With a Bang, not a Whimper: Pricking Germany's "Stock Market Bubble" in 1927 and the Slide into Depression

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In May 1927, the German central bank intervened indirectly to reduce lending to equity investors. The crash that followed ended the only stock market boom during Germany's relative stabilization 1924–1928. The evidence strongly suggests that the German central bank under Hjalmar Schacht was wrong to be concerned about stock prices—there was no bubble. Also, the Reichsbank was mistaken in its belief that a fall in the market would reduce the importance of short-term foreign borrowing and improve conditions in the money market. The misguided intervention had important real effects. Investment suffered, helping to tip Germany into depression.

During November and December 1928, the American economist James W. Angell was conducting fieldwork for his book on the German economy. Visiting more than 50 factories and mines in the process, he came away deeply impressed by the prosperity and dynamism he encountered: "[O]nly six years after her utter collapse, Germany is once again one of the great industrial nations . . . and she is rapidly increasing her power. . . . It is one of the most spectacular recoveries in the world's entire economic history."[1] From the ashes of hyperinflation, the country had apparently turned itself into one of continental Europe's great success stories. Inflation was low and stable, and the prewar exchange rate vis-à-vis the dollar had successfully been restored. Employment was rising rapidly, export volumes were surging, and labor productivity was increasing at twice the prewar rate.[2]

The image of prosperity that captivated Angell was in many ways a final flourish, followed by a rapid downturn that had already begun before his visit. The recovery after the end of hyperinflation in 1924 was briefly inter-

[1] ANU (Canberra) Angell, *Recovery*, p. 2.

[2] Employment increased by 9.1 percent between 1925 and 1929; Lölhöffel, "Zeitreihen."

rupted in 1925/26, only to peter out in 1928.[3] Many leading indicators such as housing starts and machinery orders had already started to point downwards from 1927 or 1928.[4] Revised estimates of national product show that a peak was reached in 1928.[5] Production would only "bottom out" in 1931/32, when the depths of the Great Depression had been reached. It is one of the peculiarities of the German slump that it began not with a sudden, sharp downturn, but with a slow and gradual slide into depression.[6] Compared with other industrial nations, the turning point of the German business cycle came unusually early—British industrial production only began to decline in 1929, France peaked in 1930, and the United States in 1929.[7] Why, then, was Weimar Germany's only boom so short?

The most influential interpretation is that of Knut Borchardt, who argued that Weimar's economy was doomed by high labor costs. The system of state arbitration, he suggested, drove unit labor costs up, rendering German goods uncompetitive on world markets.[8] The export surpluses that should have financed reparations never materialized. Foreign capital had to fill the gap, but left the country exposed in case of a sudden halt to inflows. Investment failed to recover to prewar levels. In the final analysis, Weimar's economy could not deliver the growth performance that would have ensured political and social stability. The very depth of the crisis after 1929 was a result of these earlier imbalances.

Critics have pointed out a number of problems with this line of reasoning. Although real wages and unit labor costs were higher than they had been in 1913, they probably failed to harm investment in the way alleged by Borchardt—the consensus view now is that the share of investment in national income during the Weimar years was no lower than before the war.[9] Also, the spectacular recovery under the Nazis proceeded with wages that may have been as high as they had been during the "roaring twenties."[10] The dominant view now sees the depth and length of the German slump as a

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[3] In its initial phase, the inflation had numerous positive effects. Compare to Holtfrerich, *German Inflation*.

[4] Ritschl, "Peter Temin." Construction peaked in the summer of 1927, and the production of consumer goods reached its high point in February 1928. Industrial production in 1928 was almost exactly as high as in 1929, before contracting sharply. James, "Economic Reasons."

[5] Ritschl, "Deutschlands Krise," table B1.

[6] Balderston, *Origins*, pp. 1–4; and James, *German Slump*.

[7] Many commodity exporters experienced early downturns during the 1920s as well, but their troubles were the primarily the results of falling prices for their main export staples. Compare to Temin, *Lessons*, p. 2.

[8] Borchardt, "Economic Causes"; and Ritschl, "Löhne." It should be noted that high real wages, in Borchardt's view, were only one of a number of structural weaknesses undermining the economic vitality of the Weimar Republic.

[9] Spoerer, "Weimar's Investment Record"; and Voth, "High Wages." Public investment by the government sector partly compensated. Compare to Holtfrerich, "Economic Policy Options."

[10] As early as 1935, real wages in Germany were higher than in 1929. Eichengreen and Sachs, "Exchange Rates," figure 2, p. 938. Note, however, that by 1933, real wages in transportation, mining, and manufacturing had fallen by approximately 5 percent relative to 1929. Eichengreen, "Perspectives."

result of the way the gold standard operated, and of the failure to cut the link with gold.[11]

If the German economy was not fundamentally "unhealthy," as Borchardt argued, an alternative explanation for the early onset of the economic crisis needs to be found. The once popular story about a decline in foreign lending to Germany as a result of the Wall Street boom has been thoroughly dismantled by Peter Temin, who demonstrated that the decline in credit occurred too early to be explained by funds being "siphoned off" to the United States.[12] He posited "autonomous" declines in investment spending as the prime cause. In 1928 alone, net investment fell by 15 percent, most of it driven by lower inventory investment. From 1927 to 1929, the fall in investment was 55 percent—more than enough to explain the fall in national product.[13] Theo Balderston and Harold James, in an attempt to find domestic reasons for the decline, argued that the failure of profitability to revive in 1927/28 soured business sentiment, and that a wave of pessimism undermined plans for additional investment.[14]

This article is an attempt to take Temin's analysis one step further. An intervention by the Reichsbank brought about the sharp fall in the market, undermining business confidence. I argue that the stock market crash in Berlin on "Black Friday," 13 May 1927, was also an important factor for the subsequent fall in investment spending.

THE REICHSBANK INTERVENTION

During the hyperinflation, German stocks were often extremely cheap. In November 1922, for example, the capitalization of Daimler Motor Works was equivalent to the value of 327 of its cars.[15] Market volatility was extremely high, with share prices often changing by 30 or even 50 percent per month in real terms.[16] After the Mark's stabilization in late 1923, stock prices first fell. In the summer of 1924, however, a long bull run began. The economic downturn in 1925/26 did little to sour the mood.

From October 1926 onwards, the Reichsbank began to believe that funds were being diverted from "productive uses" to the stock market.[17] It also feared that holdings of gold and foreign exchange could suffer if the sub-

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[11] This is the implication of Eichengreen and Sachs, "Exchange Rates." Whether it was possible to do so or not has been much debated. Compare to Borchardt, "Constraints."

[12] Temin, "Beginning." He has been challenged by Falkus ("German Business Cycle") and Balderston ("German Business Cycle" and "Beginning"). Ritschl ("Peter Temin") confirms Temin's hypothesis on the basis of new data.

[13] Compare to Temin, *Monetary Forces*, table 28, p. 156.

[14] Balderston, *Origins*, pp. 378–81. James, "Economic Reasons," pp. 39–41.

[15] Guttmann and Meehan, *Great Inflation*, p. 148.

[16] The stock market data are from Gielen (*Aktienkurse*), and was kindly made available in electronic form by George Bittlingmayer. Gielen uses a variety of sources to ensure a complete series between 1870 and 1993. His index is widely recognized as the single best source for long-run data on German stock prices. Compare to Jorion and Goetzmann, "Global Stock Markets."

[17] Beer, *Funktionswandel*, pp. 204–06.

stantial gains of foreign investors were repatriated. Reichsbank President Hjalmar Schacht decided to lean on the banks to reduce their lending against shares held as collateral. To add emphasis to his policy, banks that failed to comply were threatened with reduced (or even no) rediscount facilities. Banks were highly vulnerable to this kind of threat as the liquidity of their balance sheets was unusually low.[18] On 12 May the Berlin banks issued a joint statement in which they announced far-reaching measures to curtail lending against securities. The next day became known as "Black Friday"—prices retreated on a broad front, falling by an average of 11 percent. The impact was felt most severely in the futures market, and then spread to the cash market. The effect of the intervention on stock prices can be seen in Figure 1.

Harold James has argued that three principal factors were behind the Reichsbank's intervention. First, it felt that speculative excesses had driven up equity prices to unsustainable levels. Second, the stock market was absorbing much-needed funds that would otherwise be available for productive investment in private industry. Third, the strength of German stocks had led to inflows of "hot money," speculative balances lent principally by American firms that might be withdrawn quickly at the first sign of a downturn.[19]

Much of the literature on Reichsbank policy in the late 1920s has focused on the issue of foreign loans and reparations.[20] The second and third factors cited by James clearly weighed heavily on the minds of Reichsbank officials, Schacht most prominently among them. During 1926, Germany had increasingly attracted inflows of foreign funds, both on a long-term and a short-term basis. German interest rates were still higher than those in the United States and Britain. With free capital movement under the gold standard, the Reichsbank increasingly lost influence over the money supply (much to its chagrin). Money market rates fell below the official discount rate. This is, of course, exactly what the Mundell-Fleming model would predict with a fixed exchange rate and perfect capital mobility—monetary policy becomes largely powerless. There were also strong reasons to worry about the increasing vulnerability of the economy to speculative attack should the inflow of foreign capital come to a sudden halt.[21] As German domestic savings in the aftermath of the inflation were low, however, considerable foreign borrowing was inevitable. It was therefore through controlling access to foreign capital that Schacht attempted to reassert control over economic policy.[22]

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[18] Balderston, *Origins*, pp. 207–08.

[19] James, *Reichsbank*, p. 39.

[20] Hardach, *Weltmarktorientierung*, pp. 73–81; and Balderston, *Origins*, pp. 207–09; Compare to Müller, *Zentralbank*; and Schuker, "Reparations."

[21] The dangers of foreign borrowing in a system of fixed exchange rates have recently been demonstrated by the Asian crisis in 1997/98. Models of speculative attack devised in response are highly instructive for the case of interwar Europe; see Krugman, "Balance Sheets"; and Flood and Marion, "Perspectives."

