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"Does Financial Regulation Matter? Market Volatility and the US 1933/34 Acts"

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*presenting

Does Financial Regulation Matter?

Market Volatility and the US 1933/34 Acts[1]

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Abstract

The impact of the US 1933/34 Acts, the first national financial regulation acts in the world, on financial markets have been under debates since Stigler (1964). Major findings in the literature is that financial regulation enacted by these laws is at best being ineffective to improve financial markets until some recent studies imply indirectly that they could be effective. By studying daily returns of NYSE data from 1890 to 1970, this paper provides systematic evidence that the 1933/34 Acts have substantially reduced market volatilities after controlling for Great Depression effect and macroeconomic variables. Moreover, we show that even when we treat the existence and the date of the volatility changes as unknown, statistically identified structural changes are fully consistent with the above results that the volatility reduction time coincide with the enacting of the Acts.

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"whether SEC enforced disclosure rules actually improve the quality of information ... remains a subject of debate among research almost 70 years after the SEC's creation."

– Economic Report of the President of the U.S.A., 2003

1 Introduction

The US Securities Act of 1933 and the Federal Securities Exchange Act of 1934 are the most important laws on financial regulation. In addition to the fact that they are the first national laws on financial regulation in the world, the later also created the SEC (Securities and Exchange Commission), the first state financial market regulator in the world. The regulatory response, Sarbanes-Oxley Law (2002), to recent corporate scandals (e.g. Enron and Worldcom etc.) has been to focus once again on the same principle of the two Acts, i.e. mandatory disclosure. Moreover, all other countries' financial regulators in the world take the two Acts and the SEC as a model. However, the debate on the impact of financial regulation in general, the role of the 1933/34 Acts in particular, still remains unsettled.

Before 1933, there were no legal requirements on information disclosure in financial markets. Disclosure of financial results was voluntary. Firms could customize their balance sheet and income statement disclosure; elect whether or not to have statements audited. In fact, about half of all firms traded in the NYSE disclosed sales and cost of goods, and about 90% of firms disclosed depreciation, current assets and current liabilities (Benston, 1973). The NYSE enforced self regulation since the late 1920's that all newly-listing firms should provide an audited balance sheet, income statement. However, currently trading firms were exempted (Mahoney, 1997). After rapid expansions of the markets in the 1920s, there was an unprecedented market crash in 1929. Evidence provided in Congressional hearings in the aftermath of the 1929 crash convinced the lawmakers that the cause of the crash was large scale financial frauds. State officials estimated that financial frauds caused about US$ 25 bln losses to the investors (Seligman, 1983). As direct reactions to the unprecedented financial frauds and the market crash, the Securities Act was passed and became effective on May 27, 1933. It required all new issues sold to the public on or after July 27, 1933 to file a disclosure document. Then the Securities Exchange Act was passed and enacted in August 1934, which requires all public companies to fully disclose financial information. The SEC, created by this Act,

is the administering agency for both Acts.

According to the lawmakers financial market regulation codified by the two Acts is necessary since without a state regulation "during 1929 the prices of ... stocks on the New York Stock Exchange were subject to manipulation ..." Thus, "no one could be sure that market prices for securities bore any reasonable relation to intrinsic values ..." (SEC, 1959). However, how to evaluate the impacts of the Acts has been under debates.

In a pioneering work Stigler (1964) studied stock returns before and after the implementation of the Acts. Stigler compared how well investors fared before and after the SEC was given power to enforce mandatory disclosure for new issues. He examined the five-year price history of all new industrial stocks introduced in the 1923-1928 period and of all new industrial stocks introduced in the 1949-1955 period. To eliminate the effects of general market conditions, Stigler measured stock prices relative to market averages. He finds that there was no significant difference before and after the introduction of the SEC. In both periods the stock of newly issued shares declined substantially in the years following the IPO relative to the average market price. Thus, he concludes that the SEC's mandatory new issue disclosure requirements had no material effect. Similarly, Benston (1973) investigates whether firms' stock prices improved when they were required to disclose financial data. Benston compared the annual stock price returns of disclosers, which are firms that voluntarily disclosed data with the returns of non-disclosers, which are firms that disclosed only when required by the new law. He finds that non-disclosers did not perform better with the enactment of the Act. Thus, he concludes that "the disclosure requirements of the Securities Exchange Act of 1934 had no measurable positive effect on the securities traded on the NYSE. There appears to have been little basis for the legislation and no evidence that it was needed or desirable. Certainly there is doubt that more required disclosure is warranted." Similarly, Jarrell (1981) and Simon (1989) also report that mean returns were not changed by regulation.

Officer (1973) examines the impacts of the 1933/34 Acts on stock market volatility. He constructs a time series on stock market volatility going back to the 1890's by using the rolling 12-month standard deviation of stock market returns. He reports "a return to normal levels of variability after the abnormally high levels of the 1930's" and asserts that there was no any significant impact of the Acts. However, There are serious methodological drawbacks in Officer (1973). First, the rolling 12-month standard deviation is a poor measure for stock market volatility, which has been pointed out by a huge literature. Second, the effect of the Acts on stock market volatility was not directly

tested. The assertion was based on a study on the relationship between stock market volatility and macroeconomic variables but no joint test was conducted on the effect of both regulation and macroeconomic variables on stock market volatility.

Recently, Daines and Jones (2005) test whether bid-ask spreads fall in short run after the passage of the 1934 Exchange Act. Bid-ask spreads are used as a proxy for information asymmetries because they reflect the risk that market makers will lose money when trading against informed parties. Little evidence is found that changes in bid-ask spreads are associated with mandatory disclosure law. Using similar approaches, Mahoney and Mei (2005) study the impact of the Acts on bid-ask spreads over a further shorter period 1935-1937. They also find no evidence that the new disclosures required by the securities laws reduced bid-ask spreads.

In contrast to the overwhelming 'negative' results in studying direct impacts of the 1933/34 Acts, some recent literature provides indirect or general evidence suggests strong positive impacts of state regulation on short run performance or long run development of financial markets. By investigating the effect of The 1964 Securities Acts Amendments, which extended several disclosure requirements to large firms traded over-the-counter (OTC), Greestone et al. (2005) discover that the Amendments improved short run returns of the OTC firms. Glaeser et al. (2001) find that with more rigorous state regulation Poland had a substantially better financial development than that in the Czek Republic. Evidence discovered from cross country studies by La Port et al. (1998, 2006) and Djankov et al (2006) suggest that mandatory information disclosure supports financial market development. However, there is still no agreement in the literature on the impact of the world's first state financial regulation laws on financial markets.

By using daily return data of the NYSE from 1885 to 1970, this paper provides evidence that the 1933/34 Acts have substantially reduced stock market volatilities both in short run and in long run after controlling for Great Depression effect and macroeconomic variables. To our knowledge, this is the first direct systematic evidence that shows strong positive impacts of these Acts on reducing financial market risks. Most previous studies on direct impacts of the Acts are focused on short period around the passage of the Acts. In contrast, both short run and long run impacts of the Acts are investigated in this paper. Moreover, to further confirm the volatility reduction was indeed caused by the Acts, we examine whether the date of structural break in the mean level of stock market volatility correspondents to the passage date of the Acts by using multiple structural break test methods.

As a first step of our investigation, we estimate the monthly volatility of the stock market. We overcome the methodological drawbacks employed in the literature (e.g. Officer, 1973) by applying realized volatility measure. We use squared daily returns to construct an ex post measurement for the monthly volatility of stock market returns from February 1885 through December 1970. We then investigate the effects of two Acts on stock market volatility in both short and long run using multiple regressions. In the regression for short run 1932-1936, we introduce two dummy variables corresponding to the enforcement dates of the 1933 and 1934 Acts respectively. We regress stock market volatility on these two dummy variables and other control variables such as inflation, money growth and industrial production. We find that the mean level of stock market volatility fell about 20% after July 1933 and reduced further 30% following the enforcement of the 1934 Act. In long run, we define two periods, "pre-regulation" period: 1890-1933, and "post-regulation" period: 1934-1970. To control for Great Depression effect, we also introduce dummy variable equal to unity during the Great Depression period 1929-1939. The other control variables are the same as in short run. We find that the general level of stock market volatility fell around 15% during post-regulation period 1935 to 1960 even when control for Great Depression effect and macroeconomic variables. To investigate the robustness of our regression results, we compare the effects of SEC regulation for different time spans. Overall, different sample periods lead to quantitatively similar regression results. This suggests that the enforcement of 1933 Securities Acts and 1934 Exchange Act is associated with the reduction in the mean level of stock market volatility in both short and long run.

Although we have statistically significant regression results, still the impacts of the Acts might take place at an unknown point in time, or slowly. Moreover, there are possibilities that results from regression models with imposed dummy variables may capture things other than the impacts of the Acts. That is, we should address the following questions to make our evidence more convincing. Are there other reasons than the Acts that drives the reduction of market volatility? Are the 'regulation' dummy variables defined artificially in favor of the Acts?

