issue.

We use data by Jordà et al. (2017) for macroeconomic indicators, including the consumer price index (CPI), imports and exports, GDP, monetary aggregates, public expenditures and revenues as well as the unemployment rate. Data on firm bankruptcies was taken from HSSO (2012a,b). Additionally, we collect macroeconomic data from HSSO (2012a,b).

4 Empirical Approach

We examine the impact of deflation on several balance sheet items of leveraged firms and banks. Building on Brunnermeier et al. (2024), we apply a dynamic difference-in-differences model and use firm-level variation in debt leverage ratios:

$$Outcome_{it,f} = \alpha_i + \sum_{y \neq 1920} \beta_y Leverage_{i,k} 1_{y=t} + \varepsilon_{it} \quad (1)$$

where $Outcome_{it}$ are $f = 1, \dots, 6$ outcome variables. Cash and cash equivalents, inventory as tangible assets and profit as a share of total assets are outcome variables for non-financial firms i in year $t = 1917, \dots, 1923$. For banks, we use the asset values, loans given and profit as a share of total assets as outcome variables.

$Leverage_{i,k}$ are $k = 1, 2$ measures for the leverage ratio. To assess a firm's potential exposure to deflation, we calculate its leverage ratio in the year 1920, the year before the deflation. We define leverage as total liabilities relative to total assets, encompassing all financial and non-financial obligations, such as debt, bonds, provisions, and accruals. The first indicator is the relative leverage ratio of a firm in the year 1920. The second indicator is a dummy variable which takes the value 1 if the leverage ratio of a firm in the year 1920 is above the average leverage ratio of all firms, and 0 otherwise. Using the leverage ratio as an indicator for exposure to deflation is based on the hypothesis that firms with higher leverage face an increase in the real value of nominal debt contracts, thereby increasing the financial burden they face as compared to firms with lower leverage. Moreover, as leverage ratios can vary substantially, even within the same industry, this differentiation is highly relevant (Myers, 1984).

α_i are firm-fixed effects. Standard errors are clustered at the firm-level.

5 Results

Overall, we find no statistically significant differences in financial performance between low- and high-leverage firms in response to deflationary pressures. In contrast, financial institutions exhibit heterogenous effects of deflation depending on their initial leverage ratios

5.1 Impact of deflation on non-financial firms

Table 2 presents the results from the baseline difference-in-differences model on cash and cash equivalents, inventories held by firms, and the profitability of non-financial firms. None of the estimators indicate a statistically significantly different impact of deflation on balance sheet items between low- and high-leverage firms. Descriptive statistics confirm that no coefficient is statistically significant for cash and cash equivalents (see Figure 8 and Figure A.1), inventories (see Figure 9) and Figure A.3) and profits (see Figure 10 and Figure A.5). Overall, the empirical findings suggest that the leverage ratio of non-financial firms at the onset of the deflation did not affect several indicators of financial performance as a share of total assets.

Table 2: Non-financial firms, difference-in-differences by year and indicator

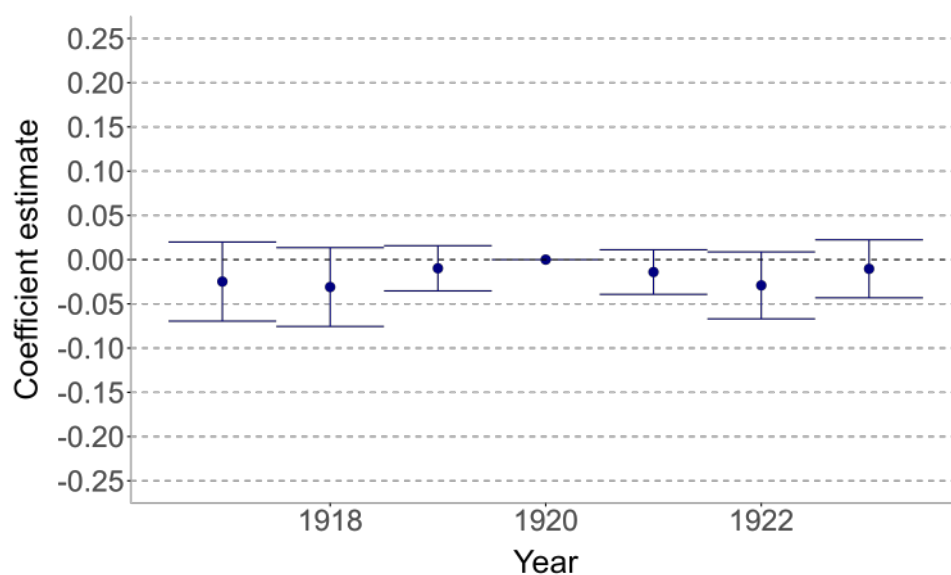
	<i>Cash and Cash Equivalents</i>		<i>Inventory</i>		<i>Profit/Deficit</i>	
	Dummy	Ratio	Dummy	Ratio	Dummy	Ratio
Leverage \times year = 1917	−0.025 (0.023)	−0.069 (0.053)	0.042 (0.023)	0.071 (0.056)	0.011 (0.013)	0.020 (0.039)
Leverage \times year = 1918	−0.031 (0.022)	−0.050 (0.052)	0.038 (0.024)	0.048 (0.061)	0.012 (0.013)	0.014 (0.042)
Leverage \times year = 1919	−0.010 (0.013)	−0.035 (0.031)	0.020 (0.020)	0.045 (0.052)	0.004 (0.009)	−0.011 (0.024)
Leverage \times year = 1921	−0.014 (0.013)	−0.003 (0.031)	−0.009 (0.022)	−0.013 (0.036)	0.018 (0.012)	0.024 (0.038)
Leverage \times year = 1922	−0.029 (0.019)	−0.004 (0.047)	0.018 (0.019)	0.050 (0.046)	0.018 (0.015)	0.037 (0.037)
Leverage \times year = 1923	−0.010 (0.016)	0.009 (0.043)	0.035 (0.022)	0.073 (0.050)	−0.001 (0.017)	0.004 (0.039)
Observations	550	550	480	480	568	568
R2	0.737	0.741	0.878	0.877	0.503	0.501

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at the firm-level are in parentheses.