[22] Of course, the various measures such as the "Beratungsstelle," whose approval for the taking of foreign loans was required, had also reduced the extent of foreign capital mobility. Compare to Hardach, *Weltmarktorientierung*, p. 57.
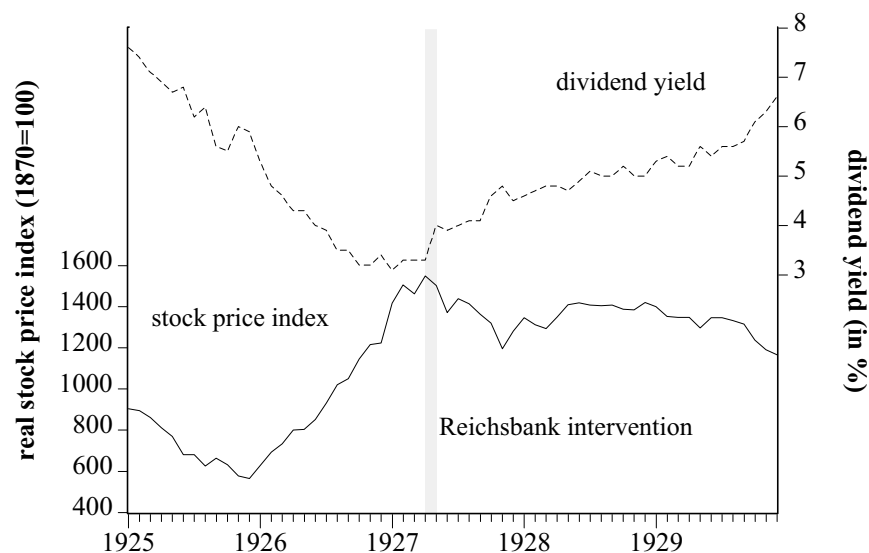
FIGURE 1
DIVIDEND YIELD AND STOCK PRICES IN GERMANY, 1925–1930

Source: Gielen, *Aktienkurse*.

In late 1926 the Reichsbank convinced the government to abolish the preferential tax treatment of bonds floated abroad. Double taxation would now be applied. Simultaneously, the German central bank lowered its discount rate from 6 to 5 percent to reduce the Mark's attractiveness to foreign lenders. The policy was more successful than its instigators had anticipated. Long-term foreign loans came to an almost complete standstill, falling from 800 million RM in the last six months of 1926 to 200 million RM in the first half of 1927. Combined with reparations transfers, the Reichsbank was losing foreign exchange to the tune of 500 million RM in the first two months of 1927 alone.[23] By April, backing for the German currency in terms of foreign exchange and gold had fallen sharply—from some 85 percent of currency in circulation in January 1927 to no more than 65 percent. Because the Dawes Plan stipulated a minimum of 40 percent backing, the Reichsbank needed to act soon. Faced with dwindling reserves, the standard response under gold-standard rules would have been to raise the discount rate again.[24] Public reaction after the crash noted that such a reversal of its decision in January would probably have dealt the Reichsbank's reputation a considerable blow.[25]

[23] Ibid., p. 78.
[24] Because foreign loans were few and far between, and the economic expansion of early 1927 increased the demand for credit from the private sector, the Reichsbank had "re-established contact with the market." Its discount rate could once again influence interest rates in the money market. Compare to Balderston, *Origins*, pp. 150–53.
[25] "Pferdekur-Warum?," *Frankfurter Zeitung*, no. 357 (15 May 1927), pp. 4–5.

Instead of raising interest rates, the Reichsbank decided to target the banks responsible for lending to the stock market. It had some evidence to suggest that both directly and indirectly, short-term funds from abroad were used to fund margin lending. Schacht felt that the sudden tightness of credit conditions was partly driven by the stock market boom. Credit that could have been used to fund productive investment was being diverted to the stock market, or so the Reichsbank argued.[26] Also, by reducing the attractiveness of German assets, a decline in stock market valuations would make capital imports less likely. In contrast, a rise in the discount rate would encourage further inflows of short-term funds.

It is in the context of foreign borrowing that the Reichsbank intervention had least to recommend it—both in the eyes of contemporaries and with hindsight.[27] The intervention in the stock market blatantly failed to achieve any of its aims in terms of foreign borrowing. Contemporary critics had already pointed out that the stock market does not absorb capital, as all purchases are matched by sales.[28] Instead of easing conditions in the money market by reducing the "claims of the stock market," the cut in lending volume simply led to an overall contraction of credit in the economy.[29] As was only to be expected, this aggravated the tightness in the money market that it was meant to cure. With long-term lending still effectively shut off as a result of the tax changes, short-term inflows increased from 300 million RM in the first quarter of 1927 to 1.1bn RM in the second—the exact opposite of what Schacht had intended. By trying to reduce the inflow of long-term loans, he had pushed up the scale of short-term borrowing abroad, rendering the German position even more precarious in case of sudden withdrawals.[30] The decision to raise interest rates on 10 June was tantamount to a public admission that the central aims of the strike against the stock market had not been achieved.[31] Also, there appears to be little evidence that

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[26] In his presentation before the cabinet, Schacht argues that a sudden crash on the bourse would release cash that had been locked up in credits to the bourse. Compare to Abramowski, "Akten," p. 608. The Reichsbank later denied having made such claims. Beer, *Funktionswandel*, p. 205.

[27] Adolf Weber, in a famous essay entitled "Is Schacht Right?" argued that the Reichsbank president's policy was fundamentally contradictory.

[28] Compare to the series of articles in the Frankfurter *Zeitung* by Gustav Cassel, Albert Hahn, Alfred Lansburgh, and Arthur Spiethoff (8, 9, 11, and 12 May, respectively.). Note that Alex Field ("Asset Exchanges") has shown that the transactions demand for money in the United States probably rose as a result of the stock market boom during the 1920s.

[29] Benning, "Freitag."

[30] Compare to Temin (*Monetary Forces*, table 27, p. 154), who shows the share of short-term lending surging from 9.7 percent in 1926 to 51.1 percent in 1927. It could be argued that the short-term lending in the second quarter all arrived before the intervention in May. This is unlikely. We do not have good, direct evidence on monthly short-term inflows, but the Institut für Konjunkturforschung calculated a balancing item for the balance of payment, which contained short-term lending as well as receipts from sales of German assets abroad. Their figures show short-term inflows of 320 million RM in April, 110 million in May, and 320 million in June; the Institute also noted that massive transfers at short maturities resumed in June (Vierteljahrhefte zur Konjunkturforschung 2 (1927), pp. 14–15).

[31] Compare to Hardach, *Weltmarktorientierung*, p. 81; Benning, "Freitag"; and Weber, *Hat Schacht Recht?*

margin lending was excessive. Although the total volume of loans to the stock market did increase rapidly in 1926/27, it was still only approximately half of what it had been in the prewar period.[32] This suggests that, contrary to Reichsbank claims, foreign loans did not lead to unprecedented credit expansion via stock market lending.

The first factor cited by James in favor of intervention has received much less attention than the other two. This article argues that critics of the Reichsbank have emphasized aims of the intervention that are easily questioned. The importance of genuine concern about the level of the market in Schacht's thinking has not been uniformly appreciated.[33] I argue that reducing speculative excesses was an important factor in its own right for the Reichsbank's actions, and not merely a fig leaf for intervention against foreign borrowing. On the one hand, the Reichsbank worried about wealth effects pushing up consumption and affecting the balance of trade. In his report to the government, Schacht made scathing remarks about the "luxury consumption" enjoyed by speculators who had made easy gains on the stock market.[34] After the intervention, he castigated the harmful consequences of such extravagance:[35] "The money that has been gained easily on the exchange is . . . not returned to the economy. I have the impression that it is used in restaurants and inns, it is being consumed, and to a large extent, it is also used to pay for foreign luxury products (such as expensive automobiles). . . . For the Reich and the German economy, these foreign luxury imports, paid with capital gains from the stock exchange, are unhealthy and unbearable. This is the only reason why the Reichsbank has intervened."

Despite the firebrand rhetoric, concern about the market's valuation and economic imbalances arising from this were not mere auxiliary arguments in the context of foreign lending. In an internal memorandum, the Reichsbank's economics and statistics division emphasized the importance of wealth effects—additional purchases of consumer goods as a result of higher net worth. In an economy impoverished by war and inflation, such a spending spree—the Reichsbank argued—was entirely understandable. Nonetheless, because of the dangers involved, it was imperative to end excessive speculation.[36] These worries must be seen in the context of a sharply deteriorating current account in 1927, which added urgency to concerns about a surge of luxury imports.[37]

[32] Benning, "Freitag," p. 116.

[33] Harold James is one of the few historians who sees the three factors as approximately equal in importance. Compare to James, *Reichsbank*, p. 39.

[34] Bericht, in: Abramowski, *Akten*, pp. 591, 608.

[35] "Dr. Schacht gegen die Spekulanten," *Stralsunder Tageblatt,* no. 122 (27 May 1927), pp. 1–2.

[36] "Nimmt die Börse Kapital in Anspruch? Betrachtungen zu den Ausführungen der FZ, Bericht der VoStA," cited in Beer, *Funktionswandel*, p. 206. Typically, wealth effects are seen as problematic if they lead to overheating, i.e., push the economy's growth rate above the sustainable long-term rate. The Reichsbank argues that additional consumption was problematic at a time when domestic capital formation was too low anyway.

[37] Deutsche Bundesbank, *Deutsches Geld- und Bankwesen*, p. 322.

Schacht also worried about the level of stock prices in its own right. The first reason was that high equity valuations were politically inconvenient. High share prices appeared to indicate that Germany had recovered fully from the war, and that its wealth was rising rapidly.[38] This was a signal that Schacht, a vociferous opponent of reparations, was not keen to send at a time when renegotiations of Germany's obligations under the Dawes Plan were about to begin:

> The artificial rise in equity values, driven by the distortion in the money market, has meant that foreigners—according to my estimates—have gained 500 million RM on the Berlin Bourse. . . the final result is . . . that we suffer from a complete illusion about the effective capital stock in Germany, the nation's economic wealth, and the true rate of capital formation. The whole atmosphere in which a revision of the Dawes Plan was likely has vanished because we in Germany have staged this chimera [of wealth].[39]

Schacht also felt that stock prices were much too high relative to fundamentals. This assessment was based on a detailed analysis of the dividend yield relative to prewar levels. The aim, therefore, was not just to restrain future increases in share prices, but to actually lower them.[40] In his report before the Reich's cabinet on 7 March 1927, the Reichsbank President pointed out that:

> . . . speculation is primarily responsible for the extraordinary excesses in terms of equity valuations. . . . There are people who claim that, at a time when the money market rate is at 5 percent, a value of 300 for a share paying a 15 percent dividend is not too much . . . I would not like to enter into a theoretical argument, but would like to point out what the situation in 1913 was like. The yield of fixed securities quoted on the Berlin stock exchange was 4.5 percent. The [dividend] yield of shares was somewhat lower, 3.97 percent, since shares offer a speculative upside. The difference in yield between bonds and shares was a mere 0.5 percent. Today, we see bonds offering a yield of 7.12 percent, while shares (even if we look at the latest dividend figures) yield 3.44 percent. That not only means that today's [dividend] yield is lower than in 1913, when we [the German people] were richer, but it also means that the difference in yields is more than 3.5 percent now . . . . This proves how unhealthy current conditions are; everybody is buying shares because they think there will be future capital gains . . . .[41]

Relative to the relationship between bond and dividend yields before the war, the Reichsbank felt that the market was grossly overvalued. As the final sentence makes clear, Schacht was concerned about the build-up of a classical bubble, where price increases are simply driven by earlier price rises, the level of the market having lost all contact with fundamentals.[42] In his

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[38] Beer, *Funktionswandel*, p. 201.

