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Debt-Inflation Channel: German Hyperinflation 1919-23

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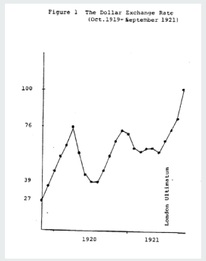
with Sergio Correia, Stephan Luck, Tom Zimmermann & M

23. March 2023

Hyperinflations are the laboratory of monetary economics

- Sargent (1983)
  “The Ends of Four Big Inflations”
  - Fiscal-monetary interaction
  - Political credibility is key to stop (1923)
    - Rational Expectation

- Dornbusch (1985)
  - FX focus



Poll

1. Did people **anticipate** (hyper)inflation in Germany 1919-23?
   a. No, they were surprised every time inflation increased.
   b. Partly. Not at first but people learned.
   c. Yes. Inflation widely anticipated from the beginning.
2. What is the main **fundamental cause** of inflation?
   a. High money growth
   b. Fiscal deficit
   c. Fiscal deficits
   d. Exchange rate depreciation
   e. Other shocks (e.g., war)
3. What are the main **expansionary channels** of inflation?
   a. Real wage declines
   b. Redistribution to debtors
4. What are the main **contractionary channels** of inflation?
   a. Resource misallocation/price dispersion
   b. Financial instability/credit crunch
   c. Increased uncertainty
   d. Other
5. What is the best asset to **hedge** against high inflation?
   a. Stocks b. Bonds c. Commodities d. Real Estate

The Debt-Inflation Channel of the German Hyperinflation

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March 23, 2023

Motivation

- How does **inflation** transmit to the **real economy**?
- What is the role of a **debt-inflation channel** through firm financing frictions?
  - Inflation $\rightarrow$ wealth redistribution to net nominal debtors
    $\rightarrow$ real effects by relaxing financing constraints
    Keynes (1923), Fisher (1933)
- How important is this financial channel relative to the **New Keynesian channel** through price/wage rigidity?
- **This paper**: Use the **German inflation of 1919-1923** to study how a "big" inflation transmits to the real economy through the debt-inflation channel

The German Inflation, 1919-1923

"Hyperinflations are the laboratory of monetary economics." – Dornbusch (1985)

- Canonical event in monetary history
  - Depreciation: 4.2 marks/dollar $\rightarrow$ 4.2 *trillion*/dollar
  - Studied by generations to understand the fundamental causes of inflation + macroeconomic and distributional effects

    Keynes (1923), Graham (1930), Bresciani-Turroni (1937), Cagan (1956), Sargent (1982), Kindleberger (1985), Dornbusch and Fischer (1986), Feldman (1993) ...

- Features of the empirical setting:
  1. Inflation was **unanticipated**
  2. Massive inflation puts **debt-inflation channel into sharp relief**
  3. **Newly digitized micro data $\rightarrow$ disentangle mechanisms**

Key Findings

1. Debt-inflation channel: aggregate evidence
   - Inflation led to a large **fall in leverage** (50%) and interest expense share (60%)
   - Large **decline in bankruptcies** (70%)

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2. Debt-inflation channel: firm-level evidence
   - **Redistribution**: High-leverage firms see relative increase in book and market equity values, along with fall in interest expenses
   - **Real effects**: High leverage firms boost employment

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   - **Real effects**: High leverage firms boost employment

3. Nominal rigidities channel
   - **Frequency of wage and price adjustment increasing** with inflation
   - Debt-inflation channel is active even with flexible prices

Conceptual Framework

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1. **Unexpected inflation $\rightarrow$ decline in bankruptcies**

2. **Debt-inflation channel**: Relaxing financing constraint $\rightarrow$ increase in output
   - Especially for firms with long-term debt

   (Kiyotaki and Moore 1997, Cordoba and Ripoll 2004, Gomes, Jermann, and Schmid 2016)

3. **Nominal rigidity channel**:
   - Low inflation: boosts output by reducing real wage
   - High inflation: wages become flexible, and inflation only has real effects through the financial channel

Historical Background

Background on Weimar Germany's Inflation

- Roots of inflation: WWI
  - Gold standard abandoned in August 1914
  - Deficit financed war spending

- Two phases of the **post-war inflation (1919-1923)**:
  1. High inflation: WWI Armistice to June 1922
  2. Hyperinflation: July 1922 to November 1923

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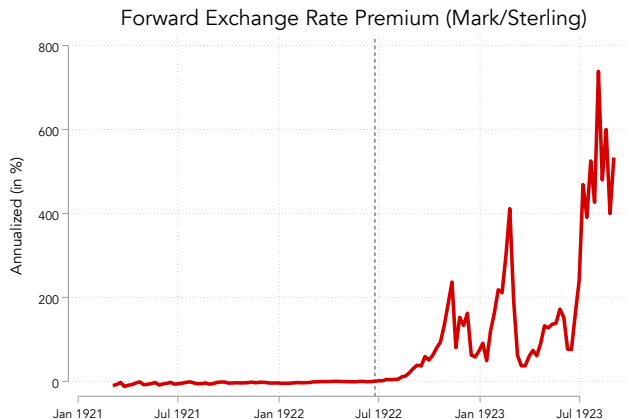
- Key factors:
  - Fiscal: Reparations, large deficits; "Tanzi effect"
  - Political economy: Lack of political will to raise taxes and cut spending
  - Monetary: Reichsbank accommodated spending by discounting government securities
  - Balance of payments: FX depreciation fueled inflation (departure from PPP)

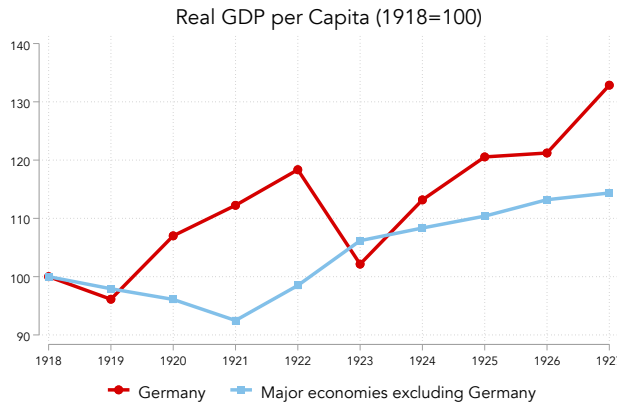
Inflation Expectations

- Average inflation during 1870-1914: 0.7%
- Before June 1922: Expectations of mark *appreciation* (Kindleberger 1985)
  - Speculation on the mark Keynes quote
  - Bank credit available
- After June 1922: Expectations of mark *depreciation*
  - Flight from the mark
  - Credit supply dries up



