STOCK VOLATILITY AND THE GREAT DEPRESSION*

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ABSTRACT

Stock volatility during the Great Depression was two to three times higher than any other period in American financial history. The period has been labelled a "volatility puzzle" because scholars have been unable to provide a convincing explanation for the dramatic rise in stock volatility (Schwert, 1989). We investigate the volatility puzzle during the period 1928-1938 using a new series of building permits, a forward-looking measure of economic activity. Our results suggest that the largest stock volatility spike in American history can be predicted by an increase in the volatility of building permits. Markets appear to have factored in a forthcoming economic disaster.

JEL Classification: G12, G14, G18, E66, N22, N24, N12, N14
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Introduction

The annualized standard deviation of US stock returns during the Great Depression reached as high as 60 percent per annum, two to three times higher than any other period in American financial history. **Figure 1** shows that stock volatility during the Great Depression stands out even when compared to the volatility of market returns over a time span of more than 200 years (1802-2013) that includes the Great Recession. A convincing explanation of why stock volatility was so high during the Great Depression has eluded scholars.[1] This has led some studies to suggest that the "excessive volatility" of stock returns in the late 1920s and 1930s might be the result of a "Peso problem" or irrational behavior by investors (Shiller, 1981). In his seminal article *"Why Does Stock Volatility Change Over Time,"* Schwert (1989) analyzes stock return data for more than 100 years and finds that various macroeconomic and financial time series are unable to predict the high levels of stock volatility observed during the Great Depression and the 1930s. Schwert concludes that *"there is a volatility puzzle."* (Schwert, 1989; Pagan and Schwert, 1990; Schwert, 1990b).

We break new ground in studying the volatility puzzle of the Great Depression. Specifically, we test the ability of building permits, a forward-looking measure of economic activity to predict stock volatility during the period 1928-1938. Building permits are well-known to academic and professional forecasters to be a forward-

[1] Mathy (2016) finds that the spikes in stock volatility during the Great Depression were generated by a series of discontinuous jumps that can be explained by banking crises, the end of the gold standard, and expectations regarding the outbreak of war in Europe. White (1990) is the classical reference on the Great Crash of 1929.

looking indicator of aggregate economic activity and stock volatility (Leamer, 2007; 2009; 2015; Flannery and Protopapadakis, 2002; Stock and Watson, 1993). Building and housing permits often show up as components of leading economic indicators (LEIs) produced by forecasters such as the Conference Board or as variables used to predict recessions (Leamer, 2007; 2009; Stock and Watson, 1993). For these reasons, the volatility of building permits can be a proxy for macroeconomic risk that leads firms to reduce or eliminate dividend payments to investors, reducing aggregate consumption in disaster models of asset pricing and stock volatility (e.g. Barro, 2006; Gabaix, 2012).

We supplement the building permit series with new databases to examine the role of economic, financial, and political factors in predicting monthly US stock volatility for the period 1928-1938. First, we employ Graham, Leary, and Roberts' (2015) new measure of financial leverage that is taken from the *Moody's Manuals*. Their series allows us to directly control for a fundamental explanatory variable of stock volatility. Second, we employ a new time series on junk bond yield spreads to test the importance of forward-looking interest rates in forecasting stock volatility.[2] Third, we hand-collect data on important political events to construct a new database of political uncertainty. Measures of political conflict are used to test the Merton-Schwert hypothesis that the high levels of stock volatility during the Great Depression were driven by the rise of communism that threatened the future of market capitalism (Merton, 1987; Schwert, 1989). We convert Banks' (1976) *annual*

[2] It is well-known in the forecasting literature that interest rate spreads are important leading indicators of economic downturns (see e.g. Stock and Watson, 1993).

database on riots, assassinations, anti-government demonstrations, and general strikes into a *monthly* measure to examine the relationship between stock volatility and political uncertainty.

Our empirical analysis suggests that stock volatility during the Great Depression can largely be explained by three variables: (1) historical lags of stock volatility, (2) financial leverage, and (3) the volatility of the growth rate in building permits. The three-variable specification accounts for about 74 percent of the movements in stock volatility for the entire sample period 1928-1938. Panel B of **Figure 2** shows that the volatility of the growth rate of building permits is especially important given that the six-month lag of the forward-looking economic indicator predicts the largest spike of stock volatility in American history. The simple model predicts the standard deviation of stock returns even better if we limit the sample period to just the Great Depression as defined by NBER recession dates. In this case, the R-squared for the three-variable model rises to nearly 85 percent. If we include the measures of political uncertainty for the shorter sample period, then the R-squared increases to over 88 percent.

The results are robust to many different specifications. We test whether the volatility of other macroeconomic factors such as retail sales and industrial production can predict stock volatility. As for financial factors, we look at the ability of corporate and junk bond spreads to predict the standard deviation of stock returns. The macroeconomic and credit channel proxies do not significantly predict stock volatility during the Great Depression. We believe that the volatility puzzle of the Great Depression is largely solved by incorporating building permits, a forward-looking measure of aggregate economic activity, into a simple model of stock volatility.[3]

Given the robustness of the baseline result, we next investigate the economic and financial factors that predict the volatility of building permits. There appears to be little evidence that macroeconomic or financial factors can predict the volatility of the forward-looking construction measure.

The paper begins with a discussion of the economic and financial data used in the study. This is followed by the empirical analysis of stock volatility. We then test the robustness of the baseline specifications. The empirical analysis concludes with a study of the role of economic and financial factors in predicting the volatility of the growth rate in building permits. The final section discusses the implications of the results and makes suggestions for future research.

I. Data

We use monthly data from January 1928 to December 1938 for the empirical analysis.[4] We combine various sources to assemble a new database with economic, financial, and political variables to explain movements in stock volatility during the Great Depression.[5] For stock volatility, we calculate the monthly sample standard

[3] Leamer (2015, p. 43) argues that *"housing is the single most critical part of the U.S. business cycle, certainly in predictive sense and, I believe, also in a causal sense."*
[4] The building permit series is consistently defined beginning in 1927 with a sample of 215 cities.
[5] A description of the data sources is presented in Appendix A.

deviation of stock returns from the daily data set compiled by Schwert (1990a).[6] Panel A of **Figure 3** shows the market capitalization of aggregate equity returns during the period 1928-1938. The market collapses with the Great Crash of 1929 and bottoms out in late 1932.

Leverage Data The data on the market value of corporate leverage is taken from Graham, Leary, and Roberts (2015). The market value of leverage is calculated as *Debt/(Debt + Market Equity*) for non-financial firms. We transform the annual series of financial leverage into a monthly series by linear interpolation for the period 1928:M1-1938:M12. The measures of book and market leverage reported by Graham, Leary, and Roberts (2015) are reproduced in Panel B of **Figure 3.** *Book Leverage* is relatively stable over the sample period compared to *Market Leverage* which shows large changes during the Great Depression (shaded area).[7]

Economic and Financial Data We use the value of building permits, *"Permits"*, as a forward-looking indicator of economic activity. The data are taken from various issues of *Dun and Bradstreet's Review*, a well-known monthly business and financial publication in the 1920s and 1930s. The forward-looking measure of economic activity is constructed from building inspector reports collected by the *F.W. Dodge Division*, a *McGraw-Hill Information Systems* Company, which provided their data to the Bureau of Labor Statistics (BLS). The value of building

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[6] Schwert (1990a) uses the value-weighted S&P composite portfolio for being the best available measure of daily stock returns in the period starting in January 1928 (Schwert, 1990a, p. 413).

[7] *Book Leverage* is depicted for illustration purposes only. In our empirical analysis, we only use *Market Leverage* for being a key control variable in stock volatility models.

permits is based on the cost of new residential and commercial buildings for 215 cities across the US.

We employ two yield spread measures for the empirical analysis. First, the interest-rate differential between AAA corporate bonds and commercial paper is used to predict stock volatility. Then a junk bond yield spread for the interwar period constructed by Basile, Kang, Landon-Lane, and Rockoff (2015) is incorporated into the baseline regression models of the standard deviation of monthly stock returns. Data on coincident economic variables are also used to assess the importance of real factors in forecasting stock volatility. We utilize the Federal Reserve's series on retail sales and industrial production (IP) to estimate the volatility of the real sector.

Political Data We construct a monthly version of Banks' (1976) annual *Cross-Polity Time-Series* for the US. The political database is widely used in economics, political science, and other social sciences. The annual database is converted into a monthly one using Banks' original sources.[8] We relied largely on the search engine for the *ProQuest Historical New York Times* to construct a monthly database of important political events. We follow the previous literature (e.g. Passarelli and Tabellini, forthcoming; Funke, Schularick and Trebesch, 2016) in our selection of conflict variables that proxy for political uncertainty. The four variables are: (1) *Anti-Government Demonstrations*; (2) *Assassinations*; (3) *General Strikes*; and (4) *Riots*. An *Anti-Government Demonstration* is any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing

[8] Appendix A has a detailed description of the sources used by Banks (1976).

their opposition to government policies or authority (excluding anti-foreign nature demonstrations). The number of *Assassinations* is defined as a politically-motivated murder or attempted murder of a high government official or politician. A *General Strike* is a strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority. Finally, a *Riot* is a violent demonstration or clash of more than 100 citizens involving the use of physical force.[9] The specific events data are then summed up to form an aggregate ***"Politics"*** variable:

$$Politics = Assassinations + Anti\text{-}Govt.\ Demonstrations + General\ Strikes + Riots$$

The descriptive statistics are reported in **Table 1.** The volatility of the economic and financial series measured by the standard deviation are much less volatile for the entire sample period (Panel A) compared to the Great Depression (Panel B). Political variables are also more volatile in the Depression, which is consistent with the hypothesis that political conflict is correlated with the poor economic conditions of the Great Depression. **Figure 4** contains panels that show the monthly frequency for each of the different measures of political conflict. *Assassinations* were quite rare with only two instances in the sample. The most frequent events were *Anti-Government Demonstrations,* followed by *Riots* and *General Strikes*. *Riots* and *Anti-Government Demonstrations* also display greater frequency during the Great Depression sub-period.