To address those questions we test for multiple structural breaks in the mean levels of the stock volatility by adopting the methodology developed by Bai and Perron (1998). In this approach, the number of break points and their location are treated as unknown. By using the Bai and Perron algorithm we identified the breakpoints in the time series of stock market volatility. The statistically identified dates of the breaks are amazingly consistent with the commencement of the

Acts with a fairly high precision! In short run, the break dates are estimated at 10/1933 and 10/1934 with 95% confidence interval [08/1933,02/1934] and [07/1934,01/1935] respectively. Two breakpoints break the time series of stock market volatility into three regimes: mean volatility fell substantially from regime 1 (01/1932-10/1933) to regime 2 (11/1933–10/1934), and then fell further during regime 3 (11/1934-12/1936). In long run, the estimated break date is 08/1934 with 95% confidence interval [09/1926,09/1941]. Mean volatility fell substantially from regime 1 (01/1890-07/1934) to regime 2 (08/1934–12/1970). To examine the robustness of the results, we also conduct the structural break test results for different sample periods. Comparing the dates when the Acts became effective with the confidence intervals of the empirically estimated break dates, we find that in short run the first break point corresponds with the enactment of Securities Act in May 1933, and the second break point corresponds with the enactment of Exchange Act in June 1934. In long run, both dates of the enactment of two Acts fall inside the confidence interval for the empirical identified break point. In summary, the 'coincidence' between the identified structural break points and the date of enacting SEC regulation further confirms that financial regulation reduces stock market volatility.

The rest of the paper is organized as follows. Section 2 presents regression results on both short and long run. Section 3 reports structural break test results. Section 4 extensions. Section 5 concludes.

2 Empirical analysis

Our goal is to examine the effect of the introduction of SEC regulation on the level of stock market volatility. It is well known now that stock market volatility varies over time and what drives volatility has long been the subject of both theoretical and empirical research in macro economics and in financial economics. Schwert (1989) find stock market volatility is related to macroeconomic variables but these variables only explain a small part of the movements in stock market volatility. A number of empirical studies (see, e.g., Brandt and Kang, 2004) have further confirmed Schwert (1989) and find that stock market volatility in the US is higher in bad times than in good times. Beltratti and Morana (2004) study the relationship between macroeconomic and stock market volatility, using S&P500 data for the period 1970-2001. They find that stock market volatility are associated in a causal way with macroeconomic volatility shocks, particularly to output growth

volatility. Previous studies also document that there is a positive relationship between volatility and trading volume. Karpoff (1987) offers a comprehensive survey on the relation between volatility and trading volume. Wang (1994) builds a model which examines the link between the nature of heterogeneity among investors and the behavior of trading volume and its relation to price dynamics. His model shows that volume is positively correlated with absolute price changes. Gallant, Rossi, and Tauchen (1992) also find a positive correlation between conditional volatility and volume.

In this paper, in order to disentangle the effect of SEC regulation on stock market volatility, we control all macroeconomic variables and trading volume that have been studied in the literature for stock market volatility. Moreover, the formation of SEC regulation was a one-time event coinciding with many other economic events. The period 1923-1939 corresponds to what was the most server boom-to-bust financial cycle in modern history. Schwert (1989) find that stock market volatility during Great Depression period from 1929 to 1939 was unusually high compared with either prior or subsequent period. This adds extra difficulties to separating the effect of SEC regulation on stock market volatility from other economic events.

2.1 Volatility measurement

The purpose of this paper is to describe historical movements in volatility and examine the impact of financial regulation on volatility, therefore we follow the approach of French, Schwert and Stambaugh (1987) and Schwert (1989).[4] We use squared daily returns to construct an ex post measurement for the monthly standard deviation of stock market returns from February 1885 through December 2005. The estimate of the monthly standard deviation is

$$\sigma_t = \left\{ \sum_{i=1}^{N_t} r_{it}^2 \right\}^{1/2} \tag{1}$$

where r_{it} is the stock market return on day i in month t (after subtracting the sample mean for the month) and there are N_t trading days in month t.

[4] How to estimate inherently unobservable stock market volatility has been one of the most active areas of research in empirical finance and time series econometrics during the past decade. Increasingly sophisticated statistical models have been proposed to capture the time variation in volatility. Parametric ARCH or stochastic volatility (SV) models are some of the examples. See Bollerslevet al. (1992) and Ghysels et al. (1996) for literature surveys. In ARCH models, the conditional variance of returns depends deterministically both on lagged squared returns and lagged variances, while in SV models the conditional variance is a stochastic process.

This realized volatility estimator has several advantages over the rolling 12-month standard deviation used by Officer (1973), which attempted to addresses similar questions as this paper. First, the accuracy of the standard deviation estimate for any month is improved because more return observations are used. Second, our monthly standard deviation estimates use non-overlapping samples of returns, whereas adjacent rolling twelve-month estimators used by Officer (1973) induce artificial smoothness. Moreover, realized volatility computed from high-frequency intraperiod returns, such as that described in equation (1), is an unbiased and effectively error-free measure of return volatility (Andersen et al., 2003).

Figure 1 plots the monthly estimates of standard deviation of stock returns over sample period 1885-1970. Summary statistics are reported in Table 1. To provide a intuitive feel on how volatility changes before and after SEC regulation, we also report summary statistics of monthly estimates of stock market volatility over different subsample periods. As we can see from Table 1, while comparing the period 1890 to 1933 with 1934 to 1970, not only did the mean level of stock market volatility reduce 25% but also the volatility of volatility reduced around 30%. The volatilities exhibit a substantial degree of positive skewness and a very large excess kurtosis.

Macroeconomic data are only available at monthly frequency. To estimate macroeconomic volatility from monthly data, we estimate a 12th-order autoregression for the returns, including dummy variables D_{jt} to allow for different monthly mean returns, using all data available for the series,

$$R_t = \sum_{j=1}^{12} \alpha_j D_{jt} + \sum_{i=1}^{12} \beta_i R_{t-i} + \epsilon_t \tag{2}$$

We then use absolute value of the residuals as the estimators of volatility. This method is a generalization of the 12-month rolling standard deviation estimator used by officer (1973), Fama (1976), Merton (1980). Summary statistics of macroeconomic variables are reported in Table 1.

2.2 Data sources

The daily stock market return series from January 1926 to December 1970, consists of returns on the value-weighted portfolio of NYSE stocks, are obtained from the Center for Research in Security Prices (CRSP). Returns before 1926 are taken from Schwert (1989 a), who uses a comparable estimator based on the daily returns of the Dow Jones composite portfolio. From 1885 to 1926, the Dow Jones returns are the only widely available daily series. From 1885 to 1896, Dow Jones

reported one index that was dominated by railroad stocks. After 1897, they report separate indexes for transportation and industrial stocks. Schwert combines these indexes to create a composite index weighting each subindex in proportion to the number of stocks in each portfolio. Schwert also made an adjustment for daily dividend yields to this daily return series. Therefore, this daily return series created by Schwert is very close to the CRSP value-weighted portfolio returns. For more details, please see Schwert (1990).

The inflation rates for 1857-1889 are from the Warren and Pearson (1993) index of producer prices; for the period of 1890-1970 are from the Bureau of Labor Statistic' Producer Price Index (PPI).

Concerning industrial production, for the period of 1889-1918, the data are Babson's Index of the physical volume of business activity from Moore (1961); for the period of 1919-1970, the data are the index of industrial production from the Federal Reserve Board.

Regarding the money supply data, the 1907-1960 data are from Friedman and Schwartz (1963); whereas the 1961-1970 data are seasonally adjusted monetary base reported by the Federal Reserve Board.

Finally, trading volume data are from Standard & Poor's (1986, p.214) report which provides monthly NYSE share trading volume for 1883-1985. Citibase (1978) contains similar data for 1986-1987. These data were kindly provided by William Schwert.

2.3 Regressions in short run and long run

So far direct evidence on the impacts of the 1933/34 Acts on financial market performance in the literature is insignificant at the best. All the existing studies in the literature focus on short-run effects of two Acts. However, series recent findings from cross country studies by La Porta et al. (1998, 2006) and Djankov et al. (2006) imply that mandatory disclosure improved efficiency of securities markets in long run. Moreover, the theory of Xu and Pistor (2006) implies that the enforcement of two Acts and the introduction of SEC regulation should have fundamental impacts on financial markets, hence it could have both short run and long-run effects on stock market volatility. Our empirical work intends to fill in the gap by investigating the effects of two Acts on stock market volatility in both short and long run.

