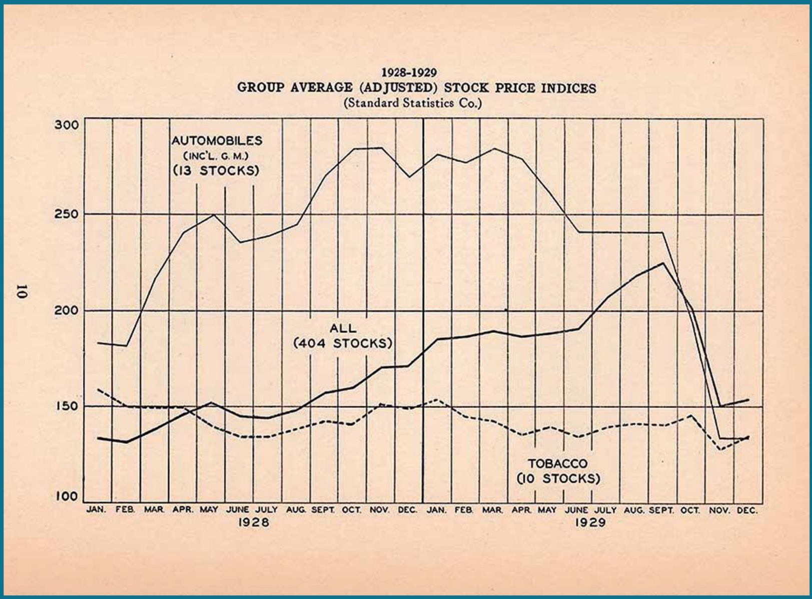
# The Stock Market Boom and Crash of 1929 Was Not a Bubble




## *A Book of Readings*

Edited by Bernard C. Beaudreau

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*To the memory of Irving Fisher*

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# PREFACE

This book is the result of a decades-old research program on the role of technology in the stock market boom and crash of 1928-1929. The first salvo, output wise, was a term paper in a graduate-level monetary theory course at the University of Western Ontario in 1983, in which it was argued that technological change and expectations could explain the boom. Over the course of the intervening years, the narrative evolved, benefitting from in-depth knowledge of U.S. tariff policy in the late 1920s especially the Smoot-Hawley Tariff Bill, resulting in the view, first presented in my 1996 book, *Mass Production, the Stock Market Crash and the Great Depression: The Macroeconomics of Electrification*, that the stock market boom and crash could well be rationalized in terms of a highly controversial legislative cycle against the background of vastly improved fundamentals, one that witnessed the Republican Party splintering with 13 Insurgent Senators crossing the floor and voting with the Democrats to lower, not raise tariffs. I would like to thank all those who, over the years, contributed to making this work possible.

# 1. Introduction

In the aftermath of the Stock Market Crash of 1929, Yale University economics professor Irving Fisher insisted that the stock market boom of 1928-1929 was not a bubble, but rather was grounded in fundamentals. According to him, U.S. industry was more productive, owing to what he referred to as improved fundamentals. In Chapter VIII of *The Stock Market Crash–and After* entitled, *Scientific Research and Invention*, he pointed out that:

> A prime reason for expecting future earnings to be greater was that we in America were applying "science and invention to industry as we had never applied them before. Inventing is now a profession. Invention is today recognized as having a high cash value and is eagerly sought after by progressive corporations. The contrast with the past, even a few years ago, is very great, and the contrast is enormous with a generation of a century ago. We still talk about the wonderful innovations–power looms, steam engines and locomotives and the various elements of the English "industrial" revolution" of the eighteenth century–which had such a profound effect on business and banking (Fisher 1930, 119).

Fisher was extremely bullish about the state of the U.S. economy, which explains his defense of the stock market boom as being based on fundamentals. The problem, however, with his approach was manifold. First, he provided no hard estimates of the extent to which productivity and hence, potential output and income had increased. His references were general in nature and could well have been culled from trade journals or even newspapers of the day. Second and perhaps more important was the crash, specifically if the boom had indeed been justified by fundamentals, then why did the DJIA crash on October 23 and 29? In other words, If the U.S. economy was, in fact, more productive as he contended, then why did the market crash, on two occasions?

The vacuum that had been left by the absence of a legitimate underlying cause or causes was soon filled by speculation. Perhaps the most celebrated was the view, put forward by the Pecora Commission, charged with investigating the causes, that the stock market boom had been caused in large part by unscrupulous Wall Street bankers who had carelessly risked millions of depositors' dollars on the floor of the stock exchange, provoking in the process a speculative bubble that burst in response to higher interest rates. In short, the fact that traditional banks had metamorphosized into investment banks, risking depositors' money on highly speculative investments, was the underlying reason.

This view has, for lack of credible alternatives, become the standard in the literature, being the object of a number of theoretical contributions. For example, Philip Cagan's work on hyperinflation provided a dynamic framework in which to explain bubble-like phenomena. The recent collapse of the U.S. housing market (i.e. 2007) provided further evidence of the presence of bubble-like phenomena, leading many to conclude that financial markets are inherently unstable and thus in need of regulation/overseeing.

There have been, however, discordant voices. First, there are the findings of Rutgers University economics professor Eugene White (1986) to the effect that Wall Street banks that invested in the stock market had done better than those which had not, casting doubt on the Pecora thesis. Second, McGrattan and Prescott (2004) and Beaudreau (2014,2018) have argued that the stock market boom was in fact motivated by fundamentals and that Irving Fisher was right all along. McGrattan and Prescott (2004) used individual stock price data, along with a series of price-earnings ratios (pre- and post- WWII), to infer that market-valued intangible assets had increased in the late 1920s, representing roughly 67 percent of the value of tangible assets, thus justifying the increase in share prices. Unfortunately, McGrattan and Prescott (2004) were unable to identify specific intangible assets, as well as being unable to rationalize (read: provide a convincing narrative) of the crash.

Beaudreau (1996,2014,2018), on the other hand, presented a refinement of their argument, pointing to a specific technology shock, namely the shift to electric unit drive, commonly known as electrification, as well as invoking the legislative struggle over the proposed Smoot-Hawley Tariff Act. According to Beaudreau (1996,2014,2018), electric unit drive vastly increased the rated capacity of much of U.S. industry. However, given the lack of market opportunities, labor markets began to weaken, prompting a political response on the part of the Republicans in the form of another general upward revision of the tariff schedule, known as the Smoot-Hawley Tariff Bill.

In short, he argued that the stock market boom and crash can be understood in terms of the legislative life-cycle of the proposed tariff bill against a background of improved fundamentals. From June 1928 when the Republican proposal was announced to July 1929, stock prices increased in response to tariff good news. They crashed, however, in October 1929 when the Party splintered, and thirteen Senators crossed the floor to join the Democrats in their quest to lower tariffs.

In so doing, he was able to do what both Fisher and McGrattan and Prescott were not, namely rationalize both the boom and the bust. Stock prices appreciated in response to good tariff news against a backdrop of improved fundamentals, and crashed when the promise of greater sales, profits and earnings was quashed by dissent and division within the Republican Party.

This volume, being a compendium of published works, provides support for the view that the stock market boom and crash was not a bubble, but rather the result of changing fundamentals. It should as such be viewed as part of a bigger research program, pioneered by Peter Garber, who showed that speculative bubbles are a rare feature of markets. In short, it is shown that the stock market boom and bust was "engineered" by the Republican Party's response to a widening output gap, namely higher tariffs.

The first article is a chapter taken from Irving Fisher's "*The Stock Market Crash—and After"* entitled *Scientific Invention and Research*, which more than any other captures the essence of his post-crash argument. The chapter details the many changes thrust upon U.S. industry in the 1920s, focusing on power technology in general and electric unit drive and purchased electric power in particular. What is noteworthy about this chapter is its upbeat tone. One gets the impression that Fisher is overcome with emotion, describing the many changes that have occurred over a relatively short period of time. In his view, these changes were equivalent in magnitude and scope to those of the first industrial revolution.

The chapter leaves the reader with the distinct impression that the stock market boom could not have been caused by anything other than improved fundamentals. This is where McGrattan and Prescott's "*The 1929 Stock Market: Irving Fisher Was Right"* starts, namely by asserting that Fisher was right. However, instead of estimating the effects of specific technologies on potential output and earnings, they use individual stock price data to estimate the value of intangible assets, from which they then conclude that Fisher was indeed correct to conclude that the boom could be justified by fundamentals.

This raises the question: why has this not become the norm? In the aftermath of the Financial Meltdown of 2008, the overriding view of the stock market in 1929 was that of a bubble, not unlike the alleged housing bubble of the 2000s. The answer, we believe, lies in its inability to explain the crash. As it turns out, both Fisher and McGrattan and Prescott were unable to provide a credible, consistent, explanation of the crash – of the precipitous decline in stock prices on October 23 and 29, 1929, which understandably weakens their argument. After all, if it could be justified by fundamentals, then why the crash?

This is the topic of the next two papers. In "*Discriminating Between Tariff-Bill-Based Theories of the Stock Market Crash of 1929 Using Event Study Data*" and "*Electrification, the Smoot-Hawley Tariff Bill and The Stock Market Boom and Bust: Evidence from Longitudinal Data,*" a refinement of the Fisher hypothesis is provided based on work first presented in Beaudreau (1996). In short, it is argued that the stock market boom and bust can be understood as resulting from a legislative cycle set against a backdrop of improved fundamentals. The conversion to electric unit drive in the 1920s contributed to increasing the rated capacity of existing machinery and equipment, prompting a legislative response on the part of the Republican Party in the form of the Smoot-Hawley Tariff Bill, which advocated closing the U.S. market in order to increase domestic firms' sales, revenues, profits and earnings. Perfectly informed investors responded by bidding share prices up. However, the tide turned in the summer of 1929 when 13 Insurgent Republicans broke with the party, and joined the Democrats in their bid to lower tariffs. The fatal blow was dealt on October 22, when the Insurgent Republican-Democrat coalition voted to lower the tariff on medicinal tannic acid, signaling their firm intention to lower all tariffs on manufactures. The bull turned into a bear, and the market plunged for the first time.

The second blow was dealt by Ranking Republican Senator David Reed in a speech in Pennsylvania on October 27 in which he proclaimed the tariff bill to be dead. Existing tariff levels, he went on to explain, were preferred to those advocated by the Insurgent Republican-Democrat coalition. All hope was gone, and the market crashed a second time.

The upshot of all of this is relatively simple, namely that the stock market boom and bust was not a bubble, but rather the result of a legislative episode that was predicated on hope, and one which witnessed it die at the hands of insurgents from within the Republican party. In short, it is the story of how the Republican Party came together and then fell apart, of fusion and then fission, the main victim of which was the stock market.

Running through all of the contributions in this volume is the view that improvements in America's power drive technology were the key factor behind the stock market boom. Fisher emphasized purchased power, while Beaudreau pointed to the introduction of electric unit drive. The penultimate article, Harry Jerome's "*Measures of Changes in Mechanization*," a chapter in *Mechanization in Industry*, published by the National Bureau of Economic Research is perhaps the best period (1934) piece on the profound changes that resulted from the introduction of electric unit drive, running from greater machine speed, to reduced machine downtime. Both contributed to increasing output with what essentially was the same capital. The role of electrification in the stock market boom of 1928-1929 is echoed in the last contribution, namely Charles Amos Dice's "The Electrical Age" which is taken from his 1929 book entitled "New Levels in the Stock Market." In short, he viewed electric power as the single most important cause of the industrial revolution of the 1920s.

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# 2. The Stock Market Crash and After[1]

## Irving Fisher

### 2.1 Preface

This book is the outgrowth of several years' study of the stock market consequent on the publication by me, in the newspapers, of weekly and daily index numbers of stock prices, sales and values. In trying to appraise the market crash during the autumn of 1929, I have made use of all sources of information available to me to date.

Readers will doubtless find some inconsistencies between my previous writings and the present book, as I have modified my opinions from time to time with the march of events and with the unfolding of evidence. I may, and probably shall, further modify them with subsequent developments.

The book is in no sense, therefore, an attempt to justify opinions hitherto expressed. It has been written without reference to any previous expressions. I had stated my opinion in September, preceding the panic, that the market had reached its peak, as proved to be the case. I also expressed the view that the recession would not be in the nature of a serious crash, in which I was mistaken. I also predicted that the new plateau of stock prices would survive any recession. This has proved true (see Chart 4).

I have also tried in this book to set forth the chief opinions held by others, whether or not they agree with my own conclusions, past or present, in the hope that the reader will in this way have before him all the chief points of view that it is practicable to assemble.

To publish the book now may seem audacious, but there is an advantage in writing tentative conclusions while impressions and memories are still fresh. Someone has said that the "true perspective" of the historian really means he waits until everyone who could contradict him has died.

It is, of course, too early to reach any absolutely sure conclusions; nothing is more difficult to analyze and understand thoroughly than a panic; especially, a panic so great and so peculiar as that which has visited the American stock market. It stands unique in the annals of finance. But even

[1] Fisher, I. The Stock Market Crash—and After. New York, NY: Macmillan, 1930.

if some of the views here expressed should later be found in need of revision, I trust this book will have served its purpose by contributing somewhat toward a better eventual understanding of the problem. The ordinary explanations now finding the greatest currency seem to me far too simple and naive.