Booming Economy until the End of 1922

- Strong growth and low unemployment until the end of 1922
  - Germany avoids 1920-21 "Depression"
- Contraction in 1923: Ruhr crisis, hyperinflation, and stabilization



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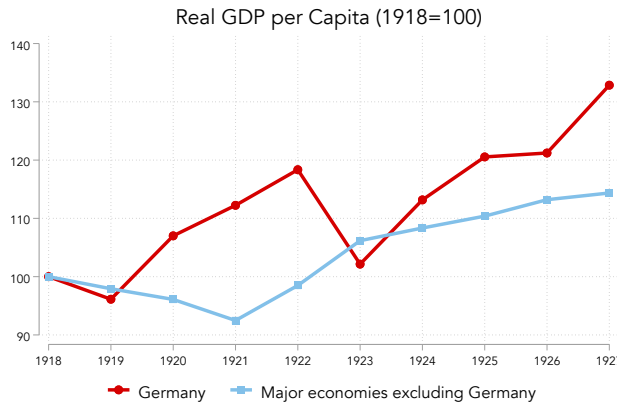


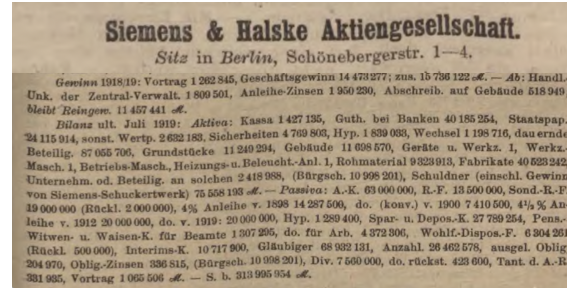
"That business in Germany was booming during most of the inflation period is a universally admitted fact."

– Graham (1930)

Data

Newly Digitized Firm-Level Data

- *Saling's Boersenjahrbuch*:
  - Balance sheets + income statements
  - ≈ 700 firms per year
  - Bond data
- Challenge: Inflation distorts accounting, especially in 1923
- Solutions:
  - Revalued "goldmark" balance sheets (legally required by January 1, 1924)
  - Employment (≈ 300 firms)
  - Stock prices from *Berliner Börsen Zeitung*



Siemens & Halske Aktiengesellschaft.

Sitz in *Berlin*, Schönebergerstr. 1—4.

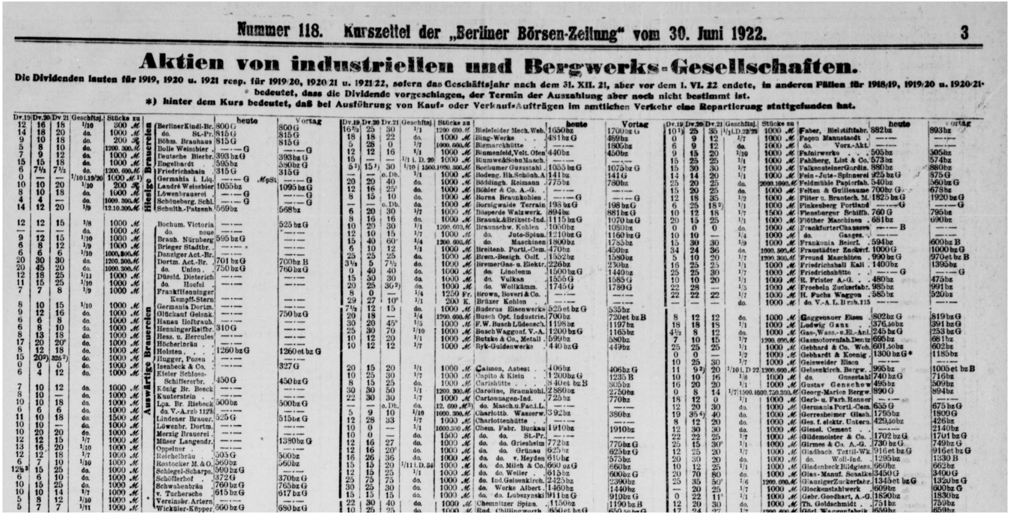
Gewinn 1918/19: Vortrag 1 262 845, Geschäftsgewinn 14 473 277; zus. 15 736 122 ℳ. — *Ab*: Handl.-Unk. der Zentral-Verwalt. 1 809 501, Anleihe-Zinsen 1 950 230, Abschreib. auf Gebäude 518 949, *bleibt Reingew.* 11 457 441 ℳ.

Bilanz ult. Juli 1919: *Aktiva*: Kassa 1 427 135, Guth. bei Banken 40 185 254, Staatspap. 24 115 914, sonst. Wertp. 2 632 183, Sicherheiten 4 769 803, Hyp. 1 839 033, Wechsel 1 198 716, dau ernde Beteilig. 87 055 706, Grundstücke 11 249 294, Gebäude 11 698 570, Geräte u. Werkz. 1, Werkz.-Masch. 1, Betriebs-Masch., Heizungs-u. Beleucht.-Anl. 1, Rohmaterial 9 323 913, Fabrikate 40 523 242, Unternehm. od. Beteilig. an solchen 2 418 988, (Bürgsch. 10 998 201), Schuldner (einschl. Gewinn von Siemens-Schuckertwerk) 75 558 193 ℳ. — *Passiva*: A.-K. 63 000 000, R.-F. 13 500 000, Sond.-R.-F. 19 000 000 (Rückl. 2 000 000), 4% Anleihe v. 1898 14 287 500, do. (konv.) v. 1900 7 410 500, 4½% Anleihe v. 1912 20 000 000, do. v. 1919: 20 000 000, Hyp. 1 289 400, Spar- u. Depos.-K. 27 789 254, Pens.-, Witwen- u. Waisen-K. für Beamte 1 307 295, do. für Arb. 4 372 306, Wohlf.-Dispos.-F. 6 304 261 (Rückl. 500 000), Interims-K. 10 717 900, Gläubiger 68 932 131, Anzahl. 26 462 578, ausgel. Oblig. 204 970, Oblig.-Zinsen 336 815, (Bürgsch. 10 998 201), Div. 7 560 000, do. rückst. 423 600, Tant. d. A.-R. 331 935, Vortrag 1 065 506 ℳ. — S. b. 313 995 954 ℳ.