In short run, corresponding to the dates when the two acts were enacted, the period between 1932 and 1936 is divided into three sub-periods: January 1932 to July 1933 (pre the 1933 Act),

August 1933 to June 1934 (post the 1933 Act, pre the 1934 Act), July 1934 to December 1936 (post the 1934 Act). In order to examine whether the enforcement of the two Acts is associated with the reduction on the mean level of stock market volatility during these different periods, our regression is:

$$\ln \sigma_{st} = \alpha + \beta_1 R_{1t} + \beta_2 R_{2t} + \gamma_1 \ln |\epsilon_{pt}| + \gamma_2 \ln |\varepsilon_{mt}| + \gamma_3 \ln |\epsilon_{it}| + \gamma_4 \ln \sigma_{st-1} + u_t \ . \tag{3}$$

Where we introduce the dummy variable R_{1t} corresponding to the enforcement of 1933 Act, R_{1t} equals to zero before July, 1933[5], one otherwise. R_{2t} corresponding to the enforcement of the 1934 Act, equal to zero before June, 1934, one otherwise. Under null hypothesis, the enforcement of two Acts has no impact on the level of stock market volatility, $\beta_1 = \beta_2 = 0$. To control for other factors affecting stock market volatility, we include in the regression the logarithms of the predicted standard deviations of PPI inflation, of money base growth, and of industrial production.[6] To address the issue of the persistence in volatility, we include one lag of the dependent variable in the regression specification.

In long run, over the period 1890 to 1970, given the impacts of the two Acts are too close to be identified separately in long run, which is confirmed statistically in our next step of analysis, we divide the long run period into two sub-periods, "pre-regulation" period: 1890-1933, and "post-regulation" period: 1934-1980. Moreover, it was discovered that stock market volatility was extraordinarily high during the Great Depression period of 1929-1939 (Schwert, 1989). Suppose the Great Depression is an exogenous factor to financial regulation, we control for the effect of the Great Depression period in our long run regression model. Following Schwert (1989), our multiple regression is:

$$\ln \sigma_{st} = \alpha + \alpha_r D_{rt} + \beta R_t + \gamma_1 \ln |\epsilon_{pt}| + \gamma_2 \ln |\varepsilon_{mt}| + \gamma_3 \ln |\epsilon_{it}| + \gamma_4 \ln \sigma_{st-1} + u_t \ . \tag{4}$$

where we introduce the dummy variable R_t equal to zero during the "pre-regulation" period (1890-1933), one for "post-regulation" period (after 1934). To control for Great Depression effect, we

[5] After July 1933, all new issued companies were required to fully disclose relevant information.

[6] Schwert (1989) relates stock market volatility to these macroeconomic variables. He argues that in a simple discounted present value model of stock prices, if macroeconomic data provide information about the volatility of future cash flows or future discount rate, they might explain some variations of stock market volatility. Using data from 1857 to 1987, He finds that these macroeconomic variables explain a small portion of the changes of stock market volatility.

define dummy variable D_{rt} equal to one from 1929-1939, zero otherwise. To control for the World War II effect, we also define the dummy variable WWII equal to one from 1942 to 1945, zero otherwise[7]. Under null hypothesis, SEC regulation does not affect the mean level of stock market volatility, $\beta = 0$. The other control variables are the same as in short run. As a robust test, impacts of regulation is also estimated without controlling Great Depression effect.

2.4 Results on short run and long run impacts

In the following we report basic regression results that the two Acts significantly reduced market volatilities both in short run and in long run.

Table 2 reports results in the short run, over the period of 1932 to 1935. The coefficients for macroeconomic variables are all insignificant, indicating that they do not explain much of the time series variation in stock market volatility during 1932 to1935. Our main interest lies in the coefficients for two regulation dummy variables. α represents the general level of volatility during the pre-1933 Act period: January 1932 to July 1933; (α+β_1) represents the general level of volatility during the post-1933 Act period: August 1933 to December 1935; (α+β_1+β_2) represents the general level of volatility during the post-1934 Act period: July 1934 to December1935. The coefficient β_1 for the 1933 Act dummy is -0.22 and significant at the 0.05 level, indicating the mean level of stock market volatility fell about 32% after July 1933. The 1934 Act dummy has a coefficient of -0.33 and is significant at the 0.05 level, implying that the mean level of stock market volatility reduced further 33% following the enforcement of the 1934 Act. The adjusted R^2 is 0.788. The coefficients for two dummy variables are negative and significant while controlling for macroeconomic variables, suggesting that there were significant reductions in the level of stock market volatility following the enforcement of two Acts in short run. Moreover, among all the factors considered only the enacting of the two Acts explains the trend of market volatility over that period of time.

There might be concerns about impacts of sample period on estimation results. In Table 2, we also report the regression results for different sample periods 1932 to 1936, 1933 to 1936, 1933 to 1935. Similar to the results for 1932 to 1935, the effects of the macroeconomic variables are not significant for all sample periods. Estimates of β_1 , the differential intercept during post-1933 Act period, are between -0.21 and -0.27 across different sample periods, and all are reliably below zero, significant at the 0.05 level. Estimates of β_2, the differential intercept for post-1934 Act

[7] 1942 is the year when the US officially declared war against Japan.

period, are between -0.28 and -0.35 across different sample periods, and all are significant at the 0.05 level. Overall, different sample periods lead to quantitatively similar regression results. This suggests that the enforcement of 1933 Securities Acts and 1934 Exchange Act is associated with the reduction in the mean level of stock market volatility in a short time of period

Table 3 summarizes the main empirical results for long run. Over the sample period of 1909 to 1970, the estimate of the coefficient for regulation dummy, which captures the 1933 and 1934 Acts, is -0.125 with a t–statistics of -4.75. This indicates that the financial regulation enacted by the two Acts reduced stock market volatility by about 12.5% for the period of 1934 to 1970 compared with the pre-regulation period of 1890 to 1933. We obtain the above result by controlling for Great Depression effect and macroeconomic variables. Consistent with Schwert (1989), the average level of stock volatility was substantially higher during Great Depression that the coefficient α_r for Great Depression dummy is 0.38 with a t-statistics 9.33. The effect of World War II on stock market volatility is insignificant. Also consistent with previous literature, the trading volume is significantly positive related to stock market volatility.The estimate of industry production coefficient is 0.02 and significant at the 0.05 level while the estimate of PPI inflation coefficient is 0.02 and significant at the 0.10 level. That is, except the exogenous Great Depression effect, the biggest factor which explains the trend of market volatility for this period of time is the regulation enacted by the Acts.

Similar to our study on short run impacts of the Acts, we investigate the robustness of our long-run results by comparing the effects of SEC regulation for different time spans (Table 3). No previous study has analyzed the possible varying effects of SEC regulation over time. We have two groups of results. Regressions of the first group contains all macroeconomic variables, sample periods start from 1909 (since we do not have data for money growth before 1909), end in different years. The second group include two macroeconomic variables, Industry production and PPI inflation, and sample periods start from 1890, end in different years.

For the first group, the estimates of the macroeconomic volatility coefficients are all positive, and some are reliably above zero. Our main interest is estimates of "Regulation" coefficient β in the table, the differential intercept during post-regulation period. They are between -0.021 and -0.085 across different sample periods, and many are reliably below zero. For example, the intercept $\hat{\beta}$ is -0.085 for sample period 1890-1970, which has the highest absolute value among the estimates of β for different sample periods. This suggests that the average level of stock market volatility fell the most during post-regulation period: 1934-1970. When the sample period expands to 1990

and afterwards, the t-statistics of the intercept $\hat{\beta}$ decreases to -0.83, indicating that there is no significant difference on the level of stock market volatility between the period of 1909-1933 and the period of 1934-1970. This might be related to regulatory failures associated with the internet bubble of late 1990s (Xu and Pistor, 2006).

For the second group, sample periods is expanded to cover two more decades data starting from 1890. However, money growth variable is dropped in the regressions for lack of data. Similar to the first group, across different sample periods, the estimates of the macroeconomic volatility coefficients are all positive, and some are reliably above zero. Estimates of β are between -0.05 and -0.125 across different sample periods. Different from the results in the first group, all estimates of β are reliably below zero and significant at the 0.05 level. The biggest drop in the mean level of stock market volatility again appears during post-regulation period 1934-1970, suggesting the average level of stock market volatility fell substantially during post regulation period: 1934-1970.

In summary, regulation effect is strong in both short run and long run that different sample periods lead to quantitatively similar regression results. This suggests that financial regulation, enacted by the two Acts, is associated with a significant reduction in the general level of stock market volatility when controlling for Great Depression effect and other macroeconomic variables.