*Irving Fisher*
*Yale University*
*December 15, 1929.*

## 2.2 Introduction

Many causes have been assigned for the stock-market crash of 1929. These usually take the form of putting the blame on different individuals or groups. United States Senator Robinson of Arkansas blames President Hoover, Secretary Mellon and Ex-President Coolidge for their "unduly optimistic statements" about business conditions, which he says, worked the country into a fever of speculation. But United States Senator Robinson, Republican, of Indiana, praises the Administration and holds that John Raskob, Chairman of the Democratic National Committee, was among those who were "psychologically" responsible for the collapse, by urging people to buy stocks.

Senator Glass blames the "stock gamblers." The Reverend John Haynes Holmes holds the brokers and their unholy ways responsible. A prominent banker ascribes the Wall Street crash largely to the blocking of the Tariff Bill in Congress. New York State Senator Hastings finds the cause in those who "sold short." Congressman Clyde Kelly blames "this nation-wide gambling house which is called the New York Stock Exchange."

Mr. Daniel W. Blumenthal finds implicated in the panic certain brokers "who successfully carried out a well-defined wash-sale conspiracy and false circulation campaign." Mr. Durant declares that the President paid no attention to his warning of an approaching crash, and blames the Federal Reserve Board for causing it. He says the Federal Reserve Board should have put down the rediscount rate to 3 per cent, while Mr. H. Parker Willis blames the Reserve Board for not having drastically raised the rediscount rate.

Sir George Paish says that the crash came because the bankers had gotten everybody into debt. The Investment Trusts have been blamed for "dumping" on the market. The New York Times praises the banks, but excoriates the "nation-wide army of speculators, large and small, who had engaged in the two-year bubble-blowing." Mr. Babson has been blamed for saying that a crash would come "sooner or later." Dr. John H. Gray blames Mr. Mellon, Mr. Coolidge, and myself for "always insisting that all was well and talking of prosperity, a new era, and increased efficiency of production." In this catalogue of wholesale and particular blamings one is reminded of that old panic of 1837, in Van Buren's administration, when the Associated Merchants of New York City published a resolution asking, "On what constitutional or moral grounds can Martin Van Buren defend himself for having caused all the disasters under which the American people are suffering?"

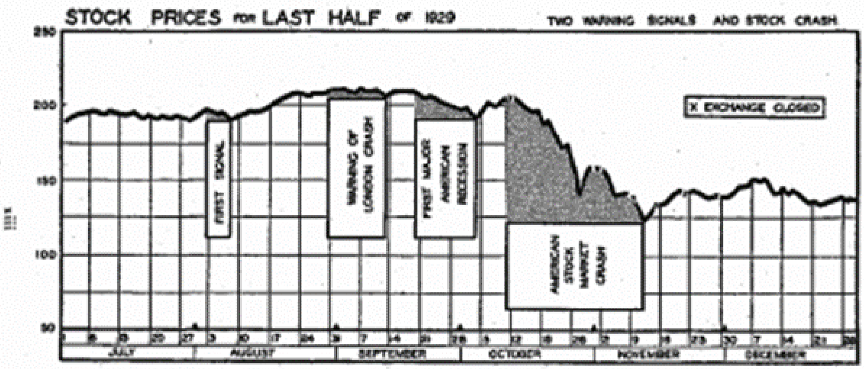


CHART 2.—The first sharp drop was after the raising of the New York Federal Reserve rediscount rate from 5 to 6 per cent on August 8. The Hatry failure in London started the British crash on August 30. During September there was heavy liquidation on the New York Stock Exchange. The American crash began October 12, lasting until November 13, when stock prices touched bottom.

Doubtless, there is some truth in almost all of these allocations of responsibility for the panic. But rather than appraising such a disaster in terms of praise and blame, an unemotional assessment of it in terms of cause and effect might yield much in public benefit by way of preventing the recurrence of such crises.

### 2.2.1 Intimations of the Panic

"Hindsight" is always clearer than foresight. Looking backward now and putting the events of the panic in perspective, we find that there were definite foreshadowings of its coming. As early as April 18, 1929, the National City Bank of New York said in a special circular:" If the rate of credit increase rises above the rate of business growth, we have a condition of inflation which manifests itself. in rising prices in some departments of the business structure, over-confidence, excessive speculation, and an eventual crash."

This statement was followed by an analysis that notes a yearly increase in the total volume of business in this country, taking business in all its forms, at a fairly uniform rate of 4 per cent; and that for the year 1928 the total production and the exchange of goods in the United States increased over 1927 at a rate somewhat below this, or about 3 per cent. As against this growth of business and production, the statement measured the growth of credits—5.1 per cent for the year 1928. This did not appear to be greatly in excess of the normal growth of business requirements. But the statement added:

> "Taking account of the extraordinary growth of brokers' loans 'for account of others' as reported by both the New York banks and the stock exchange, from $1,627,000,000 at the end of 1927 to $3,361,000,000 at the end of 1928, we find the total increase of credit, as represented by the bank figures and the loans 'for others' combined, to have been from $57,077,000,000 to $61,627,000,000, or 8 per cent, a difference as compared with the estimated increase of business which can only spell inflation."

Other observers had noted symptoms of unusual inflation of credit, denoting that the market had reached its high and might be on the verge of decline. Among these were Malcolm C. Rorty, of the International Telephone & Telegraph Company; Paul Clay, of United States Shares Corporation, and Emerson Wirt Axe. In an article in *The Annalist* of October, 18, 1929, Mr. Axe observed that "no really sustained advance is to be expected" because of the "systematic distributive campaign." On September 5th, in an address at his Annual National Business Conference, Mr. Babson said: "I still, repeat what I said at this time last year and the year before[2]; namely, that sooner or later a crash is coming which will take the leading stocks and cause a decline of from 60 to 80 points in the Dow-Jones Barometer." On the same day, in an interview with *The Hartford Courant*, I stated that while none of us was infallible, "there may be a recession of stock prices." But I did not at that time believe that there would be anything in the nature of a serious crash.

I had said, in an article published in many newspapers, May 12, 1929, that the so-called "Hoover boom" in the stock market had about reached its climax. The "Hoover market" had risen above the forecast line, calculated by the Karsten Statistical Laboratories in New Haven, by from 12 to 25

[2] At that time (1927), the Dow-Jones average was 194; 60 points below which would be 134. The lowest point reached after the crash (Nov. 13, 1929) was 199.

percent from the time of Mr. Hoover's election to his taking of the oath of office on March 4th, after which, up to the close of April, it receded to 18 percent above the line. In this article, I remarked that all previous departures from the Karsten so-called "line of fundamentals" had returned within a short period to this forecast line, and added:

"The 'Hoover Market' can hardly go much further above the forecast line. It may fall below, but in that case, it will fall to a higher level than the peaks of the previous booms."

This opinion was fulfilled. As the Karsten chart shows (with the white zone bounding the recorded average of the market each month) the continuous forecast line, based on previous records of various items of business conditions, represents with fair accuracy the long swings of the market. The departures from the line, up or down, represent the "psychological" short swings, as shown on the" accompanying chart. These characterized the collapse of the stock market at the onset of the war in 1914; the war boom of 1915-1916; the marked depression of 1917, during the period of Federal financing through higher taxes and the sale of bonds; the post-war depression of 1920-1921; the recovery and the "Coolidge boom" of 1923-1924, and the second "Coolidge boom" of 1925-1926.

The "Hoover boom" fluctuated more violently above the Karsten forecast line than any previous fluctuation, either up or down. In the retrospect, it is easy to appreciate that preliminary symptoms of the crash were not lacking.

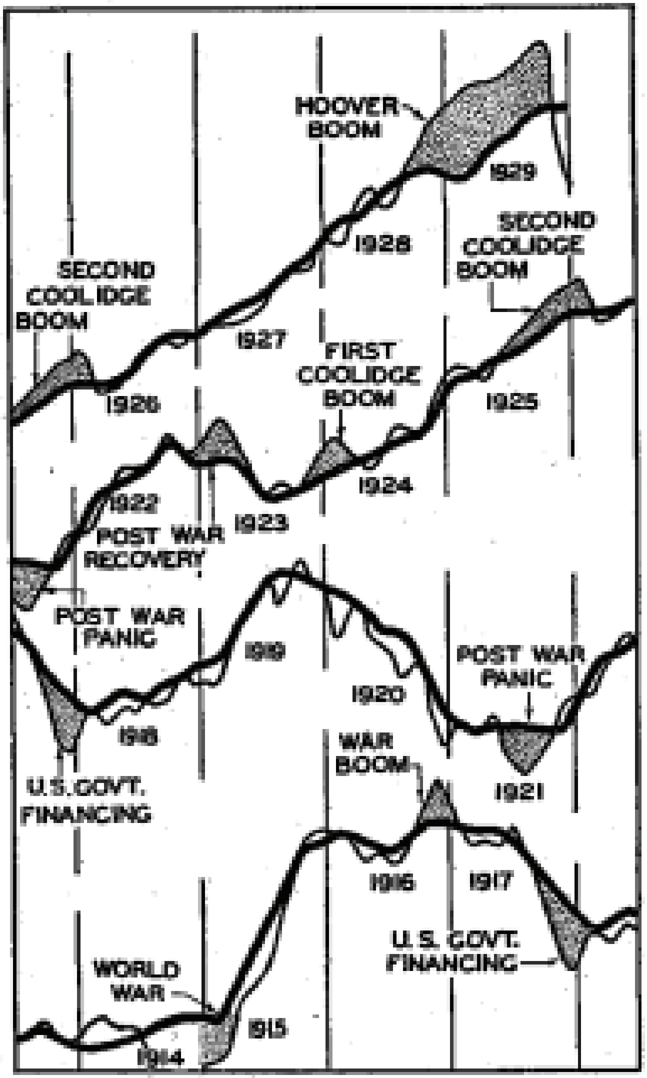


CHART 3.—Booms, recoveries and panics are here represented by departures from the Karsten "line of fundamentals" which is used to predict the course of stock prices. The Hoover boom and collapse represent the most serious departures from the line since 1913.

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## 2.2.2 Two Sides of the Picture

But it is not so easy to see in the foregoing picture the underlying factors of the panic, and to judge whether it sprang from vital defects of the business structure or from more superficial causes relating to credit and finance.

The avalanche came so swiftly, spreading such immediate and widespread disaster, that careful consideration of its origin is requisite.

The first symptomatic recession in the stock market in August and early September attracted comparatively little attention. Almost every recession during the course of the long bull market had been followed by recovery equal to the recession, and then progress upwards. But the decline of September 1929, although followed by an upward recovery, was renewed in October, and developed into terrific crashes lasting into November. Between the 5th of September and the 13th of November, the vast bear movement had carried stocks down by about 4.2 per cent, and reduced the value of stocks listed on the New York Stock Exchange by an estimated $26,000,000,000.

In the bull market stocks had reached a level more than double that of 1926—that is, the prices on the average of stocks on the New York Exchange had risen by more than 100 per cent in three short years. Before the November panic, the stock price level was not only twice the level of 1926, but nearly four times the level of 1913, before the war.

And that is not all. What has just been said applies to stocks, which were simply "held," so to speak. If an investor had bought stocks in 1913 and held them in his strong-box until September 1929, he would have had $400 for every $100 invested sixteen years before, and he would have had $200 for every $100 invested in 1926. Moreover, while stocks "held" in this way increased on average at a tremendous rate, stocks in active tradings among the market leaders increased still faster. To be specific, if in 1926 a trader, as distinguished from a strong-box holder; had bought stocks—which were then market favorites and had changed his holdings from week to week, so as each week to possess those which had proved most popular that week, instead of having merely the $200 for every $100 invested in 1926, as the strong-box holder had, he, the trader, would have $1,000 for every $100 of his original investment. These statements are evidenced by my two weekly indexes of stocks held and stocks traded—called the Investors' Index and the Traders' Index.

The public utilities stocks reached such a height that the average yield was only 3 per cent. Allied Chemical & Dye, one of the "blue chips," was selling so that the yield was only 1 3/4% per cent, and there were other stocks higher priced than that, and with correspondingly smaller yields. In many companies, the common stocks had lower yields than the bonds in those same companies.

Now with all these facts before us, we are tempted to conclude that such an advance in stock prices was thoroughly unsound, if not that deflation should go on until the level of 1926 should again prevail, or even that of 1913. Based on such a diagnosis, the prognosis would show the business of the country to be in a very bad way.

During the rise of the market, brokers' loans reached the unprecedented total of more than $8,000,000,000, and of this total $3,000,000,000 were cut off within a few weeks. Investment trusts, genuine and so-called, had become the fashion. They had absorbed $3,000,000,000 of investors' money, $1,000,000,000 of it during the rise of the market in 1929. They had had a rapid mushroom growth, rising from under 200 in number in January 1929, to 400 or more by the time of the panic.

The Federal Reserve Board had issued its warning of an inflated stock market back in March 1929, with a resultant shutting off of stock market credit that at once precipitated a near-panic. This was alleviated through the action of Charles E. Mitchell, Chairman of the National" City Bank of New York, who made $100,000,000 available to the market at high rates. For this accommodation Mr. Mitchell was severely criticized by Senator Carter Glass, a co-author of the Federal Reserve Act, and by other financial authorities. President Hazlewood, of the American Bankers' Association, in his annual address before that body, September 1, had complained about the high stock market and the enormous total of brokers' loans, so that the bankers passed a resolution condemning the situation as dangerous and asking for a thorough-going investigation of brokers' loans.