B/S revaluation | B/S errors | Saling employment validation | Summary statistics

Newly Digitized Stock Prices and Dividends

Berliner Börsen Zeitung



Nummer 118. Kurszettel der „Berliner Börsen-Zeitung“ vom 30. Juni 1922. 3

Aktien von industriellen und Bergwerks-Gesellschaften.

Die Dividenden lauten für 1919, 1920 u. 1921 resp. für 1919/20, 1920/21 u. 1921/22, sofern das Geschäftsjahr nach dem 31. XII. 21, aber vor dem 1. VI. 22 endete, in anderen Fällen für 1918/19, 1919/20 u. 1920/21.
° bedeutet, dass die Dividende vorgeschlagen, der Termin der Auszahlung aber noch nicht bestimmt ist.
***) hinter dem Kurs bedeutet, daß bei Ausführung von Kauf- oder Verkauf-Aufträgen im amtlichen Verkehr eine Repartierung stattgefunden hat.**

Dv.19	Dv.20	Dv.21	Geschftsj.	Stücke zu		heute	Vortag
					Hiesige Brauereien		
12	16	18	1/10	300 ℳ	BerlinerKindl-Br.	800 G	800 G
14	18	20	do.	1000 ℳ	do. St.-Pr.	815 G	815 G
9	10	18	do.	200 ℛ	Böhm. Brauhaus	815 G	815 G
5	8	10	do.	1200. 300 ℳ	Bolle Weissbier	—·— G	—·— G
7	9	12	do.	1000 ℳ	Deutsche Bierbr.	393 bz G	393 bz G
15	15	18	do.	1000 ℳ	Engelhardt	595 bz	580 bz G
6	7½	7½	do.	1200. 600 ℳ	Friedrichshain	315 G	315 G
0	—	—	1/10 i. 19/20	1000 ℳ 1)	Germania i. Liq.	—·— G ℳpSt	—·— G
10	10	20	1/10	200 ℛ	Landré Weissbier	1055 bz	1095 bz G
8	10	18	do.	1000 ℳ	Löwenbrauerei	—·— G	—·— G
4	4	—	do.	1000. 300 ℳ	Schöneberg. Schl.	—·— G	—·— G
14	12	20	1/9	12.10.300 ℳ	Schulth.-Patzenh.	569 bz	568 bz
					Auswärtige Brauereien		
12	12	15	1/8	1000 ℳ	Bochum. Victoria	—·—	525 bz G
—	—	—	do.	1000 ℳ	do. neue	—·—	—·—
9	12	15	1/10	1000 ℳ	Brauh. Nürnberg	595 bz G	—·—
6	8	12	1/9	1000 ℳ	Brieger Stadtbr.	—·—	—·—
6	6	6	1/10	1000, 300 ℳ	Danziger Act.-Br.	—·—	—·—
20	30	30	do.	1200. 300 ℳ	Dortm. Act.-Br.	701 bz G	700 bz B
20	45	20	do.	1000. 300 ℳ	do. Union	750 bz G	760 bz G
12	18	25	1/11	1000 ℳ	Düssld. Dieterich	—·—	—·—
11	15	25	1/10	1000 ℳ	do. Hoefel	—·—	—·—
7	7	8	1/9	1000 ℳ	Frankf. Henninger Kempff-Stern	—·—	—·—
8	10	15	1/10	1000 ℳ	Germania Dortm.	—·—	—·—
9	12	16	do.	1000 ℳ	Glückauf Gelsnk.	—·—	750 bz G
6	6	8	do.	1000 ℳ	Hanau Hofbrauh.	—·—	—·—
6	8	10	do.	1000 ℳ	HenningerReifbr.	310 G	—·—
8	13	18	do.	1000 ℳ	Hess. u. Hercules	—·—	—·—
17	20	20°	do.	1000 ℳ	Höcherlbräu	—·—	—·—
8	12	18	do.	1000 ℳ	Holsten	1260 bz G	1260 et bz G
15	20 2)	325 2)	do.	1000 ℳ	Hugger, Posen	—·—	—·—
0	0	0	do.	1000 ℳ	Isenbeck & Co.	—·—	327 G
6	4	12	do.	1000 ℳ	Kieler Schloss-Schiffererbr.	450 G	450 bz G
7	10	12	do.	1000 ℳ	König Br. Beeck	—·—	—·—
8	10	—	do.	1000 ℳ	Kunterstein	—·—	—·—
10	10	18	do.	1000 ℳ	Lpz. Br. Riebeck	500 bz	500 bz G
6	6	6	do.	1000 ℳ	do. V.-A. rzb 112½	—·—	—·—
11	10	18	do.	1500 ℳ	Lindener Brauer.	525 G	515 bz G
10	10	—	do.	1000 ℳ	Löwenbr. Dortm.	—·—	—·—
10	20	20	do.	1000 ℳ	Merzig Brauerei	—·—	—·—
12	12	15	1/7	1000 ℳ	Müser Langendr.	—·—	1380 bz G
13	16	20	1/10	1000 ℳ	Oppelner	—·—	—·—
12	12	18	1/7	1000 ℳ	Reichelbräu	505 G	500 bz
6	7	10	1/10	1000 ℳ	Rostocker M. & O.	560 bz	560 bz
12½ 3)	15	25	do.	1000 ℳ	Schlegel-Scharpe.	590 bz G	—·—
6	6	10	do.	1000 ℳ	Schöfferhof	372 G	370 bz G
10	15	25	do.	1000 ℳ	Schwabenbräu	760 bz G	765 bz G
10	10	14	1/7	1000 ℳ	v. Tuchersche	615 bz G	617 bz G
5	8	12	1/10	1000 ℳ	Vereinsbr. Artern	—·—	—·—
5	7	7	1/11	1000 ℳ	Wicküler-Küpper	660 bz G	680 bz G