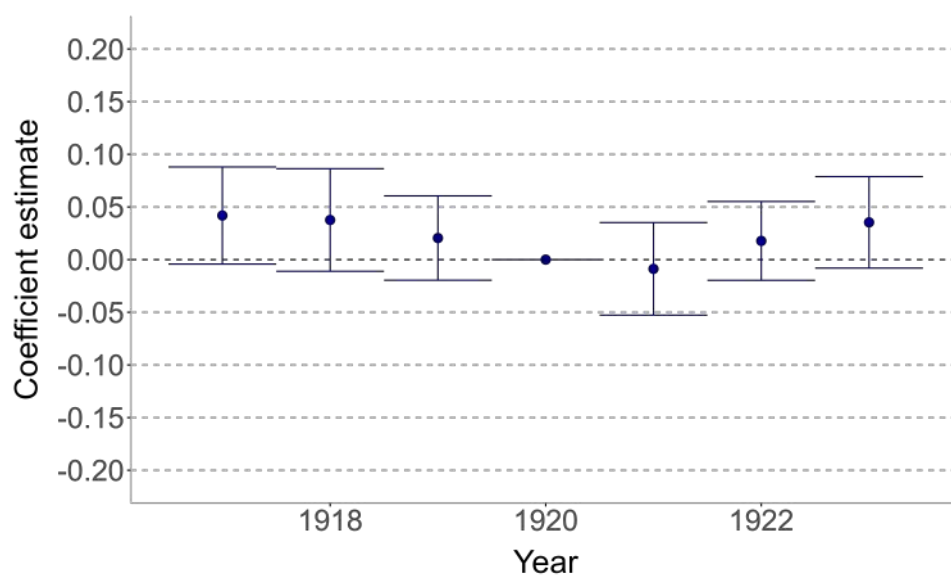
Estimates are relative to the reference year 1920.

Figure 8: Non-financial firms, difference-in-differences, leverage dummy, cash and cash equivalents by year



Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals. The bars represent 95% confidence intervals.

Figure 9: Non-financial firms, difference-in-differences, leverage dummy, inventory by year



Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals.

Figure 10: Non-financial firms, difference-in-differences, leverage dummy, profit or loss by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals.

5.2 Impact of deflation on banks

Table 3 presents the empirical results regarding banks' asset values. We do find a statistically significant positive effect of inflation on assets for high-leverage banks in 1921 once we include all bank types. However, when we distinguish between state-owned cantonal banks and other financial institutions, we find a more pronounced statistically significant positive effect of deflation on assets for cantonal banks in 1921 for the leverage ratio. We note that asset values fluctuated substantially between 1917 and 1923 for both high- and low-leverage banks (Figure A.7). Especially during the deflationary period, asset values increased substantially in 1921 before declining again in 1922, with a divergent trend emerging in 1923. A graphical representation of the results based is provided in Figure 11 for the leverage dummy.

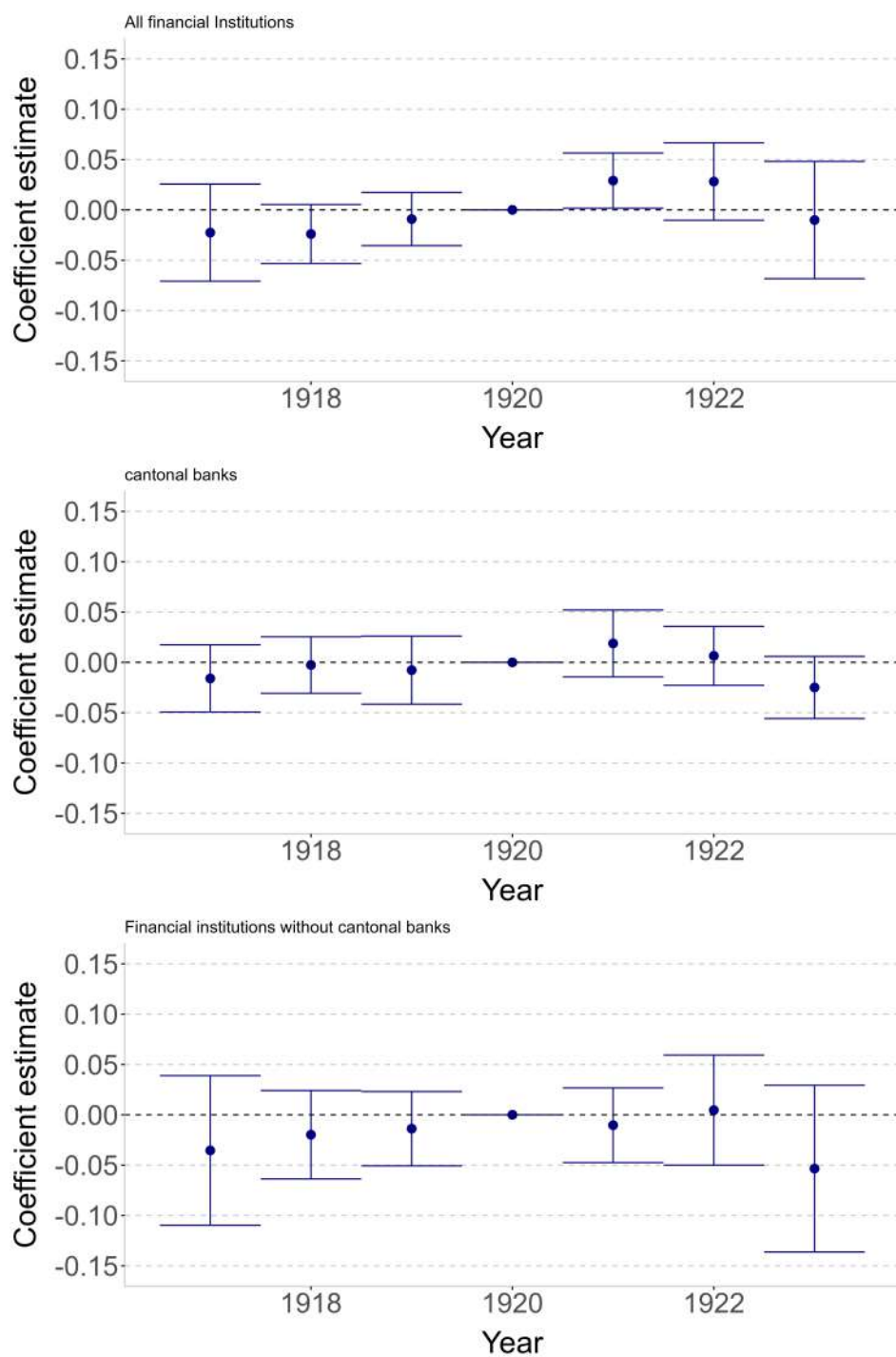
Table 3: Banks, difference-in-differences for assets by year and indicator