[9] Appendix A describes the methodology used to collect the political data.

II. Empirical Strategy

The first step in our empirical analysis is to extract a measure of volatility from the raw data. We estimate GARCH (1,1) models to construct estimates of the one-step ahead conditional standard deviation for several of the independent variables in the empirical analysis. To control for persistence in the mean of each series, we employ 12 lags of the dependent variable in the mean equation and estimate the system by Maximum Likelihood methods. We then proceed with our baseline empirical analysis of the determinants of stock volatility during the Great Depression.[10] The model can be written as follows:

$$\begin{aligned} Stock\ Vol_t = \beta_0 + \sum_{m=1}^{11} D_m + \sum_{p=1}^{7} \beta_{1,p} \cdot Stock\ Vol_{t-p} + \sum_{p=1}^{7} \beta_{2,p} \cdot Lev_{t-p} \\ + \sum_{p=1}^{7} \beta_{3,p} \cdot Permits\ Vol_{t-p} + \sum_{p=1}^{7} \beta_{4,p} \cdot Politics_{t-p} + \varepsilon_t \end{aligned} \tag{2}$$

where *Stock Vol* is our measure of stock market volatility (standard deviation of stock returns), D_m is a set of seasonal monthly dummies, *Lev* is the market value of aggregate corporate leverage, *Permits Vol* is the volatility of the growth rate of building permits estimated from a GARCH(1,1) model, *Politics* is the sum of the four measures of political conflict, and ε_t is a normally-distributed error term. A lag

[10] We employ a methodology similar to Paye (2012).

length of seven is chosen based on the Akaike Information Criterion (AIC).[11] We estimate the following OLS regression models using robust standard errors:

1. ***Autoregressive Model:*** a model that includes only the lags of stock volatility (*Stock Vol*) and seasonal dummies to measure how much of current volatility can be explained by historical volatility.
2. ***Pure Leverage Model:*** a model that adds the lags of financial leverage (*Lev*) to the initial *Autoregressive Model*. Financial leverage is widely considered a fundamental determinant of stock volatility.
3. ***Economic Model:*** a model focusing on the economic determinants of volatility. The economic specification includes financial leverage and our forward-looking variable of economic activity represented by the volatility in the growth rate of building permits (*Permits Vol*).
4. ***Political Model:*** a model that includes financial leverage and the political determinants of stock volatility to test the Merton-Schwert hypothesis.
5. ***Joint Economic-Political Model:*** a model combining the variables from the *Economic* and *Political* models.

We follow Schwert (1989) and several studies (e.g. Flannery and Protopapadakis, 2002; Elder, Miao and Ramchander, 2012; Fatum, Hutchinson and Wu, 2012), that assess models of financial volatility by comparing the R-squared of different specifications. For example, the *Economic Model* tests the hypothesis that the volatility of the growth rate of building permits predicts stock volatility. If the forward-looking measure of economic activity is statistically significant and the R-

[11] As a robustness test, we also estimated stock volatility regressions using 12 lags of the independent variables (Schwert, 1989). The basic tenor of the results remains unchanged.

squared for the model increases, the result might suggest that economic factors were important for explaining the high levels of stock volatility during the period 1928-1938. More importantly, if the R-squared of the building permit specification is even higher during the Great Depression subsample, then the finding would provide additional evidence that markets were concerned about a forthcoming economic disaster. We now turn to the empirical analysis.

III. Results

A. Stock Volatility: Full Sample Period

Table 2 shows the results for the full sample period, 1928-1938. Column 1 reports the *Autoregressive Model*. Seven lags of historical volatility explain 60 percent of the standard deviation of stock volatility for the period 1928-1938. We next control for financial leverage which is considered an important predictor of stock volatility. A higher ratio of the book value of debt relative to the market value of equity means that it is more difficult for the firm to pay off its debt obligations. Distressed firms or companies with a greater likelihood of default also generally have higher stock volatility. Seven lags of leverage are then added to the baseline autoregressive specification. Column 2 shows that leverage is statistically significant at the one percent level. Leverage increases the explanatory power of the model from 60 to 68 percent.

The results of the forward-looking economic model appear in Column 3 of **Table 2**. The F-statistics for the volatility of the growth rate in building permits is significant at the one percent level. The building permit specification increases the R-squared by five percentage points to 73 percent. We follow-up the forward-looking economic model with a political model of stock volatility. The empirical analysis is reported in Column 4. The results show that the aggregate political measure is not significant at conventional levels.[12] This is somewhat surprising given that some political events in the sample period were quite notable and widely reported in the press. For example, Anton Cermak, the Mayor of Chicago, was murdered in February 1933 even though the hit targeted President Roosevelt.[13] Senator Huey Long was killed in a shooting in September 1935, year before the outspoken congressman was poised to run for President of the United States against Roosevelt.[14] Overall, the results suggest that the volatility of building permits had a larger impact on stock volatility. The forward-looking economic variable is statistically significant in all specifications. However, the R-squared of the political measure only increases the fit of the model by three percentage points to 69 percent relative to the baseline model of historical lags of stock volatility and financial leverage. Finally, we combine the forward-looking economic model with the political specification in Column 5. The volatility of building permits remains statistically

[12] Voth (2002) finds that political variables explain a significant fraction of stock volatility using stock market data for a sample of 10 countries during the period 1919-1938. His analysis does not control for leverage, however.

[13] The front-page headlines of the *New York Times* read *"Cermak in Critical Condition at Hospital; 'Glad It Was I, Not You,' He Tells Roosevelt." New York Times*, February 16th, 1933.

[14] We also tested whether the Economic Policy Uncertainty (EPU) Index constructed by Baker, Bloom, and Davis (2016) could predict stock volatility during the Great Depression and 1930s. The EPU variable was not statistically significant. The results are available from the authors by request.

significant at the one percent level while the aggregate political variable is not significant at the five or ten percent level. The R-squared rises to 74 percent in the economic and political model of stock volatility.

The baseline results for the full sample period are then subjected to a battery of robustness checks.[15] We test whether the volatility of retail sales, industrial production, money supply growth, inflation, the interest-rate differential between AAA corporate bonds and junk bonds, and the yield spread between AAA corporate bonds and prime commercial paper spreads can predict stock volatility. The baseline empirical results are robust to including many different economic indicators as shown in **Table 3**. The additional explanatory variables are not statistically significant in the stock volatility regressions. The volatility of the growth rate of building permits is significant at the one percent level in all specifications.

We next assess the explanatory power of the *Economic Model* by examining the residuals from a stock volatility regression on financial leverage and the volatility of building permits, (i.e. excluding the historical lags of stock volatility).[16] Panel A of **Figure 5** shows the residual series along with 95 percent confidence intervals. **Figure 5** indicates that a very simple model of stock volatility predicts stock volatility quite well given the high level and persistence of the standard

[15] Schwert (1989) relies on economic variables such as the volatility of industrial production, money growth, interest rates, and inflation to explain stock volatility. He does not incorporate building permits (as defined by *Dun and Bradstreet's Review*) into his models of stock volatility.

[16] The regression used to compute the residual series also contains monthly seasonal dummy variables.

deviation of stock returns during the late 1920s and 1930s. The R-squared is about 61 percent for the two-variable specification. There are only two outliers in the residual graph that are outside of the 95 percent confidence intervals. The first outlier is the largest stock volatility spike in US financial history. Even though the regression residual of the dramatic rise in stock volatility during 1929 is outside the 95 percent confidence bands, the two-variable regression model explains more than 50 percent of the volatility spike. The simple regression model significantly reduces the amplitude of the largest stock volatility spike in US history to a much lower level.

The stock volatility model also does a good job at predicting the second largest volatility spike in US history that occurred during the "recession within the Great Depression" of 1937-38. The regression residual of the 1937-38 downturn is just outside the 95 percent confidence intervals shown in Panel A of **Figure 5**. Overall, we interpret the residuals from the simple model of stock volatility as strong evidence that including the volatility of the growth rate of building permits largely explains the "volatility puzzle" of the Great Depression identified by Schwert (1989).