[39] Bericht, in: Abramowski, *Akten*, p. 591.

[40] For a view to the contrary, compare to Balderston, *Origins*, p. 212.

[41] Bericht, in: Abramowski, *Akten*, p. 590

[42] As Charles Kindleberger ("Bubbles") put it: "A bubble may be defined loosely as a sharp rise in price of an asset . . . , with the initial rise generating expectations of further rises and attracting new buyers—generally speculators interested in profits from trading in the asset rather than its use or earning capacity."

Stralsund speech, he actually referred to the conditions in the German equity market as a bubble.[43] This is why Schacht believed that nothing better could happen to Germany than a crash.[44] Genuine concern about an overvalued stock market and the fundamental imbalances in the economy it created were important factors for intervention in their own right.[45]

Much of the literature on Reichsbank policy during the 1920s has found fault with the intervention in May 1927 because it did not achieve its professed aims in the money markets and in terms of foreign lending.[46] Money market conditions did not ease, and the inflow of foreign funds was not curbed. The only possible remaining defense of the Reichsbank's intervention is that there was a speculative bubble in the German stock market, as Schacht forcefully argued, and that pricking it reduced dangerous imbalances in the German economy.

WAS THERE A BUBBLE?

After the market's fall, the sharpness of the correction itself was seen by some as a sign that there was "irrational exuberance" in the markets before. Schacht argued as much, and some foreign observers agreed. On 15 May, two days after "Black Friday," the New York Times reported Wall Street circles as saying that "the panicky collapse on the Berlin Stock Exchange was universally ascribed to a vastly overextended speculation."[47] Also, margin requirements for firms trading equities forward were raised rapidly during the boom, from 5 percent in 1925 to 15 percent in 1927.[48] As Peter Rappoport and Eugene White have argued in the case of brokers' loans in the United States in 1929, such increases can be seen as a sign that market participants feared a bubble.[49] Yet there is no universally accepted and foolproof test for the existence of a bubble.[50] Instead, this section reviews the most important pieces of evidence and discusses the direction of potential biases. I conclude that there was no systematic overvaluation in the German

[43] Schacht used the term "Börsenblase." See "Dr. Schacht gegen die Spekulanten," *Stralsunder Tageblatt,* no. 122 (27 May 1927), p. 2.

[44] Schacht said that ". . . this level of share prices will under all circumstances collapse and that nothing better could happen to us than that it collapses . . ." Bericht, in: Abramowski, *Akten*, p. 608.

[45] Note also the context in which the Reichsbank President discusses the stock market's valuation. Whereas the traditional interpretation sees the stock market as merely one factor aggravating the foreign loan worries of the Reichsbank, the line of argument is reversed here. Schacht argues that abnormal conditions in the money market as a result of foreign loans are leading to excesses in the stock market—which are a cause for worry in their own right.

[46] Benning, "Freitag," pp. 166–72; and Hardach, *Weltmarktorientierung,* pp. 78–81.

[47] "What Caused Berlin Stock Panic?," *New York Times* (15 May 1927), p. 11.

[48] The "Liquidationskasse" guaranteed trades in forward shares, but did not act as a central counterparty in Berlin (the main stock exchange at the time). Compare to Veesenmayer, "Neugestaltung," p. 212.

[49] Rappoport and White, "Was there a Bubble?"

[50] The extensive literature on rational bubbles and intrinsic bubbles cannot be reviewed here. For an overview, see Froot and Obstfeld, "Intrinsic Bubbles."
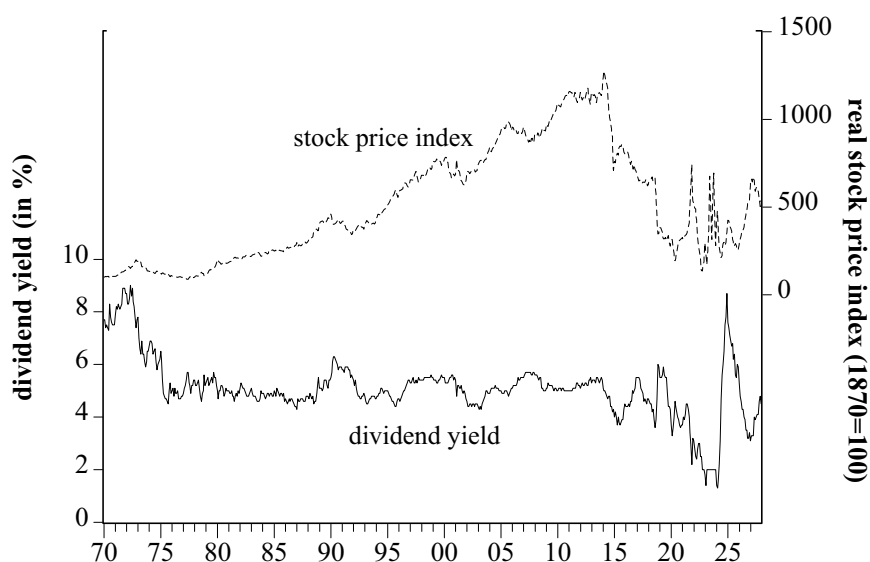
FIGURE 2
DIVIDEND YIELD AND STOCK PRICES IN GERMANY, 1870–1928

Source: Gielen, *Aktienkurse*.

stock market prior to the Reichsbank's intervention. First, valuations of stocks do not appear very high. Second, there is no time-series evidence for an asset bubble. Third, the share price increases on the German market are in line with those of other countries recovering from a traumatic disruption such as the hyperinflation. Finally, other macroeconomic indicators that are normally affected by a bubble fail to indicate an imbalance.

The market's rebound between December 1925 and April 1927 was spectacular indeed—an increase of 163.8 percent in real terms over a period of 17 months. But a rapid increase in the index alone is clearly insufficient to prove that there was a bubble in the German stock market. Even at the height of the boom—immediately before the Reichsbank's intervention—the stock price index was down by half compared to its 1913 level. But because shares simply represent an entitlement to future dividends, any judgement on over- or undervaluation has to take the dividend yield into account—as Schacht did in his presentation to the cabinet in March 1927.

Figure 2 shows the long-term development of the dividend yield (the ratio of dividends to share prices, in percentage points) and the market index. Over the period 1926 through early 1927, the dividend yield declined sharply. During the period December 1925 to April 1927, it averaged a mere 3.8 percent. In January 1927 it reached its lowest value of 3.1 percent. By contrast, the historic long-term average (1870–1913) was 5.4 percent. As Schacht had argued, the level of share prices relative to dividends appeared
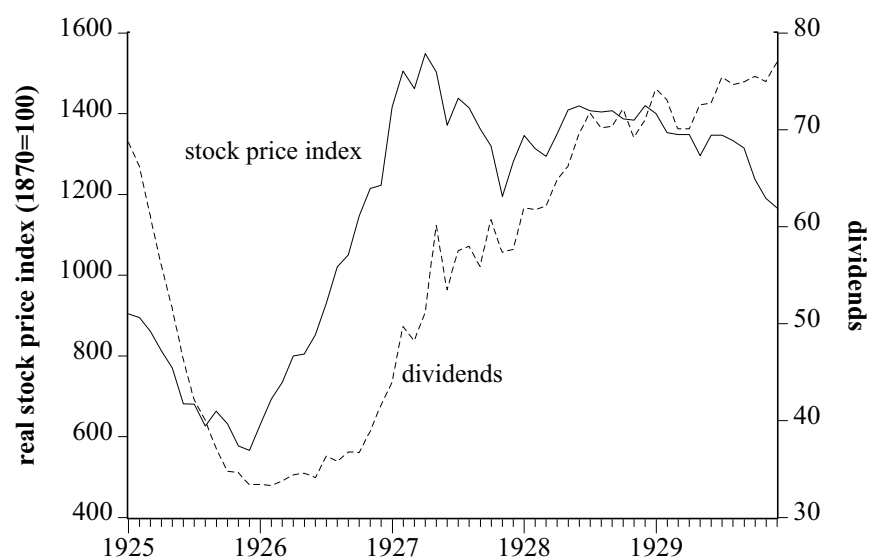
FIGURE 3
STOCK PRICE AND DIVIDENDS, 1925–1930

Source: Gielen, *Aktienkurse*.

to be unjustifiably high. However, as the German economy emerged out of the mini-slump in 1926, there were also good reasons to believe that both prices and dividends would continue to rise in the near future. Dividends had declined more than share prices (by 72 percent since 1913), reducing the dividend yield compared to the prewar standard. By paying a higher price for stocks in terms of the current dividend yield, investors implicitly assumed that dividends would not permanently remain depressed on such a scale. By 1927, according to Maddison, real German GDP per capita was already 10.5 percent higher than in 1913.[51] Even if wages had risen more than output prices and labor productivity, thus reducing profits, it appears unlikely that the shift in factor shares could be large enough to reduce dividends to such paltry levels permanently.

As rapid subsequent dividend growth makes clear, investors were correct in thinking that fundamentals would eventually recover. The turnaround in prices preceded that in dividends by approximately six months. The rapid rise of dividends throughout the rest of the 1920s appears to justify the gains in the stock market (Figure 3).

To judge if future dividend growth explains the German bull market in 1926/27, we need a model of share prices. Investing in an equity with a divi-

[51] Maddison, *World Economy*. The share price index does not adjust for those firms listed in 1913 that were now located on the territory of a foreign state. Total German GDP in 1926 was 2.3 percent below the 1913 value (using post-1918 territory). Note that Ritschl ("Deutschlands Krise") has recently presented detailed evidence suggesting that Maddison's estimates (based on Hoffmann's (*Wachstum*) data) may be too optimistic.

dend yield below the rate of return on riskless assets will be rational if investors anticipate (sufficiently large) price increases in the future. Ultimately, these must be underpinned by the company's ability to generate cash.