	<i>all banks</i>		<i>cantonal banks</i>		<i>all banks w/o cantonal banks</i>	
	Dummy	Ratio	Dummy	Ratio	Dummy	Ratio
leverage \times Year = 1917	−0.023 (0.024)	0.029 (0.108)	−0.016 (0.016)	−0.047 (0.106)	−0.035 (0.037)	0.042 (0.120)
leverage \times Year = 1918	−0.024 (0.015)	0.009 (0.056)	−0.003 (0.014)	−0.087 (0.063)	−0.020 (0.022)	0.024 (0.064)
leverage \times Year = 1919	−0.009 (0.013)	−0.018 (0.037)	−0.008 (0.016)	−0.089 (0.058)	−0.014 (0.018)	−0.008 (0.043)
leverage \times Year = 1921	0.029** (0.014)	−0.001 (0.036)	0.019 (0.016)	0.213*** (0.055)	−0.010 (0.018)	−0.044 (0.034)
leverage \times Year = 1922	0.028 (0.019)	0.031 (0.064)	0.006 (0.014)	0.162* (0.081)	0.005 (0.027)	−0.018 (0.066)
Leverage \times year = 1923	−0.010 (0.029)	−0.004 (0.068)	−0.025 (0.015)	0.009 (0.130)	−0.053 (0.041)	−0.093 (0.083)
	483	483	162	162	321	321
R2	0.845	0.841	0.841	0.843	0.843	0.843

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at the firm level are in parentheses.

All estimates are relative to the reference year 1920.

Figure 11: Banks, difference-in-differences, leverage dummy, assets by year and bank type

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals.

Average bank profits declined with the trend beginning even before the onset of deflation (see Figure A.8). During the deflation period in the years 1921 and 1922, profits declined more sharply for high-leveraged banks compared to their low-leveraged counterparts. The difference is statistically significant at the five percent level (see Table 4). Once we distinguish between cantonal banks and other financial institutions, differences are not statistically significant between high-leverage cantonal banks compared to low-leverage cantonal banks. For non-state-owned banks, however, the results are more pronounced and statistically significant at the one percent level when we use the leverage dummy variable. On average, high-leverage non-state-owned banks had a 1.3 to 3 percentage points lower profit compared to low-leverage counterparts. A graphical representation of the results based on the leverage dummy is provided in Figure 12.

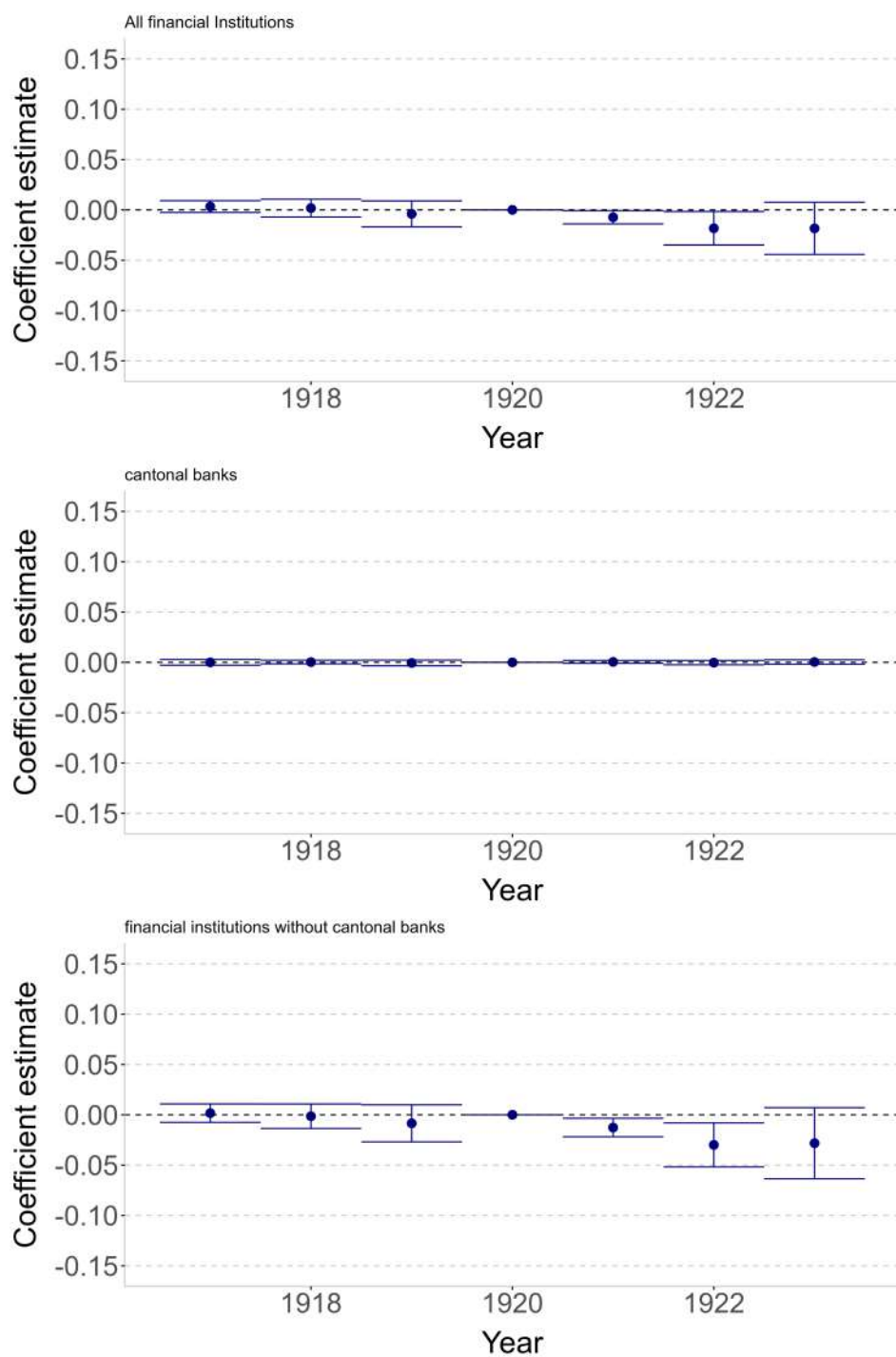
Table 4: Banks, difference-in-differences for profits by year and indicator