B. Stock Volatility: The Great Depression Sub-sample

If the volatility of the growth rate of building permits is important for explaining stock volatility, then the leading indicator should be even more important when the sample period is restricted to just the Great Depression period. GDP declined by one-third between 1929 and 1933 and the unemployment rate increased to nearly 25 percent (Friedman and Schwartz, 1963). Given the large decline in coincident macroeconomic indicators, a forward-looking indicator like building permits should also exhibit a large decline and an increase in volatility. This is actually what we observe in the time series of building permits in 1929, as shown in **Figure 6**.[17] The value of building permits was approximately $213 million USD at the beginning of 1929. Two months later, building permits increased to nearly $229 million in February, and to $372 million in March 1929. In April 1929, building permits rose to a level of almost $480 million. The rise is a 62 percent increase over the previous year. The forward-looking economic measure fell to $260 million in May and to $218 million in June. One month before the Great Crash in October 1929, the value of building permits declined to a level of $183 million. The value of building permits fell by more than 60 percent between April and September 1929.[18] To visualize the pattern described above in terms of second moments, **Figure 7** shows the volatility of building permits and stock returns for the period January 1928-March 1933. The volatility of the growth rate of building permits leads the Great Crash of 1929 and stock volatility. Our finding is broadly similar to the well-known relationship between housing starts and the recent downturn of 2007-09 (Gjerstad and Smith, 2014; Leamer, 2015).

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[17] On the real estate dynamics during the 1920s, see Brocker and Hanes (2014) and White (2014).

[18] Romer (1990) argues that the Great Crash increased uncertainty which led to a decline in the consumption and production of durable goods.

Table 4 reports the empirical results from the Great Depression period, July 1929-March 1933. Columns 1 and 2 report the results for the autoregressive and leverage models, respectively. Both the historical lags of volatility and leverage are statistically significant. Adding leverage to the historical lag model increases the R-squared from 42 to 63 percent. Column 3 shows the results for the economic model. The volatility of building permits is once again statistically significant at the one percent level. The R-squared strikingly rises 22 percentage points to a total of 85 percent when the building permit variable is added to the model.

Column 4 reports the political model of stock volatility during the Great Depression. The political uncertainty variable is not significant at conventional levels. The R-squared rises from 63 percent in Column 2 to 69 percent in the political specification. Column 5 of **Table 4** presents the empirical results of the Great Depression period for the economic-political model. The volatility of the growth rate of building permits is statistically significant at the one percent level, while the political conflict variable is not significant at conventional levels. The R-squared rises to 88 percent in the economic-political model. The results from the Great Depression sub-sample period as defined by NBER recession dates suggest that the volatility of the growth rate of building permits predicts stock volatility even better under more severe economic conditions.

Finally, we examine the regression residuals of the Great Depression sub-sample. Panel B of **Figure 5** presents the regression residuals calculated from a regression of stock volatility on lags of financial leverage and the volatility of the growth rate of building permits. The R-squared for the residual regression is almost 72 percent.[19] The regression residuals are shown with 95 percent confidence intervals. Panel B indicates that the regression residuals are not statistically significant except for one month in 1931. The Great Depression sub-sample provides even stronger evidence that the volatility of the growth rate of building permits largely explains the "stock volatility puzzle" of the Great Depression. Given the importance of the construction measure in forecasting stock volatility during the Great Depression, a natural follow-up question is: what factors explain the volatility of building permits? We examine this question in the next section.

C. What drives the Volatility of the Growth Rate in Building Permits?

We estimate several regressions to examine the factors that predict the volatility of the growth rate of building permits for the sample period 1928-1938. The dependent variable for the regressions is the conditional standard deviation of the growth rate of building permits (*Permits Vol*). We consider three possible channels that could drive the volatility of the growth rate of building permits: (1) *Real Channel* (retail sales volatility); (2) *Monetary Channel* (money growth volatility); and the (3) *Credit Channel* (AAA Corporate Bond-Junk Bond Spread; Prime Commercial Paper-AAA Corporate Bond Spread). The volatility of each variable is estimated using a standard GARCH(1,1) model with robust standard errors, except for the two credit spreads which are included directly in the model as in Schwert

[19] We do not include monthly seasonal dummy variables in the Great Depression sub-sample given the short time period.

(1989). A lag length of 7 is employed for each independent variable. We regress the volatility of the growth rate of building permits on each of the three channels. The empirical results are reported in **Table 5**. Column 1 shows the regression using only historical lags of the volatility of the growth rate of building permits. The F-stat for the lags is significant at the ten percent level of significance, and the R-squared is only 24 percent for the baseline regression. Next, we add the volatility of retail sales to the baseline specification. The volatility of retail sales is not statistically significant at conventional levels. Historical lags of the volatility of the growth rate of building permits are also not statistically significant at the five or ten percent level. The R-squared for the predictive regression model is 27 percent.

We next replace the volatility of the growth rate of retail sales with the volatility of money growth. Column 3 reports the empirical results of the monetary model. Both independent variables are not statistically significant and the R-squared is only 27 percent. The volatility of money growth does not appear to predict stock volatility. The results for the credit channel models are presented in Columns 4 and 5. In the junk bond specification, both the historical lags of the dependent variable and the credit measure are not significant at conventional levels. The R-squared from the credit channel model is 26 percent. For the credit channel model that employs the interest-rate differential between corporate bonds and commercial paper, the financial factors are not significant. The R-squared for the specification using commercial paper is 29 percent Finally, we combine the independent variables from the money model, the real sector specification, and the credit channel regressions. The results of the fully specified model appear in Column 6. The historical lags of the volatility of the growth rate of building permits and the other variables are not statistically significant. We find little evidence that standard economic and financial variables can predict the volatility of the growth rate of building permits.

IV. Concluding Remarks

Were the high levels of stock volatility during the Great Depression really a puzzle? We do not think so. We believe that the puzzle is largely resolved by incorporating the volatility of building permits into a simple model of stock volatility. First, we collected data on a new monthly series of building permits reported by *Dun and Bradstreet's Review* for 215 US cities. Building permits are a well-known leading indicator used to forecast and predict modern stock volatility and recessions. We supplement the forward-looking measure with new data on financial leverage and political uncertainty. The volatility of the growth of building permits predicts a significant portion of stock volatility for the entire sample period. More importantly, the forward-looking measure of economic activity predicts stock volatility *even better* during the Great Depression as defined by NBER recession dates. This is shown by an R-squared of 85 percent for a simple three-variable model of stock volatility. Moreover, this is also shown by the fact that after controlling for only two variables (leverage and building permits volatility), the extreme levels of stock volatility observed in the Great Depression are reduced to conventional deviations from model-predicted values. The empirical results are robust to a variety of different specifications.

Given the importance of leading indicators, we then explore the determinants of the volatility of the growth rate of building permits. We find little evidence that standard economic and financial measures can forecast the volatility of the growth rate of building permits. Overall, our analysis suggest that future research might test whether forward-looking economic measures such as the value of building permits or housing starts have greater explanatory power for predicting stock volatility during a period of severe economic and financial stress. Perhaps new studies will test this hypothesis by looking at global equity stock markets during the Great Depression and other turbulent episodes in economic history.

REFERENCES

Baker, Scott R., Nicholas Bloom, and Steven J. Davis (2016). Measuring Economic Policy Uncertainty. *Quarterly Journal of Economics* 131(4), 1593-1636.

Banks, Arthur S. (1976). *Cross-National Time Series, 1815-1973*. In: Inter-University Consortium for Political and Social Research, No. 7412.

Barro, Robert J. (2006). Rare disasters and asset markets in the twentieth century. *Quarterly Journal of Economics*, *121*(3), 823-866.

Basile, Peter F., Sung Won Kang, John Landon-Lane, and Hugh Rockoff (2015). Towards a History of the Junk Bond Market, 1910-1955. *NBER Working Paper*, n. 21559.

Elder, John, Hong Miao, and Sanjay Ramchander (2012). Impact of macroeconomic news on metal futures. *Journal of Banking & Finance* 36(1): 51-65.

Fatum, Rasmus, Michael Hutchison, and Thomas Wu (2012). Asymmetries and state dependence: The impact of macro surprises on intraday exchange rates. *Journal of the Japanese and International Economies* 26(4): 542-560.

Flannery, Mark J. and Aris A. Protopapadakis. (2002). Macroeconomic Factor do Influence Aggregate Stock Returns. *Review of Financial Studies* 15(3):751-782.

Friedman, Milton and Anna J. Schwartz. (1963). *A Monetary History of the United States*. Princeton: Princeton University Press.

Funke, Manuel, Moritz Schularick, and Christoph Trebesch (2016). Going to extremes: Politics after financial crises, 1870–2014. *European Economic Review* 88, 227-260.

Gabaix, Xavier (2012). Variable Rare Disasters: An Exactly Solved Framework for Ten Puzzles in Macro-Finance. *Quarterly Journal of Economics*, *127*(2), 645-700.

Gjerstad, Steven D. and Vernon L. Smith (2014). *Rethinking housing bubbles: The role of household and bank balance sheets in modeling economic cycles*. Cambridge University Press.

Graham, John R., Mark T. Leary, and Michael R. Roberts (2015). A Century of Capital Structure: The Leveraging of Corporate America. *Journal of Financial Economics*, 118, 658-683.

Brocker, Michael and Christopher Hanes (2014). The 1920s Real Estate Boom and the Downturn of the Great Depression: Evidence from City Cross-Sections. In: White, Eugene N., Kenneth Snowden, and Price Fishback (editors), *Housing and Mortgage Markets in Historical Perspective*, p.161-201. University of Chicago Press and National Bureau of Economic Research.