Dv.19	Dv.20	Dv.21	Geschftsj.	Stücke zu		heute	Vortag
16⅔	25	30	1/1	1200. 600 ℳ	Bielefelder Mech. Web.	1650 bz	1700 bz G
18	18	22	do.	1000 ℳ	Bing-Werke	481 bz G	489 bz
5	28	0	1/7	1000. 600 ℳ	Bismarckhütte	—·—	1805 bz
12	12	16	1/1	1000 ℳ	Blumenfeld, Velt. Ofen	440 bz	450 bz
15	—	—	1/1 i. D. 20	1000 ℳ	Blumwe & Sohn Masch.	—·—	—·—
5 1)	15 1)	30	1/10	1500.1000.300 ℳ	Bochumer Gussstahl	1055 bz G	1075 bz G
—	—	o. Db.	1/1	1000 ℳ	Bodeng. Hh. Schönb. A	141 bz	141 G
20	20	40	do.	1000 ℳ	Böddingh. Reimann	775 bz	780 bz
12	16	25°	do.	1000 ℳ	Böhler & Co. A.-G.	—·—	—·—
8	15	10	do.	1000 ℳ	Borna Braunkohlen	—·— G	—·— G
—	—	o. Db.	do.	1000 ℳ	Borsigwalde Terrain	198 bz G	198 bz G
6	20	30	1/7	1000 ℳ	Bösperde Walzwerk.	894 bz	881 bz G
8	16	16	do.	1000 ℳ	Braunk. & Brikett-Ind.	1115 bz G	1070 bz G
10	20	30	1/1	1200. 600 ℳ	Braunschw. Kohlen	1050 bz	1080 bz
12	10	15	1/7	1000 ℳ	do. Jute-Spinn.	1210 bz G	1160 bz G
15	40	60°	1/4	1200. 600 ℳ	do. Maschinen	1800 bz	1785 bz
6	10	12	1/1	1000 ℳ	Breitenb. Portl.-Cem.	470 bz	450 bz
25	25	25	do.	1000 ℳ	Brem.-Besigh. Oelf.	1552 bz	1580 bz
3½	5	7½	do.	1000 ℳ	BremerGas- u. Elektr.	226 bz	230 bz
0	40	40	do.	1000 ℳ	do. Linoleum	1500 bz G	1440 bz
15	30	30	do.	1000 ℳ	do. Vulkan	1555 G	1585 G
20	25	30 2)	do.	1000 ℳ	do. Wollkämm.	1745 G	1789 G
8	0	—	1/4	1250 Fr.	Brown, Boveri & Co.	—·—	—·—
29	27	10°	1/1	200 K.	Brüxer Kohlen	—·—	—·—
7½	12	15	do.	1000 ℳ	Buderus Eisenwerke	525 et bz G	535 bz
20	18	—	1/4	1200. 600 ℳ	Busch Opt. Industrie.	700 bz	720 et bz B
30	20	45°	1/5	1000 ℳ	F. W. Busch Lüdensch.	1198 bz	1197 bz
25	30	70	1/10	1000 ℳ	Busch Waggonf. V.-A.	1200 bz G	1165 bz
10	12	20	1/1	1000 ℳ	Butzke & Co., Metall	599 bz	580 bz
10	12	12	1/7	1000 ℳ	Byk-Guldenwerke	440 bz G	449 bz
20	15	20	1/1	1000 ℳ	Calmon, Asbest	406 bz	406 bz G
10	25	30	1/7	1000 ℳ	Capito & Klein	1200 bz G	1235 B
8	15	25	do.	1000 ℳ	Carlshütte	840 et bz B	805 bz
30	30	50	1/1	1200. 300 ℳ	Caroline, Braunkohl.	2880 bz	2750 bz
22	30	30	1/7	1000 ℳ	Cartonnagen-Ind.	725 bz	770 bz
—	—	o. Db.	do.	12. 600 ℳ 3)	do. Masch. u. Fac. i. L.	—·—	—·—
5	9	10	1/10	1000. 300 ℳ	Charlottb. Wasserw.	392 bz	380 bz
12	28	33	1/7	1000 ℳ	Charlottenhütte	—·—	—·—
10	0	—	1/1	1000.300 ℳ	Chem. Fabr. Buckau	1910 bz	1910 bz
10	0	—	do.	1500 ℳ	do. do. St.-Pr.	—·—	—·—
12	16	27	do.	1000 ℳ	do. do. Griesheim	772 bz	770 bz G
12	16	20°	do.	1000 ℳ	do. do. Grünau	625 bz	625 bz G
16	26	36	do.	1000 ℳ	do. do. v. Heyden	610 bz	575 bz
15	15	20	1/11 i. D. 24	1000 ℳ	do. do. Milch & Co.	660 bz G	660 bz
12	15	25	1/1	1000 ℳ	do. do. Weiler	615 bz	600 bz G
25	75	75	do.	1000 ℳ	do. Ind. Gelsenkirch.	2425 bz	2390 bz
30	25	30	do.	1000 ℳ	do. Werke Albert	1460 bz	1440 bz
15	15	15	do.	1000 ℳ	do. do. Lubszynski	911 bz G	910 bz G
22	30	40	do.	1000 ℳ	Chemnitzer Spinn.	1150 bz	1190 bz B
10	25	25	do.	1000 ℳ	Rud. Chillingworth	650 et bz G	650,50 bz G