	<i>all banks</i>		<i>cantonal banks</i>		<i>all banks w/o cantonal banks</i>	
	Dummy	Ratio	Dummy	Ratio	Dummy	Ratio
Leverage \times year = 1917	0.003 (0.003)	0.000 (0.006)	0.000 (0.001)	0.009 (0.013)	0.002 (0.005)	-0.003 (0.007)
Leverage \times year = 1918	0.002 (0.004)	-0.018 (0.013)	0.000 (0.001)	0.007 (0.008)	-0.001 (0.006)	-0.024 (0.015)
Leverage \times year = 1919	-0.004 (0.006)	-0.041 (0.030)	-0.001 (0.001)	0.001 (0.008)	-0.008 (0.009)	-0.046 (0.032)
Leverage \times year = 1921	-0.007** (0.003)	-0.016 (0.010)	0.000 (0.001)	-0.002 (0.011)	-0.013*** (0.005)	-0.015 (0.010)
Leverage \times year = 1922	-0.018** (0.008)	-0.051* (0.030)	0.000 (0.001)	0.002 (0.013)	-0.030*** (0.011)	-0.045 (0.032)
Leverage \times year = 1923	-0.018 (0.013)	-0.050 (0.036)	0.000 (0.001)	0.015 (0.014)	-0.028 (0.017)	-0.046 (0.036)
Observations	291	291	77	77	214	214
R2	0.587	0.593	0.836	0.837	0.584	0.574

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at the firm level are in parentheses.

All estimates are relative to the reference year 1920.

Figure 12: Banks, difference-in-differences, leverage dummy, profits by year and bank type

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals.

The proportion of loans to total assets changed little over time for both high-leveraged and low-leveraged banks (see Figure A.9), yet low-leverage banks consistently maintained a lower ratio. Table 5 visualizes the empirical results for the difference-in-differences estimation. The empirical findings suggest that high-leveraged banks have statistically significantly issued more loans in the year 1921 as opposed to low-leveraged banks. However, this result is no longer statistically significant once we distinguish between cantonal banks and all other financial institutions. In the year 1923, cantonal banks reversed the trend. High-leverage state-owned banks experienced a stronger decline in the proportion of loans issued relative to total assets. Loans issued often have multi-year maturities and cannot be adjusted simultaneously on an annual basis. A delayed reaction to deflation could therefore be plausible, particularly if deflationary effects persist over multiple years. A graphical representation of the results is provided in Figure 13.