Here is a picture that portended-and predicted the disaster that came. In the rapidly mounting aggregate of margin accounts the unsoundness of the situation stands revealed. From it, many have hastily concluded that the new plateau of stock prices was wholly unwarranted and merely the result of insane speculation.

But there is another side of the picture. Of course, a judge is not fitted to pronounce judgment until he has heard both sides. There is the story of the Irish justice of the peace who heard one side of the case which was so convincingly presented that he said: "Stop. My decision is made." Whereat the opposing attorney cried, "Your Honor, you have not yet heard my side." To this, the learned judge answered: "I don't want to hear the other side. It might have a tendency to confuse the court. The case is perfectly clear to me now."

However confusing it may be to study this intricate problem, those legislators and leaders of business and finance, to whom the nation looks for guidance, owe it to themselves and their country to function as a fair court and to hear the other side.

To begin at the beginning: Since every stock price represents a discounted value of the future dividends and earnings of that stock, there are four reasons that may justify a rise in the price level of stocks:

(1) Because the earnings are continually plowed-back into business instead of being declared in dividends, this plowing-back resulting in an accumulation at compound interest, so to speak;
(2) Because the expected earnings will increase on account of technical progress within the industry;
(3) Because less risk is believed to attach to those earnings than formerly;
(4) Because the "basis" by which the discounting is made has been lowered.

When the situation is calmly examined, it is found that all four of these causes were at work, tending to raise the prices on the stock market during the years preceding the panic of 1929.

## 2.3 Chapter VIII: Scientific Research and Invention

A prime reason for expecting future earnings to be greater was that we in America were applying science and invention to industry as we had never applied them before.

Inventing is now a profession. Invention is today recognized as having a high cash value and is eagerly sought after by progressive corporations. The contrast with the past, even with a few years ago, is very great, and the contrast is enormous with a generation or a century ago.

We still talk about the wonderful innovations—power looms, steam engines and locomotives and the various elements in the English "industrial revolution" of the eighteenth century—which had such a profound effect on business and banking. But let us see who invented these inventions.

James Watt, inventor of the steam engine, was not a professional inventor. He was a maker of mathematical instruments. Richard Arkwright, who invented the spinning jenny was a barber. Edmund Cartwright, who invented the power loom, was a clergyman. Robert Fulton, who invented the steamboat, was a portrait painter. Invention was not then a vocation and was seldom appreciated until the inventor was dead and not even, then unless the invention was important.

Even within the memory of men now living the business world, looked askance upon inventors and upon scientific work in general, which was largely confined to the universities. The self-made business man would in such times say that he would have nothing to do with a college-bred man in his establishment; On the other hand, the university man of the academic type, was equally contemptuous of the man who was merely making money. It is said of Professor Louis Agassiz that when he was asked why he did not use his brains to build up a fortune, he replied that he was too busy to make money. Willard Gibbs, the greatest scientist America ever produced, the Isaac Newton or Einstein of America, lived out his days obscure and unappreciated except among a small group of specialists. It is now said of Gibbs that unlike any other scientist, none of his work has ever been undone. It is also said that in the metallurgical industry alone, billions of dollars have been made, thanks to Willard Gibbs. But it probably never crossed his mind that he was laying the foundations for others to make money. His studies were made from the hope of pure science alone.

But after 1919, something happened. The implications of it are not yet sufficiently gauged. It was of enough significance to cause President Hoover's Committee on Recent Economic Changes to remark that "acceleration rather than structural change is the key to an understanding of our recent economic developments." The committee added: "But the breadth and scale and 'tempo' of recent developments gives them new importance."

What has happened is indicated by the fact that in the United States, eight million three hundred thousand workers produced in 1925 one-quarter more than nine million wage workers turned out during 1919.

The new indexes of the Federal Reserve Board measuring industrial production record this gratifying advance which reflects an increase in the American standard of living. The indexes cover, directly and indirectly, four-fifths of the industrial production of the nation—directly in about thirty-five industries, and collaterally in many more. They were occasioned by the striking increase in recent years of the output of many industries; Thus the quantity of automobiles increased by 204 per cent between 1919 and 1925; the output of petroleum refining advanced by 108 per cent; rubber goods by 59 percent; glass by 78 per cent; cement by 101 per cent; brick, pottery and other clay products by 68 percent; chemicals and acids by 36 per cent; paints and varnishes by 40 per cent; carpets and rugs by 38 per cent; silk goods by 37 per cent; iron, steel and non-ferrous metals by 32 per cent; and various items of food, drink, and tobacco by from 6 to 51 per cent.

The general volume of production had increased between 1919 and 1927, inclusive, by 46.5 per cent; primary power by 22 per cent; and primary power per wage earner, by 30.9 per cent (between 1919 and 1925) and productivity per wage worker by 53.5 per cent between 1919 and 1927. During this period (1919-1927), wage earners in factories had decreased by 2.9 per cent, but wages paid increased by 1.4 per cent (1919-1925). Prime cost increased (1919-1925) by 7.2 per cent, but unit prime cost decreased by 24.5 per cent. Productivity per wage earner, which had increased very slightly between 1899 and 1909 and actually diminished from 1909 to 1919, took an unprecedented leap after 1921, recording its increase by more than one-half from 1919 to and including 1927, at the same time that unit prime costs were diminishing (1919-1925) by nearly one-quarter.

The measurement of this astounding increase in production and in values, mainly during the course of the long bull market, is accurate. The new index of production of the Federal Reserve Board being worked by what is I have called the "Ideal Formula" in my book *The Making of Index Numbers*, shows how far, in this machine-power civilization, man is emancipating himself from the curse of Adam. From the hewing of wood and the drawing of water, the sweat and toil of the old slave population, man has thrust his burden upon the machine. He now watches the index gauges reveal their welcome increases in per capita output.

What are the reasons for this throbbing change since 1919, and especially since 1922?

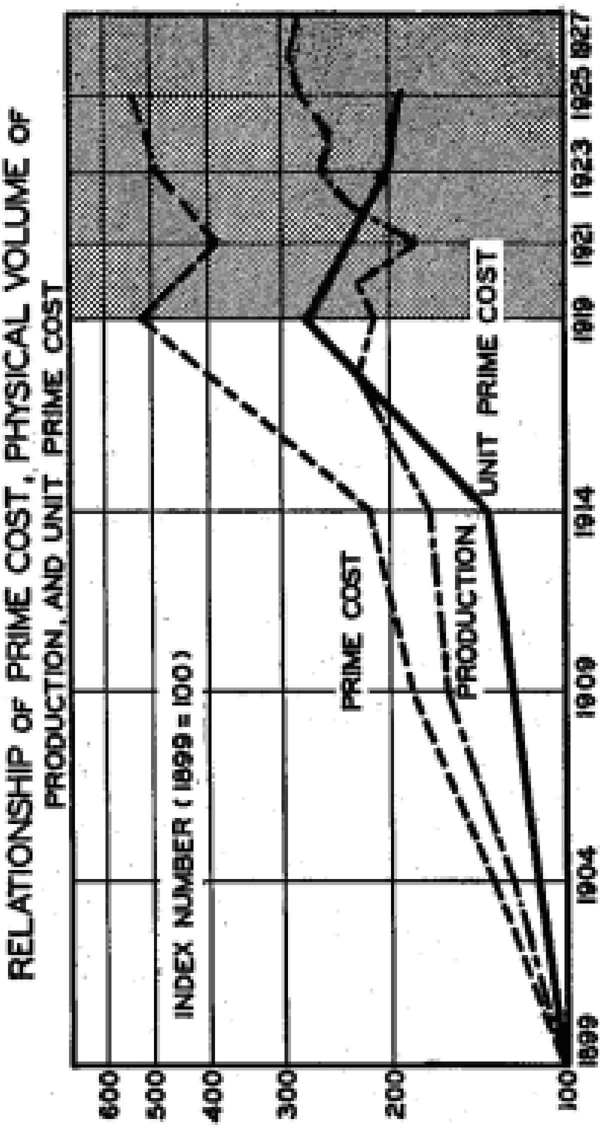


CHART 14.—By prime cost is meant the sum of labor and material costs. During the period 1919-1925, large scale production and sales combined with increased product per man to reduce sharply unit prime cost after it had risen for 20 years.

### 2.3.1 Scientific Workers in Industry

After the war there was an exodus of professors capable of scientific research from the universities into industry. This was chiefly what may be called an accident, due to war inflation. Professors' salaries had lost their purchasing power. There was a similar exodus from the scientific bureaus of the government in Washington. In order to live, research students and professors turned increasingly to the higher emoluments of industry, and industry soon found that it had tapped a new and vast resource in human ingenuity backed by scientific training. For almost the first time, science in America came to be appreciated for its cash value, the more so, perhaps, because the war had revealed how much farther Germany had made use of such technical science and invention than the rest of the world.

Another accidental cause of accelerating "tempo" of invention was that the war left wages 115 percent above the previous level and the cost of living only 70 percent above it. Employers feared to cut wages, lest strikes and diminished output result, and they turned to labor-saving inventions instead. Thus, a by-product of inflation, as in the case of the university professors, was pushed into industry to great economic advantage.

In the past few years the industries have added gigantic research laboratories to their, equipment. In the laboratory of the American Telephone and Telegraph Company today there are 4,000 scientific men—more than any university could equal. Industry has realized that the continued development of modern life, with its comforts and conveniences, depends upon scientific research. Inventions due to research are now the chief breadwinners of our industrial system.

Already more than three hundred substances indispensable to our life today are produced as by-products of the distillation of coal. Chemists have found hundreds of new uses for the former waste of the farm, which used to be so hard to dispose of. One of the chief topics of discussion today wherever employers, workers, engineers, scientists, bankers or educators gather together is scientific research.

At a recent meeting of the New York State Chamber of Commerce, Dr. Robert A. Millikan, one of the world's foremost physicists, took occasion to quote the words of Pasteur: "In our century science is the soul of the prosperity of nations, and the living source of all progress. Undoubtedly the tiring discussions of politics seem to be our guide—empty appearances. What really leads us forward is a few scientific discoveries and their application."

## 2.3.2 Edison as a Forerunner

The fiftieth anniversary of the work of Thomas A. Edison, in bringing forth the incandescent lamp, was celebrated during the summer and fall of 1929. As an inventor and organizer of inventive research, Edison is the symbol of the entrance of science into the industrial renaissance. His latest announcement of the invention of synthetic rubber derived from the common goldenrod is a triumph of organized research. Even at its comparatively high cost this invention of rubber would have checked the exactions of the foreign rubber monopolists and defeated the British plan for restriction of rubber output had it been brought out when Mr. Hoover, then Secretary of Commerce, was inveighing against their monopoly. Mr. Edison's researches with the object of further cheapening synthetic rubber are in process; in this his great staff may yet achieve another triumph that will be reflected in added economies and higher values of securities of the rubber industry.

The life of Edison really links the past, when science was scarcely appreciated, to the present when it is almost idolized. He was the first conspicuous professional inventor. The chief significance of this recent celebration of Edison by the world is not in his own singular contribution to progress, but in the extent of the appreciation of invention by the public.

This change, most of which has occurred since the war, and a great part of which has occurred during the time when prices doubled during the long bull market, is reflected in the congestion and recongestion in the Patent Office. Under Mr. Hoover, when he was Secretary of Commerce, the Patent Office had been reorganized in order to catch up with its work. But by the end of the fiscal year 1928-1929, the Commissioner of Patents reported that the "number of cases now awaiting action (103,236) is so great that at this rate of gain it would take from five to six years to make the work practically current, or so that an applicant who is paying the fees for performing the work may obtain an official action with reasonable promptness." In this report the Commissioner, Thomas E. Robertson, said:

"It is a noteworthy fact that more patents have been granted during the last ten years than during the 100 years from President Washington's inauguration in 1789 until President Harrison's inauguration in 1889."

## 2.3.3. Daily News of Inventions

Pick up the daily paper, and note the multiplying reports of new inventions and processes and business methods that are the outcome of scientific research. Almost every day's paper gives half a dozen new instances showing how inventions and the exploitation of them through the use of capital are affecting savings, producing short cuts and increased productivity. A cable dispatch from Berlin tells of a new method of producing synthetic helium by which Germany may be freed from the United States, where the chief natural supply exists. The same dispatch announces an interoceanic line of Zeppelins; which will require capital. The same paper tells of successful experiments in perfecting the seadrome; so that the model will be succeeded by a real seadrome, weighing some 40,000 tons, to be towed out 350 miles from shore and anchored. The account adds that it will cost $1,500,000,000. Money must always be raised to develop inventions, and the process usually adds to the volume of debt including brokers' loans.

In the same paper, there is the announcement of a new all-airline between New York and Los Angeles, spanning the continent in thirty-six hours. On another page is a report that in Poland a rivet-less bridge has been constructed by a new process of welding. There is also the news account of the distillation of coal to make fuel oil. An expert announces that the railroads are saving coal; one line uses 70 pounds now to 170 pounds used ten years ago.