In the consumption capital asset pricing model (CAPM), a representative consumer maximizes the discounted value of future expected consumption. Asset demand and returns are determined endogenously. Let the consumer maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$$

where E denotes the expectations operator, $0 < \beta < 1$ is the discount factor, and $u(c)$ is the utility of consumption. Then, with $A_{t+1} = R_t (A_t + y_t - c_t)$, where A is the value of a share in an enterprise in terms of consumption goods, y is income, and R is the gross rate of return on the asset, the Euler equation will be $u'(c_t) = E_t \beta R_t u'(c_{t+1})$.[52] If the firm pays non-negative dividends d that follow a Markov process, then the consumer's wealth will change according to

$$(p_{t+1} + d_{t+1})s_{t+1} = \frac{p_{t+1} + d_{t+1}}{p_t}\left[(p_t + d_t)s_t + y_t - c_t\right]$$

If $(p_t + d_t)s_t = A_t$ (where p is the price of a share and s is the number of shares owned), Thomas Sargent shows that this implies, under fairly general assumptions, that

$$E_t\left(p_{t+1} + d_{t+1}\right) = \beta^{-1}p_t$$

so that equity prices—net of dividends and discounting—follow a first order univariate Markov process. For this

$$p_t = \sum_{j=1}^{\infty} \beta^j E_t d_{t+j} + \gamma_t \left(\frac{1}{\beta}\right)^t$$

is a general class of solutions (γ is a martingale that follows $E_t \gamma_{t+1} = \gamma_t$).[53] If we assume $\gamma_t = 0$ and a constant growth rate of dividends g so that $E_t d_t = d_0(1 + g)^t$, and set $\beta = 1/(1 + i)$ where i is the interest rate for discounting future dividends (including an appropriate risk premium), we can write the price of a share as

$$p = \frac{d_0(1+g)}{i-g} \Leftrightarrow g = \frac{pi - d_0}{d_0 + p}$$

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[52] With $(1/R_t)A_{t+1}$ as control. Compare to Sargent, *Macroeconomic Theory*, p. 93.
[53] Ibid., pp. 92–95.

We thus have a formula giving the implied rate of future dividend growth based on current share prices, dividends, and interest rates.[54] Dividends and share prices are observed. The difficulty is in choosing the appropriate rate at which future dividends should be discounted, and the risk premium. It is common to use the long-run excess return on stocks as a measure of the risk premium. In the United States, excess returns have been too large to be explained by plausible levels of risk aversion.[55] The much lower returns documented in other countries pose much less of a problem for asset pricing models. A risk premium of 3 percent appears to be an upper bound on the appropriate rate—the long term real return on German equity (over the period 1924–1991) was 1.91 percent.[56]

Instead of using a single interest rate to calculate implicit rates of dividend growth, we use a number of plausible alternatives. Figure 4 gives implied rates of dividend growth for German shares for three series of i—an assumed expected real rate of return of 8 percent, the average real yield on mortgage bonds with a gold clause (plus the 3 percent premium) for the period 1925–1930, and the real rate of return on shares in the prewar period (1870–1913).

The implied rates of dividend growth derived from the interest rate market do increase over the period when the bubble was allegedly developing, but they never reach levels that suggest overvaluation. Using the return on gold bonds plus the 3 percent risk premium, the implied growth rate of dividends rises to a peak of 3.5 percent in the early months of 1927. It then falls during the months immediately preceding the Reichsbank intervention. The implied dividend growth rates on the basis of an expected return of 8 percent real are consistently higher, while the implied rates of dividend growth derived from historical rates of return on shares are lower. How realistic was a rate of dividend growth of 2 to 4.5 percent?

Before World War I the implied rate of dividend growth had been 1.81 percent (1870–1913).[57] This seems to suggest that the German market was indeed overvalued when the Reichsbank decided to strike. Yet before World War I, dividends had actually grown at a rate of 4.5 percent per annum.[58] Between 1925 and 1927 investors even at their most optimistic moments were therefore only betting on rates of dividend growth that were in the same range as those seen during the prewar era. More importantly, Weimar

[54] The formula is very similar to the one used in Shiller ("Stock Prices"), and represents the standard "fundamental value" of a share. Compare to Campbell, "Asset Pricing," p. 1530. Note that the basic implications remain unchanged if one allows for time-varying discount rates. Ibid., p. 1531.

[55] Mehra and Prescott, "Equity Premium"; and Siegel and Thaler, "Anomalies."

[56] Compare to Jorion and Goetzmann ("Global Stock Markets"), table 1, p. 964. Note that, by using a higher risk premium than implied by long-run average returns, we bias our results *in favor* of finding "exuberantly" high rates of expected dividend growth.

[57] The rate for the period 1910–1913 is almost identical. The interest rate used is the average bond yield. Compare to Deutsche Bundesbank, *Deutsches Geld- und Bankwesen*, table F-2.01, p. 278.

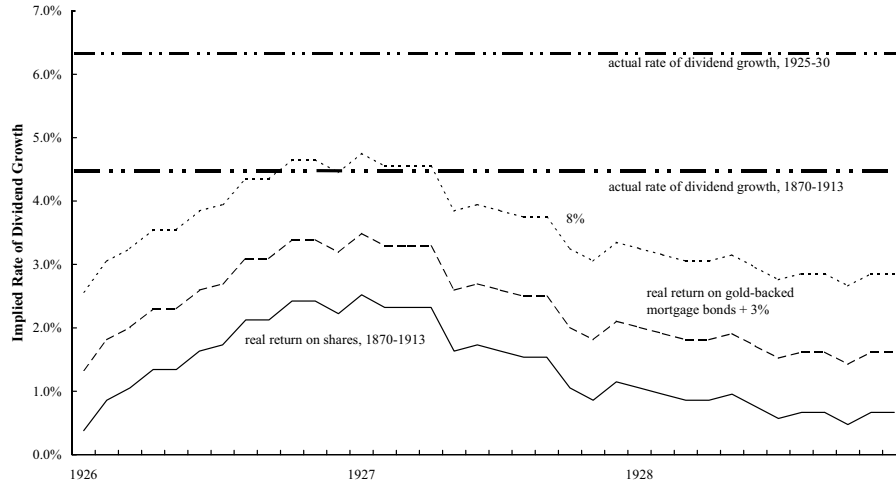[58] The real rate of increase was 4.08 percent.

FIGURE 4
IMPLIED RATE OF DIVIDEND GROWTH, 1926–1928

Source: See the text.

Germany's economy delivered even higher rates of dividend growth. In the years after the intervention to prick the "bubble," and into the first year of the Great Depression, dividends continued to grow at a healthy rate of 6.3 percent (April 1927–December 1930). Not even the constant discount rate of 8 percent, nor the monthly interest rate plus a 3 percent premium, give implicit rates of dividend growth that are significantly higher than this. The sharp fall in dividends seen in 1931/32 was arguably driven by the unique nature of the Great Slump, and was not a result of a cyclical downturn that rational investors should have anticipated in 1926/27.[59]

The spectacular rise in stock prices took place at a time when the very high interest rates after the stabilization of the Mark gradually came down. That this drove up equity valuations should come as no surprise. In his seminal contribution, Robert Shiller showed that most of the variation in stock prices cannot be explained by changing interest rates. Instead, changes in the discount factor must be responsible.[60] Interest rates were not artificially low as a result of an inflow of foreign capital.[61] Instead, the normaliza-

[59] The extent to which Weimar's economy was already doomed in the second half of the 1920s has been hotly discussed by Borchardt ("Economic Causes"), Holtfrerich ("Policy Options"), Ritschl ("Goldene Jahre?"), and Voth ("High Wages"). Balderston (*Origins*) provides evidence that wages were indeed out of line with productivity (by the standards of 1913), but that this is not necessarily a sign of Weimar's economy being destined for collapse.

[60] Shiller, "Stock Prices."

[61] It is possible to argue that there was a vicious cycle that could have driven a self-sustaining bubble in the German stock market. Under this story, inflows of foreign funds lowered interest rates and pumped up valuations of German equities, both as a result of added margin lending and the change in
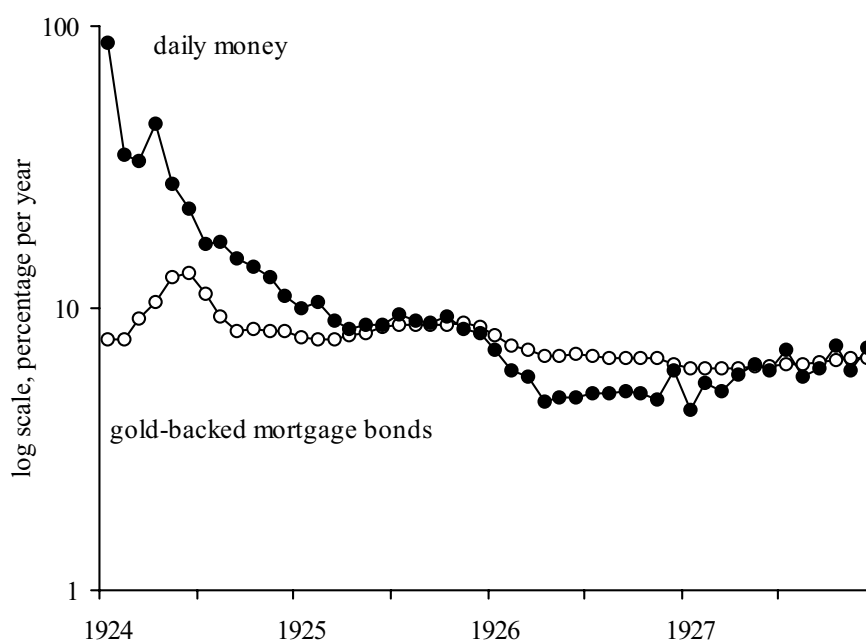
FIGURE 5
INFLATIONARY EXPECTATIONS, 1924–1927

Source: See the text.

tion of conditions in German money and capital markets was primarily responsible for the decline in rates, but not yet complete.[62] After the end of the hyperinflation, trust in the currency gradually returned, reducing risk premia and inflationary expectations. Figure 5 plots the interest rate for daily money alongside the yield on gold-backed mortgage bonds.[63] Whereas the mortgage bonds offered some protection against a recurrence of inflation, daily money did not. The difference between the two—abstracting from the difference in maturity, which will have had only a relatively small influence—is an indicator of inflationary expectations.[64] The figure demonstrates the extent to which the overall fall in interest rates is a result of normaliza-

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the discount factor. The high returns on German assets would then lead to further capital inflows, producing explosive behavior of both foreign liabilities and share prices. There is one crucial underlying assumption—that capital inflows lowered interest rates. The empirical evidence does not support such a connection. Although the money market rate was mildly (and insignificantly) negatively correlated with short- and long-term capital inflows $r = -0.25$ and -0.35, respectively), the yield on gold bonds is either positively correlated or close to zero $r = 0.6$ and -0.01). As Temin (*Monetary Forces*, p. 156) argued, the link between domestic credit and foreign loans was not as close as some observers believed.

[62] Most observers note that German interest rates remained unusually high compared to the pre-1913 period as well as in an international perspective. Compare to Holtfrerich, "Policy Options."

[63] Institut für Konjunkturforschung, *Konjunkturstatistisches Handbuch*.

[64] For an earlier application of the same approach, see Garber, "Transition."