Leamer, Edward E. (2007) Housing *is* the business cycle. *Proceedings of the Jackson Hole Economic Policy Symposium*. Federal Reserve Bank of Kansas City.

Leamer, Edward E. (2009). *Macroeconomic Patterns and Stories*. Berlin: Springer-Verlag.

Leamer, Edward E. (2015). Housing *really is* the business cycle: What survives the lessons from 2008-09? *Journal of Money, Credit, and Banking* 47(1), 43-50.

Mathy, Gabriel. (2016). Stock Volatility, Returns Jumps, and Uncertainty Shocks during the Great Depression. *Financial History Review*, 23(2).

Merton, Robert C. (1987). On the Current State of the Stock Market Rationality Hypothesis. In: R. Dornbusch, S. Fischer and J. Bossons (editors), *Macroeconomics and Finance: Essays in Honor of Franco Modigliani*. Cambridge: MIT Press.

Pagan, Adrian R. and G. William Schwert. (1990). Alternative Models for Conditional Stock Volatility. *Journal of Econometrics* 45, 267-290.

Passarelli, Francesco, and Guido Tabellini (forthcoming). Emotions and political unrest. *Journal of Political Economy*.

Paye, Bradley S. (2012). Déjà vol': Predictive Regressions for Aggregate Stock Market Volatility using Macroeconomic Variables. *Journal of Financial Economics* 106(3), 527–546.

Romer, Christina D. (1990). The Great Crash and the Onset of the Great Depression. *Quarterly Journal of Economics 105*(3), pp.597-624.

Schwert, G. William (1989). Why Does Stock Volatility Change Over Time? *Journal of Finance*, *44*(5), 1115-1153.

Schwert, G. William (1990a). Indexes of US Stock Prices from 1802 to 1987. *Journal of Business*, *63*(3).

Schwert, G. William (1990b). Stock Market Volatility. *Financial Analysts Journal* 46, 23-34.

Schwert, G. William (2013), *Updated Volatility Charts*. Available at G. W. Schwert's website: http://schwert.ssb.rochester.edu/volatility.htm. Access date: August 29, 2016.

Stock, James H., and Mark W. Watson (1993). A procedure for predicting recessions with leading indicators: econometric issues and recent experience. In: Stock, James H. and Mark W. Watson (editors), *Business Cycles, Indicators and Forecasting*. University of Chicago Press, 95-156.

Voth, Hans-Joachim (2002). Stock price volatility and political uncertainty: Evidence from the interwar period. *Centre for Economic Policy Research, CEPR Discussion Paper,* n. 3254.

White, Eugene N. (1990). The Stock Market Boom and Crash of 1929 Revisited. *Journal of Economic Perspectives*, 4(2), 67-83.

White, Eugene N. (2014). Lessons from the Great Real Estate Boom of the 1920s. In: White, Eugene N., Kenneth Snowden, and Price Fishback (editors), *Housing and Mortgage Markets in Historical Perspective*, p.115-158. University of Chicago Press and National Bureau of Economic Research.

Table 1. Summary Statistics

Panel A. *Full Sample (1928:M1–1938:M12)*

Variable	Mean	Median	Std. Dev.	N. Obs.	Min	Max	Percentile, conditional on non-zero 10th	25th	75th	90th
Stock Returns Vol	0.017	0.014	0.009	132	0.005	0.049	0.007	0.010	0.022	0.031
Market Value of Leverage	14.606	12.236	6.155	132	7.648	27.093	9.326	10.222	16.086	25.918
Building Permits Vol	0.037	0.028	0.025	132	0.024	0.193	0.025	0.026	0.038	0.052
Assassinations	0.015	0.000	0.123	132	1	1	1	1	1	1
General Strikes	0.046	0.000	0.244	132	1	2	1	1	1	2
Riots	0.435	0.000	0.745	132	1	3	1	1	2	2
Anti-Government Demonstrations	0.397	0.000	0.883	132	1	6	1	1	2	2
Total Political Events	0.908	0.000	1.267	132	1	8	1	1	2	3

Panel B. *Great Depression Sub-sample (1929:M8–1933:M3)*

Variable	Mean	Median	Std. Dev.	N. Obs.	Min	Max	Percentile, conditional on non-zero 10th	25th	75th	90th
Stock Returns Vol	0.023	0.021	0.011	45	0.007	0.049	0.009	0.013	0.028	0.040
Market Value of Leverage	21.055	25.918	6.052	45	11.830	27.093	11.830	16.086	27.092	27.092
Building Permits Vol	0.033	0.029	0.010	45	0.024	0.083	0.025	0.026	0.036	0.046
Assassinations	0.022	0.000	0.015	45	1	1	1	1	1	1
General Strikes	0.066	0.000	0.252	45	1	1	1	1	1	1
Riots	0.755	1.000	0.933	45	1	3	1	1	2	3
Anti-Government Demonstrations	0.578	0.000	0.965	45	1	5	1	1	2	2
Political Events	1.422	1.000	1.322	45	1	5	1	1	3	3

Table 2. Determinants of Stock Market Volatility, 1928-1938

The *Autoregressive Model* contains 7 lags of stock returns' sample standard deviation. The *Pure Leverage Model* augments the *Autoregressive Model* with 7 lags of *Lev* (Market Leverage). The *Economic Model* adds *Permits Vol* (estimated Volatility of Building Permits' Growth Rate) to the *Pure Leverage Model*. The *Political Model* combines the *Pure Leverage Model* with 7 lags of *Lev* (Market Leverage) and 7 lags of *Politics* (Sum of the following political events that proxy for Political Uncertainty: *Assassinations*, *General Strikes*, *Riots*, and *Anti-Government Demonstrations*). The *Economic-Political Joint Model* adds the variables from the *Economic and Political Models*. All specifications include seasonal monthly dummies. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Dependent Variable: Stock Volatility

Full Sample (1928:M1–1938:M12)

Full Sample (1928:M1-1938:M12)		**[1]** Autoregressive Model	**[2]** Pure Leverage Model	**[3]** Economic Model	**[4]** Political Model	**[5]** Economic-Political Joint Model
Lags of Variable:		$R^2 = 0.60$	$R^2 = 0.68$	$R^2 = 0.73$	$R^2 = 0.69$	$R^2 = 0.74$
Stock Vol	Sum Coefficients	0.843	0.514	0.449	0.519	0.402
(Std. Dev. of Stock Returns)	F-Test Statistic	157.91	40.50	43.51	30.89	36.44
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***
Lev	Sum Coefficients	-	0.001	0.001	0.001	0.001
(Market Leverage)	F-Test Statistic	-	32.72	26.13	32.79	26.50
	p-value	-	0.000**	0.000***	0.000**	0.000***
Permits Vol	Sum Coefficients	-	-	0.088	-	0.111
(Building Permits Growth Volatility)	F-Test Statistic	-	-	30.22	-	24.37
	p-value	-	-	0.000***	-	0.001***
Politics	Sum Coefficients	-	-	-	0.000	0.001
(Sum of Political Conflict Variables)	F-Test Statistic	-	-	-	4.92	3.04
	p-value	-	-	-	0.670	0.882
Seasonal Dummies		YES	YES	YES	YES	YES
N. Observations		132	132	132	132	132

Table 3. Robustness Checks
Dependent Variable: Stock Volatility

Full Sample (1928:M1-1938:M12)		[1]	[2]	[3]	[4]	[5]	[6]
		Retail Sales	Industrial Production	Money (M2) Supply Growth	Inflation (PPI)	AAA-Junk Spread	CP-AAA Spread
Lags of Variable:		$R^2 = 0.76$	$R^2 = 0.75$	$R^2 = 0.74$	$R^2 = 0.74$	$R^2 = 0.75$	$R^2 = 0.74$
Stock Vol	Sum Coefficients	0.458	0.441	0.443	0.360	0.505	0.429
(Std. Dev. of Stock Returns)	F-Test Statistic	32.09	22.16	39.32	33.40	44.29	41.62
	p-value	0.000***	0.002***	0.000***	0.000***	0.000***	0.000***
Lev	Sum Coefficients	0.001	0.001	0.001	0.001	0.001	0.001
(Market Leverage)	F-Test Statistic	27.50	22.16	24.98	23.75	15.32	22.63
	p-value	0.000***	0.002**	0.000***	0.001***	0.032**	0.002***
Permits Vol	Sum Coefficients	0.090	0.117	0.095	0.117	0.112	0.086
(Building Permits	F-Test Statistic	27.54	20.54	24.98	27.42	29.28	22.81
Growth Volatility)	p-value	0.000***	0.004***	0.000***	0.000***	0.000***	0.002***
Retail Sales Vol	Sum Coefficients	0.000	-	-	-	-	-
(Retail Sales Volatility)	F-Test Statistic	10.19	-	-	-	-	-
	p-value	0.178	-	-	-	-	-
IP Vol	Sum Coefficients	-	-0.020	-	-	-	-
(Industrial Production	F-Test Statistic	-	6.00	-	-	-	-
Volatility)	p-value	-	0.540	-	-	-	-
M2 Vol	Sum Coefficients	-	-	-0.834	-	-	-
(Money Supply Growth Volatility)	F-Test Statistic	-	-	4.74	-	-	-
	p-value	-	-	0.692	-	-	-
PPI Vol	Sum Coefficients	-	-	-	0.004	-	-
(Inflation Volatility)	F-Test Statistic	-	-	-	4.67	-	-
	p-value	-	-	-	0.699	-	-
AAA-Junk Spread Vol	Sum Coefficients	-	-	-	-	0.000	-
(AAA Corporate Bond vs. Junk	F-Test Statistic	-	-	-	-	9.74	-
Bond Spread Volatility)	p-value	-	-	-	-	0.204	-
CP-AAA Corporate Spread Vol	Sum Coefficients	-	-	-	-	-	0.000
(Prime Commercial Paper vs. AAA	F-Test Statistic	-	-	-	-	-	3.36
Corporate Bond Spread Volatility)	p-value	-	-	-	-	-	0.850
Seasonal Dummies		YES	YES	YES	YES	YES	YES
N. Observations		132	132	132	132	132	132