There is the recent announcement of the front-drive car that is "pulled, not pushed" by its engine. There is the announcement by S. T. Bloom, a consulting engineer, of Chicago, that important new appliances in refrigeration will soon result in the quick freezing of retail meat-cuts, fruits, vegetables, dairy products—in fact, of every perishable foodstuff, and that office buildings, hotels, large stores, and even homes will soon he refrigerated in summer "as they are heated in" winter. Cornstalks have been recently utilized to make pulp for the production of newsprint paper, and now the chemists at the University of Illinois announce that the refuse from this process may be turned into gas for use on farms. A system of television is being adapted for broadcast service in the homes.

The largest and most powerful oil-electric locomotive in the world, a hurtling power plant, without need of a costly or overhead wire system, generates the power it consumes on the Canadian National Railways. Some 300,000,000 pounds of artificial silk, known as rayon among silk manufacturers, was made from cellulose during 1929. Elmer A. Sperry, inventor of the gyroscope compass, super-power searchlights and airway beacons, has just adapted an electrical machine for testing the rails of the great railways' system of the nation. A "Robot chemist" or an automaton with an electric eye, radio brains and magnet hands recently functioned without human supervision in an improvised laboratory before the New York Electrical Society in New York. It helped in producing an economic cold light, in analyzing a sample weighing a millionth of a gram, and in demonstrating a photo-electric cell used to control analysis in new scientific apparatus.

Samuel W. Parr states that the American output of chemical products alone has advanced in fifty years from an insignificant sum to more than $2,000,000,000 annually.

The American Chemical Society reports a tremendous increase in research by which pure and practical science has been advanced, and calls for half a million dollars more for the fund to report scientific knowledge. In his address at Dearborn, Michigan, on October 21, 1929, President Hoover said: "If we would have our country improve its standard of living and at the same time accommodate itself to increasing population, we must maintain, on an even more-liberal scale than ever before, our great laboratories of both pure and applied science."

The extent to which industrial research prevails as a new trend in manufacturing progress in the United States is revealed in the survey of the National Bureau of Economic Research, published in 1929 as part of the report on Recent Economic Changes of the President's Unemployment Conference, of which Mr. Hoover was chairman. Of the 599 manufacturing concerns supplying information, the report states 52 per cent recorded the carrying on of research as a company activity; testing laboratories were conducted by an additional 7 percent, leaving 41 per cent, or a minority, in which research work had not yet been initiated. These statistics were based on a questionnaire, sent out during 1928 to 5,000 manufacturing concerns with a commercial rating of one million dollars or over.

In certain industries, such as cement manufacture, leather tanning, gas and electric utilities, cooperative research had been organized, taking advantage of the activities of various national associations. In certain other industries such as the manufacture of machinery, machine tools, drugs, cosmetics and pharmaceuticals, individual concerns engaged in highly competitive work we're carrying on their own laboratories. Some 58 per cent of those reporting stated that their budgets for research were increasing from year to year, and 39 per cent reported that their research activities had already shown a profit.

The very names of many of the standard stocks on the Stock Exchange symbolize this new inventive and scientific era; as, for instance, the radio, airplane and motion picture stocks, such as Radio Corporation, Curtiss-Wright, and Fox Films. A vast number, whose names are not so indicative, are just as definitely founded on new inventions such as Maytag and Remington-Rand, while a still larger number, while of older vintage, such as American Telephone and Telegraph, General Electric, Allied Chemical and Dye, and Johns-Manville, have recently transferred or added to their processes new inventions.

A whole group of companies are exploiting inventions for the supremely important purpose of increasing power and effecting mergers on the basis of economies achieved through these inventions. Martin Insull, the Chicago power magnate, states that as a consequence of the added power which invention has contributed to industry, the forty-five and one-half million workers in the United States have achieved an output equivalent to from six hundred million to nine hundred million workers before the power era.

## 2.3.4 Greater Productivity Per Unit

By the enterprise of Mr. Insull, who is a chief executive of the electric power companies distributing power over sections of the Middle West, a. flood of light is poured upon a main cause of America's recent prosperity. This appears in a study entitled America's New Frontier published by the Middle-West Utilities Company. This company serves four thousand communities of less than ten thousand population.

Mr. Insull finds a tremendous savings the far greater productivity per unit of electric power distributed to small communities, as compared with power units in the congested cities.

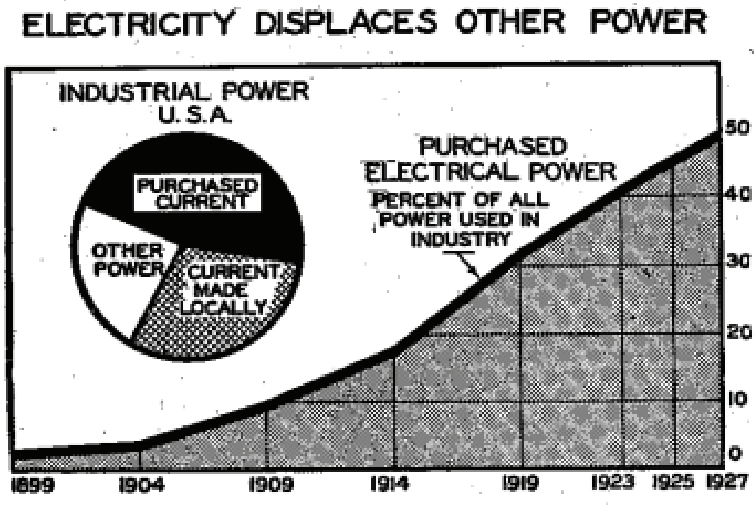


CHART 15.—Total primary factory power applied through electric motors increased, 1919-1927, from 55 per cent to 78 per cent. Inset: 50 per cent purchased, 28 per cent made locally.

Until 1910-1912, neither steam power nor early electric power could be distributed beyond the length of the leather transmission belt. Invention came in to permit long-distance transmission. Until then the big cities had had it all their own way in manufacturing. Only compact populations could use such power cheaply. The farms and small towns were part of the vast American hinterland, isolated, bucolic, remote from the currents of progress. Civilization was based on power, but it was distinctly urban. Up to twenty years ago the burden of the world's work had, it is true, been largely shifted from the backs of men to machines by power generated by the burning of fuel or the force of waterfalls. Then came mobile electric transmission. Along with it came the speeding of transportation of men and materials on railroads and by means of automobiles. A vast accession of usable power, accelerating every business transaction and means of human intercourse, is now being distributed at the point where it can be used most economically. It is spread more evenly over the land, relieving congestion in one place, remedying sparseness in another.

Distributable electric power travels with lightning speed. Qualities by which it quickens decentralizing tendencies in our industries are defined by Owen D. Young, as mobility, divisibility, applicability, and reliability. President Glenn Frank, of the University of Wisconsin, contrasts its advantages with steam power in these words: "In a machine civilization created by steam power, the worker must go to the power; but in a machine civilization created by electric power, the power can be taken to the worker."

The late Guy E. Tripp, Chairman of the Board of the Westinghouse Electric Company, was one of the first to discern the possibilities of the network of more than one hundred thousand miles of high voltage electric power lines, distributing energy over a large part of the United States, and making it an asset, not only in the big cities, but available at almost any point on the map. To this Mr. Tripp added the advantages of improved transportation—the faster rail service, the automobile and the highway systems, all of which made transportation flexible as well as more speedy

These causes work together to explain why the present gain in number of industrial wage earners is vivifying, as it were, the extremities of the nation, in the towns of less than 10,000 population. The smaller communities are living richer lives. They have better schools, they have built new highways. Nearly every family owns a car. Its members visit the 'metropolitan centers, but they return to the "open spaces" with all the amenities of the city. The amount of primary factory power applied through electric motors has increased from 5 percent in 1899 to 39 per cent in 1914, and to 78 percent in 1927. The increase exceeds one-fifth since 1919.

By the same speeding process, the motor car has increased prosperity and added to expectations of gains in real income. It has created the modern suburb, freeing it from the limited area around the railroad station. At the beginning of 1929, there were 5,426,900 motor vehicles on farms. Of these, 697,300 were motor trucks, and 4,729,600 were automobiles. Both the car and truck alike contribute to the fullness of life on the modern farm. The truck permits rapid haulage to the railways and prompt shipping to whatever markets offer the best demand at the moment. The motor car not only saves the farmer's time (a vital matter in view of labor shortage) but also gives his wife and children contact with the social advantages of the town-Churches, lectures, schools and the theater are all available to the family which owns a car.

As a consequence of this inventive triumph, road construction is going forward in the total-yearly investment of $1,500,000,000 for construction and maintenance. American surfaced highways now total 625,000 miles, which is approximately one-tenth of all the highways in the world, surfaced or otherwise.

The automobile industry has "hooked up" with other revolutionary inventions, the radio, motions and sound pictures, and the network of telephone, telegraph and the electric traction lines, purveying to the fundamental need of communication of all sorts. This is responsible for the great real estate developments that have taken place along parkways and suburban boulevards.

The transformation into a motorized existence helps further to explain the increased "tempo" of production and the rapid accretion in value of the securities of all industries that have been affected by the speeding-up processes of scientific research and invention.

### 2.3.5 Savings of Packing Industry

It is said of the packing industry that it utilizes "all of the pig but the squeal." The cost of beef, pork and lamb to the consumer is today much less than it would be had not the packing industries organized on a large scale and utilized every part of the slaughtered animal to increase their income and pay the costs of production. These costs were formerly paid for by the meat, the hides, and to a limited extent by the fat, bones and horns. Now every part of the animal contributes its quota to the total revenue.

The effect of utilizing these waste products is often to increase the income received by the farmer for his crops, as well as to lower the price of the staple crops to the manufacturer and consumer. In the future, factories may well be located in rural districts near the sources of the raw materials that have heretofore been wasted. Costs of farm products will be distributed over a large number of new products which now bring in nothing, and often entail costs up the farmer to get rid of them.

### 2.3.6 An Agricultural Revolution

Research is bringing about an agricultural revolution, which is of special significance in this discussion of enhanced values, since agriculture is the source of nearly all food and most raw materials utilized by man.

Economists classify agriculture as an extractive industry, subject to the tyranny of the law of “decreasing returns.” At a given stage of the science and art of agriculture, additional bushels of wheat or of any other crop could be wrested from the soil only with a disproportionately increased expenditure of labor and capital. If there were no changes in the methods of agriculture, foodstuffs and other raw materials and products of the farm must continuously advance in price as population increases and the demand for farm products grows. But this, which was the logic of Ricardo, Malthus and their followers, implies that practices and appliances remain unchanged. Under such assumptions the theory is correct. But economists cannot reckon without taking account of the scientific researchers and inventors who have revolutionized agriculture half a dozen times since the eighteenth century, until today scientific farming has been transformed almost into a manufacturing industry.

Subsoil plowing, better fertilizers, better breeds of farm animals, new and improved crops, utilization of waste products, and, last and most important, improved means of transportation have increased manifold the area and productivity of economic land since Ricardo laid down his famous law of rent, based upon the “permanent and indestructible qualities of the soil.”

Agricultural chemists long ago taught the farmer the value of soil analysis for showing what lands are suited to particular crops, what kinds of fertilizer to use. These chemists have found hundreds of new uses for the former wastes of the farm, which used to be so hard to dispose of. Cottonseed, which formerly was a nuisance, is now a crop second only in value to the cotton fiber itself. The cellulose of straw is now being worked up into wallboard and building material. Up to the present our corn fields have produced only a single crop, corn, to repay the farmer for his toil and capital outlay. The cornstalks, heretofore largely waste, are now being made into writing paper and other papers of excellent quality, while from the corncobs come furfural, which may supplement or supersede gasoline in our motor cars and gas engines. Bagasse, the waste of sugarcane, makes a standard wallboard.

How revolutionary inventions for farming have become is seen in the new Mason Process of drying alfalfa. This invention permits "making hay while it rains" as well as while the sun shines, and makes practicable the growing of this main forage crop in the states of heavy rainfall in. the East, where the chief dairy herds are located. It is reducing a dairy system from the need of devoting ten to one hundred acres to pasture per cow to a system whereby three animals can be kept in prime condition on one acre. In his forthcoming book, *The Great Food Problem and Its Solution*, Dr. Orrin W. Willcox, calculates that the earth's population may increase in almost unbelievable numbers through application of recently discovered laws of plant growth, chemical fertilization, and transmutation of food properties. These, combined with selection of plants with highest power to absorb nutrients from the soil, Dr. Willcox says, may permit a maximum density of population of ninety-six thousand people per square mile!

What has been said of farming is also true of other basic industries. The wastes of our forest areas have become and will become increasingly the sources of foodstuffs, of specialized building materials and of chemicals of great value. If research and invention should cease, the Malthusian law of population might begin to operate rigorously and property grow apace. But we are only just beginning to scratch at the surface of the earth for the material conveniences and sources of power which can be made to minister to our needs and comforts. Our continued progress in well-being rests absolutely upon the ability of the chemists, physicists and engineers to-extract further utilities from the earth-faster than the ever-growing population can consume them.

But the rate at which they have accelerated this process in recent years readily accounts for the increased real income of the nation, which, with its prospects of still greater income, have warranted the higher plateau of securities by which the nation's industries and economies are valued. The prospects of still greater income need emphasizing. The difficulty in most cases has been that the securities affected by inventions and rapid growth have often been sold at high prices after and not before the greatest ratio of growth took place. It is future growth, not past growth, that gives value. In recent years the stock market has reflected increasingly through the operations of investment counsel and investment trusts, more intelligent calculations of future growth.