TABLE 1
UNIT ROOT TESTS: STOCK MARKET RETURNS

Sample period	December 1925– April 1927	January 1926– April 1927	February 1926– April 1927	December 1925– May 1927
ADF	–4.4**	–6.04**	–4.3**	–3.7*
PP	–5.1**	–5.3**	–4.5**	–4.3**
DW	2.4	2.2	2.2	2.1

* indicates significance at the 5-percent level.
** indicates significance at the 1-percent level.
Source: Gielen, *Aktienkurse*.

tion in the German economy after 1925. Normalization was also notable in terms of volatility. The extreme swings seen during the period 1919–1923—often apparently related to political events—were now largely a thing of the past.[65] Since investors needed to be compensated less for volatility, valuations could also be higher.

Standard yardsticks such as the dividend yield therefore do not suggest that the German equity market was rapidly becoming overvalued in 1926 and early 1927. We can strengthen this result by analyzing the time-series properties of our data. James Hamilton and Charles Whiteman have argued that the existence of a bubble is hard to prove conclusively—test results may simply be driven by an inappropriately specified model.[66] In particular, tests will be prone to show the existence of a bubble where there was none—investors may be examining fundamentals that the econometrician cannot observe. By using these tests, we stack the odds *against* our hypothesis that there was no bubble in the German stock market.[67]

Behzad Diba and Herschel Grossman introduced a bubble test that examines the stationarity of equity returns. They argue that, in the case of a rational bubble, first differences of share prices will be nonstationary.[68] For the period when "bubble trouble" was allegedly building rapidly, we can clearly reject the null hypothesis of nonstationarity based on the augmented Dickey-Fuller and the Philipps-Peron test statistics (Table 1).[69]

An alternative approach is to examine the time-series properties of share prices. Robert Shiller and Campbell suggest to test if share prices and dividends are $I(1)$ and cointegrated; if they are, there is little reason to suspect that there is a bubble building up.[70] The Johansen test allows us to test for

[65] Bittlingmayer, "Output."

[66] Hamilton, "Testing"; and Hamilton and Whiteman, "Observable Implications."

[67] Note also that most tests of nonstationarity have relatively low power, i.e., they are likely to be unable to reject the null of nonstationarity even when it should be. This reinforces the bias *against* our hypothesis. Compare to Campbell and Perron, "Pitfalls."

[68] Diba and Grossman, "Rational Bubbles."

[69] For the Philipps-Perron test, I used the Newey-West truncation at two lags. The DW statistic shows that the lag length is sufficient to ensure that the residuals are free from serial correlations.

[70] Campbell and Shiller, "Cointegration." Rappoport and White ("Was there a Bubble?") apply this procedure to the American stock market in 1929, and find no evidence of a bubble based on this test. Note, however, that they find that their bubble variable—derived from a model of the brokers' loan market—also is cointegrated with dividends and stock prices.

TABLE 2
JOHANSEN TEST FOR COINTEGRATION: DIVIDENDS AND SHARE PRICE

	Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesis: Number of Co Vectors
January 1925–September 1935	0.132	18.3	12.53	16.31	0*
	0.000003	0.0036	3.84	6.51	1
January 1925–December 1929	0.28	19.75	12.53	16.31	0*
	0.002	0.17	3.84	6.51	1
January 1925–December 1928	0.38	23.3	12.53	16.31	0*
	0.005	0.24	3.84	6.51	1

* indicates significance at the 5-percent level.
Sources: Gielen, *Aktienkurse*.

the number of cointegrating vectors. If there is one cointegrating vector for two variables, then they are cointegrated. If the null of no vector cannot be rejected, or there are as many vectors as there are variables, then there is no evidence of cointegration. Table 2 gives the results for using the Johansen procedure for the dividend and share price series.[71]

For most sample periods covering the "bubble," there is clear evidence from the Johansen cointegration test that dividends and share prices are cointegrated—and that there is therefore no reason to suspect that rapid price increases were fundamentally irrational. However, if we restrict the sample to the brief period when price increases were most rapid—January 1926 to April 1927—the cointegrating relationship between share prices and dividends is no longer apparent in the data.[72] This could be seen as evidence in favor of a bubble. However, simple estimation of cointegrating vectors using two variables ignores the fundamental importance of the discount factor, as demonstrated by Shiller. If we include the interest rate on mortgage-backed bonds in our estimation procedure, the results clearly indicate the presence of one cointegrating vector.[73]

The time-series properties of the dividend yield have also been used as a test for the existence of bubbles in stock markets.[74] A unit root in the price-dividend ratio violates the no-bubble assumption. Testing for unit roots in the price-dividend ratio during the bubble period—January 1926 to April 1927—using both the augmented Dickey-Fuller and the Phillips-Perron

[71] Pretesting showed conclusively that there was no trend in the data; we also assumed no trend in the data generating process. Objections might be raised because we use cointegration techniques on a relatively brief period. Note, however, that recent work by Choi and Chung ("Sampling Frequency") and Hooker ("Testing for Cointegration") suggests that higher frequency may compensate for reductions in sample length.

[72] The Johansen test rejects the presence of a maximum of only one integrating vector, i.e., no cointegration either. Note that the period is extremely short for cointegration analysis, which by its very nature is a long-term concept.

[73] We reject the hypothesis of no cointegrating vector with a likelihood ratio statistic of 49.3 (the 95-percent critical value = 34.9), but cannot reject the presence of at most one vector (18.6 vs. a 95-percent critical value of 19.96).

[74] Craine, "Rational Bubbles."

technique allows us to reject the null of nonstationarity.[75] This suggests that our failure to find cointegration between dividends and share prices during the "bubble" period may be a result of the low power of the tests in a restricted sample.

How do we square the very high equity returns in Germany with the absence of a bubble? International evidence suggests that such a combination of factors is not unusual. Clearly, an economy recovering from hyperinflation is in an special situation. So is its stock market. Poor stock returns during inflationary periods have been observed in almost all countries.[76] Once countries stabilize, their markets "re-emerge."[77] Unusually high returns are often associated with this return to normalcy—as they are with recovery from other traumatic events such as war.[78] Table 3 gives descriptive statistics for five equity markets after very high rates of inflation had been brought under control, and compares these figures with the results for Germany during Weimar's only boom.[79] Because the German inflation was even more extreme than other episodes, and because higher returns follow more spectacular stabilizations, we are biasing our result against finding "normal" gains in the German case.[80]

For every time period chosen, poststabilization returns in Germany are lower than they were in our sample of countries recovering from extreme inflation. They are also lower in each period than any return in any one individual country in the "control" sample. Average returns are highly sensitive to the periods used. We therefore choose the German sample periods so as to maximize the return, increasing the likelihood of finding spectacular gains in the German stock market compared to other countries. For all observation windows, a starting date of July 1924 was found to serve the purpose. In this way, we are biasing our results in favor of finding dangerously and "exuberantly" rapid equity price appreciation in postinflationary Germany. Nonetheless, German monthly returns are below the average observed in other countries that saw a period of normalization in their stock markets. The only exception is the average return over 60 months following stabilization, when the German return is 0.1 percent higher. Again, judged against

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[75] The PP statistic is –5.6 vs. a 1-percent critical value of –3.9, whereas the ADF statistic is –5.2 vs. a 1-percent critical value of –3.9.

[76] Fama and Schwert, "Asset Returns"; and Beaulieu, "Rendements."

[77] The countries classified as re-emerging in table 3 are recovering from a range of events that caused a temporary halt to market activity or an extreme fall in valuations. Compare to Goetzman and Jorion, "Global Stock Markets."

[78] Henry ("Stock Market Liberalization") finds that successful stabilization programs are significantly associated with large increases in stock market values. The rise in the market is larger if inflation was particularly high.

[79] The information in column 1, table 2 is from Goetzmann and Jorion ("Re-emerging Markets").

[80] Henry, "Stock Market Liberalization." Note also that the returns in Table 3 for the control sample are derived from price indices, whereas the German figures use the performance index. Because the latter includes re-invested dividends, we further stack the odds against finding German returns that are lower than typical ones.

TABLE 3
MONTHLY RETURNS AFTER STABILIZATION

Length of Period (months)	Five Markets Recovering from High Inflation* (percentage)	Germany (percentage)	Germany [period chosen to maximize returns**] (percentage)
12	6.6	–0.8	4.0
24	4.2	–0.7	3.0
36	3.4	1.6	3.3
48	4.6	1.1	2.5
60	1.8	1.1	1.9

* The countries and the dates of stabilization are Mexico 1987, Peru 1993, Poland 1991, Argentina 1991, and Brazil 1994. Rates of return are from the S&P/IFC Emerging Markets Data-base except for Poland, where the FIBV statistics were used. S&P/IFC indices are from Datastream. The FIBV statistics are available at http://www.fibv.org. As the latter are only available on an annual basis, the year immediately after stabilization was used.
** The observation period begins in July 1924.
Sources: Goetzmann and Jorion, "Re-emerging Markets"; and Gielen, *Aktienkurse.*

the background of other stock markets recovering from similar blows, the German market shows no signs of irrational exuberance.

The amount of margin lending—prominent in Schacht's thinking when he decided to intervene—also does not suggest that excessive speculation, taking advantage of cheap credit, drove the market to unsustainable heights. All lending to the stock market ("Reports/Lombards") amounted to no more than 7 percent of market capitalization in April 1927. In contrast, the available data for the prewar years suggests much higher levels, with total lending equivalent to 25 percent of the value of all shares in 1910.[81] If lending to the stock market was modest, how could its reduction cause such a precipitous decline on "Black Friday"? The reduction in lending itself was not significant. What mattered was the widespread perception of a "Höchstpreispolitik"—the Reichsbank effectively signaled that it would not tolerate future increases in share prices.[82] Hence investors realized that the return on their investment would be determined by dividends alone, with no capital gains possible. This dramatically reduced the expected pay-off from investing in equity.

Finally, we can examine the macroeconomic environment. Bubbles normally do not descend out of the blue; a number of authors have argued that they are systematically related to other imbalances in the economy.[83] Past episodes suggest that five main variables can be examined. The majority of bubbles have been associated with unusually high growth, unusually low inflation, a deteriorating current account, a rapid rise in the money supply as well as falling savings rates. On the checklist compiled by Stephen King, the canonical cases score high—the bubbles in Japan and the United Kingdom in the late 1980s, in Mexico in the early 1990s, and in the United States

[81] Benning, "Freitag," p. 116.
[82] "Pferdekur-Warum?," *Frankfurter Zeitung*, no. 357 (15 May 1927), pp. 4–5.
[83] King, "Bubble Trouble."

in the late 1990s. Germany in the 1920s, in contrast, only shows some of the familiar signs of a bubble building up. Growth of close to 10 percent in 1927 and a relatively rapid deterioration of the current account are the only features of the macroeconomic picture that fully fit the bill.[84] Inflation is below trend, but rising relatively quickly towards the end of the period—not a perfect parallel with the unusual degree of stability seen in the United States or Japan. On all other scores, interwar Germany does not show the normal signs of an economy heading towards excessive asset inflation. To this we might add the observation that most other major asset bubble episodes saw "spillovers" from the stock market into the real estate market—such as in Britain and Japan in the 1980s. Central banks have all the more reason to worry about wealth effects if property values surge, as most households hold much more equity in their homes than they invest in the stock market. Germany saw no significant increases in real estate prices, let alone a "bubble."[85] The balance of evidence—including the absolute level of the stock market, valuation measures, time series properties, and typical accompanying factors—therefore strongly suggests that there was no bubble in the German stock market.