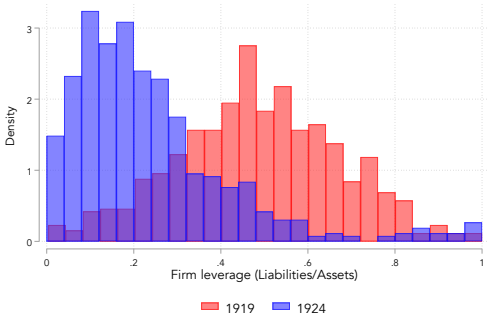
Dv.19	Dv.20	Dv.21	Geschftsj.	Stücke zu		heute	Vortag
10 1)	25	35	1/1 i. D. 22/23	1000 ℳ	Faber, Bleistiftfabr.	882 bz	893 bz
0	9	12	1/7	1000 ℳ	Façon Mannstaedt	—·—	—·—
6	9	12	do.	1000 ℳ	do. Vorz.-Akt.	—·—	—·—
9	15	20	1/10	1000 ℳ	Fafnirwerke	505 bz	505 bz
15	25	25	1/1	1000 ℳ	Fahlberg, List & Co.	573 bz	574 bz
15	30	30	1/7	1000 ℳ	FalkensteinerGardin.	880 bz	880 bz
14	14	20	1/1	1000 ℳ	Fein-Jute-Spinnerei	925 bz G	875 G
25	20	25	do.	2000.1000 ℳ	Feldmühle Papierfab.	540 bz	560 bz G
15	20	25	do.	1000 ℳ	Felten & Guilleaume	700 bz G	678 bz
12	18	35	1/2	1000 ℳ	Filter u. Brautech. M.	1825 bz G	1920 bz G
6	25	18 2)	1/1	1000 ℳ	Finkenberg Portland	—·— G	—·— G
10	12	18	1/7	1500 ℳ	Flensburger Schiffb.	760 G	795 bz
20	15	25	1/1	1000 ℳ	Flöther Maschinen	681 bz	690 bz
0	0	0	do.	1000 ℳ	FrankfurterChaussee	—·— B	—·—
10	10	—	1/4	1000 ℳ	do. Gasges.	—·—	—·—
15	30	30	1/9	1000 ℳ	Frankonia Beierf.	594 bz	600 bz B
34	24	36	do.	1000. 500 ℳ	Fraustädter Zuckerf.	1000 G	1000 bz G
5	10	20	1/7	1200. 300 ℳ	Freund Maschinen	990 bz G	970 et bz B
16	25	25	1/1	1000 ℳ	Friedrichshall Kali	1400 bz	1395 bz
25	25	30	1/7	1000 ℳ	Friedrichshütte	—·— G	—·— G
10	10	20	1/1	1000 ℳ	R. Frister A.-G.	480 bz	475 bz
22	28	—	1/5	1000 ℳ	Froebeln Zuckerfabr.	985 bz	991 bz
22	22	22	1/7	1000 ℳ	H. Fuchs Waggon	585 bz	520 bz
—	—	—	do.	1000 ℳ	do. V.-A. L. B rzb. 115	—·—	—·—
8	12	12	do.	1000 ℳ	Gaggenauer Eisen	802 bz G	819 bz G
18	18	18	1/1	1000 ℳ	Ludwig Ganz	376,50 bz	391 bz G
4½	8	12	do.	1000 ℳ	Gas-, Wass.- u. El.-Anl.	245 bz G	253 bz G
7	10	15	1/7	1200. 600 ℳ	Gasmotorenfab. Deutz	695 bz	681 bz
25	25	25	1/1	1000 ℳ	Gebhard & Co. Web.	601,50 bz	602 bz
0	0	—	1/2	1000 ℳ	Gebhardt & Koenig	1300 bz G*	1185 bz
10	25	30	1/7	1000 ℳ	Geisweider Eisen	—·—	—·—
11	9 3)	20	1/10 i. D 22	1200. 600 ℳ	Gelsenkirch. Bergw.	995 bz	1005 et bz B
10	10	16	1/8	1000 ℳ	do. Gussstahl	740 bz G	716 bz
16	20	20	1/1	1000 ℳ	Gustav Genschow	495 bz	509 bz
0	8	14	1/7	1500.1000.750.300 ℳ	Georg-Marien Bergw.	890 G	894 bz
18	12	0	1/1	1000 ℳ	Gerb- u. Farb. Renner	—·—	—·—
12	20	30	do.	1000 ℳ	Germania Portl.-Cem.	655 G	675 bz G
19	35 4)	40	do.	1000 ℳ	Gerresheimer Glash.	1795 bz	1800 G
8	12	20	do.	1000 ℳ	Ges. f. elektr. Untern.	429,50 bz	426 bz
12	30	30	do.	1000 ℳ	Giesel. Cement	—·—	2140 bz
22	22	25	1/7	1000 ℳ	Gildemeister & Co.	1702 bz G	1701 bz G
25	15	30°	1/1	1000 ℳ	Girmes & Co. A.-G.	730 bz G	749 bz G
12	25	20	1/7	1000 ℳ	Gladbach. Textil-Wk.	916 et bz G	916 et bz G
20	30	20	do.	1000 ℳ	do. Woll-Ind.	1295 bz	1330 B
10	12	25	1/1	1000 ℳ	Gladenbeck Bildgiess.	660 bz	662 bz
20	70	80	do.	1000 ℳ	Glas-Manuf. Schalke	3450 G	3400 G
25	35	50°	1/6	1200. 600 ℳ	GlauzigerZuckerfabr.	1345 et bz G	1320 bz G
—	20	25	1/7	1000 ℳ	Glockenstahlwerk	609 bz	600 bz G
0	22	11°	1/1	1000 ℳ	Gebr. Goedhart, A.-G.	1830 bz	1830 bz
12	20	30	do.	1000 ℳ	Th. Goldschmidt	751 bz	759 bz
17	24	27	1/7	1200. 600 ℳ	Görl. Waggonfabrik	659 bz	659 bz

Stock price data validation (nonfinancials and bank stocks)