### 2.3.7 Effect of Invention on Price-Earnings Ratio

The effect of new inventions on the ratio of the price of stocks to earnings is to increase that ratio, because what gives these new stocks their value is the future earnings after the new process will have had time. This necessarily implies that, in the meantime, the earnings are so small that the price-earnings ratio is high. For instance, the public utilities, up to the September and October breaks in the market, showed a ratio of prices to earnings of more than 20 to 1. That is, the prices of stocks were over twentyfold the earnings. The reason for this high level of prices relative to earnings lay partly in the increased gains to be expected in the spread of application of new inventions through the power group of industries. There has been much careless talk, since the crash, about stock prices having been inflated far above what earnings warrant. But the people who say this so glibly do not specify the particular stocks. When any actual stock is examined with an unusually high price relative to its current earnings it is almost invariably found that it represents a new and very promising invention, and that those who have bought the stock and put its price so high are not so much the ignorant public as the insiders, who have carefully weighed and measured the future prospects, and who have bought the stock when the current earnings were near zero, making a price-earnings ratio of even over 100 to 1 for the time being. That is what happens whenever one "gets in on the ground floor."

The more recent the invention, the higher the ratio of price to earnings is apt to be, because in its early stages the earnings have not had time to develop.

It follows that the larger the proportion of stocks representing new inventions in the index, as compared with the number of stocks of the ordinary variety, the higher the price-earnings ratio of the whole group. It further follows that today, with so many more of these new-invention companies listed on the stock exchange, the price-earnings ratio should be higher than formerly. With the increased application of research, American investors are justified in greater expectations of future dividends.

# 3. THE 1929 STOCK MARKET: IRVING FISHER WAS RIGHT

ELLEN R. MCGRATTAN AND EDWARD C. PRESCOTT[1]

## Abstract

Many stock market analysts think that in 1929, at the time of the crash, stocks were overvalued. Irving Fisher argued just before the crash that fundamentals were strong and the stock market was undervalued. In this article, we use growth theory to estimate the fundamental value of corporate equity and compare it to actual stock valuations. Our estimate is based on values of productive corporate capital, both tangible and intangible, and tax rates on corporate income and distributions. The evidence strongly suggests that Fisher was right. Even at the 1929 peak, stocks were undervalued relative to the prediction of theory.

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[1] McGrattan, Ellen R. and Edward Prescott. "The 1929 Stock Market: Irving Fisher Was Right," International Economic Review 45(4), (2004) 991-1009. The Federal Reserve Bank of Minneapolis and University of Minnesota, USA; Arizona State University and Federal Reserve Bank of Minneapolis, USA. We thank two anonymous referees, the editor, and seminar participants at the Bank of Portugal, the Federal Reserve Bank of Chicago, the SED, MIT, the University of Michigan, the University of Kansas, and the Federal Reserve Bank of Kansas City for their helpful comments. We especially thank Kent Daniel and Lee Ohanian for comments on an earlier draft. We also thank the National Science Foundation for financial support. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System. Please address correspondence to: Edward C. Prescott, Research Department, Federal Reserve Bank of Minneapolis, 90 Hennepin Avenue, P.O. Box 291, Minneapolis, MN 55480-0291. Phone: 612-204-6455. E-mail: edward.prescott@asu.edu.

## 3.1 Introduction

"Fisher Says Prices of Stocks Are Low," said a headline in the *New York Times* on October 22, 1929, referring to economist Irving Fisher. Two days later, the stock market crashed, and by the end of November the New York Stock Exchange was down 30% from its peak. Fisher had based his statement on strong earnings reports, few industrial disputes, and evidence of high investment in research and development (R&D) and in other intangible capital. But, since market prices fell dramatically so soon after Fisher's statement, most analysts and economic historians concluded that Fisher was wrong: in October 1929 stocks were overvalued. In this article, we use modern growth theory to evaluate this conclusion. When stocks of corporations are correctly priced, this theory says, their market value should equal the value of corporations' productive assets, what we will call the *fundamental value of corporations.*[2] Productive assets include both tangible and intangible assets. We have direct measures of corporate tangible capital and land and of the tax rates that affect the prices of these assets. We also have measures of profits and the growth rate of the economy that, together with the tangible capital measures, allow us to infer the size of the stock of intangible capital in the corporate sector. We can thus compare the total value of corporate productive assets to the actual market value of corporate stocks at the time of the crash.

Our results support Fisher's view. A conservative estimate of the fundamental value of U.S. corporations in 1929—which assumes as low a value for intangible capital as observations allow—is at least 21 times the value of after-tax corporate earnings (or 1.9 times gross national product or GNP). The highest estimate of the actual 1929 market value of corporate stocks (based on samples of publicly traded stocks) is 19 times the value of after-tax corporate earnings at their peak in 1929 (or 1.67 times GNP). This is strong evidence that Fisher was right: Stock prices in the fall of 1929 were a little low relative to fundamental values.

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[2] Another approach that has been taken to determine whether the stock market in the late 1920s was overvalued is to estimate the present value of future dividends using dividend and interest rate data. With this approach. Findings have varied. Compare, for example. Shiller's (1981) Figure l with Donaldson and Kamstra's (1996) Figure 7. The reason is that accurately estimating the present value of dividends in this way is difficult, if not impossible.

Our estimate of the fundamental value of corporations depends in an important way on the value of intangible capital owned by corporations. Fisher's (1930) conclusion that the stock market was not overvalued in August of 1929 followed from his view that the corporate stock of intangible capital was large. We find that only if the value of corporate intangible capital was zero and the real return on tangible capital was very high by historical standards would the conclusion reached by De Long and Shleifer (1991) and Rappoport and White (1993)—that the stock market was 30% overvalued follow.

Then the question is how big is the stock of corporate intangible capital? Fisher (1930) provides many examples of intangible investments, but was limited to anecdotal evidence to make his case that the stock in 1929 was large. We do not have direct measures either, but we use national income statistics to construct an estimate.[3] We show that even for the smallest level of intangible capital consistent with the data, the stock market in October 1929 was not overvalued relative to the predictions of theory. We estimate that the stock of intangible corporate capital was sizable—at least 60% of the stock of tangible corporate capital.

If stock prices were not inflated beyond their fundamental values in October 1929, why did the market crash? Answering that question is not addressed here. But we can point out here that the dramatic decline in stock prices is consistent with monetary policy actions at the time.[4] Before the crash, the Federal Reserve severely tightened credit to stock investors because, it said, “the unprecedented rise of security prices gave unmistakable evidence of an absorption of the country's credit in speculative security operations to an alarming extent” (Federal Reserve Board, 1929, 1-2). Not long after the crash, the Fed eased credit, and stock prices recovered.[5] This correlation is worthy of its own detailed investigation.

[3] The large decline is also coincidental with the speech on October 25 by Attorney General Mitchell, who said he would deal vigorously with antitrust violations (see Bittlingmayer, 2002).

[4] Hall (2001) has an alternative way to estimate the value of corporate intangible capital, namely the value of corporate equity and debt less the value of corporate tangible assets. His method cannot be used for determining whether the stock market is over or undervalued as it assumes that the market is correctly valued.

[5] The recovery in stock prices is evidence that a Great Depression was unexpected in 1929 and early 1930. Additional evidence of that is provided by Dominguez et al. (1988), who use historical data to forecast future output.

**Table 3.1: Five Estimates of Market Value of All U.S. Corporations on August 30, 1929 Based on Subsets of Corporations**

| Data Source and Coverage Value/GNP | Market Value of Companies Covered ($Billions) | Price/Earnings Ratio | Estimated Total Market |
|---|---|---|---|
| Sloan (1936), 135 industrials | 30.8 | 17.5 | 1.54 |
| S&P, 50 industrials | 26.2 | 18.4 | 1.62 |
| S&P, 90 composite | 43.3 | 19.0 | 1.67 |
| Fisher (1930), 45 industrials | n.a. | 14.1 | 1.24 |
| NYSE, 846 listed | 89.7 | n.a. | 1.24 |

## 3.2 The Market Value of U.S. Corporations in 1929

To assess Fisher's view that stock prices in 1929 were low, we first report estimates for the *market value* of U.S. corporations at the end of August 1929, when stock prices peaked. By “market value” here, we mean the market capitalization of corporations. Data are available for large, representative subsets of U.S. corporations. Here, we use these data to produce a range of estimates for the market value of all U.S. corporations.

Table 3.1 reports five estimates of the market value of all U.S. corporations at the end of August 1929 relative to GNP in 1929. The first four estimates are obtained by multiplying the ratio of price to after-tax earnings (the P/E ratio) for a subset of corporations by the total U.S. after-tax corporate profits of the U.S. economy. All estimates are relative to 1929 GNP. This is a good way to estimate the total market value as long as the P/E ratio for the set of corporations is near the P/E ratio for the corporate sector as a whole. Also reported in Table 3.1 are the market value relative to GNP and the P/E ratio for each subset of companies. The fifth estimate in Table 3.1 is obtained by multiplying the market value of all companies trading on the New York Stock Exchange (NYSE) by a factor that held throughout the post-World War II period; for that period, we have data on the market value of all corporations from the Federal Reserve Board's U.S. flow of funds accounts (Federal Reserve Board, 1945-2000).[6]

In Table 3.1, the estimates for the market value of U.S. corporations range between 1.24 and 1.67 times GNP. We think that the best estimate is 1.54 times GNP, which is 17.5 times after-tax corporate earnings. This estimate is based on the study of Sloan (1936). The estimate we will use as

[6] This estimate is essentially the same as that of Jovanovic and Rousseau (2001), who use the same data sources.

the actual market value in our comparison, however, is 1.67 times GNP in 1929, or 19 times the after-tax corporate earnings in 1929, based on the Standard and Poor's (S&P) composite price index. By using a high estimate of the market value, we are being conservative in evaluating Fisher's view that the stock market was not overvalued just before the crash of 1929.

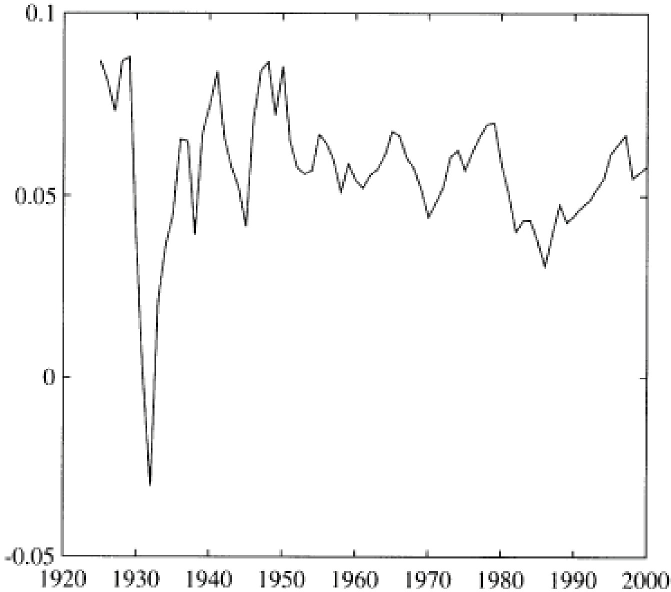
We view the estimate of Sloan (1936) as the best because it is the result of a detailed study of 135 industrial corporations, using the best data available at the time. The study was done at the Standard Statistics Company, which later merged with Poor's Publishing to become Standard and Poor's. The corporations studied had fully documented financial histories over the 1922-33 period and were thought to be representative of large companies in business at that time. The study provides detailed income accounts and balance sheets for the aggregate and specific details for major industries and major corporations.

At the peak of the stock market in late August and early September 1929, the common stocks of the companies in Sloan's (1936) sample had a market value of $30.8 billion. This is about one-third of the market value of all stocks traded on the NYSE at that time. For the year 1929, the after-tax net profits available for the common stock of these companies totaled $1.76 billion. If the companies in the Sloan (1936) study are representative of the U.S. economy, then we can use the market value and after-tax profits for these companies to get an estimate of the total value of all corporations.

In Figure 3.1, we plot the annual ratio of economy-wide after-tax corporate profits to GNP in the United States between 1925 and 2000. Starting in 1929, these data are available in the U.S. national income and product accounts (NIPA) published by the BEA in its *Survey of Current Business.* For earlier years, we must construct our own measures of after-tax corporate profits; we do so by applying the BEA's methodology. For 1929, the BEA reports after-tax profits equal to 8.8% of GNP. Using the BEA's methodology, we estimate that although profits were high in 1929, this year was not an outlier. After-tax profits in all years from 1925 to 1929 were high by postwar standards.

If we multiply the P/E ratio of Sloan (1936), 17.5, by 1929 total NIPA earnings, we get an estimate for the market value of all corporations in late August and early September 1929 of 1.54 times GNP [=(30.8/1.76)x0.088].