Table 4. Determinants of Stock Market Volatility during the Great Depression

The *Autoregressive Model* contains 7 lags of stock returns' sample standard deviation. The *Pure Leverage Model* augments the *Autoregressive Model* with 7 lags of *Lev* (Market Leverage). The *Economic Model* adds *Permits Vol* (estimated Volatility of Building Permits' Growth Rate) to the *Pure Leverage Model*. The *Political Model* combines the *Pure Leverage Model* with 7 lags of *Lev* (Market Leverage) and 7 lags of *Politics* (Sum of events proxying Political Uncertainty: *Assassinations*, *General Strikes*, *Riots*, and *Anti-Government Demonstrations*). The *Political-Economic Joint Model* adds the variables from the *Economic and Political Models*. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Dependent Variable: Stock Volatility

Great Depression: NBER Recession Date Sub-sample (1929:M8–1933:M3)

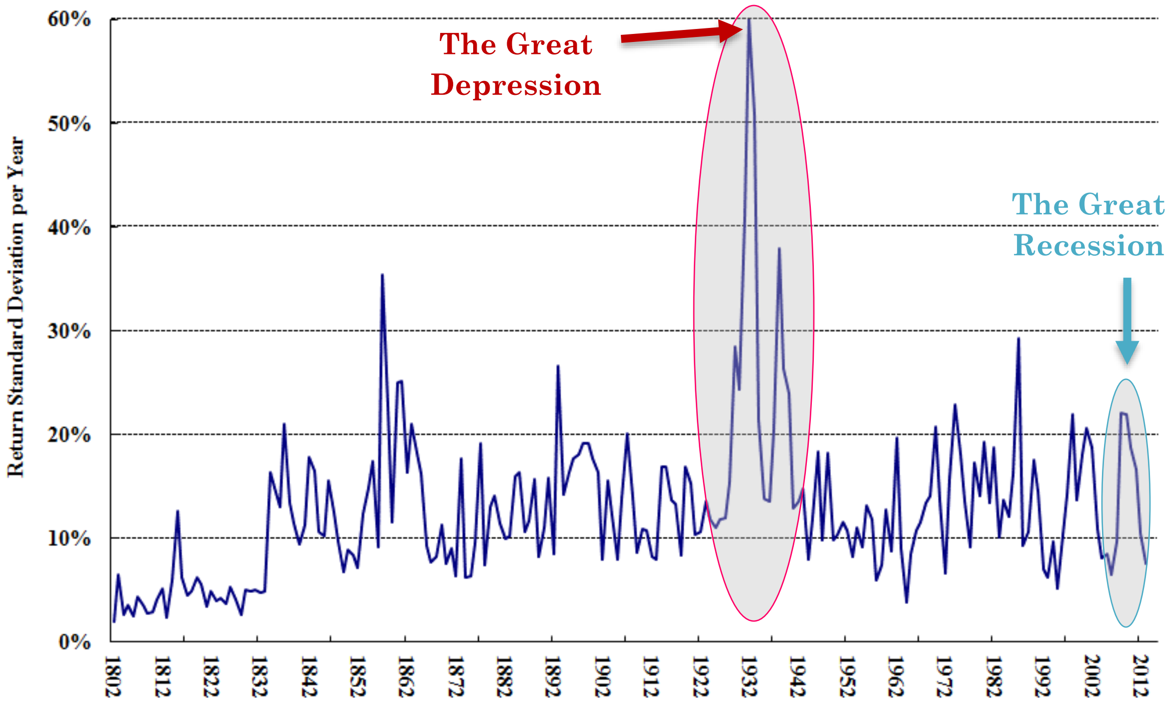
Great Depression Subsample (1929:M8-1933:M3)		**[1]** Autoregressive Model	**[2]** Pure Leverage Model	**[3]** Economic Model	**[4]** Political Model	**[5]** Economic-Political Joint Model
Lags of Variable:		$R^2 = 0.42$	$R^2 = 0.63$	$R^2 = 0.85$	$R^2 = 0.69$	$R^2 = 0.88$
Stock Vol	Sum Coefficients	0.683	0.049	-0.649	0.035	-0.717
(Std. Dev. of Stock Returns)	F-Test Statistic	34.36	38.20	23.80	15.89	28.53
	p-value	0.000***	0.000***	0.001***	0.026**	0.000***
Lev	Sum Coefficients	-	0.001	0.002	0.000	0.002
(Market Leverage)	F-Test Statistic	-	230.81	90.27	16.36	37.92
	p-value	-	0.000**	0.000***	0.022**	0.000**
Permits Vol	Sum Coefficients	-	-	0.688	-	0.767
(Building Permits Growth Volatility)	F-Test Statistic	-	-	30.08	-	21.90
	p-value	-	-	0.000***	-	0.003***
Politics	Sum Coefficients	-	-	-	0.007	0.000
(Sum of Political Conflict Variables)	F-Test Statistic	-	-	-	4.50	4.28
	p-value	-	-	-	0.721	0.747
Seasonal Dummies		NO	NO	NO	NO	NO
N. Observations		44	44	44	44	44

Table 5. The Determinants of the Volatility of the Growth Rate of Building Permits

The *Autoregressive Model* contains 7 lags of Building Permits' Growth Volatility (*Permits Vol*). Each additional specification augments the Autoregressive model with one variable of interest. (1) *Real Model* (retail sales volatility); (2) *Monetary Model* (money growth volatility); and the (3) *Credit Model* (AAA Corporate Bond-Junk Bond Spread; Prime Commercial Paper-AAA Corporate Bond Spread). See Section III.C for details. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Full Sample (1928:M1-1938:M12)		**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
		Autoregressive Model	Real Model	Monetary Model	Credit Model 1	Credit Model 2	All Channels
Lags of Variable:		$R^2 = 0.24$	$R^2 = 0.27$	$R^2 = 0.27$	$R^2 = 0.26$	$R^2 = 0.29$	$R^2 = 0.37$
Permits Vol	Sum Coefficients	0.434	0.449	0.450	0.414	0.442	0.432
(Building Permits	F-Test Statistic	12.02	10.18	13.28	10.58	15.40	10.36
Growth Volatility)	p-value	0.100*	0.178	0.065*	0.158	0.031**	0.169
Retail Sales Vol	Sum Coefficients	-	0.002	-	-	-	0.002
(Retail Sales Volatility)	F-Test Statistic	-	5.01	-	-	-	6.11
	p-value	-	0.659	-	-	-	0.526
Money Growth Vol	Sum Coefficients	-	-	0.563	-	-	0.574
(Monetary Aggregate	F-Test Statistic	-	-	11.19	-	-	5.38
Growth Volatility)	p-value	-	-	0.131	-	-	0.614
AAA-Junk Spread	Sum Coefficients	-	-	-	0.000	-	0.000
(AAA Corporate Bond	F-Test Statistic	-	-	-	2.72	-	4.74
vs. Junk Bond Spread)	p-value	-	-	-	0.909	-	0.692
CP-AAA Spread	Sum Coefficients	-	-	-	-	0.000	0.000
(Prime Commercial Paper	F-Test Statistic	-	-	-	-	8.38	10.90
vs. AAA Corporate Spread)	p-value	-	-	-	-	0.300	0.143
Seasonal Dummies		YES	YES	YES	YES	YES	YES
N. Observations		132	132	132	132	132	132