2.5 Specification tests

To confirm that our basic results are robust, this section presents additional short run and long run regression results. In short run, we report more regression results in Table A1 from different sample periods. The results are qualitatively similar to those in Table 2. Estimates of β_1, the differential intercept during post-1933 Act period, are between -0.20 and -0.26 across different sample periods, and all are reliably below zero, significant at the 0.05 level. Estimates of β_2, the differential intercept for post-1934 Act period, are between -0.11 and -0.24 across different sample periods and they are all statistically significant. In long run, we drop the money growth variable and re-estimate the models for periods of 1909-1960, 1909-1970. As in Table 3, all estimates of β are negative and most of them remain statistically significant, which indicates the association between the introduction of SEC regulation and the reduction in the general level of stock market volatility.

In table A3, we also report regression results without controlling for Great Depression effect.

This corresponds to an alternative hypothesis that the Great Depression is endogenously associated with how the financial market is regulated. Again, all estimates of β are negative and statistically significant.

3 Structural break in the time series of stock market volatility

The results provided in previous section are based on estimated coefficients of dummy variable(s), which are defined by dates that the Acts were enacted. Interpreting those as evidence that the 1933/34 Acts reduced market volatility faces some potential challenges. First, market volatility reduction might be caused by some other reasons instead of by enacting the 1933/34 Acts. That is, if the structural break of the time series data occurs at a different date than 1934, the imposed dummy variable(s) in Regressions (3) and (4) might capture that structural break(s), but economic interpretations could be different. Second, the precise timing of the effects of the Acts is not known since the influence of SEC regulation might take place slowly. That is, even without a doubt that the Acts indeed reduced market volatility the estimated regulation effect from Regressions (3) and (4) might be incorrect if the dummy variables were imposed on wrong dates.

To address these challenges and further test the hypothesis that the mean level of volatility is reduced since financial regulation is introduced, we employ a structural break test. The classical Chow (1960) test is one of the earliest techniques that test for structural breaks in a linear regression model. It is popular in the case where the date of the event causing the break is widely accepted. One just needs to split the sample into two subperiods, estimate the parameters for each subperiod, and then test the equality of the two sets of parameters using a classic F statistics. However, Chow test is hard to apply when the break date is not known precisely. Thus, we adopt Bai and Perron (1998) (abbreviated as BP hereafter) test approach for multi-structural breaks. The BP methodology explicitly treats the number of break points and their location as unknown, endogenous to the data.

3.1 Econometric methodology

We use the Bai and Perron (1998, 2003a, b) method to test for multiple structural breaks in the mean levels of the stock volatility both for short run (1932-1936) and for long run (1890-1970). Following BP, we regress the stock market volatility on a constant and control variables. We

assume the parameter vector for control variables is not subject to shifts and is estimated using the entire sample, and only test for structural breaks in the constant.

Before we present a more formal discussion of the BP model, we provide a general outline for the BP method. First, an efficient algorithm developed by BP searches all possible sets of breaks and determines the set that produces the maximum goodness-of-fit (R^2). The statistical tests then determine whether the improved fit produced by allowing an additional break is sufficiently large given what would be expected by chance (due to the error process), according to asymptotic distributions. Starting with a null of no breaks, sequential tests of k vs. k+1 breaks allow one to determine the appropriate number of breaks in a data series. Bai and Perron determine experimentally critical values for tests of various size and employ a "trimming" parameter π, expressed as a percentage of the number of observations, which constrains the minimum distance between consecutive breaks. All methods discussed are implemented in a GAUSS program developed by Bai and Perron.

3.1.1 Model and the estimators

In this sub-section, we briefly review the methodology of Bai and Perron (1998, 2003) for estimation and inference in a simple multiple mean break model that is utilized in our empirical analysis. We consider the simple structural change in mean model, because structural breaks in the mean level of stock market volatility can be interpreted as the direct effect of SEC regulation.

We consider a partial structural change regression model with m breaks ($m+1$ regimes),

$$\ln \sigma_t = \alpha_j + x_t^{'}\beta + u_t, \qquad t = T_{j-1}+1,.., \ T_j \quad for \quad j = 1,...,m+1, \qquad (5)$$

where σ_t is realized stock volatility in month t as computed in equation (1) and α_j ($j = 1,...,m+1$) is the mean level of stock volatility in regime j. x_t is a vector of control variables including lagged dependent variable and the logarithms of the predicted standard deviations of PPI inflation, of money base growth, and of industrial production. β is the corresponding vector of coefficients. u_t is the disturbance at time t. The m-partition $(T_1,...,T_m)$ represents the breakpoints for the different regimes (in our case of 1890 to 1970 data, $T_0 = 0$ corresponding to the start date: January 1890, and $T_{m+1} = T$ corresponding to the end date: December 1970). This is a partial structural change model since the parameter vector β is not subject to shifts and is estimated using the entire sample. Consider estimating equation (5) using least squares. For each m-partition (T_1, . . . ,

T_m), the least squares estimates of α_j are generated by minimizing the sum of squared residuals,

$$S_T(T_1, ..., T_m) = \sum_{i=1}^{m+1} \sum_{i=T_{i-1}+1}^{T_i} (\ln \sigma_t - \alpha_j - x_t^{'}\beta)^2 \tag{6}$$

Let the regression coefficient estimates based on a given m-partition $(T_1, ..., T_m)$ be denoted by $\hat{\theta}(\{T_1, ..., T_m\})$, where $\hat{\theta} = (\alpha_1, ...\alpha_{m+1}, \beta)$. Substituting these into equation (6), the estimated breakpoints are given by

$$(\hat{T}_1, ..., \hat{T}_m) = \arg \min_{T_1,...T_m} S_T(T_1, ..., T_m) \tag{7}$$

The breakpoint estimators correspond to the global minimum of the sum of squared residuals objective function. Once we obtain the breakpoint estimates, we can calculate the corresponding least squares regression parameter estimates as $\hat{\theta} = \hat{\theta}(\{\hat{T}_1, ..., \hat{T}_m\})$.

3.1.2 Estimating the number of breaks

We estimate the number of breaks through a sequential procedure which consists of locating the breaks one at a time, conditional on the breaks that have already been located. Specifically, we start from locating the first break and test for its significance against the null hypothesis of no break. If the null hypothesis is rejected, we then look for the second break conditional on the first break being the one already found, and test for the existence of that second break against the null of one single break, and so on. In the estimation process we apply the following three statistics developed by BP.

The first is a $\sup F$ statistic which tests no structural break, $m = 0$, versus the alternative hypothesis that there are $m = b$ breaks. This statistic is defined as

$$SupF_T\ (b) = F_T(\hat{\lambda}_1, ..., \hat{\lambda}_b) \tag{8}$$

where $\hat{\lambda}_1, ..., \hat{\lambda}_b$minimize the global sum of squared residuals, $S_T(T\lambda_1, ..., T\lambda_b)$ and

$$F_T(\lambda_1, ..., \lambda_b) = \frac{1}{T}(\frac{T-(b+1)q-p}{2b})\hat{\theta}' R'[R\hat{V}(\hat{\theta})R']^{-1}R\hat{\theta}\ . \tag{9}$$

Where, $\theta = (\alpha_1, ...\alpha_{m+1}, \beta)$ is the vector of regression coefficient estimates, $\hat{V}(\hat{\theta})$ is an estimate of the variance-covariance matrix for $\hat{\theta}$; and R is defined such that $(R\theta)' = (\theta_1 - \theta_2, ..., \theta_b - \theta_{b+1})$.

The second is the BP Double Maximum statistics, which test the null hypothesis of no structural breaks against the alternative hypothesis of an unknown number of breaks. The statistics

are defined as $UD\max = \max_{1 \leq m \leq M} SupF_T(m)$ and $WDmax$, which applies different weights to the individual $Sup\ F_T(m)$ statistics so that the marginal $p-$values are equal across values of m.

The last one is the $SupF_T(l+1|l)$ statistic, which tests the null hypothesis of l breaks against the alternative hypothesis of $l+1$ breaks. With this statistic, the number of breaks is estimated as follows. It begins with the global minimized sum of squared residuals for a model with a small number l of breaks. Each of the intervals defined by the l breaks is then analyzed for an additional structural break. From all of the intervals, the partition allowing for an additional break that results in the largest reduction in the sum of squared residuals is treated as the model with $l+1$ breaks. The $SupF_T(l+1|l)$ statistic is used to test whether the additional break leads to a significant reduction in the sum of squared residuals.

We use the following strategy in identifying the number of breaks. First, we examine the double maximum statistics ($UDmax$ and $WDmax$) to determine whether any structural breaks are present. If the double maximum statistics are significant, we examine the $SupF_T(l+1|l)$ statistics to determine the number of breaks by choosing the $SupF_T(l+1|l)$ statistic that rejects for the largest value of l. In the process we follow Bai and Perron (2004) recommendation to use a trimming parameter $\pi = 0.15$[8].

3.2 Structural change results

We conduct the structural break test both in short run and long run. In short run, 1932-1936, the control variables include lagged volatility and the logarithms of the predicted standard deviations of PPI inflation, of money base growth, and of industrial production.