Figure 3.1: The Ratio of After-Tax Corporate Profits to GNP, 1925-2000

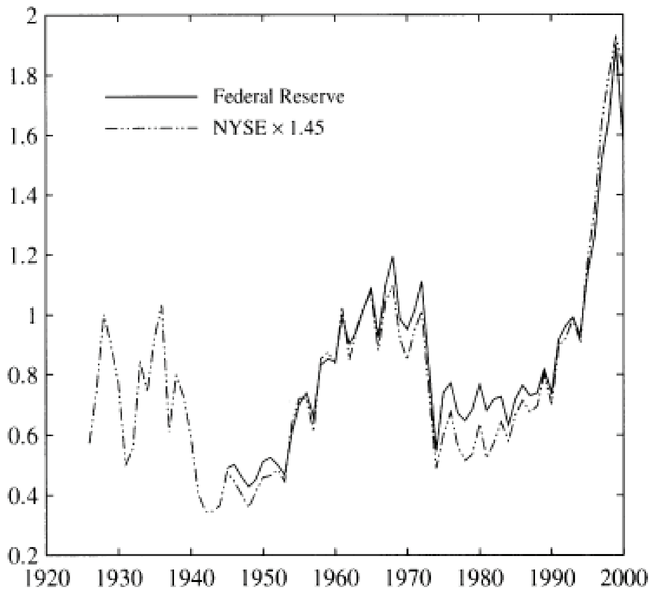



We use the same procedure with companies in the S&P indices. In Table A3.2 of our Appendix, we provide a list of the 50 companies in the S&P industrial index, the 20 companies in the S&P index of railroads, and the 20 companies in the S&P index of public utilities. The S&P composite stock index comprises these 90 companies. Along with names, we report on the market capitalization of each company at the end of August 1929 and their net earnings for the year 1929. The market capitalization is computed with data from the University of Chicago's Center for Research on Security Prices (1926-2000) (CRSP). Net earnings are the after-tax profits for common stockholders, which is the sum of common stock dividends plus surplus for the year reported by Moody's Investor Services (1930) and Poor's Publishing Company (1930).

For the 50 industrial companies in the S&P index, the ratio of the total market capitalization to net earnings is 18.4. Aggregate earnings and this PIE ratio imply an estimate for the aggregate market capitalization of 1.62 times GNP. This is slightly higher than Sloan's (1936) estimate, which was based on a broader subset of industrial companies.

To compute an estimate of the total market capitalization using all 90 companies in the S&P composite index, we first construct weights on industrials, railroads, and public utilities using the entire population of companies in the CRSP database for August 1929. We find that the market capitalization of railroads (SIC 4000) in the CRSP population is 12% of the total. We find that the market capitalization of public utilities-including electric, gas, and sanitary services (SIC 4900) as well as communications (SIC 4800) and local and interurban passenger transit (SIC 4100)-accounts for 17% of the total market capitalization of the CRSP population of companies. The remaining 71% is assumed to be in industrials. With weights of 23%, 32%, and 45% on railroads, utilities, and industrials, respectively, we match aggregate market capitalizations with the S&P subsample.

Figure 3.2: Two Measures of the Value of U.S. Corporations, End of Year, Relative to GNP, 1925-2000




If we weight market capitalizations and net earnings for the three S&P categories and then take the ratio, we have a P/E ratio of 19.0.[7] Aggregate

[7] Stock prices fell by about 30% between the end of August and the end of December 1929. Multiplying our estimate of the P/E ratio for the end of August by 0.7 gives 13.3. This is equal to the ratio of the end-of-year market capitalization to 1929 earnings reported by Standard and Poor's (1990)

earnings and this P/E ratio imply an estimate for the aggregate market capitalization of 1.67 times GNP, which is close to that for industrials only.

An estimate of 19.0 for the P/E ratio is significantly higher than that reported by Fisher (1930), who cites the Standard Statistics Company as the source for his data. Fisher's Chart 11 shows monthly P/E ratios for 45 industrial companies between 1928 and 1929. If we take a 12-month average ending in August 1929, we find the P/E ratio to be 14.1, which is consistent with a total market capitalization of 1.24 times GNP. Unfortunately, there is some ambiguity as to whether Fisher's numbers are averages of P/E ratios or ratios of market capitalization to total earnings.

But there is other evidence on the total market capitalization in 1929 that is consistent with Fisher's estimate. Throughout the postwar period, the market value of all listed shares on the NYSE was very near to 69% of the total value of all domestic corporations reported by the Federal Reserve Board (1945-2000). We use that statistic to convert NYSE values to data for all U.S. corporations. In Figure 3.2, we plot the end-of-year market value of all listed shares on the NYSE multiplied by 1.45 (or 110.69) for the period 1925-2000 and the end-of-year total value of all domestic companies from the Federal Reserve for the period 1945- 2000. The Fed's measure includes the total value of equity of all publicly traded and closely held domestic corporations plus the value of their net debt (debt liabilities less debt assets). Before 1974, net debt is a small share of the total value. In 1929, net debt is actually slightly negative, according to the aggregate balance sheet figures reported in the *Statistics of Income* by the U.S. Internal Revenue Service (1916-99) (IRS); corporations were net creditors.[8]

Figure 3.2 shows that the market value of NYSE-listed shares as a fraction of the total value of all U.S. companies has been remarkably constant. The two time-series in Figure 3.2 are close for the entire post-World War II period—not only on average, but also at peaks and troughs. If we assume that the ratio of NYSE values to the total is about 1.45 in the pre-World War II period as well, we can use the NYSE market capitalization in August 1929 to get an estimate for the total value of all U.S. corporations. The market value of shares for the 846 companies listed on the NYSE in August 1929 was $89.7 billion. Thus, our estimate of the total value is about $130 billion (=$89.7 x 1.45), or 1.24 times 1929 GNP. If we assume that aggregate earnings are 8.8% of GNP, this implies a P/E ratio of 14.1, which is the same as Fisher's (1930) estimate (based on 45 industrial companies).

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[8] Thus, any measure that we get of the value of corporate equity in 1929 overstates the total value of corporations, equity plus debt.

To summarize, the range of estimates for the market value of all U.S. corporations relative to GNP is from 1.24 to 1.67. We think that Sloan's (1936) estimate of 1.54 is the best, but to be conservative, we will work with the highest estimate of 1.67 times GNP, or 19 times corporate earnings.

## 3.3 The Fundamental Value of U.S. Corporations in 1929

Now we need an estimate of the *fundamental value* of U.S. corporations to compare with the market value just reported. By "fundamental value" here, we mean the value of the underlying productive assets-both tangible and intangible-of the corporate sector. In this section, we construct a lower-bound estimate of the fundamental value of U.S. corporations in August 1929. We show that this estimate exceeds the contemporary market value of U.S. corporations.

If corporate investments are positive and funded out of retained earnings, growth theory says that the fundamental value of a corporation should be equal to

$$V = (1 - \tau_{dist})(K_T' + (1 - \tau_{prof})K_I') \tag{3.1}$$

where $K_T'$ is the end-of-period resource cost of tangible capital, $K_I'$ is the end of-period resource cost of intangible capital, $\tau_{dist}$ is the tax rate on corporate distributions, and $\tau_{prof}$ is the tax rate on corporate profits.[9] The price of tangible capital for the shareholders is $(1 - \tau_{dist})$, not 1. The distribution tax affects this price because a dollar reinvested is not taxed, but a dollar distributed is. The price of intangible capital also depends on the corporate profits tax rate because investments in intangible capital are expensed and reduce taxable corporate income.

In the next sections, we describe the measures we use for the tax rates and capital stocks.

**3.3.1 Marginal Tax Rates**. We start our computation of the fundamental value of corporations by estimating effective tax rates corporations faced in 1929. The two rates we need are those in Equation (3.1): $\tau_{dist}$ and $\tau_{prof}$.

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[9] For details on the derivation of Equation (3.1), see McGrattan and Prescott (2003a). In McGrattan and Prescott (2003a), we also include the possibility of capital subsidies that are not relevant for 1929.

**Table 3.2: Marginal Tax Rates on U.S. Corporate Income, 1925-29**

| | % Tax Rate on | |
|---|---|---|
| Year | Profits | Dividends |
| 1925 | 15.1 | 9.8 |
| 1926 | 15.1 | 10.0 |
| 1927 | 15.7 | 10.2 |
| 1928 | 14.1 | 11.0 |
| 1929 | 13.2 | 10.3 |
| Average | 14.6 | 10.3 |

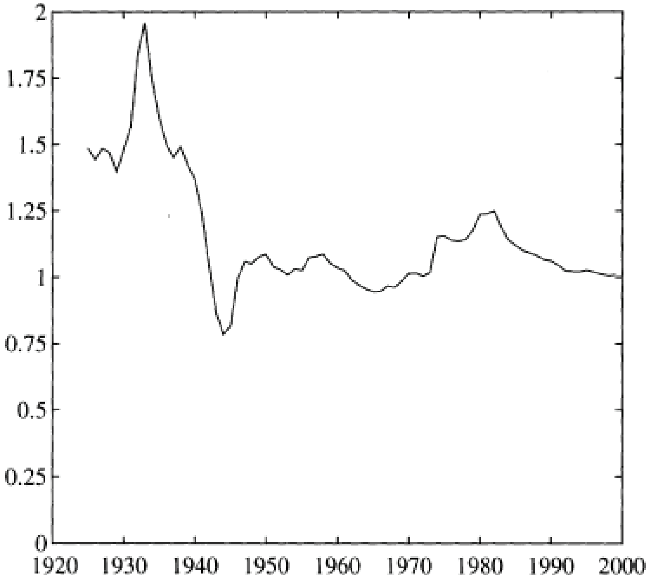
In Table 3.2, we report marginal tax rates on U.S. corporate profits and dividends for the years 1925-29. These are estimates of the tax paid on an additional dollar of these income types. Calculating the tax rate on profits is straightforward: We take the ratio of the NIPA profits tax liability to the before-tax profits (from Table A.3.1 in the Appendix). The tax rate on dividends is more complicated: It is a weighted average surtax rate on net income computed from data compiled and published by the U.S. Internal Revenue Service (1916-99). In 1929, individual incomes were subject to either the normal tax or a surtax or both. As the names suggest, the normal tax was meant to be the primary source of revenues during non-emergencies. The surtax was used to meet revenue shortfalls typically occurring during wars or crises. The normal tax was not assessed on dividend income, but the surtax was. To compute a single tax rate on dividend income, then, we take a weighted average of surtax rates assessed on each net income class, where the weights are fractions of dividend income for each class (see the Appendix for details).

Both tax rates shown in Table 3.2 are nearly constant over the 1925-29 period, a period of stable tax policy, and low when compared to rates during and after World War II. The tax rate on corporate profits was on average 14.6%, and the tax rate on dividends was on average 10.3%.

**3.3.2 Capital Resource Costs**. By "resource cost," we mean the tax-unadjusted cost of attaining the asset. In the case of tangible capital, it is reproduction costs. We need estimates of the costs of capital assets, both tangible and intangible. We show that accounting for only tangible capital leads to the conclusion that the stock market in 1929 was close to 30% overvalued. Taking account of intangible capital as well-which Fisher (1930) argued was economically important—leads to the opposite conclusion: The stock market was not overvalued. In this way, we see that inclusion of intangible capital is crucial in the analysis.

**3.3.2.1 Tangible corporate assets**. We start with the resource cost of tangible capital, by which we mean things such as structures, equipment, and inventories, and add to the BEA measure of that the value of land in the corporate sector. Prior to 1947, inventories are not reported by the BEA so we instead use the value of inventories from balance sheets on corporate tax forms available from the IRS' *Statistics of Income.* For corporate land, we use nonresidential land from corporate balance sheets reported in Goldsmith (1956) and the *Statistics of Income.*

Figure 3.3: The Ratio of U.S. Corporate Tangible Capital and Land to GNP, 1925-2000




In Figure 3.3, we plot the total resource cost of end-of-period tangible capital plus the value of land, both relative to GNP, for the period 1925-2000. In 1929, the resource cost of total measured, tangible capital, which includes the value of inventories and land, was 1.4 times GNP.[10] This ratio changed little until the Great Depression period, when output fell more than 30%. By postwar standards, 1.4 times GNP is high. But tax rates on capital were much higher in the postwar period.

[10] We have left out capital of foreign subsidiaries, which is also not included in BEA measures. But this capital is insignificant in 1929.

Using the average tax rates in Table 3.2 and our formula (3.1), we compute a fundamental value of 1.26 times GNP [=(1-0.103)x1.4] for tangible capital alone. Our estimate for the actual market value is 1.67 GNP—33% higher than the fundamental value of tangible capital.

#### 3.3.2.2 Intangible corporate assets: The determining factor.

De Long and Shleifer (1991) and Rappaport and White (1993) both argue that the stock market was significantly overvalued in August 1929-by as much as 30%.[11] Since our estimate so far includes only corporations' tangible assets, an overvaluation of 30% is consistent with predictions of standard growth theory only if the value of intangible assets was negligible. Was it? Fisher (1930) did not think so. He based his view that stock prices were low in 1929 largely on his view that intangible assets were economically important. In this section, we use data that Fisher (1930) did not have to derive a conservative estimate for the value of all intangible capital at the time of the crash. In particular, data from the U.S. national accounts and sources used by the BEA suggest that the value of intangible capital at that time was at least as high as 0.57 times 1929 GNP.

Investments in intangible capital include investments in scientific research and invention, in patent and monopoly rights, and in organizational capital. Fisher (1930) provides some anecdotal evidence that these types of investments were significant in 1929 and were resulting in high economic profits and high stock values.