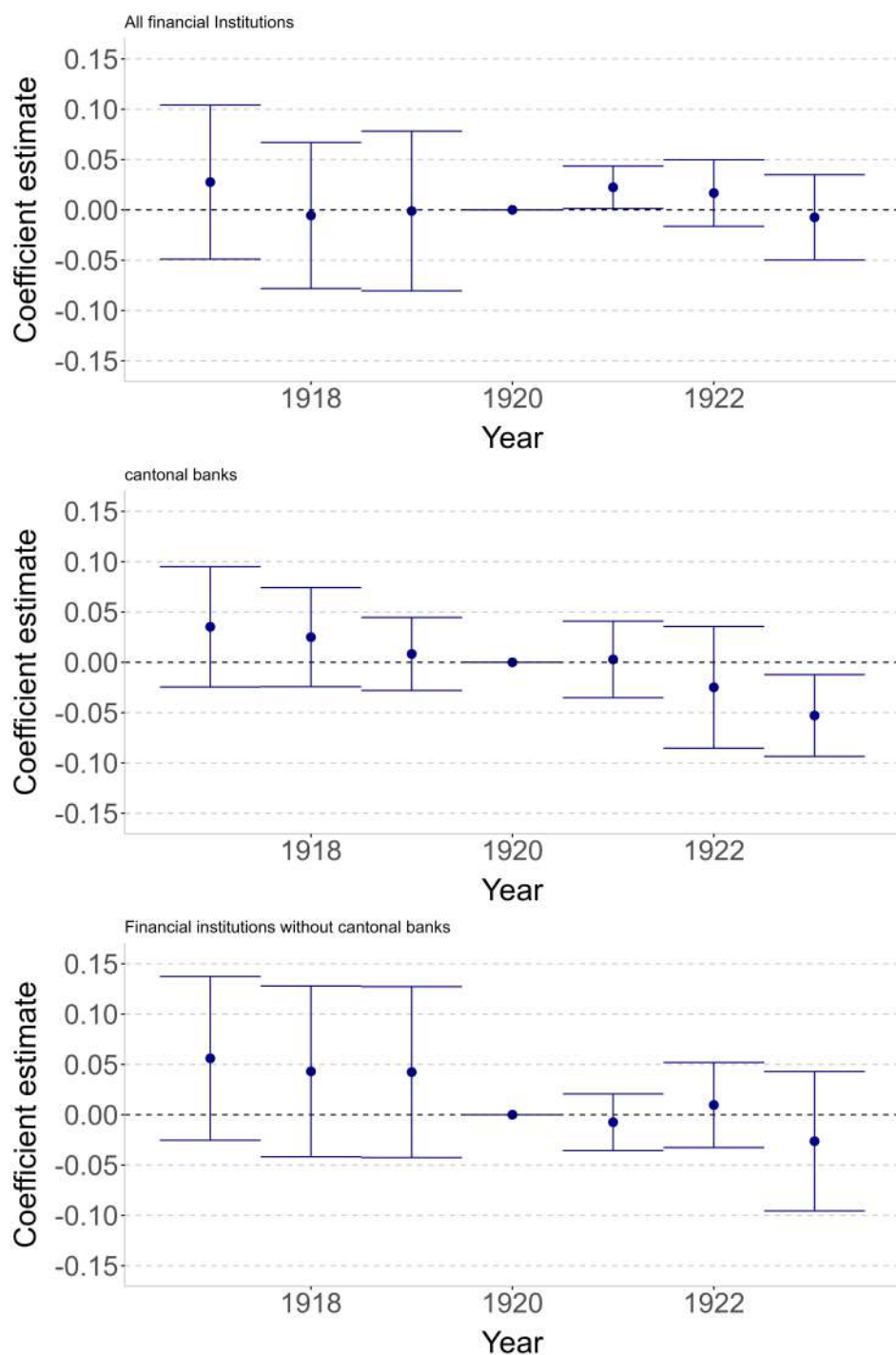
Table 5: Banks, difference-in-differences for issued loans by year and indicator

	<i>All Banks</i>		<i>Cantonal Banks</i>		<i>All Banks w/o Cantonal Banks</i>	
	Dummy	Ratio	Dummy	Ratio	Dummy	Ratio
Leverage \times year = 1917	0.028 (0.038)	0.145 (0.099)	0.035 (0.029)	0.346 (0.234)	0.056 (0.040)	0.196 (0.118)
Leverage \times year = 1918	-0.006 (0.036)	-0.042 (0.102)	0.025 (0.024)	0.082 (0.221)	0.043 (0.042)	0.040 (0.129)
Leverage \times year = 1919	-0.001 (0.040)	0.013 (0.092)	0.008 (0.018)	0.116 (0.205)	0.042 (0.042)	0.066 (0.093)
Leverage \times year = 1921	0.022** (0.011)	0.102* (0.056)	0.003 (0.018)	0.199 (0.152)	-0.007 (0.014)	0.037 (0.064)
Leverage \times year = 1922	0.017 (0.017)	0.108 (0.074)	-0.025 (0.029)	0.150 (0.244)	0.010 (0.021)	0.072 (0.076)
Leverage \times year = 1923	-0.007 (0.021)	0.001 (0.095)	-0.053** (0.020)	-0.214 (0.148)	-0.026 (0.034)	0.018 (0.117)
Observations	379	379	162	162	217	217
R2	0.960	0.960	0.956	0.953	0.960	0.959

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at the firm level are in parentheses.

All estimates are relative to the reference year 1920.

Figure 13: Banks, difference-in-differences, leverage dummy, issued loans by year and bank type

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations. The bars represent 95% confidence intervals.

6 Conclusion

We examine the impact of deflation on Swiss firms and banks during the post-World War I period, focusing on the debt-deflation channel. Our findings suggest that while macroeconomic indicators and firm bankruptcy rates reflect the adverse economic effects of the deflationary period in the aggregate, we do not find empirical evidence that non-financial firms' leverage ratios at the onset of deflation influenced their financial performance. This result implies that the debt-deflation channel as hypothesized by Irving Fisher (Fisher, 1933; King, 1994) does not explain the dynamics observed in Swiss firm balance sheets during this period for all sectors.

Banks may have acted as effect intermediaries, however, and absorbed part of the economic shock during the deflationary period, thereby reducing the impact of deflation on high- versus low-leveraged firms. This interpretation is supported by the increase in the volume of loans issued by highly-leveraged banks in the first year of deflation, which may reflect the rising financial needs of firms and households as they navigated the economic downturn. By providing liquidity during this period, banks may have mitigated the immediate effects of deflation on firms, particularly those with high leverage.

However, our analysis of bank balance sheets reveals that this intermediary role came at a cost. Banks with higher leverage at the onset of deflation experienced statistically significant lower profitability during the deflationary period, which points towards their vulnerability to financial instability. This suggests that while highly-leveraged banks may have helped stabilize firms' access to credit, their own financial fragility increased under the deflationary pressures which amplified the real burden of debt and reduced margins.

The observed behavior highlights a trade-off: while banks may have play a stabilizing role for firms during the initial deflationary period, their own vulnerabilities could exacerbate systemic risks. Overall, our findings contribute to a deeper understanding of the economic consequences of deflation and show the importance of targeted policies to safeguard financial institutions.