BP statistics for structural change in the mean value of the stock market volatility series between January 1932 (01/1932) and December 1936 (12/1936) are reported in Panel A of Table 3. Both double maximum statistics ($UDmax$ and $WDmax$) are significant at conventional significance levels, which suggests existence of structural changes in the mean level of the volatility over this period of time. In addition, $SupF(2|1)$ statistics is significant at the 1% level, whereas the $SupF(3|2), SupF(4|3)$ and $SupF(5|4)$ statistics are all insignificant. This indicates that there are two structural breaks (three regimes) for the volatility series. The break dates are estimated at 10/1933 and 10/1934 respectively. And 95% confidence interval for the two breaks are

[8] We implement the Bai and Perron (1998, 2003a, b) method using the GAUSS program available from Pierre Perron's homepage (http://econ.bu.edu/perron/).

[08/1933,02/1934] and [07/1934,01/1935] respectively. To summarize, these numbers consistently show that mean volatility fell substantially from regime 1 (01/1932-10/1933) to regime 2 (11/1933–10/1934) after the enacting of the 1933 Act in July 1933; and then fell further during regime 3 (11/1934-12/1936) since the 1934 Act was enforced in August 1934. Figure 3 provides graphical depictions of the means of the three regimes identified by the BP procedure for the stock market volatility series.

To investigate long run impacts of the Acts on market volatility, in order to control for Great Depression effect, we first regress stock market volatility on a constant and dummy variable for Great Depression period (1929-1939) for the time series between 1890 and 1970. Then we apply the BP procedure to the residual from the regression as stock market volatility adjusted for Great Depression effect.

Panel B of Table 3 reports the structural break test results for volatility series adjusted for Great Depression effect in long run (1890-1970). Both double maximum statistics ($UDmax$ and $WDmax$) are significant at conventional significance levels; however, $SupF(2|1)$, $SupF(3|2)$ and $SupF(4|3)$ are all insignificant. This suggests that there is only one structural break for the volatility series between 1890 and 1970. To summarize, we find that mean volatility of the market fell substantially from regime 1 (01/1890-07/1934) to regime 2 (08/1934–12/1970) after the enforcement of the two Acts in July 1933 and August 1934 respectively. Figure 4 plots the two regimes identified by structural break test.

To examine the robustness of the results, we also report the structural break test results for different sample periods in Table 4. As can be seen by comparing the dates when the Acts became effective with the confidence intervals for the empirically estimated break dates in Table 3, in short run the first break point corresponds with the enactment of Securities Act in May 1933, and the second break point corresponds with the enactment of Exchange Act in June 1934. In long run, both dates of the enactment of two Acts fall inside the confidence interval for the empirical identified break point.

Overall, given the coincidence of the BP break points and the date of introducing SEC regulation, it is strong evidence supporting that financial regulation reduce stock market volatility.

4 Concluding remarks

The research on the effectiveness of the 1933/34 Acts and the SEC is a general research subject that its significance is beyond financial regulation. In his famous criticism of the SEC, Stigler (1964) stated that "It is doubtful whether any other type of public regulation of economic activity has been so widely admired as the regulation of the securities markets by the Securities and Exchange Commission. In another influential paper criticizing the 1934 Act and the SEC, Benston (1973) claimed that "The Securities Exchange Act of 1934 was one of the earliest and, some believe, one of the most successful laws enacted by the New Deal." (Benston, 1973). In general, Stigler (1971) and Peltzman (1976) argued that regulation is actually a benefit bought by lobbying groups to improve their economic status. Given the concentration of regulatory benefits and diffusion of regulatory costs the power of lobbying groups as rent-seekers is further enhanced. Therefore, debates on the effectiveness of the SEC is vital for our understanding of regulation in general.

In the previous sections, we present key results of our empirical findings that stock market volatility is substantially lower during post-regulation period than pre-regulation period even when controlling for the Great Depression and other macroeconomic variables. We also identify some break points both during short run and long run. One major break point of mid 1934 coincides with the date of the passage of Securities Act which is consistent with our hypothesis that the introduction of SEC regulation effectively affect stock market volatility.

Our results are consistent with findings of Djankov et al. (2006), Greenstone et al. (2006) and La Porta et al. (2006). They are also consistent with the arguments of Xu and Pistor (2006) that the mandatory disclosure law and SEC regulation may improve investor information. Prior to SEC regulation, investors formed their expectations of future returns by relying on information obtained directly from a number of private market sources such as brokers and underwriters. Allegedly, according to the lawmakers, the information provided by these private sources is usually inadequate, sometimes misleading or even fraudulent. The 1934 Exchange Act vested SEC with the power to monitor the market and ensure compliance with the law. The core provision of the 1933 and 1934 Acts is that all issuers must disclose relevant information to Investors and to Regulator before proceeding with issuing shares to the public. It established a mandatory disclosure and registration system for all securities that were issued to the public. It dramatically increases the availability of quality information regarding future issue performance. If such effects could reduce the riskiness of

the purchase, then information effects of securities regulation should be reflected in the reduction of stock volatility.

Although, we believe, our finding of positive impacts of the 1933/34 Acts in reducing market volatility is the first in the literature, there are reports on reduction of idiosyncratic stock volatility after the implementation of mandatory disclosure law. However, these findings have been interpreted differently by their discovers. Stigler (1964) was the first who finds that the variance of the post-SEC new issue returns fell by approximately half. But he interpreted the decline in volatility as driving away of high-risk issuers from the public market due to the enforcement of the Securities Act of 1933. That is, this was construed as a 'side impact' which has to be consistent with his 'major findings' that the Act was at best ineffective in improving the market. In a debate on this issue, Friend and Herman (1964) interpreted the finding of volatility reduction as important evidence of a beneficial effect of mandatory disclosure. They argue that full disclosure, by providing investors with more accurate information on the intrinsic values of new issues, can reduce not only the uncertainty on the typical investor's demand prices for new issues but also the scale of fraudulent and manipulative practice in the market. Along a similar line of thoughts as Friend and Herman, Seligman (1983) argued that a decline in price variance discovered by Stigler (1964) "would imply that investors were receiving material information in the post-SEC (1949-1955) period that they had not received in the pre-SEC (1923-1928) period."

Using a market- and risk-adjusted approach derived from the Capital Asset Pricing Model, Jarrell (1981) had similar findings that post-SEC idiosyncratic volatility was substantially reduced than that of pre-SEC. Moreover, Jarrell studied corporate bond default rates. He found that default risks declined after the SEC began enforcement of its compulsory disclosure requirements. However, similar to Stigler, Jarrell argued that lowering the risk for new issues by the SEC is a bad news for investors since this was the result of implementing the mandatory disclosure system which tended to exclude risky or new firms.

Simon (1989) examines the dispersion of abnormal returns of IPOs from the pre-SEC period (1926-1933) and that of the post-SEC period (1934-1939). She finds a substantial reduction in the variance of stock price residuals in the post-SEC period. That is, dispersion of abnormal returns were significantly lower after the establishment of the SEC than before and for all issues (including IPO and seasoned issuances) and in both NYSE and regional markets. She interpreted this as a reduction of investors' forecast errors after the establishment of the SEC.

Even agreed with interpretations of Friend-Herman-Selilgman on Stigler-Jarrell-Simon findings that the idiosyncratic volatility has been reduced in Post-SEC period, one may still wonder that by diversifying investment portfolios the welfare impact of reducing idiosyncratic volatility may be very limited. However, the impact will be much more significant if there is a systematic reduction of market volatility.

Our finding of the reduction of stock market volatility during the post-SEC period is also related to equity premium literature. The equity premium is the expected excess return on a market portfolio over the risk-free interest rate. The reduction in stock market volatility should correspond to a reduction in the equity premium since we would expect investors demand lower expected return when the risk is reduced. This somehow contradicts Stigler's finding (1964) of no significant difference in stock returns before and after the implementation of the Acts. This could be due to the methodology Stigler employed to measuer the returns.

Table 1
Summary Statistics for Monthly Estimates of the Standard Deviations of Stock Returns, Growth Rates of the Producer Price Index, the Monetary Base, and Industrial Production, 1890-1970

This table reports means, standard deviations, skewness, kurtosis, and autocorrelations at lags 1, 2 of the monthly standard deviation estimates over different sample periods.