THE CONSEQUENCES OF THE CRASH

The preceding section argued that Schacht's attempt to bring down the stock market was misguided. Did the intervention have significant real effects? Some contemporaries feared that the Reichsbank's intervention would wreak havoc in the economy. The Berlin correspondent for Associated Press reported that

> "[i]ndustrial leaders declare that the restriction of bank credits not only will affect share prices adversely but also will handicap the industrial life of the country. It is pointed out that the reorganization of Germany's industries has not been finished and can be carried out successfully only if the Bourse is able to absorb the new shares which Germany's industries will be obliged to market."[86]

The fear was therefore that equity offerings would dry up as the market weakened. The literature's view about "Black Friday's" consequences is contradictory. Whereas Gerd Hardach maintains that the crash had severe effects, Albrecht Ritschl has argued that it was of little consequence.[87] Balderston concluded that weakness in both the bond and the equity market was responsible for the early start of the depression in Germany.[88] I argue that the slump in equity prices had important real effects and that it reduced

[84] Deutsche Bundesbank, *Deutsches Geld- und Bankwesen*, p. 322.
[85] The author would like to thank an anonymous referee for this observation.
[86] *Commercial and Financial Chronicle* (14.5.1927), p. 2835.
[87] Hardach, *Weltmarktorientierung*; and Ritschl, "Deutschlands Krise," pp. 88–90. Ritschl ("Peter Temin," p. 4) finds a larger impact on machinery investment.
[88] Balderston, "Beginning." He later revised his position (Balderston, *Origins*).

investment. It is in this sense that "Black Friday" contributed to the early onset of the German slump.

In the case of the U.S. depression after the crash of 1929, analysis of the transmission mechanism has focused on declines in consumption. Contemporaries did not anticipate a fall in business activity as a direct result of the crash.[89] Also, wealth effects—reductions in consumer spending as a result of lower net household wealth—appear to have been very small.[90] However, the crash may have weakened household balance sheets, and uncertainty over future income may have caused a reduction in expenditure on consumer durables.[91] In Germany, consumer spending continued to rise for a full year after the crash—principally because of rapid wage growth driven by very generous public sector pay awards.[92] What the crash did influence was investment activity—the single most important determinant of variations in GDP during the late 1920s.[93] If the stock market's artificial crash in 1927 mattered for the early German downturn, we need to find a link between the market's level and private sector investment.

James Tobin first set out theoretical reasons why the ratio of the market's valuation of capital to the cost of acquiring new capital—Tobin's q—should help to explain variations of investment over time.[94] Typically, empirical studies show only a weak connection between investment and q (either marginal or average).[95] Robert Barro's work on the United States in the 1920s and 1980s, however, demonstrates that share prices themselves are better predictors of investment and output than Tobin's q.[96] This is mainly because the calculated equity component of q turns out to be a poor proxy for share prices.[97] Using share prices, Barro finds that over the period 1921–1989, share prices explain a significant proportion of the variation in investment. The collapse in share prices in 1929 can also explain an important part of the decline in U.S. investment and GDP, 1930–1932. We take this analysis further by implementing a Barro-style investment equation.

As the AP correspondent argued, German firms were reliant on the stock market for an important part of their financing. Figure 6 compares aggregate investment with the level of share prices in Germany, 1925–1935.[98] Both series track each other closely. The sharp run-up in equity prices precedes the turning point of the investment series. Also the downward turning point

[89] Dominguez et al., "Forecasting the Depression."

[90] Most studies show that wealth effects are very small. Compare to Poterba, "Stock Market Wealth."

[91] Mishkin, "Household Balance Sheet"; and Romer, "Great Crash."

[92] James, "Economic Reasons."

[93] Temin, "Beginning"; and Temin, *Monetary Forces*, pp. 149–60.

[94] Tobin, "General Equilibrium."

[95] Summers, "Taxation"; and Clark, "Investment."

[96] Barro, "Stock Market"; and Fama, "Stock Returns."

[97] Barro, "Stock Market," p. 549.

[98] Investment is the net investment series, without inventory, in Ritschl ("Deutschlands Krise"), interpolated by the output of investment goods according to Institut für Konjunkturforschung (*Konjunkturstatistisches Handbuch*).
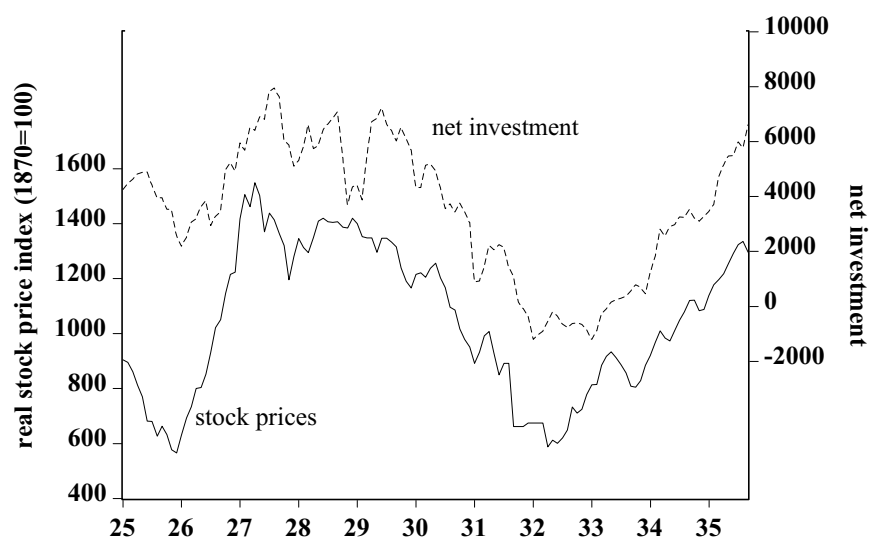
FIGURE 6
STOCK PRICES AND INVESTMENT, 1925–1935

Source: See the text.

is reached just a few months after the Reichsbank's intervention. Some brief episodes apart, both series begin their long decline in 1927, after Schacht's intervention. It is only after the stock market index began its recovery in 1932 that investment turns upwards. Granger-causality tests clearly demonstrate that equity valuations mattered for investment—for the period January 1925 to September 1935, the standard *F*-test gives a statistic of 6.2, equivalent to a probability of only 2.5 percent that we cannot reject the null of no granger causality running from share prices to investment. The reverse, testing for investment causing share prices, yields a statistic of 0.24, equivalent to a 78 percent probability.

Following Barro, we use share prices directly in constructing q. From the Johansen procedure, there is consistent evidence that share prices and investment in Weimar's economy are cointegrated (Table 4).[99] The estimated vector for the period 1925–1929 is[100]

$$\ln(I) = 3.08 + 0.88\ln(S)$$

It is only when the sample period is extended beyond the onset of the Great Depression that this relationship begins to fall apart. Nonetheless, for the period as a whole, investment and share price track each other quite

[99] Pretesting established that the data series are not trended; also, we assumed no trend in the data generating process.

[100] The result is essentially unchanged if we include the interest rate on gold-backed mortgage bonds. $\ln(I) = 5.5 + 0.77\ln(S) - 0.88\ln(i)$.

TABLE 4
JOHANSEN TEST FOR COINTEGRATION: INVESTMENT AND SHARE PRICE INDEX

	Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesis: Number of Co Vectors
January 1925–September 1935	0.02	2.54	12.5	16.3	0
	0.0001	0.014	3.84	6.5	1
January 1925–December 1929	0.247	16.5	12.5	16.3	0*
	0.000005	0.00299	3.84	6.5	1
January 1925–December 1928	0.32	18.2	12.5	16.3	0*
	0.13	0.62	3.84	6.5	1
1870–1913	0.364	19.4	15.4	20.04	0*
	0.0098	0.42	3.76	6.65	1

* indicates significance at the 5-percent level.
Sources: See the text.

closely, and the run-up in prices in 1926/27 appears to be more a correction of a prior undervaluation than a period of irrational exuberance. The crash induced by the curtailment of margin lending therefore caused investment spending to be lower than it otherwise would have been.

The results are robust to a number of alternative specifications and testing strategies. One factor to consider is the cost of capital, as proxied by interest rates.[101] Also, work on irreversibility and investment in recent years suggests a link between uncertainty and capital formation.[102] As the handful of years between the wars is not ideal for testing the long-run co-movement of stock prices and investment, I include data on the prewar period. Finally, I examine the robustness of the main findings in a VAR framework.

As the results in Table 4 show, share prices and investment also co-integrate during the period 1870–1913. Granger-causality tests strongly reject the possibility of stock prices not causing investment (*F*-statistic 14.4), while failing to reject the hypothesis that investment does not cause stock prices.

The determinants of investment in Germany and the United States, 1870-1940 are shown in Table 5. To avoid the problems of nonstationarity, I use first-order differences of all variables except for interest rates and the volatility of output. I also include the long-run cointegrating vector from the Johansen procedure. It emerges as significant throughout. When modeling investment in the years during and after the intervention, I find that in the short run, the elasticity of investment with respect to stock prices was 0.19 and 0.21. This is less than in the cointegrating vector. Interest rates had some effect on investment (significant at the 16-percent level of probability), but this disappears when a proxy for uncertainty is included. The latter is, however, wrongly signed. Overall, even over the short run, we can explain 11–18 percent of the variation in investment.

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[101] Voth ("High Wages") argues that high interest rates were crucial in holding down investment.
[102] Dixit and Pindyck, *Investment*; and Bernanke, "Irreversibility."