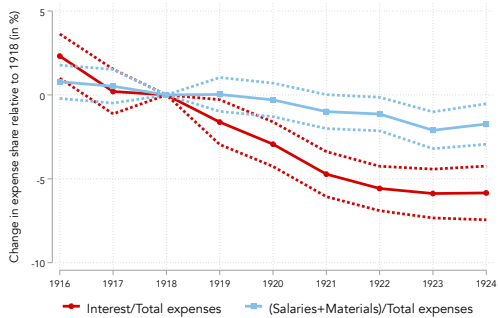
Aggregate Evidence on the Debt-Inflation Channel

Fall in Firms' Leverage and Interest Expenses

...But Salaries Remain a Constant Share of Total Expenses



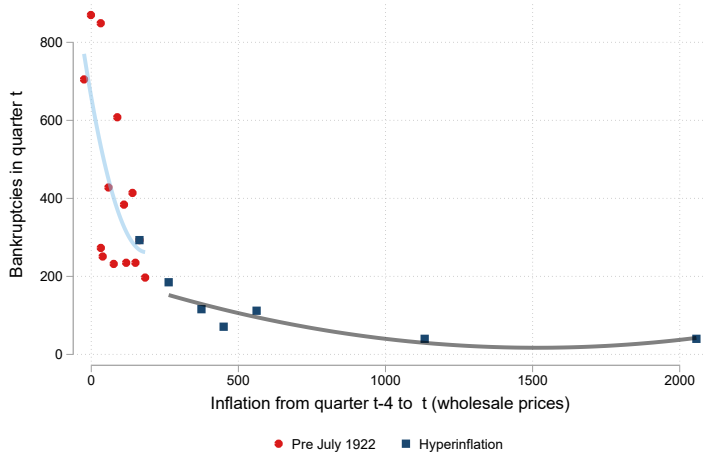
(a) Fall in leverage from 1919 to 1924



(b) Interest and salaries as share of total expenses

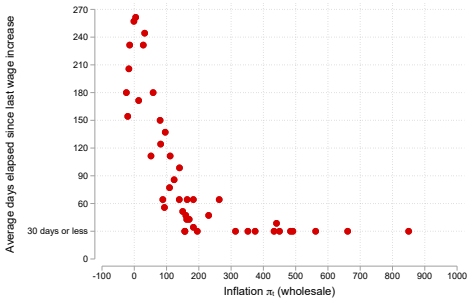
Inflation and Bankruptcies

- Reduction in leverage and interest costs reduced likelihood of financial distress

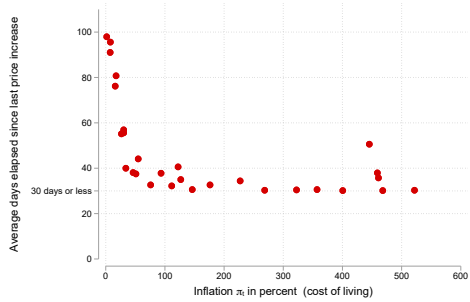


Adaptive expectations version

Increasing Frequency of Wage and Price Adjustment

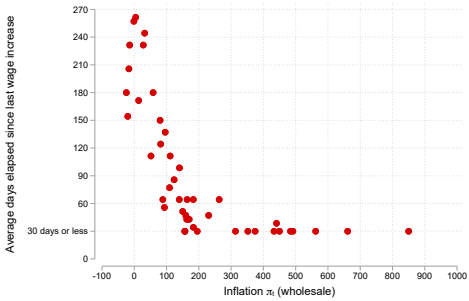


(a) Declining interval between wage increases



(b) Declining interval between price increases

Increasing Frequency of Wage and Price Adjustment



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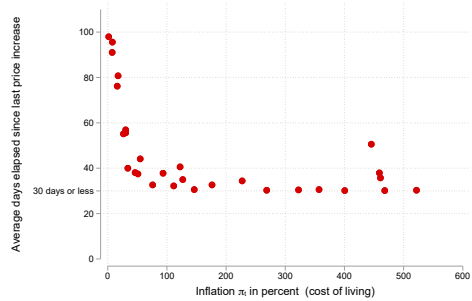


(b) Declining interval between price increases

- Consistent with menu cost models (Alvarez et al 2019)
- Implication: Limited scope for expansionary effect through nominal rigidity channel (Golosov and Lucas 2007)

Underlying wage and price data

Firm-Level Evidence on the Debt-Inflation Channel

Firm-Level Analysis

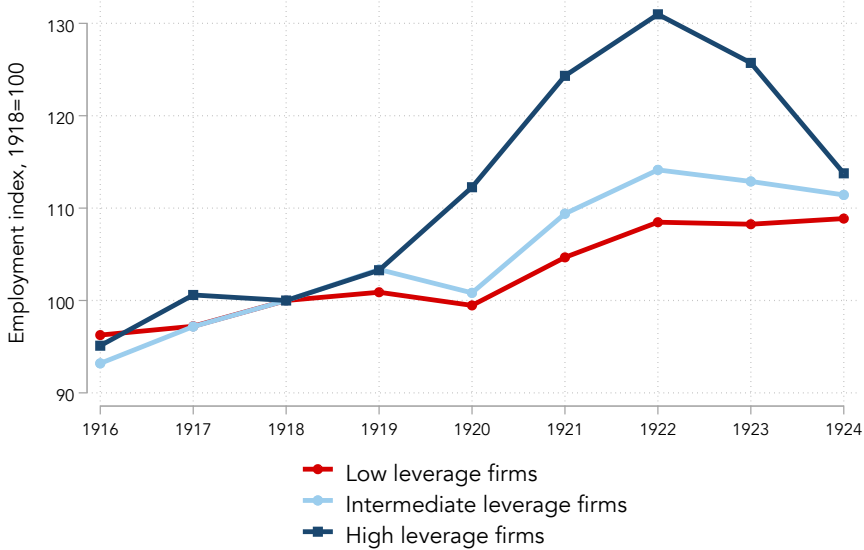
- Is the debt-inflation channel present in the cross-section of firms?
  - Does debt-inflation merely redistribute wealth or does it affect real activity?