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A Appendix

Table A.1: Summary statistics, non-financial firms

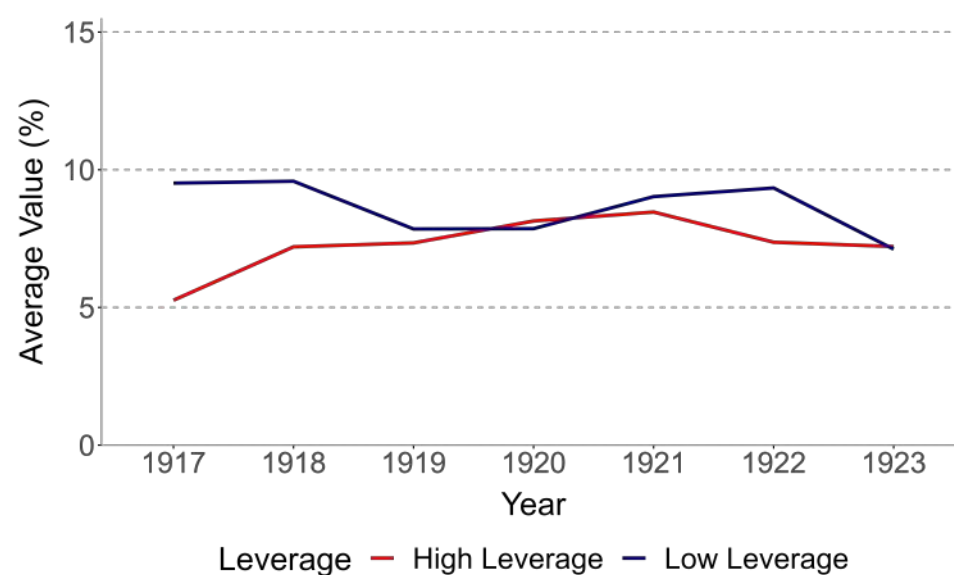
	Mean	SD	Min	Max
Cash and Cash Equivalents	0.079	0.107	0	0.605
Inventory	0.190	0.171	0.001	0.727
Profit/Deficit	0.061	0.056	0	0.469

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

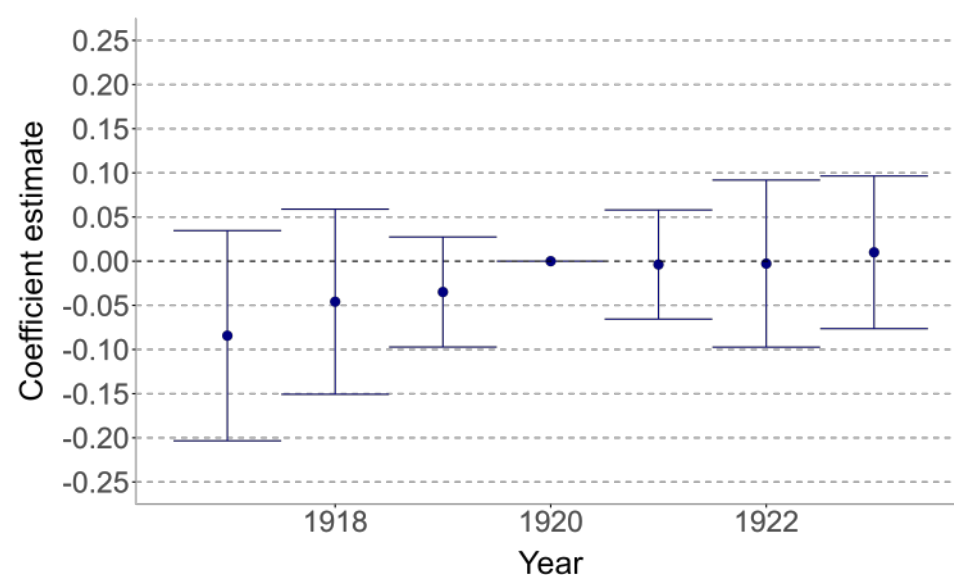
Table A.2: Summary statistics, banks

	Mean	SD	Min	Max
All banks				
Assets	0.214	0.236	0	0.922
Profit/Deficit	0.019	0.031	0	0.296
Loans	0.522	0.303	0.001	0.948
Cantonal banks				
Assets	0.183	0.168	0	0.753
Profit/Deficit	0.007	0.003	0.001	0.016
Loans	0.623	0.164	0.106	0.895
Non-cantonal banks				
Assets	0.258	0.290	0	0.923
Profit/Deficit	0.023	0.036	0	0.296
Loans	0.443	0.355	0.001	0.948

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

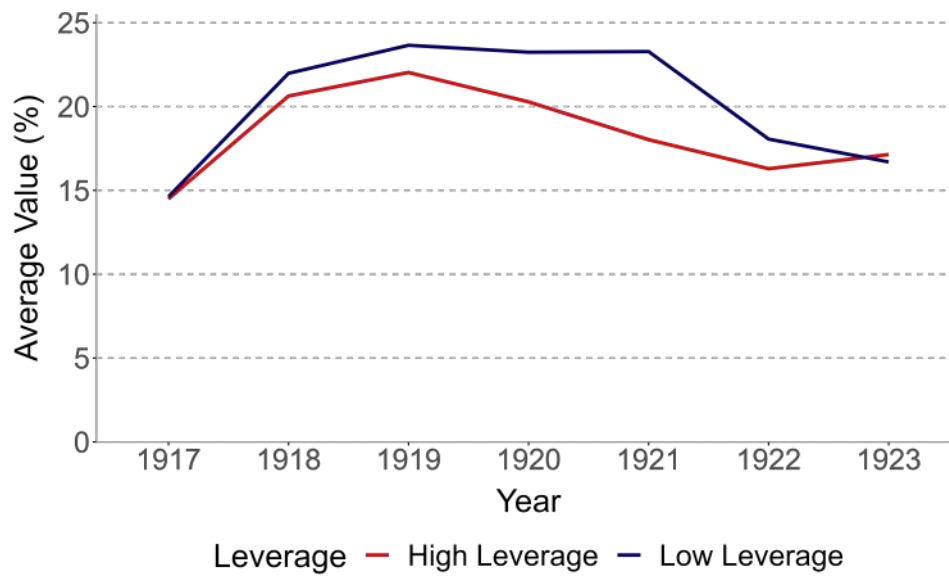
Figure A.1: Cash and cash equivalents as a share of all assets by leverage levels