Volatility Series	Sample Period	Mean	Std.Dev.	Skewness	Kurtosis	r_1	r_2
Stock volatility	1890-1900	0.042	0.020	1.87	6.87		
	1890-1910	0.040	0.019	2.17	9.36		
	1890-1920	0.039	0.018	2.06	9.03		
	1890-1929	0.038	0.020	3.74	27.55		
	1890-1930	0.039	0.021	3.44	24.21		
	1890-1933	0.044	0.029	2.66	11.88		
	1934-1940	0.055	0.027	1.44	5.27		
	1934-1950	0.042	0.023	1.99	7.94		
	1934-1960	0.036	0.021	2.31	10.11		
	1934-1970	0.033	0.020	2.35	10.63		
PPI inflation rates	1891-1970	0.008	0.009	3.14	17.65	0.35	0.28
Monetary base growth rates	1909-1970	0.006	0.007	2.94	15.88	0.40	0.26
Industrial production growth rates	1890-1970	0.019	0.019	2.10	9.65	0.35	0.22

Table 2
Stock market volatility and the SEC regulation, macroeconomic fundamentals in short run

This table reports estimates of equation in short run: $\ln \sigma_{st} = \alpha + \beta_1 R_{1t} + \beta_2 R_{2t} + \gamma_1 \ln|\epsilon_{pt}| + \gamma_2 \ln|\varepsilon_{mt}| + \gamma_3 \ln|\epsilon_{it}| + \gamma_4 Volm_t + \gamma_5 \ln \sigma_{st-1} + \gamma_6 \ln \sigma_{st-2} + u_t$.(1), where the dummy variable R_{1t} corresponding to the enforcement of the 1933 Act, R_{1t} equals to zero before July, 1933, one otherwise. R_{2t} corresponding to the enforcement of the 1934 Act, equal to zero before June, 1934, one otherwise. The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). $Volm_t$ is the growth rate of trading volume from month t-1 to month t. The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors.

			Macroeconomic variables						
Sample period	β_1	β_2	IP	PPI	Base	$Volm$	σ_{st-1}	σ_{st-2}	R2
1932-1935	−0.312	−0.238	0.036	−0.018	−0.015	0.010	0.416	0.013	0.781
	(−3.81)	(−1.79)	(1.26)	(−0.88)	(−0.44)	(0.16)	(.3.55)	(0.08)	
1932-1936	−0.311	−0.281	0.029	−0.034	−0.008	−0.010	0.469	−0.026	0.806
	(−3.73)	(−2.21)	(1.25)	(−1.69)	(−0.25)	(−0.15)	(3.90)	(−0.19)	
1933-1936	−0.374	−0.228	0.048	−0.039	−0.005	−0.14	0.470	0.003	0.755
	(−3.13)	(−1.85)	(1.44)	(−1.66)	(−0.16)	(−1.65)	(3.65)	(0.02)	
1933-1937	−0.279	−0.205	0.050	−0.058	0.001	0.024	0.722	−0.198	0.683
	(−2.39)	(−2.82)	(2.02)	(−1.75)	(0.03)	(0.14)	(4.19)	(−1.34)	

Table 3
Stock market volatility and the SEC regulation, macroeconomic fundamentals in long run

This table reports estimates of equation: $\ln \sigma_{st} = \alpha + \alpha_r D_{rt} + \beta_1 R_t + \beta_2 WWII + \gamma_1 \ln|\epsilon_{pt}| + \gamma_2 \ln|\varepsilon_{mt}| + \gamma_3 \ln|\epsilon_{it}| + \gamma_4 Volm_t$

$+\gamma_5 \ln \sigma_{st-1} + \gamma_6 \ln \sigma_{st-2} + u_t$.(2), where the dummy variable R_t equal to zero during the "pre-regulation" period (1890-1933), one for "post-regulation" period (after 1934). The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). $Volm_t$ is the growth rate of trading volume from month t-1 to month t. To control for Great Depression effect, we define dummy variable D_{rt} equal to one from 1929-1939, zero otherwise. WWII is the dummy variable for the World War II, equal to one from 1942 to 1945, zero otherwise. The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors

			Macroeconomic variables							
Sample period	Regulation	Recessions	WWII	IP	PPI	Base	$Volm$	σ_{st-1}	σ_{st-2}	R2
1909-1960	−0.055	0.311	−0.021	0.023	0.019	0.016	0.177	0.457	0.112	0.595
	(−1.75)	(6.51)	(−0.52)	(2.16)	(1.60)	(1.36)	(4.35)	(9.41)	(2.27)	
1909-1970	−0.065	0.301	−0.007	0.020	0.021	0.020	0.181	0.478	0.115	0.602
	(−2.16)	(6.81)	(−0.17)	(2.05)	(1.84)	(1.88)	(4.41)	(11.19)	(2.59)	
1890-1960	−0.080	0.294	−0.012	0.019	0.020		0.207	0.472	0.114	0.542
	(−2.86)	(6.81)	(−0.31)	(2.20)	(1.93)		(5.89)	(11.54)	(2.84)	
1890-1970	−0.094	0.293	0.008	0.018	0.022		0.210	0.485	0.117	0.562
	(−3.42)	(7.22)	(0.22)	(2.22)	(2.21)		(5.95)	(13.05)	(3.14)	

Table A1

This table presents additional regression results for short run. It reports estimates of equation in short run: $\ln \sigma_{st} = \alpha_e + \beta_1 R_{1t} + \beta_2 R_{2t} + \gamma_1 \ln|\epsilon_{pt}| + \gamma_2 \ln|\varepsilon_{mt}| + \gamma_3 \ln|\epsilon_{it}| + \gamma_4 \ln \sigma_{st-1} + u_t$ (1), where the dummy variable R_{1t} corresponding to the enforcement of the 1933 Act, R_{1t} equals to zero before July, 1933, one otherwise. R_{2t} corresponding to the enforcement of the 1934 Act, equal to zero before June, 1934, one otherwise. The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors.

			Macroeconomic variables				
Sample period	β_1	β_2	IP	PPI	Base	lagged vol	R2
1931-1936	−0.204	−0.235	0.028	−0.025	0.005	0.525	0.70
	(−2.46)	(−2.54)	(1.13)	(−1.02)	(0.17)	(4.92)	
1931-1937	−0.196	−0.152	0.040	−0.050	0.007	0.599	0.66
	(−2.76)	(−1.84)	(1.64)	(−1.51)	(0.25)	(6.75)	
1932-1937	−0.263	−0.154	0.041	−0.058	0.001	0.591	0.72
	(−3.87)	(−1.79)	(1.75)	(−1.84)	(0.02)	(6.18)	
1932-1938	−0.259	−0.113	0.037	−0.067	−0.008	0.617	0.67
	(−4.09)	(−1.73)	(1.67)	(−2.34)	(−0.31)	(8.01)	

Table A2

This table presents additional regression results for long run. It reports estimates of equation: $\ln \sigma_{st} = \alpha_e + \alpha_r D_{rt} + \beta R_t + \gamma_1 \ln|\epsilon_{pt}| + \gamma_2 \ln|\varepsilon_{mt}| + \gamma_3 \ln|\epsilon_{it}| + \gamma_4 \ln \sigma_{st-1} + u_t$ (2), where the dummy variable R_t equal to zero during the "pre-regulation" period (1890-1933), one for "post-regulation" period (after 1934). The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). To control for Great Depression effect, we define dummy variable D_{rt} equal to one from 1929-1939, zero otherwise. The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors.

			Macroeconomic variables				
Sample period	Regulation	Recessions	IP	PPI	Base	lagged vol	R2
1909-1960	−0.077	0.398	0.029	0.022		0.477	0.57
	(−2.36)	(7.70)	(2.48)	(1.64)		(12.33)	
1909-1970	−0.089	0.386	0.027	0.023		0.509	0.58
	(−2.90)	(8.08)	(2.53)	(1.89)		(15.92)	
1909-1980	−0.061	0.337	0.014	0.022		0.554	0.56
	(−2.17)	(7.35)	(1.46)	(2.13)		(17.42)	

Table A3

This table presents additional regression results for long run. It reports estimates of equation: $\ln \sigma_{st} = \alpha_e + \alpha_r D_{rt} + \gamma_1 \ln|\epsilon_{pt}| + \gamma_2 \ln|\varepsilon_{mt}| + \gamma_3 \ln|\epsilon_{it}| + \gamma_4 \ln \sigma_{st-1} + u_t$ (2), where the dummy variable R_t equal to zero during the "pre-regulation" period (1890-1933), one for "post-regulation" period (after 1934). The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). We do not control for Great Depression effect. The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors.