According to Fisher (1930), industrial research increased significantly after World War I. Scientists from universities and government labs moved to industry jobs in part because their real wages had fallen significantly with wartime inflation. An example Fisher cites is the American Telephone and Telegraph Company, which employed 4000 scientists, “more than any university could equal” (Fisher, 1930, p. 125). Fisher also cites a study of the National Bureau of Economic Research (NBER), which found that research was being done at 59% of the 599 manufacturing firms surveyed. Examples of new inventions reported in “almost every day's paper” (p. 127) at the time include rivet-less bridges, distilled coal for fuel oil, front-drive cars, pulp made from cornstalk, railroads requiring no overhead wire, artificial silk, and automata with electric eyes. In his fiscal year 1928-29 report, the Commissioner of Patents noted that more patents had been granted during the previous 10 years than over the 100-year span 1789-1889 (Fisher 1930, 127). Implicitly, Fisher's view is that these inventions and

[11] Both studies take a very different approach from ours here.

patents had led to a large stock of intangible capital and would continue to for some time.

Fisher (1930) also cites "management engineering" (p. 144) as a reason for increased stock values. What Fisher means by this is the introduction of methods for better coordination of production and sales and for better planning of plant layouts and the subdivision of tasks. Fisher refers to it as the "Fordizing" (p. 142) of business. He cites a study done by the NBER, which concluded that "the greater complexity of business problems and of the organization necessary to cope with them, have forced attention upon better methods of coordinating the plans and the work of specialists and executives" (Fisher, 1930, 143). In other words, these investments enhanced the stock of corporate intangible capital.

Although Fisher had many good examples of intangible capital, he did not have sufficient data to actually measure it. We do. As we show in McGrattan and Prescott (2000), we can estimate the value of intangible capital using data from the U.S. national income and product accounts, available since 1929. In particular, we can infer $K_i$ from the following relation between after-tax NIPA profits and corporate capital stocks:

$$\Pi = iK_T + (i-g)(1-\tau_{prof})K_i \tag{3.2}$$

where $\Pi$ is the after-tax NIPA profits, $i$ is the real interest rate, and $g$ is the trend growth rate of real output.[12] Two assumptions are needed to derive Equation (3.2)

First, we assume that the after-tax rate of return for tangible corporate capital is equal to the rate of return for intangible corporate capital and all other types of capital. (This is $i$ in (3.2)) Otherwise, firms would not be operating in the interest of their owners. Second, we assume that tax policy is unchanging, so that steady-state analysis is appropriate.[13]

To see why (3.2) holds, consider how the BEA computes NIPA corporate profits. Suppose that the true income from capital in the corporate sector is $r_T K_T + r_I K_I$ where $r_T$ and $r_I$ are rental rates for tangible capital and intangible capital, respectively. If we subtract depreciation allowances for tangible capital, property taxes, and any expenses like R&D that are related to intangible investment, we have the BEA measure of before-tax corporate profits. This is the income subject to corporate profits tax. Thus, the BEA measure of after-tax corporate profits is:

[12] For details on the derivation of Equation (3.2), see McGrattan and Prescott (2000, 2003a).

[13] Support for this assumption is Table 3.2 and the time series of macro aggregates in Kendrick (1961).

(3.3) $$\Pi = (1-\tau_{prof})(r_T K_T + r_i K_l - \delta_T K_T - \tau_{prop} K_T - X_l)$$

where $\delta_T K_T$ is the depreciation rate of tangible capital, $\tau_{prof}$ is the property tax rate, and $X_l = K_l' - (1-\delta_l)K_l$ is intangible investment. In McGrattan and Prescott (2003a), we show that the real after-tax return to tangible investment is $(1-\tau_{prof})(r_T - \delta_T - \tau_{prop})$, and the real return to intangible investment is $r_l - \delta_l$. The return on intangible investment is not affected by the corporate income tax rate because intangible investment can be expensed whereas tangible investment must be capitalized. Equation (3.2) follows immediately from the fact that both of these returns are equal to , the real interest rate.

Using (3.2), we can infer the resource cost of intangible capital using observations on after-tax corporate profits (Figure 3.1), the resource cost of tangible capital (Figure 3.3), and the tax rate on corporate profits (Table 3.2). We also need estimates of the real interest rate *(i)* and the trend growth rate of the economy (*g*).

We start with an estimate of the real interest rate *i*. Because of unmeasured intangible investment, we cannot directly infer *i* from corporate profits and corporate capital. But we can infer *i* from data for the noncorporate sector, which invests only a negligible amount in scientific research, organizational capital, and other intangibles; most of noncorporate capital is housing, farmland, and consumer durables. To construct *i* , we take the ratio of after-tax noncorporate profits-rental income, proprietors' capital income, net interest, and services of government and consumer capital to the stock of capital generating these profits.[14] In 1929, this ratio is 4.73%. For the period 1929-2000, the ratio averages 4%.

As theory predicts, our estimate for *i* is similar in magnitude to the average return on long-term debt.[15] For example, nominal yields for Moody's Aaa-rated corporate bonds averaged 4.7% for the period 1925-29. We view this as a good approximation to the real yield since the United States was on a gold standard during this period, and given no trend in the relative price of gold, expectations15 of inflation should have been near zero. Corporate bonds are fully taxable, so the relevant after-tax rates are somewhat lower. If we use yields on municipal tax-exempt high-grade bonds, which averaged 4.1% over 1925-29, our estimates of both the value

[14] We estimate that half of net interest payments are intermediate financial services and subtract that half from noncorporate profits

[15] Because of a modest equity risk premium, our estimate for *i* is slightly lower than the average return on equity after taxes and costs of diversifying. See McGrattan and Prescott (2003c) for a comparison of asset returns.

of intangible capital and the fundamental value of the stock market would be higher. Thus, we view the 4.73% return on noncorporate capital as a conservative (i.e., high) estimate for the real interest rate.

Now to the trend growth rate of the economy ($g$), which is the sum of the growth in population and the growth in technology. Annual population growth had fallen to 1% by the late 1920s, and annual technological growth averaged 1.6% in the pre-depression period, according to estimates of Kendrick (1961). Summing these, our estimate for $g$ is 2.6%, which is also a conservative estimate. This value is lower than an arithmetic average of growth rates of real GNP in the late 1920s. A larger value for $g$ leads to higher estimates for the value of intangible assets and the fundamental value of the stock market.[16]

We can now compute our estimate for the resource cost of intangible capital:

$$(3.4) \qquad K_I = \frac{\left[\Pi/K_T - i\right]}{(1-\tau_{prof})(i-g)} K_T = \frac{\left[0.083/1.42 - 0.0473\right]}{(1-0.146)(0.0473-0.026)} K_T = 0.61 K_T.$$

The values used in (3.4) are as follows: 0.146 is the average corporate tax rate in 1925-29; 0.083 is the average ratio of after-tax corporate profits to GNP in 1925-29; 0.0473 is our estimate of the real interest rate based on the noncorporate sector; 1.42 is the average ratio of the resource cost of beginning-of-period tangible capital to GNP in 1926-29; and 0.026 is our estimate of the trend growth rate. The result is a value for the resource cost of intangible capital at least as large as 0.61 times the tangible capital stock. This estimate is consistent with those found for the postwar United States and United Kingdom (McGrattan and Prescott, 2003a). The fact that it is sizable is also consistent with Fisher's evidence.

We deduce from (3.1) and (3.4) that very low estimates of intangible capital and very high returns to tangible capital are required for the conclusion that the stock market in 1929 was overvalued. The reason is simple. By (3.1) and the fact that the value of tangible capital was high, a low prediction for the fundamental value of corporate equities requires a low value for intangible capital. With the value of intangible capital low, the return on tangible capital would have had to be extremely high in order to generate corporate profit shares as high as those observed in the 1920s. In the extreme case, with the value of intangibles equal to zero, the real

[16] We should also note that higher growth rates are associated with higher interest rates since the interest rate is the inverse of the marginal rate of substitution. A very low prediction for intangible capital for the United States in 1929 requires a historically high interest rate and a historically low growth rate.

after-tax return on tangible capital has to be 5.9% (i.e., $\Pi/_{K_T}$ in Equation (3.4)), which is much higher than estimates based on national account data.

If we use our estimate in (3.4), we find that a conservative estimate for the fundamental value of U.S. corporations in 1929 was 1.9 times 1929 GNP, or 21.6 times 1929 after-tax corporate earnings. A fundamental value any lower is not justified by observations on profits, capital stocks, tax rates, growth rates, and interest rates.

With the highest reasonable estimate of the market value of U.S. corporations at the time being 1.67 times GNP, or 19 times corporate earnings, we conclude, as Fisher did, that corporate stocks were not overvalued at the time of the crash. If anything, they were undervalued.

## 3.4 Summary

In February 1930, Irving Fisher's book *The Stock Market Crash—and After* was published. In this book, Fisher explains why he believed that stock prices were low in the fall of 1929, placing much emphasis on the value of intangible assets. Galbraith (1955), like many economic historians before and after him, viewed the crash as clear evidence that Fisher was wrong. Fisher's book attracted little attention, according to Galbraith (1955), because "one trouble with being wrong is that it robs the prophet of his audience when he most needs it to explain why" (p. 146).

Here, we have examined this period with the aid of tools Fisher did not have: historical data and modern theory. We have, in effect, asked, what *level* of stock prices is justified by the value of tangible and intangible assets owned by corporations, which we have called the *fundamental value.* At the start, we set out to quantify by how much the market was overvalued relative to this fundamental value. Theory and data forced us to conclude that it was actually undervalued. Our conservative estimate of the fundamental value of U.S. corporations in 1929 is no less than 21 times corporate earnings (or 1.9 times GNP), whereas a conservative estimate for the market value of U.S. corporate equities in 1929 is no greater than 19 times corporate earnings (or 1.67 times GNP). In other words, with regard to the value of the 1929 stock market, Irving Fisher was right.

But, the primary goal of this study is not to assess the acumen of Fisher. Rather, our goal is to further the development of a theoretical benchmark useful for determining whether the stock market is overvalued or undervalued at a point in time. The value of such a theory is a better basis for investors and policymakers to make informed decisions.

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# Appendix

## Table A3.1: Relation of Corporate Profits and Taxes in NIPA and IRS, 1925-29 (billions)

| | l925 | 1926 | 1927 | 1928 | 1929 |
|---|---|---|---|---|---|
| Total receipts less total deductions, IRS | 9.3 | 95 | 8.7 | 10.7 | 11.9 |
| Plus: Adjustment for misreporting on income tax returns | 0.5 | 0.6 | 0.5 | 0.5 | 0.7 |
| Posttabulation amendments and revisions | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Income of organizations not filing corporation income | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| Depletion on domestic minerals | 0.5 | 0.6 | 0.5 | 0.5 | 0.6 |
| Adjustment to depreciate expenditures For mining exploration | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| State and local corporate profits tax accruals | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Bad debt adjustment | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 |
| Net income received from equities in foreign corporations | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Less: Tax-return measures of Gains, net of losses, from sale of property | 0.5 | 0.6 | 0.5 | 0.6 | 0.7 |
| Dividends received from domestic corporations | 1.2 | 1.5 | 1.7 | 1.9 | 2.6 |
| Income on equities in foreign corporations and branches | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 |
| Costs of trading or issuing corporate securities | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| Equals: Profits before taxes, NIPA | 9.3 | 9.3 | 8.3 | 9.9 | 10.6 |
| Federal income and excess profits taxes, IRS | 1.2 | 1.2 | 1.1 | 1.2 | 1.2 |
| Plus: Posttabulation amendments and revisions | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Amounts paid to U.S. Treasury by Federal Reserve banks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| State and local corporate profits tax accruals | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Less: U.S. tax credits claimed for foreign taxes paid | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Equals: Profits tax liability, NIPA | 1.4 | 1.4 | 1.3 | 1.4 | 1.4 |
| Profits after tax. NIPA | 7.9 | 7.9 | 7.0 | 8.5 | 9.2 |
| Profits after tax relative to GNP (%) | 8.7 | 8.1 | 7.3 | 8.7 | 8.8 |