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

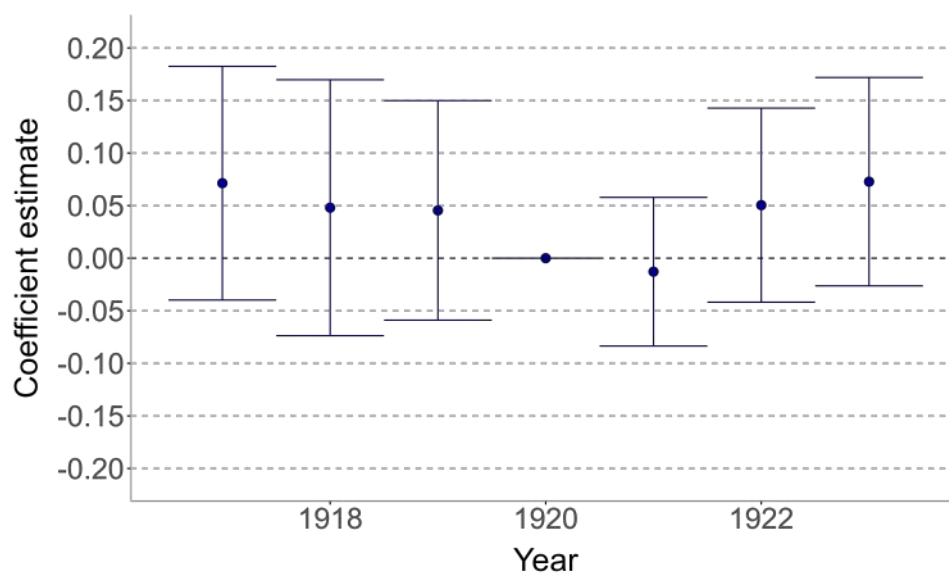
Figure A.2: Non-financial firms, difference-in-differences, leverage level, cash and cash equivalents by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

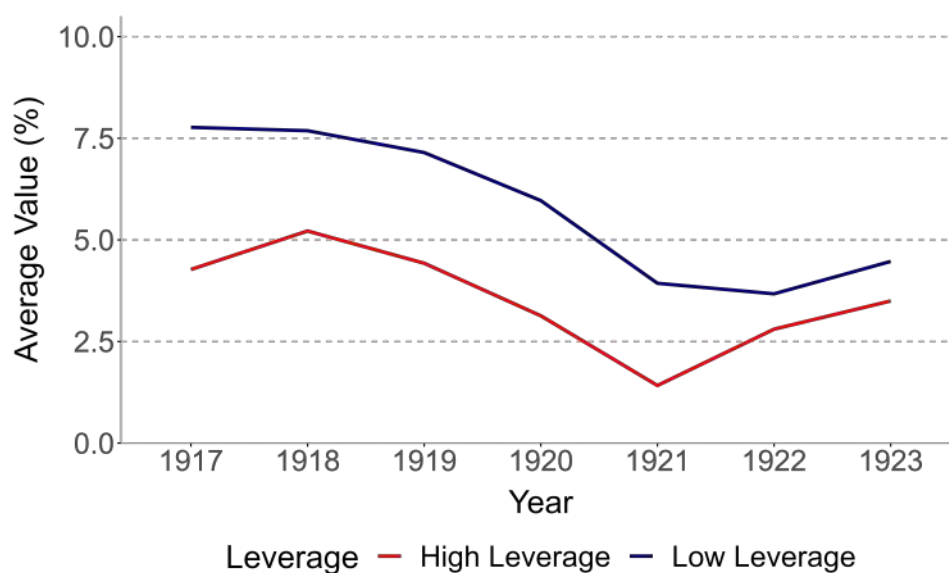
Figure A.3: Non-financial firms, leverage level, inventories as a share of all assets by year



Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

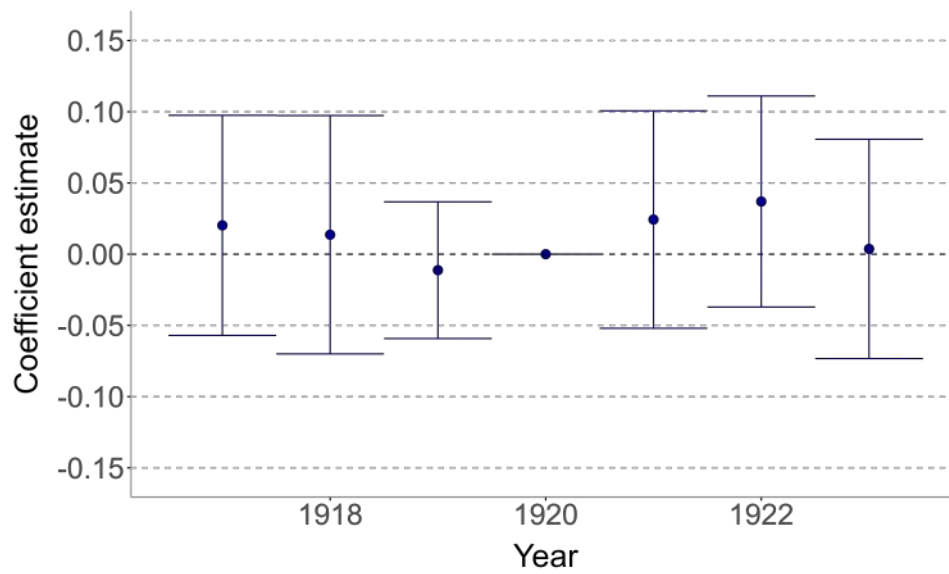
Figure A.4: Non-financial firms, difference-in-differences, leverage level, inventories by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