- Firm-level measures of exposure to the debt-inflation channel, as of 1918-19
  - $Liabilities/Assets = 1 - \frac{BookEquity}{Assets}$
  - $Debt/Assets$

- Advantages of firm-level analysis:
  - Identification: Control for time-varying industry-specific shocks + firm characteristics
  - Quantify extent of redistribution
  - Estimate real effect on employment

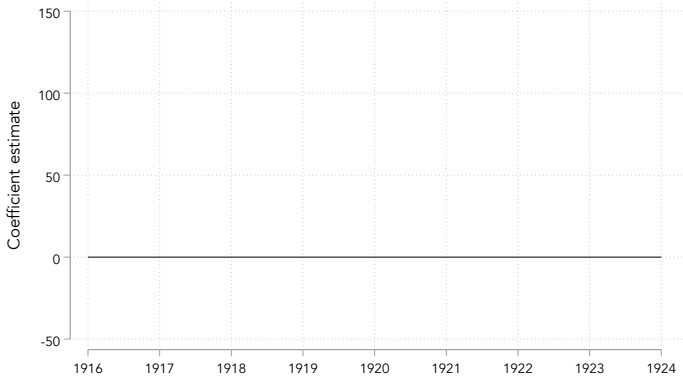
Employment Dynamics across High and Low Leverage Firms

Terciles of *Liabilities*/*Assets*$_i$



Employment Dynamics across High and Low Leverage Firms

$$\ln(\textit{Employment}_{it}) = \alpha_i + \gamma_{st} + \sum_{k \neq 1918} \beta_k \left(\frac{\textit{Liabilities}}{\textit{Assets}} \right)_i \mathbf{1}_{k=t} + \epsilon_{it}$$



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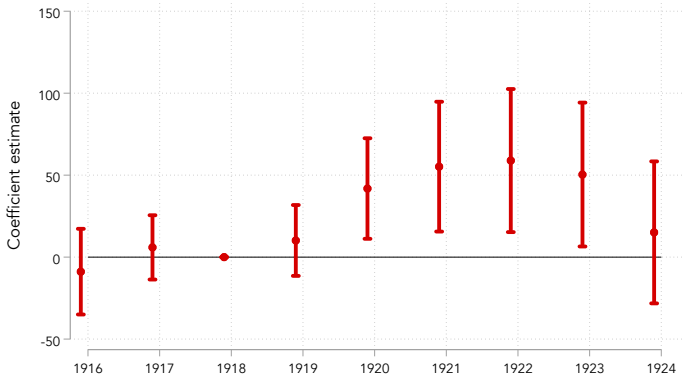

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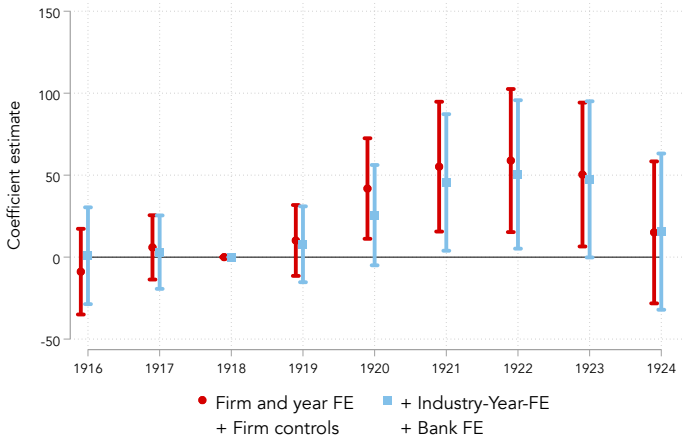

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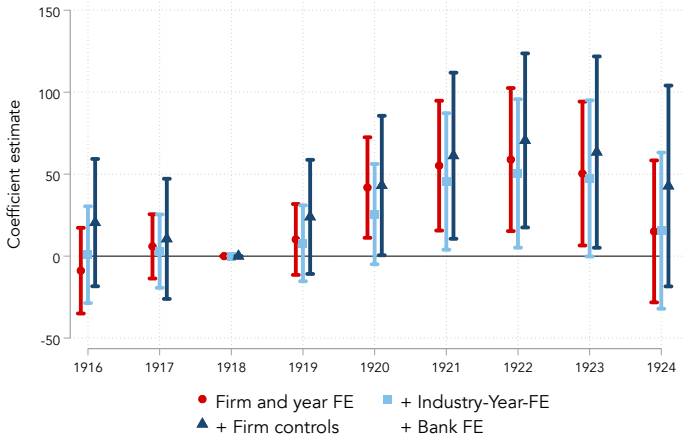

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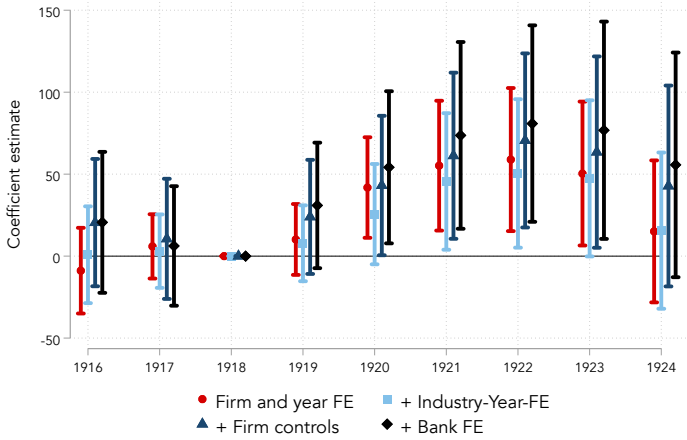
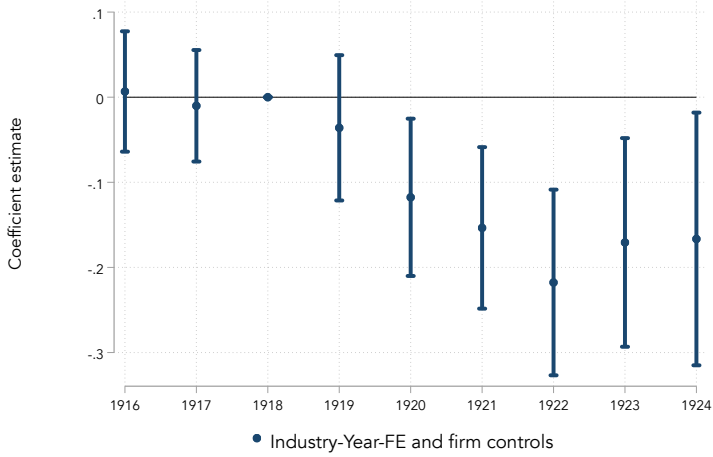
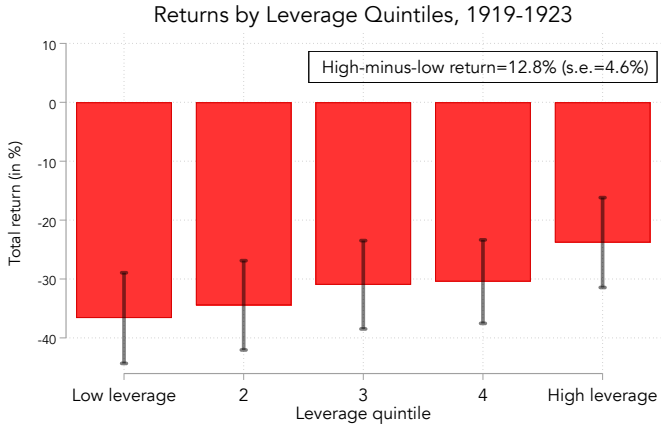