		Macroeconomic variables				
Sample period	regulation	IP	PPI	Base	Lagged vol	R2
1890-1960	−0.048	0.032	0.021		0.636	0.46
	(−1.83)	(3.14)	(1.86)		(15.59)	
1890-1970	−0.064	0.033	0.026		0.644	0.49
	(−2.47)	(3.44)	(2.41)		(18.21)	
1890-1980	−0.060	0.024	0.024		0.650	0.49
	(−2.53)	(2.72)	(2.55)		(19.85)	

Table A4

This table presents additional regression results for long run. It reports estimates of equation: $\ln \sigma_{st} = \alpha_e + \alpha_r D_{rt} + \beta R_t + \gamma_1 \ln |\epsilon_{pt}| + \gamma_2 \ln |\varepsilon_{mt}| + \gamma_3 \ln |\epsilon_{it}| + \gamma_4 v_t + \gamma_5 v_{t-1} + \gamma_6 \ln \sigma_{st-1} + u_t$, where the dummy variable R_t equal to zero during the "pre-regulation" period (1890-1933), one for "post-regulation" period (after 1934). The control variables include the logarithms of the predicted standard deviations of PPI inflation , of money base growth , and of industrial production (IP). We also include current and lagged trading volume growth (v) as control variables. The t-statistics in parentheses use Newey-west heteroskedasticity and autocorrelation consistent standard errors.

			Macroeconomic variables						
Sample period	Regulation	Recessions	IP	PPI	Base	Volume	Lagged volume	Lagged vol	R2
1909-1960	−0.067	0.358	0.023	0.020	0.017	0.194	0.046	0.513	0.586
	(−2.12)	(7.12)	(2.04)	(1.59)	(1.43)	(4.89)	(1.31)	(12.74)	
1909-1970	−0.077	0.346	0.021	0.021	0.021	0.199	0.043	0.538	0.593
	(−2.52)	(7.43)	(2.03)	(1.79)	(2.02)	(5.01)	(1.23)	(16.23)	
1890-1960	−0.094	0.338	0.018	0.021		0.226	0.044	0.529	0.532
	(−3.38)	(7.39)	(2.03)	(1.97)		(6.63)	(1.45)	(15.04)	
1890-1970	−0.107	0.336	0.018	0.023		0.229	0.041	0.546	0.553
	(−3.91)	(7.79)	(2.15)	(2.23)		(6.77)	(1.39)	(18.12)	

Table 4

This table reports Bai and Perron Statistics for Tests of Multiple Structural Breaks for the stock market volatility series and the dates for the structural breaks in the mean level of the volatility series and their 90% confidence intervals for each of the break dates. Control variables include lagged dependent variable and the logarithms of the predicted standard deviations of PPI inflation, of money base growth, and of industrial production. The break dates correspond to the end of each regime. In Panel A, Sample period is 01/1932 to 12/1936. In Panel B, sample period is 01/1890 to 12/1970. ***Significant at the 1% level. **Significant at the 5% level.

Panel A

	Test				
UDmax	WDmax (5%)	F(2|1)	F(3|2)	F(4|3)	F(5|4)
15.85***	17.89***	14.31***	4.67	1.07	0.76
	Numbers of break selected				
Sequential	2				
	Estimates with 2 breaks				
	Regime 1	Regime 2		Regime 3	
mean of volatility	17.94	11.37		7.76	
end date	10/1933	10/1934			
90%CI	[08/1933,01/1934]	[08/1934,12/1934]			

Panel B

	Test			
UDmax	WDmax (5%)	F(2|1)	F(3|2)	F(4|3)
22.37***	22.37***	6.66	2.64	0.40
	Numbers of break selected			
Sequential	1			
	Estimates with 1 break			
	Regime 1		Regime 2	
mean	27.08		14.54	
end date	07/1934			
90%CI	[01/1929,07/1939]			

Table 5

This table reports Bai and Perron Statistics for Tests of Multiple Structural Breaks for the stock market volatility series and the dates for the structural breaks in the mean level of the volatility series and their 90% confidence intervals for each of the break dates. Control variables include lagged dependent variable and the logarithms of the predicted standard deviations of PPI inflation, of money base growth, and of industrial production, also the growth rate of trading volume. The break dates correspond to the end of each regime. In Panel A, Sample period is 01/1932 to 12/1936. In Panel B, sample period is 01/1890 to 12/1970. ***Significant at the 1% level. **Significant at the 5% level.

Test					
UDmax	WDmax (5%)	F(2|1)	F(3|2)	F(4|3)	F(5|4)
15.07***	17.20***	14.59***	6.83	0.91	0.54
Numbers of break selected					
Sequential	2				
Estimates with 2 breaks					
	Regime 1	Regime 2		Regime 3	
end date	10/1933	10/1934			
90%CI	[08/1933,01/1934]	[08/1934,12/1934]			

Panel B

Test				
UDmax	WDmax (5%)	F(2|1)	F(3|2)	F(4|3)
17.41***	17.41***	5.46	2.33	0.57
Numbers of break selected				
Sequential	1			
Estimates with 1 break				
	Regime 1		Regime 2	
end date	07/1934			
90%CI	[06/1927,10/1940]			

Table 6

This table reports structural change results for different sample periods.

Sample period	Regime 1	Regime 2	Regime 3
1932-1935	01/1932-10/1933	11/1933-10/1934	11/1934-12/1935
1932-1937	01/1932-10/1933	11/1933-12/1937	
1933-1935	01/1933-10/1933	11/1933-8/1934	9/1934-12/1935
1933-1936	01/1933-10/1933	11/1933-10/1934	11/1934-12/1935
1933-1937	01/1933-10/1933	11/1933-12/1937	
1890-1960	01/1890-07/1934	08/1934-12/1960	
1890-1980	01/1890-10/1933	11/1933-07/1967	08/1967-12/1980