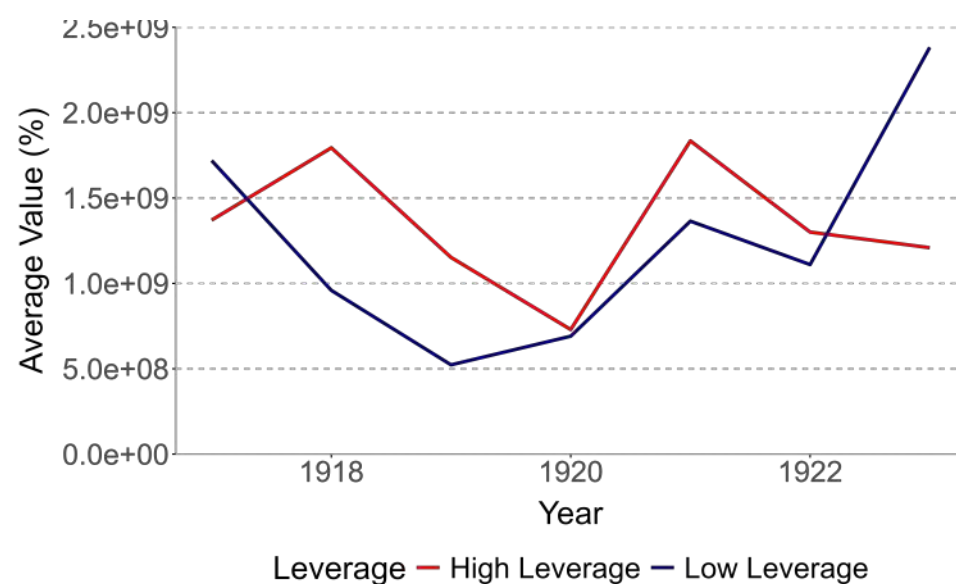
Figure A.5: Non-financial firms, profit as a share of balance sheet total by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

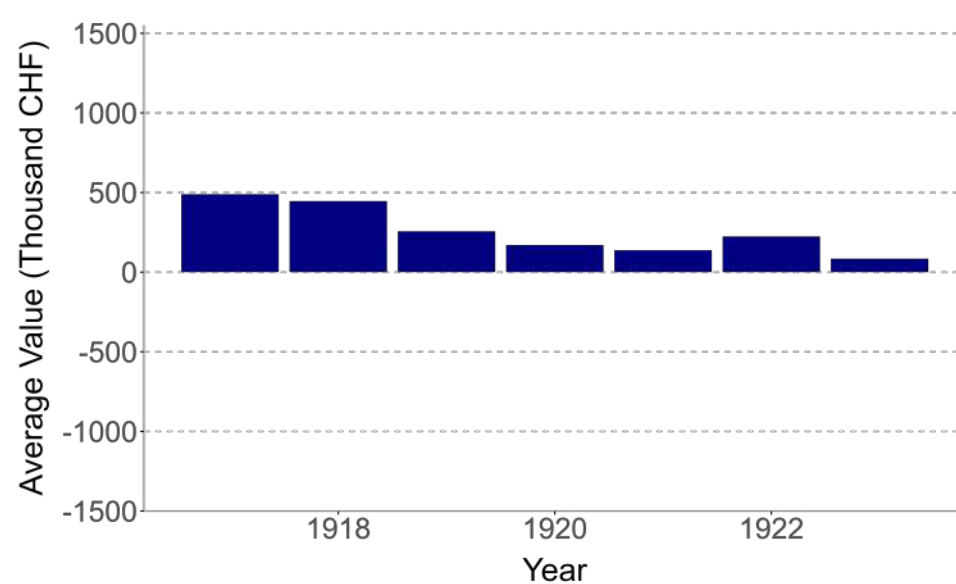
Figure A.6: Non-financial firms, difference-in-differences, leverage level, profit as a share of balance sheet total by year



Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

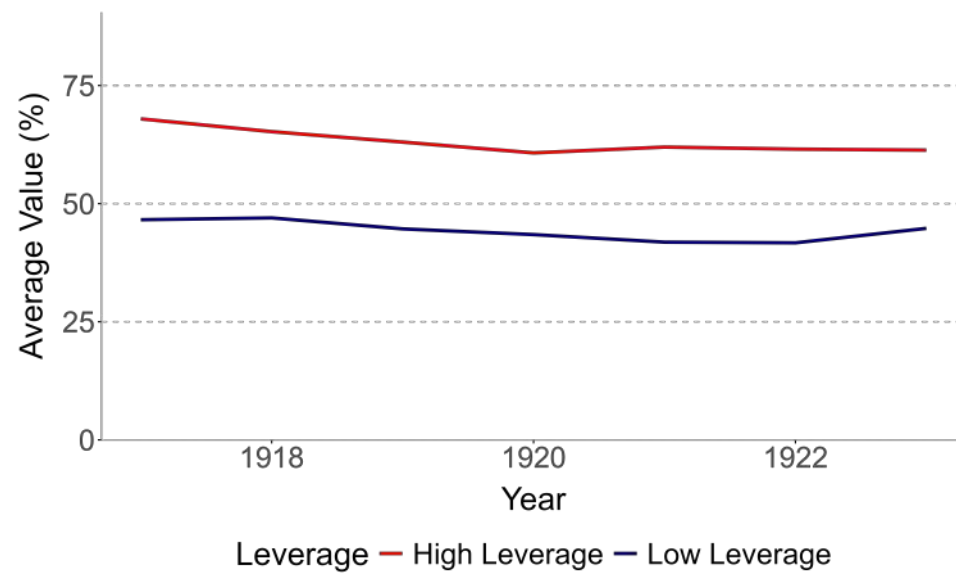
Figure A.7: Banks, average asset values by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

Figure A.8: Banks, average total profit by year

Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.

Figure A.9: Banks, average loans issued by year



Data source: Steiger (1918, 1919, 1920, 1921, 1922, 1923, 1924) and own calculations.