Leverage and Interest Expenses

$$\textit{Interest Expense Share}_{it} = \alpha_i + \gamma_{st} + \sum_{k \neq 1918} \beta_k \left(\frac{\textit{Liabilities}}{\textit{Assets}} \right)_i \mathbf{1}_{k=t} + \epsilon_{it},$$



High Leverage Firms Have Higher Stock Returns during the Inflation



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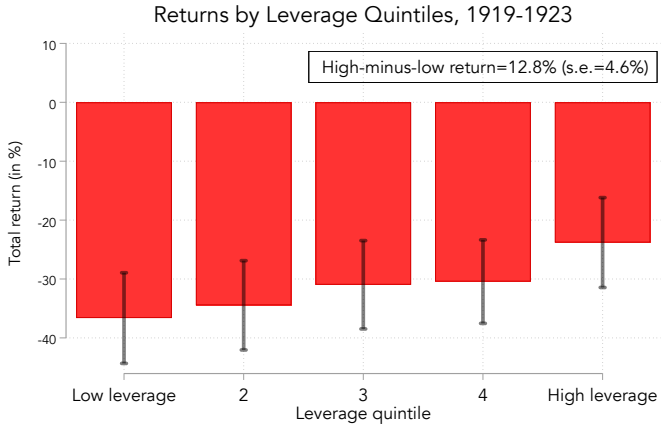
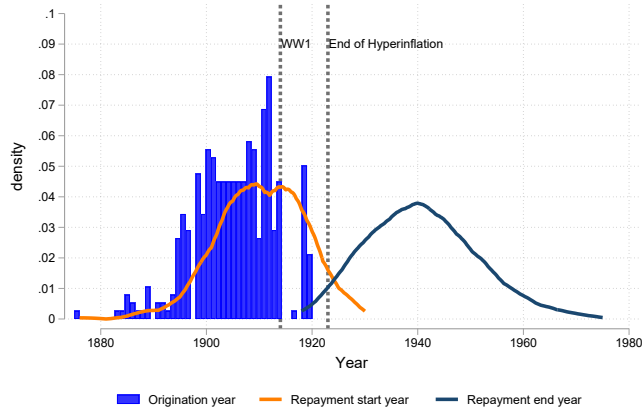


- Redistribution from debt to equity holders, in contrast to limited evidence from moderate inflation in 1970s (Summers 1981; French, Ruback, Schwert 1983; Modigliani-Cohn 1984)

Portfolio returns over time | Robustness: Sorting by debt/assets | Robustness: Regressions with controls

Fixed-Rate Long-Term Bond Financing

- 51% of firms have long-term bond financing in 1918-19
- Median repayment end year: 1940



Stronger Effects for Firms with More Long-Term Debt

Estimate effect separately by **quartile of LT debt share**:

$$Y_{it} = \alpha_i^q + \gamma_{st}^q + \beta^{\mathbf{q}} \left(Debt/Assets\right)_{i,1918-19} \times \mathbf{1}_{t \geq 1920} + \epsilon_{it}^q$$

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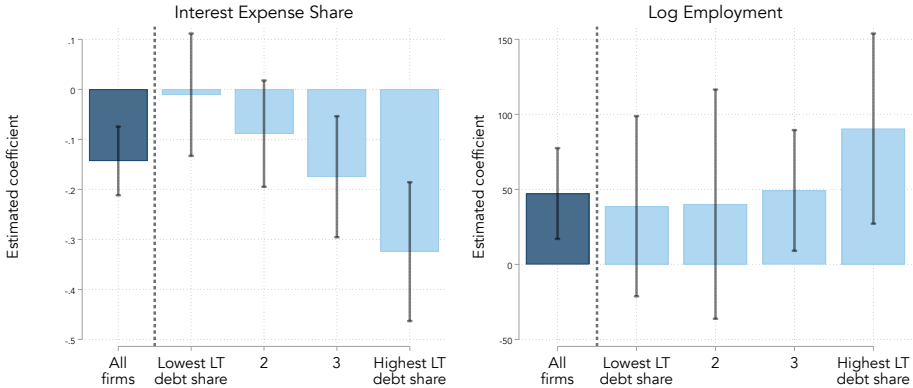

Conclusion

- Aggregate and firm-level evidence of debt-inflation from the German inflation
  - Redistribution toward net debtor firms → real effects
  - Key frictions: long-term nominal debt and financing constraints

- Aggregate effects?
  - PE aggregation: 14% employment increase (75% of total) → debt-inflation is expansionary even with flexible prices
  - Reduction in credit supply → next paper

- External validity? Sargent and Robbins
  - Relevant channels may differ during smaller inflations
  - Monetary policy response
  - Structure of debt contracts matters (fixed/floating, long-term/short-term, domestic/FX)

Thank you!