TABLE 5
DETERMINANTS OF INVESTMENT IN GERMANY AND THE UNITED STATES, 1872–1940

	1 January 1925–December 1930	2 January 1925–December 1930	3 1872–1913	4 1876–1913	5 1889–1912	6 1889–1912	7 United States 1891–1914, 1921–1940
Inv(−1)							0.393**
							(4.7)
Stock		0.195*	0.29**	0.32**			
		(1.68)	(2.3)	(2.1)			
Stock(−1)	0.21**		0.22*		0.35**	0.62***	0.56***
	(2.0)		(1.8)		(2.4)	(3.2)	(9.8)
Stock(−2)			0.32***				
			(2.9)				
Vola(−1)		0.035**				0.01	
		(2.3)				(0.89)	
Private discount					−0.028		
					(1.23)		
Bondyield				−0.12*			
				(1.78)			
Bondyield (−1)	−0.06	−0.04					
	(1.4)	(0.9)					
ECM	9e−5***	9e−5***	0.38***	0.27**	0.32***	0.58*	
	(2.9)	(3.2)	(3.8)	(2.6)	(2.9)	(4.2)	
Constant	7.4	7.2	−0.02	0.46*	0.09	−0.02	
			(1.28)	(1.8)	(1.2)	(0.66)	
adj. R^2	0.11	0.18	0.27	0.15	0.16	0.58	0.67
Standard error	0.23	0.23	0.09	0.09	0.09	0.08	0.081

* indicates significance at the 10-percent level.   ** indicates significance at the 5-percent level.   *** indicates significance at the 1-percent level.
Notes: The dependent variable is the first difference of log net investment. Lags refer to months in the case of regressions (1) and (2), and to years in all other cases. *Interest* is the yield on gold-backed mortgage bonds for the Weimar sample, and the yield on bonds with fixed coupons in the years 1889–1912. *Private discount* is the private discount rate. For 1925–1930, *Vola* is the standard deviation of industrial output for the period *t*–5 to *t*, where *t* is the month of observation; for 1889–1912, it is the standard deviation of net national product (NNP) in 1913 prices for the period *t*–2 to *t*, where *t* is the year of observation. *ECM* is the cointegrating vector from the Johansen procedure.
Sources: Institut für Konjunkturforschung, *Konjunkturstatistisches Handbuch*; Deutsche Bundesbank, *Deutsches Geld- und Bankwesen*, p. 278; Gielen, *Aktienkurse*; and Barro, "Stock Market."

The long-run behavior of investment and stock prices yields similar results. We find elasticities for Germany that are very similar to the U.S. ones reported by Barro. These are not affected by the inclusion of interest rates, which have a strong, significant, negative effect when we use bond yields, or output volatility, which is imprecisely estimated and wrongly signed. Figure 7 presents the results from estimating a vector error correction model, where we impose the cointegrating vector from the Johansen estimation. To plot the impulse response functions, we use the standard Choletzky orthogonalization, and the ordering of responses—investment, stock prices, interest rates. A one-standard-deviation increase in stock prices raises investment by six percentage points. A one-standard-deviation rise in bond yields (equivalent to 87 basis points) lowered investment cumulatively by nine percentage points.

Variance decompositions show that, of the exogenous variables, changes in the stock market index explain 28 percent of changes (not caused by lags of investment itself). Changes in interest rates explain 62 percent. This suggests that the valuation of the stock market mattered in the way predicted, but that it was only one of a number of factors contributing to the downturn of investment in the period before 1930. Clearly, the Great Depression in Germany with the associated collapse in investment could not have been avoided by simply refraining from the intervention in May 1927. What the Reichsbank's action did contribute to was the unusually early downturn of investment *before* 1930. A good part of the "investment shortfall" that some authors have found, if it did exist, may well be the result of the central bank's attempt to force down share prices.[103]

How large was the damage? If we take the Lucas critique seriously and assume that the parameter values in our model themselves might change if alternative policies had been pursued, calculating a counterfactual becomes impossible.[104] To gauge the magnitudes involved, however, let us assume that the elasticities estimated in Table 5 are broadly correct. Then, if stock prices had increased at an annual rate of 2 percent after April 1927, dividend yields could have recovered substantially. By the end of 1928, the stock price index would have been 16.6 percent higher than it actually was, suggesting that investment could have been between 7 and 15 percent higher.

Why did the intervention have such strong effects in the stock market itself? By leaning on the banks, the Reichsbank effectively signaled it would intervene to reign in share prices. Contemporary commentators were shocked by these strong-arm tactics.[105] Some spoke of a "Reichsbank dicta-

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[103] Spoerer ("Investment Record") and Voth ("Fate of the Weimar Republic") present evidence that investment in interwar Germany was not lower than during the Empire. For a view to the contrary, see Borchardt, "Economic Causes."

[104] Lucas, "Policy Evaluation."

[105] The Frankfurter Zeitung spoke of a "Höchstpreispolitik." "Pferdekur-Warum?," *Frankfurter Zeitung*, no. 357 (15 May 1927), pp. 4–5.
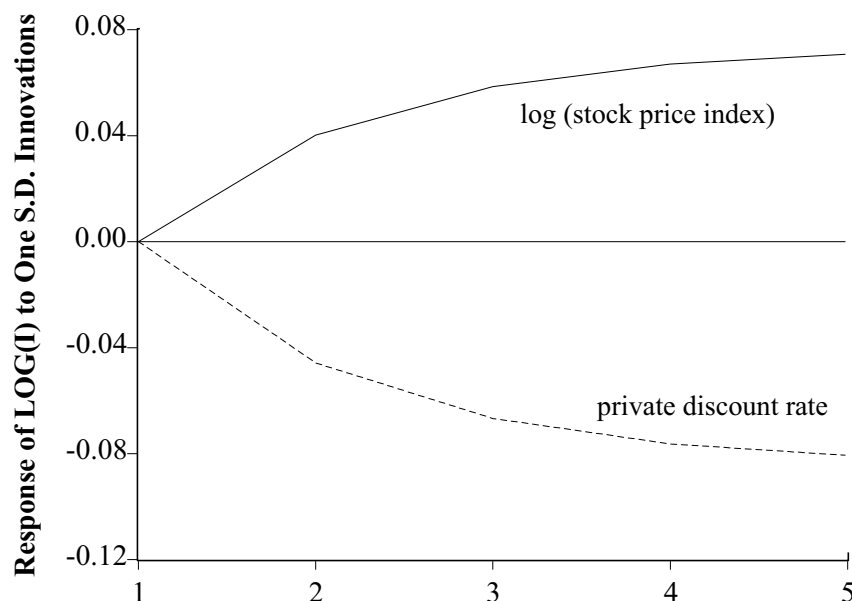
FIGURE 7
IMPULSE RESPONSE FUNCTIONS FROM VECTOR ERROR CORRECTION MODEL

Source: See the text.

torship."[106] Even those that also worried about a bubble felt that the inter-vention was much too crude.[107] The strong effects on the stock market itself are therefore largely the result of a wide-spread perception that the Reichs-bank would cap capital gains by whatever means necessary.

We also need to understand the strong repercussions for the economy and investment in the aggregate. In Barro's study, the results are insensitive to the inclusion of after-tax profits in the estimation equation, making it un-likely that the stock market variables merely proxy for cash-flow effects. When we use dividends as an explanatory variable in the vector error-cor-rection model estimated before, it explains almost none of the variation, and has only an insignificant impact on investment. Writing about the Great Depression, Peter Temin encouraged scholars to take the role of expecta-tions more seriously.[108] The stock market was perceived as a direct indicator of economic health—the very reason why Schacht felt that high equity values undermined Germany's case for a re-vision of the Dawes Plan. As his

[106] "Gewaltsame Krediteinschränkung," *Frankfurter Zeitung*, no. 354 (13 May 1927); "Pferdekur -Warum?," *Frankfurter Zeitung*, no. 357 (15 May 1927), p. 4: "Es handelt sich um einen beispiellosen Reglementierungsversuch, um eine planwirtschaftlichen Aktion ersten Ranges…"

[107] "Pferdekur-Warum?," *Frankfurter Zeitung* no. 357 (15 May 1927), pp. 4–5.

[108] As Temin (*Lessons*, p. 104) put it: "Modern theories of the economy have brought expectations onto the stage as a lead actor, unlike its earlier position as extra or understudy. Our historical accounts need to follow suit."

prominent critic Adolf Weber put it after the intervention: "The public judges economic conditions according to the quotations for shares published daily in the newspapers. It believes that the sad numbers … demonstrate the bad state of our [the German] economy."[109] The collapse in share prices is a highly plausible cause for the increasing pessimism in Germany's business community, adding to the effects of a continuing profit squeeze emphasized by earlier authors.[110]

In addition to "animal spirits," two other factors can be cited that can help us to understand why the stock market rout led to an investment and business downturn—the weakening of firm balance sheets and lower stock market liquidity. Recent literature on the Great Depression has highlighted the importance of the cost of credit intermediation.[111] Negative shocks to household and firm wealth will weaken balance sheets. In the presence of asymmetric information, lending becomes more risky. Credit volume will contract, aggravating the slump.[112] A downturn can thus be amplified by higher agency costs of lending—the "financial accelerator."[113] For the United States, Ben Bernanke shows how bank failures and panics drove up the cost of intermediation.[114] In an international perspective, Bernanke and James argue that debt-deflation effects were important in reducing the effectiveness of financial intermediation, aggravating the Great Depression.[115]

Declines in the value of a firm's assets as a result of a stock market crash will lower the value of collateral it can offer. This in itself may cause greater asymmetric information problems, causing a rise in long-term interest rates for private firms and a fall in investment.[116] This problem is aggravated if the stock market slump causes a reduction in new equity issuance. Because banks will not accept debt/equity ratios above a certain limit, they will be more reluctant to lend, thus reducing opportunities to raise external financing still further. Just as the anonymous businessman cited by the Associated Press had predicted, the floatation of new shares on German stock exchanges was reduced sharply by Schacht's intervention. Although Germany in the recent past is not known for its use of equity-based financing, earlier periods show a very different picture. In 1913 the ratio of market capitalization to GDP was higher in Germany than in the United States.[117] Over the period 1880–1930, the degree of co-movement between the equity issuance and investment is striking. Issuance fell off sharply after the

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[109] Weber, *Hat Schacht Recht?*, p. 12.
[110] Balderston, *Origins;* James, "Economic Reasons"; and Borchardt, "Economic Causes."
[111] Bernanke and James, "Gold Standard"; and Eichengreen and Grossman, "Debt Deflation."
[112] Mishkin, "Asymmetric Information."
[113] Bernanke, Gertler, and Gilchrist, "Financial Accelerator."
[114] Bernanke, "Nonmonetary Effects." Temin (*Lessons*) finds that the cross-sectional evidence does not support the Bernanke hypothesis.
[115] Bernanke and James, "Gold Standard."
[116] Calomiris and Hubbard, "Firm Heterogeneity"; and Greenwald and Stiglitz, "Information."
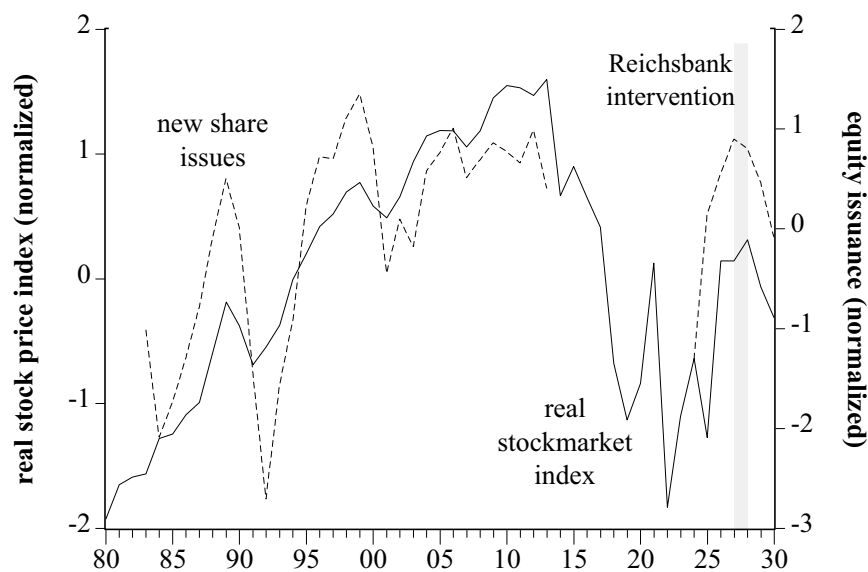[117] Rajan and Zingales, "Great Reversals," table 3, p. 55.