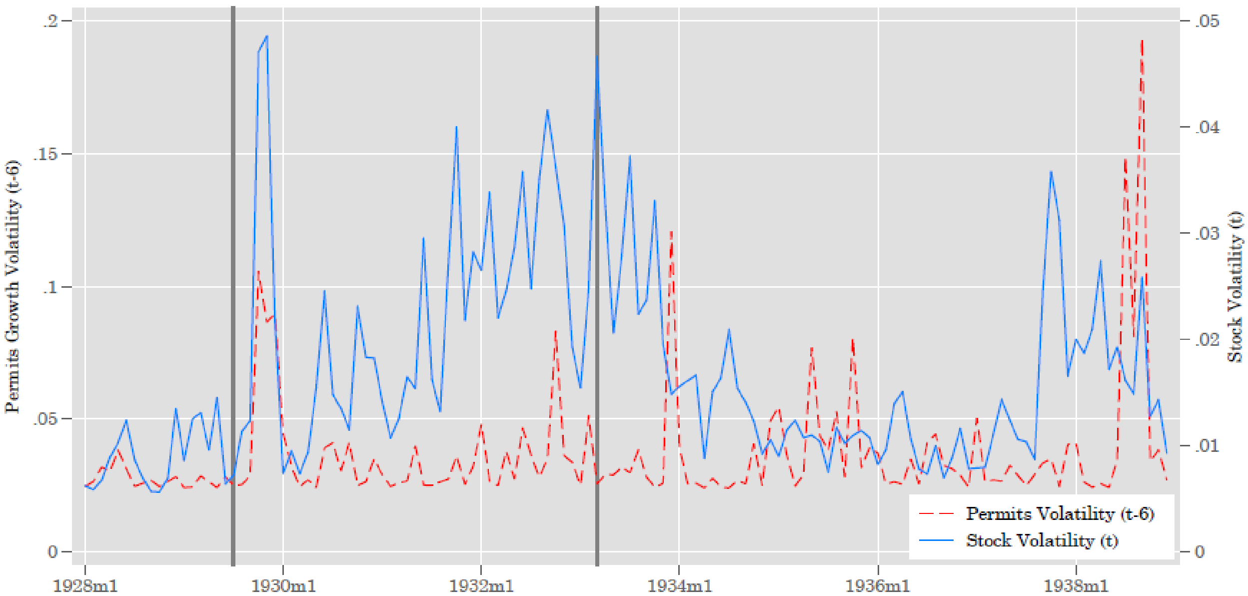
Figure 1. Annualized Standard Deviations of US Stock Returns, 1802-2013



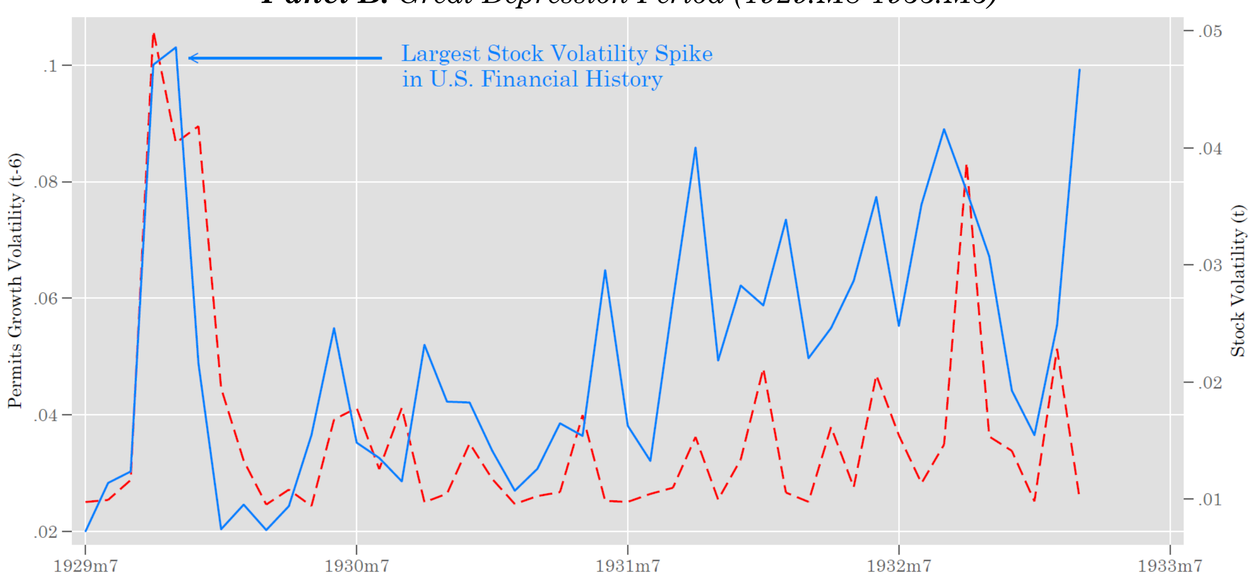
Notes: The figure shows the time series of annualized stock returns volatility calculated from monthly data. The two highlighted periods are the Great Depression of 1929-1933 and the Great Recession of 2008-2010. Data are taken from the website G. William Schwert and available in http://schwert.ssb.rochester.edu/volatility.htm.

Figure 2. Volatility of Stock Market Returns and the Volatility of the Sixth Lag of the Growth Rate in Building Permits

Panel A. *Full Sample (1928:M1-1938:M12)*



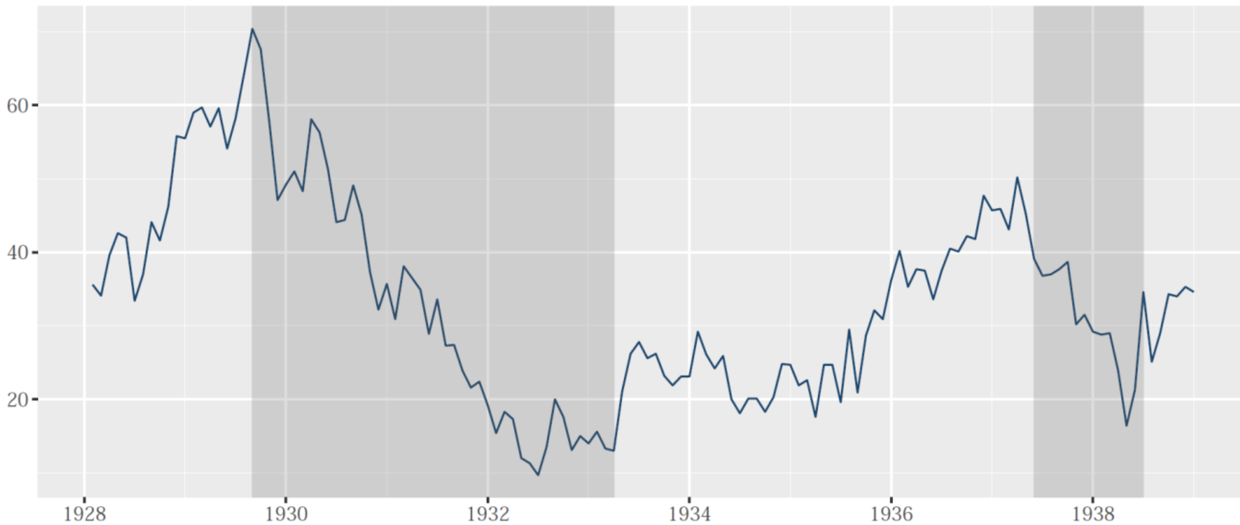
Panel B. *Great Depression Period (1929:M8-1933:M3)*



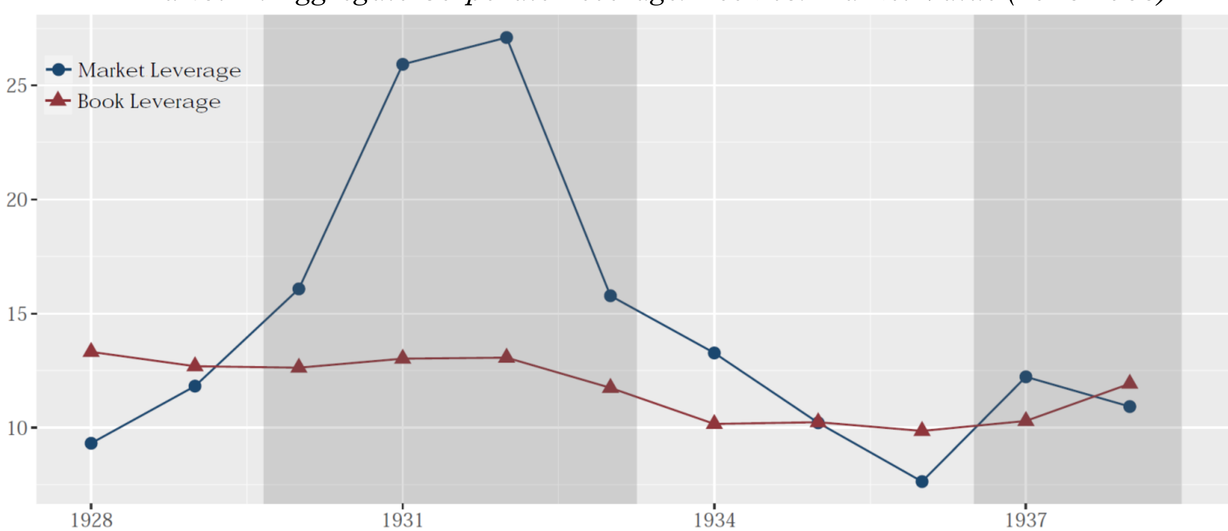
Notes: The figures show the volatility of the growth rate of building permits (lagged) and stock volatility. We lag the volatility of building permits by six months to show the high correlation between the two series in the Great Depression. The two vertical lines in **Panel A** mark the start and the end of the Great Depression as defined by the NBER. **Panel B** shows just the Great Depression period to illustrate the high correlation between the volatility of building permits and stock volatility.