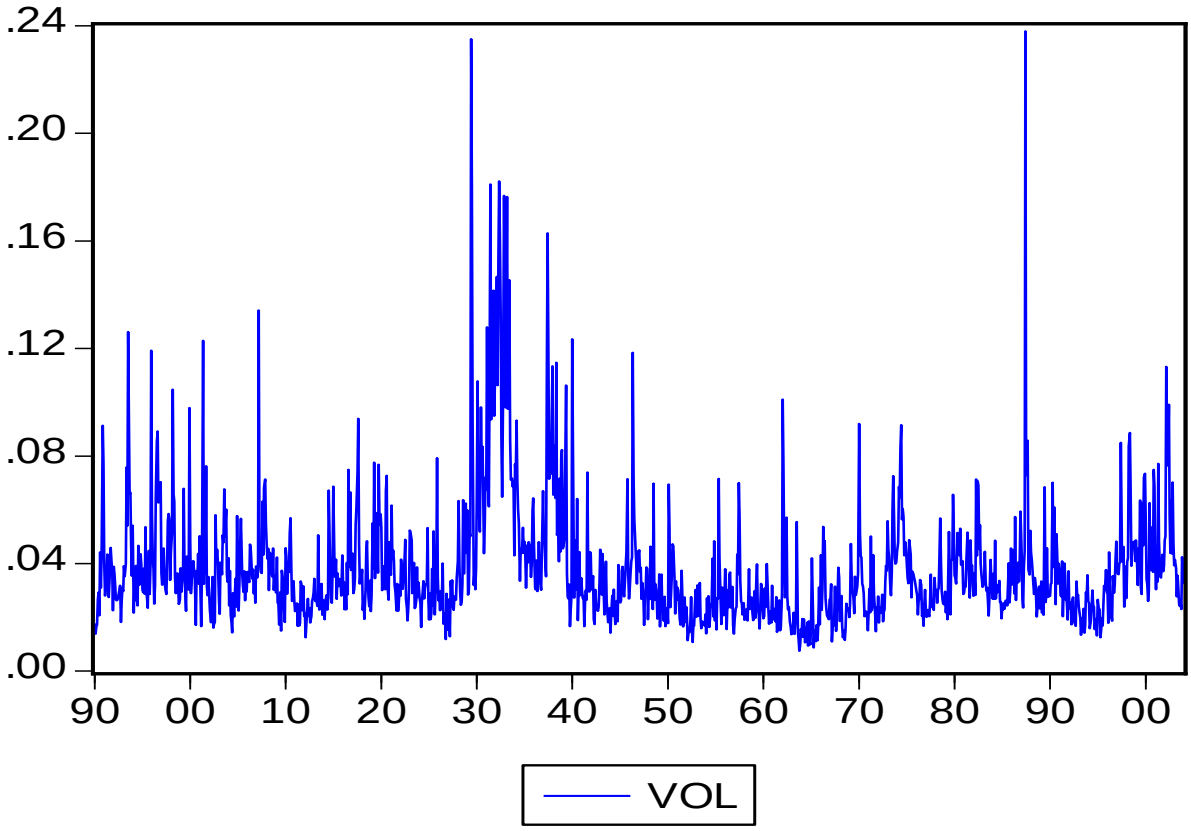

Figure 1: **Time series plot for stock market volatility**

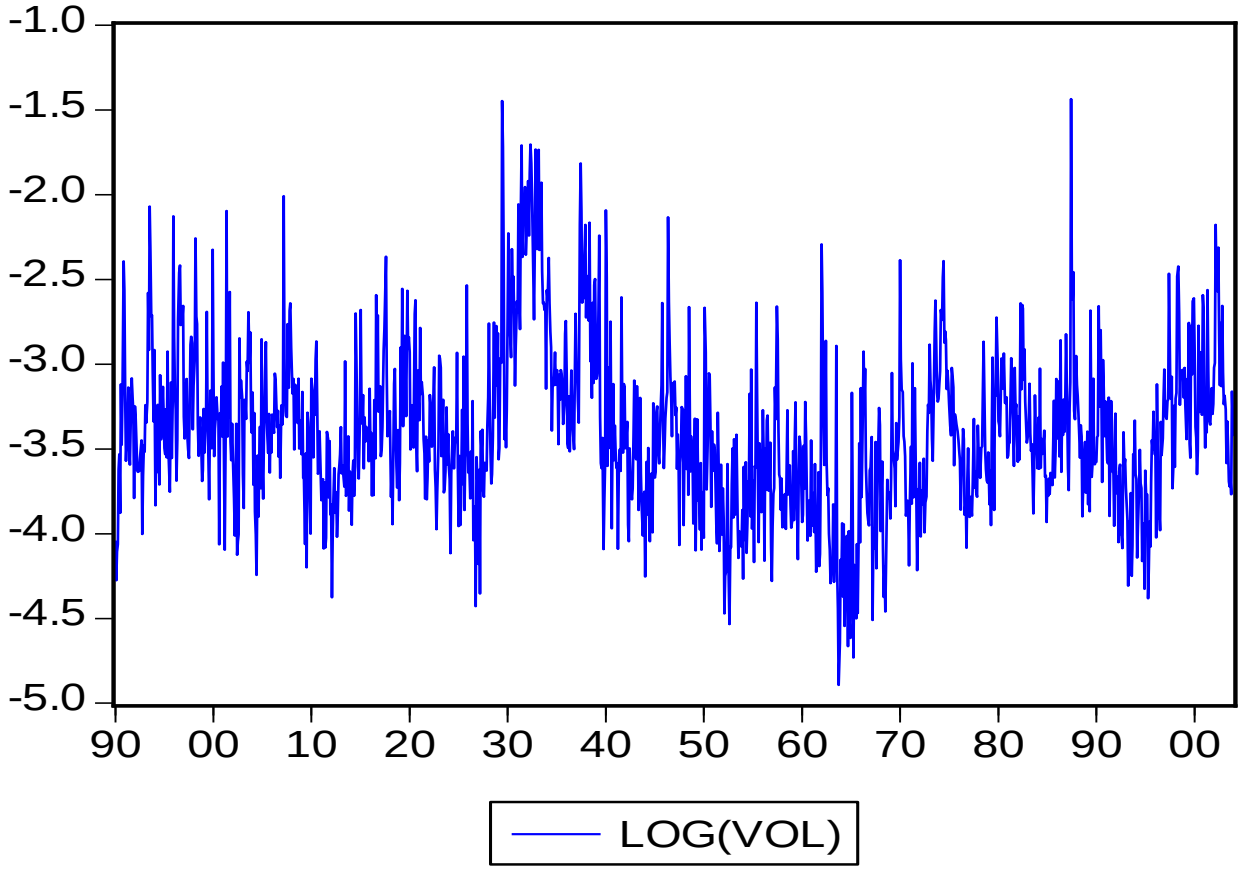

Figure 2: **time series plot for log(vol)**

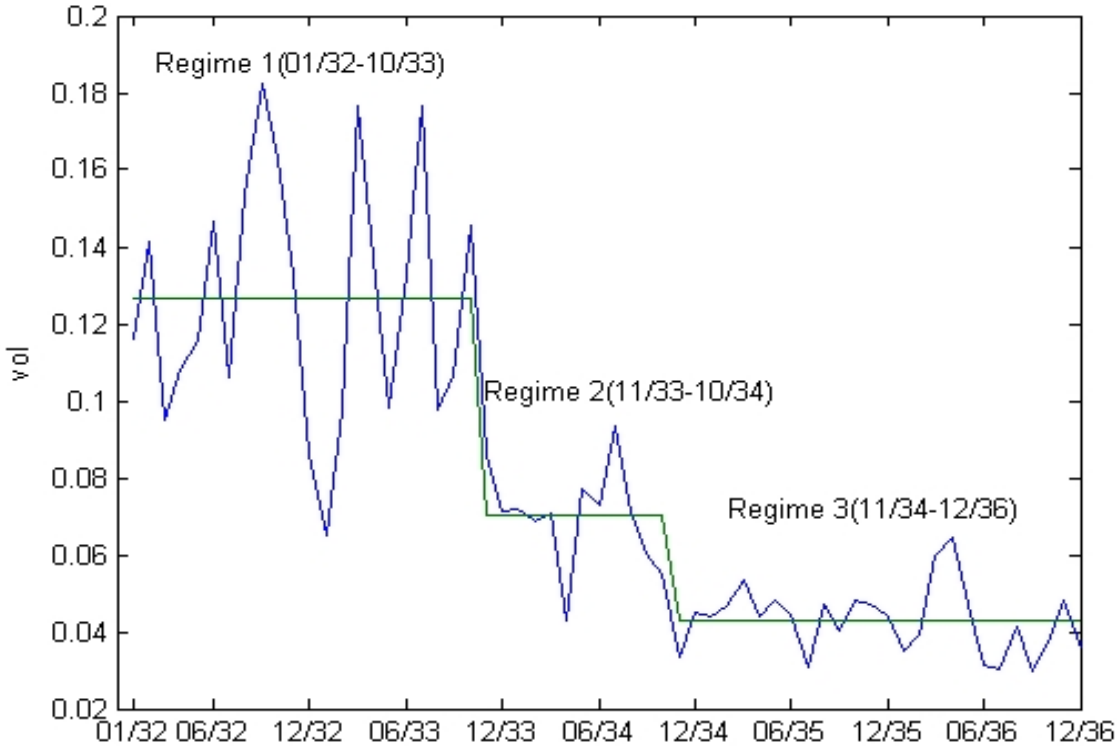

Figure 3: **Volatility and structral breaks: 1932-1936** Reported are the structural breaks in the mean level of market volatility for January 1932 to December 1936. We find three three distinct periods: 01/32-10/33, 11/33–10/34, and 11/34-12/36.

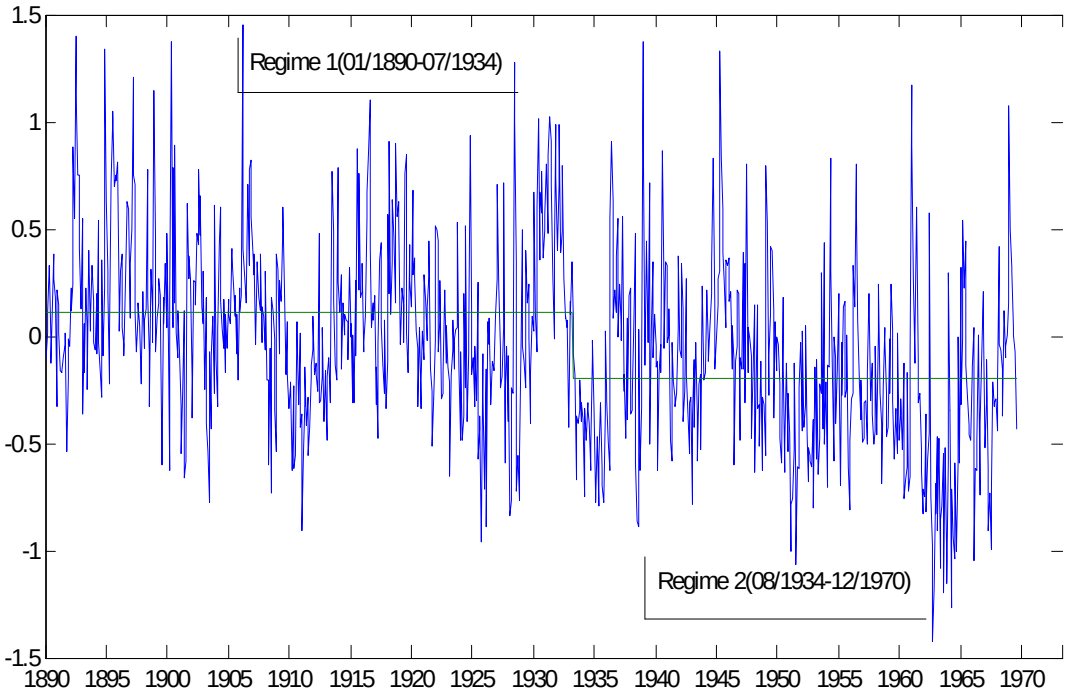

Figure 4: **Volatility and structral breaks: 1890-1970** The test statistics suggest one structural break (two regimes) for the volatility series: regime 1 (01/1890-07/1934) amd regime 2 (08/1934–12/1970).

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