FIGURE 8
NEW SHARE ISSUANCE AND REAL STOCK PRICE INDEX, 1880–1930

Sources: Gielen, *Aktienkurse*; and Deutsche Bundesbank, *Deutsches Geld- und Bankwesen*.

Reichsbank intervention (Figure 8). It peaked in the second quarter of 1927, at the time of the market high before the intervention. Despite a brief re-bound in the third quarter of 1928, it would not recover pre-intervention levels before the postwar period. The consequences of the decline in new issuance were all the more severe because the German economy relied on financing via the stock market to an unusual extent—in 1926, the value of new equity offerings was equivalent to one-third of net capital formation.[118]

In the German situation during the interwar period, there is every reason to expect particularly drastic effects from financial accelerator effects. Banks' capital ratios were low after the hyperinflation. More importantly, the universal bank system meant that many banks held equity stakes in companies that borrowed from them. Not only would the value of collateral offered by firms therefore be hit by a stock market crash—the banks' own equity base would be adversely affected. The rapid collapse in lending after 1928 may well have been driven in part by the events on the stock exchange.

One other consequence also strongly suggests that the investment slow-down following the Reichsbank intervention in 1927 was caused by the stock market crash. Trading volume on the exchanges fell sharply. Direct figures are not available, but the revenues from stamp duty indicate the orders of magnitude involved. From an average of 9.55 million RM per

[118] The figures for new capital formation are from Ritschl, "Deutschlands Krise." Information on new issuance is from Vierteljahrhefte zur Konjunkturforschung 2 (1927) and from Deutsche Bundesbank, *Geld- und Bankwesen*.

month in March through May, revenues fell to 5.17 million during the rest of the year. The collapse in trading volume made German shares less liquid—transaction costs rose significantly.[119] Consequently, the stock market's role in allocating capital became more difficult. In a series of studies, the World Bank has recently argued that stock market liquidity has an important influence on subsequent growth.[120] In a cross-section of 47 economies, Ross Levine and Sara Zervos found that for every reduction in the value of stock market turnover relative to GDP by ten percentage points, growth during the period 1976–1992 suffered by 0.9 percent per annum.[121]

CONCLUSION: A "SOFT LANDING" GONE WRONG

This article analyzed the German stock market bust of 1927, when the German central bank intervened indirectly to lower the level of share prices. Much of the literature has interpreted Schacht's intervention primarily in the context of foreign capital flows. In Germany, monetary policy was constrained by gold standard rules. Massive capital flows under fixed exchange rates can—as the Reichsbank argued—easily have destabilizing consequences.[122] In the context of foreign borrowing, the attack on the stock market was nonetheless an unmitigated disaster because it failed to stem the inflow of foreign funds and did not help to ease conditions in the money market. This article has argued that concern about the stock market was not a mere auxiliary to worries about foreign loans. Instead, Schacht and the Reichsbank were directly concerned about overvaluation in the market, and believed that a crash would be the "best thing that could happen to the German people."

Without raising interest rates sharply as such, it was one of the more effective interventions carried out by a central bank. On 13 May the share index compiled by the Reichskreditanstalt closed 22 percent below its level of 3 May, and 11 percent down on the day.[123] By November, despite temporary recoveries, the index was still down by one-quarter, never to recover pre-intervention levels before the Great Depression had run its course.[124] In assessing the benefits and dangers of this move, we first examined if there is evidence of a bubble developing in the German market. The conclusion from cointegration analysis, an examination of the time-series properties of the data, and a dividend yield model was that the rapid run-up in prices prior

[119] Note, however, that the revenues from stamp duty were affected by the decline in share prices, as well as changes in the volume and price of traded bonds.

[120] Levine, "Financial Development."

[121] Levine and Zervos, "Stock Markets." Calculating the impact of the stock market intervention via the liquidity channel is not possible, as we lack direct figures on the value of turnover.

[122] Krugman, "Balance Sheets."

[123] Benning, "Freitag,," p. 147; and Beer, *Funktionswandel*, p. 204.

[124] Gielen, *Aktienkurse*; Balderston, "Beginning," pp. 414–15. The price of some stocks suffered by as much as 40 percent. Compare to Benning, "Freitag," p. 161.

to Schacht's intervention was not caused by "irrational exuberance." Instead, lower interest rates and a wider normalization of economic conditions after the end of hyperinflation were responsible. Compared to other markets recovering from traumatic events (such as a hyperinflation), asset price increases in Germany were not particularly steep.

Pricking a nonexisting bubble had significant economic consequences. Far from the "blessing" that Reichsbank President Schacht expected it to be, it had strong adverse consequences.[125] Weimar's only investment boom quickly came to an end, and the economy's downturn was in part caused by Schacht's ill-considered intervention in the equity market. Our analysis thus lends indirect support to Temin's argument about the onset of the Great Depression in Germany. The timing of changes in international capital flows does not suggest that they played a crucial role in tipping the economy into recession in 1927/28. Instead, domestic reasons for the downturn need to be sought.[126] In addition to a surge in pessimism because of continued low profits, as suggested by Balderston, James, and Borchardt, this article argues that there were other important reasons why business sentiment turned sour in 1927/28. The stock market crash is precisely the kind of domestic event that could—as suggested by Temin—have led to a sharp decline in business sentiment, reinforcing the effects of continuing low profitability.

We also argued that the destruction of equity values—by lowering the value of collateral, of some of the banks' own equity holdings, and by sharply reducing public offerings—increased the cost of financial intermediation. This substantially aggravated the early downturn in Germany. Via the "financial accelerator" mechanism, the stock market crash probably was instrumental for the reduction in credit and the curtailment of business investment. Both GDP and capital stock could have been markedly higher had it not been for the Reichsbank's intervention. Germany in the 1920s was, in relative terms, much larger an economic power than it is today—the world's second-largest economy. On a speculative note, one might therefore add that the early German downturn, and the consequences it had for her trading partners, did nothing to stabilize the world economy prior to the outbreak of the Great Depression.[127] As an observer of the Federal Reserve Bank of New York put it in the summer of 1927: ". . . the whole episode was a blunder."[128]

Should asset bubbles be pricked? Rapid increases in asset prices present central banks with a dilemma. Simulation studies of monetary policy find that an explicit targeting of asset prices—over and above their effect on the

[125] Schacht said that ". . . this level of share prices will under all circumstances collapse and that nothing better could happen to us than that it collapses . . ." Bericht, in: Abramowski, *Akten*, p. 608.

[126] Temin, "Beginning" and *Monetary Forces*, p. 248.

[127] Ritschl ("Peter Temin") has examined the extent to which the downturn in Germany was predictable. In contrast to the findings by Dominguez et al. ("Forecasting"), for the United States he concludes that most of the decline in output from 1927 onwards was predictable.

[128] Hardach, *Weltmarktorientierung*, p. 80f.

price level—may amplify "boom-bust" cycles.[129] If there is a danger of price increases spilling over into the rest of the economy, it may appear sensible to "step on the brakes" and deflate what appears to be a bubble. At the same time, active intervention in asset markets, and deliberate attempts to change prices, may be as dangerous as other forms of tinkering with the price mechanism. Distortions in relative prices may cause misallocation of resources, and perhaps more importantly, growth and investment can suffer if the central bank decides to intervene at an inappropriate time.

Three policy lessons appear to emerge from Germany's "Black Friday." First, distinguishing bubbles from increases in asset prices driven by fundamentals (or sensible beliefs about the future development of fundamentals) is no easy matter. Despite applying relatively sophisticated valuation analysis based on long-run comparisons of the German data, the Reichsbank appears to have attacked a nonexisting "Spekulationsblase."[130] Even with more advanced recent techniques, the bias tends to be in favor of finding a bubble where there is none.[131] Given that monetary policy has to operate under this veil of uncertainty, central banks may be well-advised to only intervene when there is overwhelming evidence of "irrational exuberance."

Second, a differential approach that targets speculators directly (by restricting brokers loans, etc.), is no more likely to avoid negative consequences for the economy as a whole than a more aggressive tightening of overall monetary policy. The unforeseen severity of the crash implies that fine-tuning can be hard to achieve. The similarities in the cases of Japan in 1989, the United States in 1929, and Germany in 1927 suggest that balance sheet effects may have been crucial in transmitting the effects of asset prices to the economy as whole.[132] Effective counter-cyclical policy would then imply that policy has to become expansionary very rapidly once the stock market "bubble" had been deflated.

Third, the difficulty of predicting the consequences of deflating "bubbles" should be taken into account when appraising their apparent dangers. On balance, there appears to be good reason to apply the most stringent standards before rapidly rising share prices can call for central bank intervention. Only if spill-over effects threaten price stability in the economy as a whole is intervention likely to be justified. The details of the Reichsbank intervention in 1927 also cast an interesting light on the issue of central bank intervention in general. In the case of exchange rates, the general belief is that central banks should stand aside (unless conditions are extreme) because they are not powerful enough vis-à-vis market players. In contrast, stock market interventions by central banks appear to be "too successful." Because neither the extent of the market's fall brought about by specific

[129] Bernanke and Gertler, "Monetary Policy."

[130] Schacht in his speech in Stralsund, "Dr. Schacht," in *Stralsunder Tageblatt*, 27 May 1927.

[131] Hamilton, "Testing"; and Hamilton and Whiteman, "Observable Implications."

[132] Bernanke and Gertler, "Monetary Policy."

measures nor the amount of "collateral damage" in the rest of economy can be controlled or anticipated accurately, it may be best not to intervene at all.

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