Figure 3. Book Measures vs. Market Measures of Aggregate Corporate Leverage (1928-1938)

Panel A. *Aggregate Market Value of Equity (1928M1-1938:M12)*

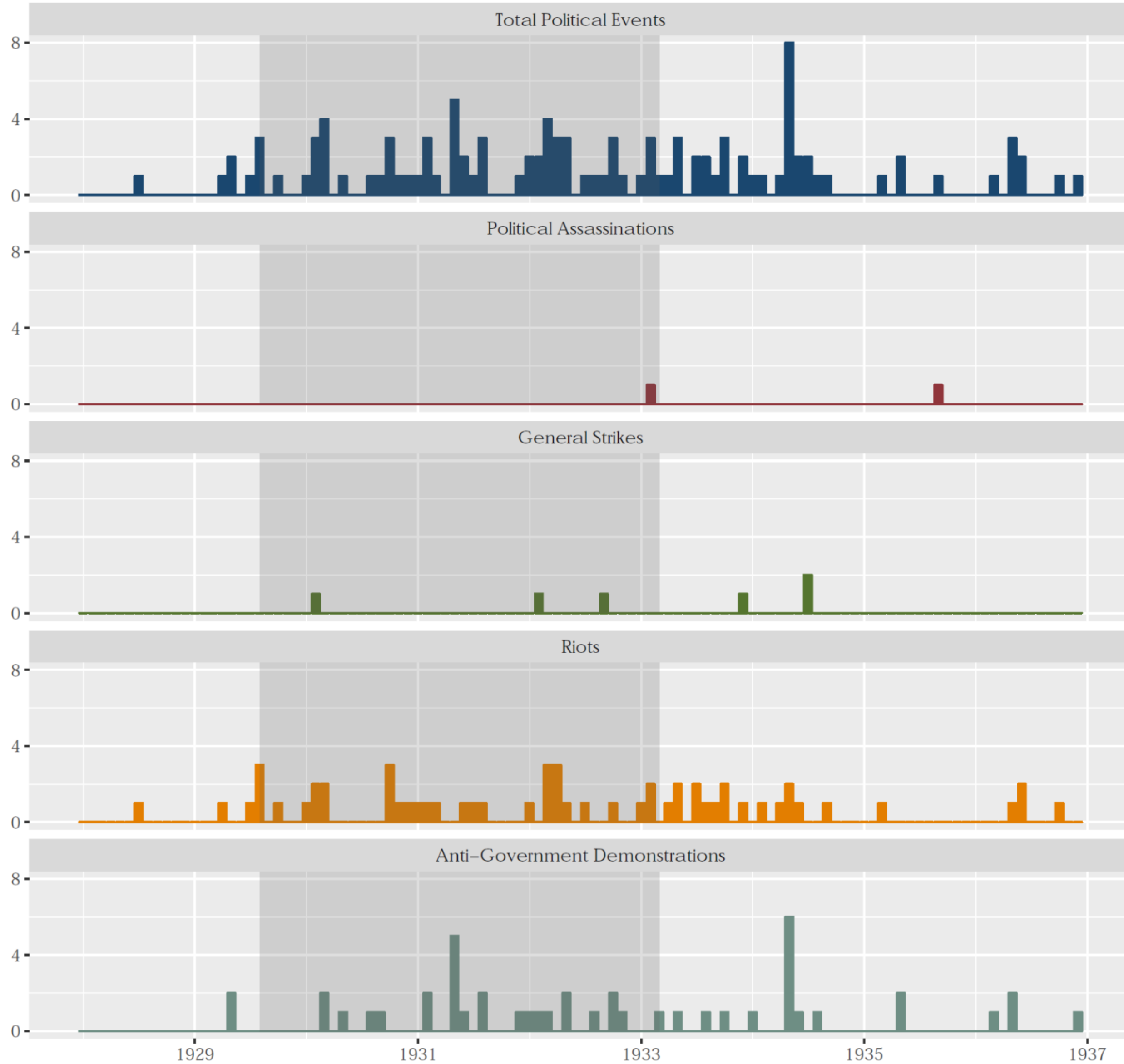


Panel B. *Aggregate Corporate Leverage: Book vs. Market Value (1928-1938)*



Notes: The darker shaded area in both graphs represents the Great Depression as defined by the NBER. In Panel A, the *Aggregate Market Value of Equity* (in Million USD) is the sum of market values for all CRSP Securities, where the market value is calculated as the product of the outstanding number of shares and the price of each security. In Panel B, the *Market Value of Leverage* is defined as *Debt / (Debt + Market Value of Equity)* and the *Book Value of Leverage* is defined as *(Total Debt / Total Assets)*. Both measures of corporate leverage are taken from Graham, Leary, and Roberts (2015).

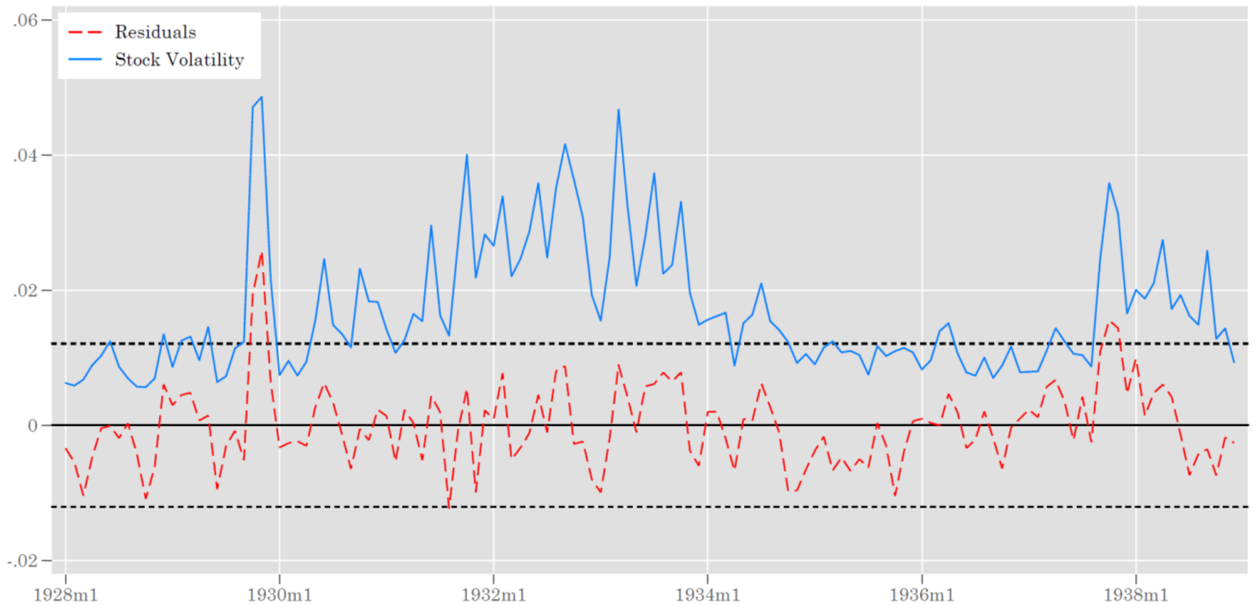
Figure 4. Monthly Frequency of Important Political Events, 1928:M1-1938:M12



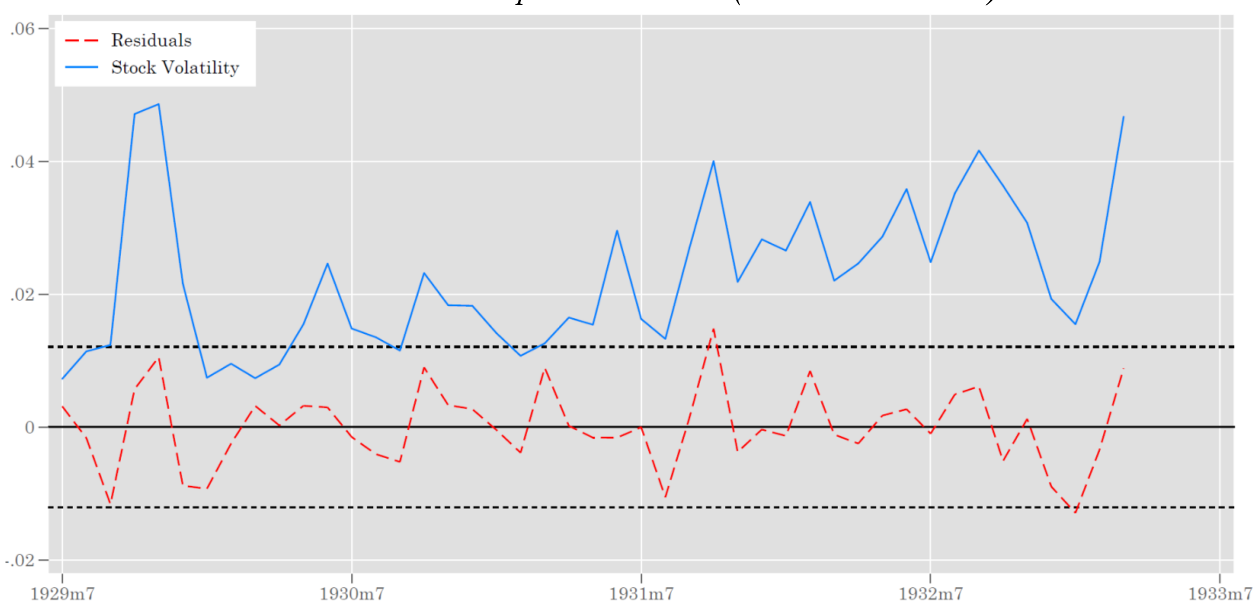
Notes: The shaded areas in all graphs represent recession periods as defined by the NBER. The first darker shaded area is the Great Depression. Data Appendix A.1 describes in detail how each type of event is defined according to Banks' (1976) methodology.

Figure 5. Residuals of Stock Volatility Regressions

Panel A. *Full Sample (1928:M1-1938:M12)*

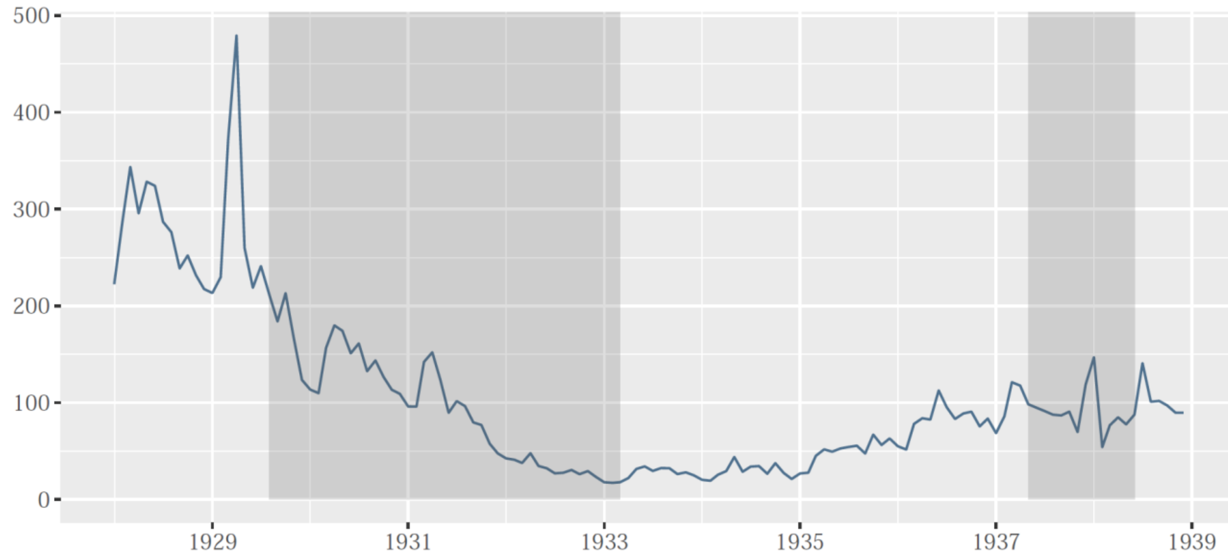


Panel B. *Great Depression Period (1929:M8-1933:M3)*



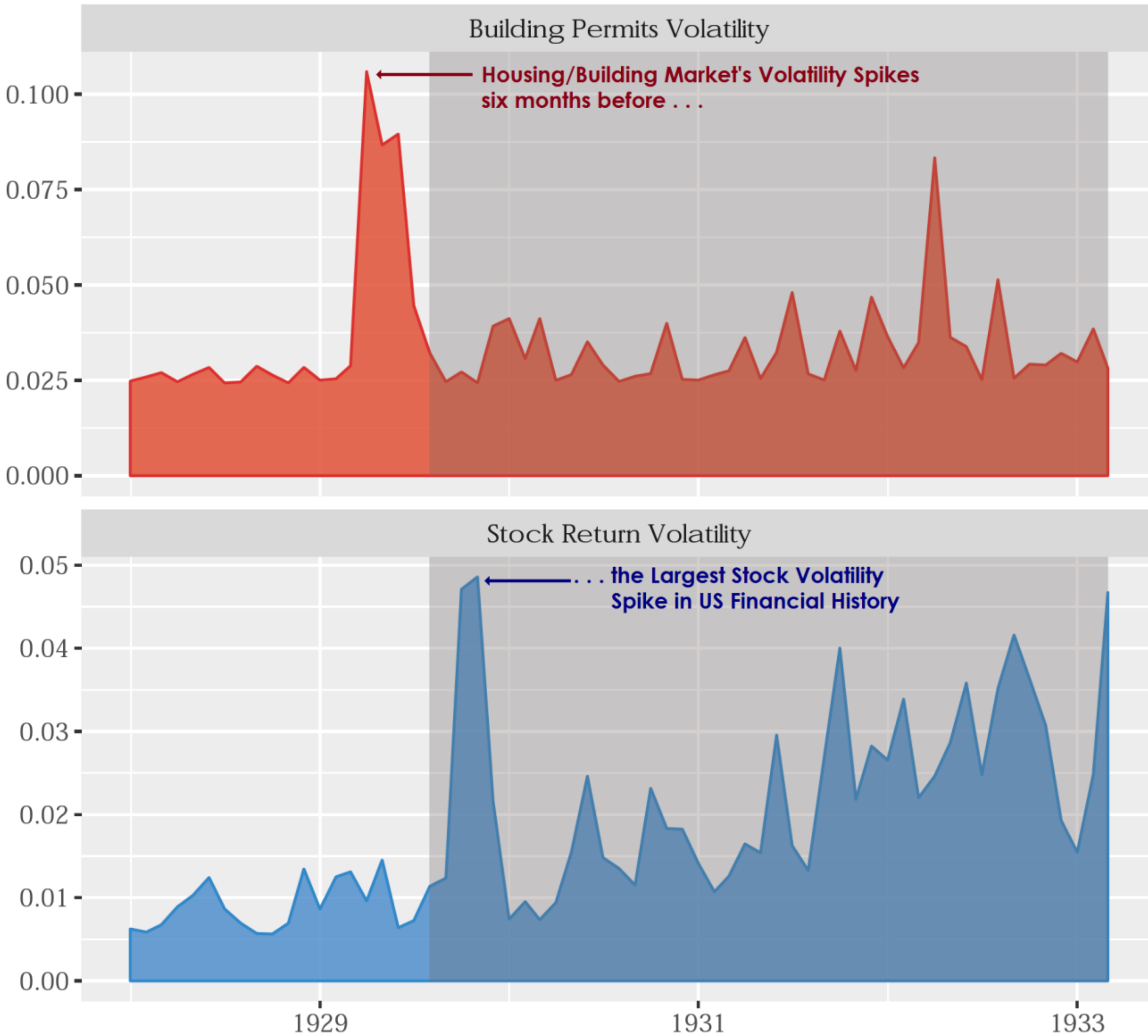
Notes: The figures show the original time series of stock volatility (continuous blue line) and stock volatility regression residuals (dashed red line) after controlling for two variables: financial leverage (*Lev*) and the volatility of the growth rate of building permits (*Permits Vol*). The residuals in **Panel A** are constructed from a regression of stock volatility on financial leverage, the volatility of the growth rate of building permits, and a set of seasonal monthly dummies. The residuals shown in **Panel B** are calculated from a regression of stock volatility on financial leverage and the volatility of the growth rate of building permits during the Great Depression as defined by the NBER.

Figure 6. Aggregate Building Permits in the United States (1928:M1-1938:M12)



Notes: The first darker shaded area represents the period of the Great Depression as defined by the NBER. The largest spike registered in the building permits time series is in April 1929, six months before the Great Crash of 1929. The data on building permits are taken from various issues of *Dun & Bradstreet's Review*.

Figure 7. The Volatility of Building Permits Leads the Stock Market Crash of 1929



Notes: The sample period in both figures is from January 1928 to March 1933 to highlight the behavior of both series around the Great Depression (shaded area). The data on building permits are taken from various issues of *Dun & Bradstreet's Review*. The stock data are taken from CRSP. Stock volatility is obtained by calculating the monthly standard deviation from daily stock returns. The volatility of the growth rate of building permits is estimated using a standard GARCH(1,1) model as described in the data section.

Appendix A. Data Sources

A.1. Political Uncertainty Data: Monthly Reconstruction of the Banks (1976) Dataset

We construct a US-monthly version of the classical *Cross-Polity Time-Series* annual dataset originally collected by Banks (1976) for more than 160 countries. The data set is widely used in political science, economics, as well as other social sciences. The *Cross-Polity Times Series* is currently updated every year by Databanks International.[20] We used Banks' (1976) original sources to convert his annual database into a monthly measure for the following types of political events: anti-government demonstrations, assassinations, general strikes, and riots. Specifically, we primarily relied on the search engine for the *New York Times* to pinpoint the monthly date of anti-government demonstrations, assassinations, general strikes and riots.

A.2. Housing Data: US Aggregate and City-Level Building Permits Value

Data are taken from various issues of the *Bradstreet & Dun's Review*. The aggregated series is the sum of city-level data. The index is based on a consistent set of 215 cities for period 1928-1938.

A.3. Stock Exchange Volatility Data

We follow Schwert (1989, 1990a) and calculate stock volatility as the sample standard deviation of the S&P index returns aggregated monthly from daily data.

A.4. Market Value of Corporate Leverage Data

The market value of leverage is taken from Graham, Leary, and Roberts (2015). Their market value of leverage is calculated as (*Debt / Debt + Market Equity*) for non-financial firms. We transform their data from annual to monthly for the period 1920:M1-1938:M12 by linear interpolation.

A.5. Macroeconomic Time Series

All aggregate time series used in our analysis were downloaded from Federal Reserve Bank of St. Louis's (FRED) data base.

[20] The current version of the data is available for purchase at www.cntsdata.com for a larger time and geographic span.