## Table A3.2: Market Value at Month-End August 1929 and Net Earnings for Year 1929, All Companies in S&P Composite Index

| **Companies** | Market Value ($Millions) | Net Earnings ($Millions) | Price/Earnings Ratio |
|---|---|---|---|
| 50 Industrials | | | |
| General Motors | 3,132.0 | 236.5 | 13.2 |
| General Electric | 2,852.0 | 77.3 | 36.9 |
| U.S. Steel | 2,086.1 | 172.4 | 12.1 |
| Standard Oil of New Jersey | 1,753.1 | 120.9 | 14.5 |
| Union Carbide Carbon | 1,114.1 | 35.4 | 31.4 |
| Anaconda Copper | 1,060.3 | 69.1 | 15.3 |
| Woolworth (F.W.) | 967.7 | 35.7 | 27.1 |
| Standard Oil of California | 963.4 | 46.6 | 20.7 |
| Allied Chemical Dye | 762.3 | 27.4 | 27.8 |
| Sears. Roebuck | 754.8 | 30.1 | 25.1 |
| Texas Company | 685.7 | 48.3 | 14.2 |
| Radio Corp. | 647.5 | 11.5 | 56.4 |
| Reynolds Tobacco | 603.5 | 32.2 | 18.7 |
| International Nickel | 598.9 | 20.2 | 29.7 |
| International Harvester | 590.2 | 31.3 | 18.8 |
| Eastman Kodak | 483.9 | 21.6 | 22.4 |
| American Radiator Standard | 478.6 | 19.4 | 24.6 |
| Standard Brands | 476.3 | 17.3 | 27.5 |
| American Can | 440.4 | 19.8 | 22.2 |
| Kresge (S.S.) | 438.7 | 14.8 | 29.6 |
| National Biscuit | 436.0 | 19.7 | 22.1 |
| Kennecott Copper | 418.9 | 52.1 | 8.0 |
| American Tobacco | 394.3 | 27.0 | 14.6 |
| Burroughs Adding Machine | 352.5 | 11.7 | 30.2 |
| General Foods | 340.5 | 19.4 | 17.5 |
| Bethlehem Steel | 331.5 | 35.2 | 9.4 |
| United Fruit | 314.3 | 17.8 | 17.7 |
| Pullman, Inc. | 290.3 | 17.7 | 16.4 |
| Timken Roller Bearing | 261.5 | 14.2 | 18.5 |
| Chrysler Corp. | 300.9 | 21.9 | 13.7 |
| American Smelting Refining | 226.9 | 18.3 | 12.4 |
| Westinghouse Air Brake | 203.8 | 8.8 | 23.1 |
| Goodyear Tire Rubber | 204.5 | 13.1 | 15.7 |
| National Cash Register | 151.6 | 6.2 | 24.3 |
| Paramount Publix | 146.7 | 15.5 | 9.4 |
| St. Joseph Lead | 138.9 | 7.5 | 18.6 |
| American Locomotive | 94.2 | 4.2 | 22.7 |
| Allis Chalmers | 90.8 | 4.3 | 21.0 |
| Stewart Warner | 84.2 | 6.8 | 12.3 |
| U.S. Rubber | 75.3 | -2.7 | -27.8 |
| International Paper | 74.3 | -4.3 | -17.2 |
| Briggs Manufacturing | 73.6 | 2.4 | 30.3 |
| Twentieth Century-Fox Film Corp. | 65.0 | 8.4 | 7.7 |
| American Sugar Refining | 35.3 | 3.5 | 10.1 |

| | | | |
|---|---|---|---|
| Abitibi Paper | 27.5 | 1.9 | 14.1 |
| Endicott Johnson | 26.6 | 2.0 | 13.0 |
| Armour and Co. | 13.5 | 0.8 | 16.5 |
| Cuban American Sugar | 12.8 | 1.1 | 12.0 |
| American Woolen | 6.6 | -4.2 | -1.6 |
| International Mercantile Marine | 3.0 | 2.4 | 1.2 |
| **Total, 50 Industrials** | 26,085.5 | 1,420.8 | 18.4 |
| 20 Railroads | | | |
| Pennsylvania R.R. | 1.253.0 | 101.4 | 12.4 |
| New York Central | 1,187.3 | 78.1 | 15.2 |
| Canadian Pacific | 772.2 | 36.8 | 21.0 |
| Atchison, Topeka & Santa Fe | 717.2 | 54.8 | 13.1 |
| Union Pacific | 655.8 | 45.3 | 14.5 |
| Southern Pacific | 572.6 | 34.4 | 16.7 |
| Chesapeake Ohio | 409.4 | 32.2 | 12.7 |
| Baltimore Ohio | 348.0 | 26.4 | 13.2 |
| Norfolk Western | 332.2 | 40.9 | 8.1 |
| Great Northern | 311.4 | 25.7 | 12.1 |
| Delaware, Lackawanna Western | 276.2 | 13.3 | 20.7 |
| Northern Pacific | 275.9 | 21.8 | 12.7 |
| Southern Railway | 197.6 | 15.1 | 13.1 |
| Illinois Central | 193.0 | 12.4 | 15.6 |
| Reading Co. | 185.7 | 18.3 | 10.1 |
| Louisville Nashville | 176.7 | 13.7 | 12.9 |
| Atlantic Coast Line | 161.0 | 19.9 | 8.1 |
| Chicago North Western | 158.9 | 14.0 | 11.3 |
| Lehigh Valley | 112.5 | 7.4 | 15.3 |
| New York, Chicago St. Louis | 64.8 | 5.2 | 12.4 |
| Total, 20 Railroads | 8,361.2 | 617.0 | 13.6 |
| 20 Public Utilities | | | |
| Consolidated Edison of New York | 1,887.0 | 32.1 | 58.7 |
| United Gas Improvement | 1,098.0 | 27.6 | 39.7 |
| North American Co. | 942.4 | 27.0 | 34.9 |
| Columbia Gas system | 850.9 | 26.4 | 32.2 |
| Inter. Telephone Telegraph | 685.6 | 17.7 | 38.7 |
| Public Service of New Jersey | 532.0 | 22.1 | 24.1 |
| American Power Light | 351.9 | 3.3 | 105.4 |
| Detroit Edison | 348.1 | 13.1 | 26.5 |
| Pacific Gas Electric | 283.1 | 10.9 | 26.0 |
| American Water Works Electric | 281.6 | 6.6 | 42.5 |
| Standard Power Light | 245.6 | 7.5 | 32.9 |
| Western Union Telegraph | 233.4 | 17.5 | 13.4 |
| Peoples Gas of Chicago | 209.4 | 6.3 | 33.3 |
| Southern California Edison | 202.3 | 7.7 | 26.1 |
| Pacific Telephone Telegraph | 191.5 | 10.7 | 17.9 |
| National Power Light | 171.5 | 11.8 | 14.5 |

| | | | |
|---|---|---|---|
| Brooklyn Union Gas | 125.5 | 5.6 | 22.6 |
| Brooklyn-Manhattan Transit | 45.8 | 5.0 | 9.1 |
| Twin City Rapid Transit | 9.0 | 1.0 | 8.6 |
| Interborough Rapid Transit | 7.4 | 3.1 | 2.4 |
| Total, 20 Public Utilities | 8,702.1 | 263.1 | 33.1 |
| **Weighted Total, 90 Composite** | 16,403.8 | 863.6 | 19.0 |

A3.1 *Sources and Background Data.* In this Appendix, we describe sources for the data used in the figures and tables of the main text, and we display some detailed data behind some calculations in the text. Data and codes are available at http://minneapolisfed.org/research/sr/sr294.html.

Figure 3.1
*After-tax corporate profits:* See notes for Table A.1 for 1925-28; and U.S. Bureau of Economic Analysis (1929-2000), NIPA Table 1.14, for 1929 and after.
*GNP:* Romer (1989), Table 3.2, for period before 1929; and U.S. Bureau of Economic Analysis (1929-2000), NIPA Table 1.9, for 1929 and after.

Figure 3.2
*Market value of all U S. corporations:* Federal Reserve Board (1945-2000). Add market value of domestic corporations (in the level table of "Corporate Equities") and the sum of corporate net debt (=total liabilities-total financial assets+corporate equities held directly or in mutual funds) derived from level tables of domestic corporations issuing equity. See McGrattan and Prescott (2003b) for complete details.
*Market value of all listed NYSE companies:* U.S. Bureau of Economic Analysis (1932-2000).
*GNP:* See notes to Figure 3.1.

Figure 3.3
*Tangible corporate capital:* U.S. Bureau of Economic Analysis (1925-2000), fixed asset Table 6.1.
*Inventories:* U.S. Internal Revenue Service (1916-99), corporate balance sheets, before 1946; and U.S. Bureau of Economic Analysis (1929-2000), NIPA Table 5.12, for 1946 and after.
*Land:* Goldsmith (1956), Table W-30, before 1946; and U.S. Internal Revenue Service (1916-99), corporate balance sheets, for 1946 and after.
*GNP:* See notes to Figure 3.1.

Table 3.1
*Market value and earnings of 135 industrials:* Sloan (1936, p. 5).
*S&P company list, market values, earnings*: See notes for Table A3.2.
*Price-earnings ratio of 45 industrials:* Fisher (1930, p. 86), Chart 11.
*Number of NYSE companies:* New York Stock Exchange (1960), historical section.
*Market value of all listed NYSE companies:* See notes to Figure 3.2.
*GNP:* See notes to Figure 3.1.

Table 3.2
*Tax rate on profits:* Rows in Table A.1-"Profits tax liability, NIPA" to "Profits before taxes, NIPA." *Tax rate on dividends:* U.S. Internal Revenue Service (1916-99), basic tables for individual returns (Tables 2 and 7 for years 1925-29) and instructions for 1040, which have the surtax rates. Tax rates are constructed as follows: take the ratio of "Net income" to "Number of returns" for each net income class from Table 2; find the marginal surtax rate for that net income class in the 1040 instructions; multiply the marginal surtax rate for each net income class by the fraction of dividend income earned by that class found in Table 7; and add across classes to get a weighted average.

Table A3.1
*NIPA profits after tax, 1925-28:* All original data sources listed in U.S. Bureau of Economic Analysis (1985), Table 3. Some data are missing because they are not in the public domain. Any missing figures appear in bold and are estimated to be proportional to "Total receipts less total deductions," with the factor of proportionality equal to the 1929 ratio.

Table A3.2
*Company list:* Standard and Poor's (1990, p. 115) *Market values:* CRSP monthly stock database.
*Earnings:* Moody's Investor Services (1930) and Poor's Publishing Company (1930).
Other data cited in text.
*Population:* U.S. Bureau of the Census (1990), Table 16.
*GNP deflator:* Romer (1989), Table 2.
*Return on noncorporate capital:* McGrattan and Prescott (2003c).
*Bond yields:* Federal Reserve Board (1943), Table 128.

# 4. Discriminating Between Tariff-Based Theories of the Stock Market Crash of 1929 Using Event Study Data[1]

Bernard C. Beaudreau

## Abstract

Jude Wanniski (1978) argued that the Smoot-Hawley Tariff Bill was a key factor in the Stock Market Crash and the Great Depression. The specter of higher tariffs and lower foreign trade, he argued, depressed share prices, leading ultimately to the Stock Market Crash of October 1929. Bernard Beaudreau (1996, 2005), on the other hand, made the reverse argument, namely that the specter of higher tariffs from November 1928 to October 1929 fueled the Stock Market Boom as investors anticipated higher revenues and profits from the anticipated increase in sales and revenues. The Stock Market Crash, he argued, came on the heels of the defeat of the Thomas Recommittal Plan which foretold of lower, not higher as Wanniski contended, tariffs on manufactures. Using Event Study data from January 14, 1929 to October 29, 1929, this paper attempts to discriminate between these two hypotheses. The results show that "good" tariff bill news as reported in the New York Times contributed to stock price appreciation, and vice-versa, confirming the latter theory.

## 4.1 Introduction

The role of the Smoot-Hawley Tariff Bill in the Stock Market Crash of 1929 remains a contentious issue. Most argue that it was irrelevant, while others see it as a critical factor. For example, Jude Wanniski (1978) argued that the specter of higher tariffs led to the Stock Market Crash in October 1929. Specifically, the defeat of the Thomas Recommittal Plan on October

[1] Beaudreau, Bernard C. "Discriminating between Tariff Bill-Based Theories of the Stock Market Crash of 1929 Using Event Study Data." Essays in Economic and Business History 32, (2014) 80-99.

21, 1929 combined with the Senate's overall repudiation of Pennsylvania Senator David A. Reed's prediction that the tariff bill was dead (the Reed Declaration) on October 27, 1929, tilted the balance in favor of higher tariffs, lower world trade and lower stock prices (i.e. the crash). Bernard Beaudreau (1996,2005), on the other hand, pointed out that these same events tilted the balance in favor not of higher tariffs, but rather of lower tariffs, thus compromising the 1928 Republican electoral promise of higher tariffs, sales, profits and earnings for manufactures, and leading to lower stock prices. Higher tariffs on manufactures, Ranking Old-Guard Senator Reed Smoot reasoned, would translate into higher domestic sales for U.S. firms, and in the process, would close the existing output gap opened up by the spread of mass-production techniques. Consider, for example, the following remarks made by Senator Smoot in the Senate, in response to claims by Democrats that unemployment was increasing in 1927 and 1928.

> Senator Smoot insisted that the picture drawn by the Democrats on Monday, when the Senate passed the Senate resolution, was much overdrawn. He admitted that some unemployment existed, but insisted that it did not compare with that of 1920 and 1921 when the Republicans came into power after eight years of Democratic administration. As for one reason for a degree of unemployment, Senator Smoot referred to large importations of foreign merchandise that have been steadily reaching American shores in spite of the Republican protective tariff… These imports have a tendency to supplant large quantities of American goods, despite the tariff, thus slowing down many American industries. There also was an over-supply or over-production in many lines, Senator Smoot contended, and over-production or under-consumption in the textile industries. A slow-down of many industries helps to increase industrial unemployment, and the result is immediately felt in the lowering of the consuming power of the wage earners. This has brought about what may be called an oversupply or overproduction existing in many lines; and we might add that mass production has cut a great figure in the amount of production in the United States in special lines. (New York Times, March 8, 1928)

This paper attempts to discriminate between these hypotheses using event study data. Specifically, tariff bill news data obtained from the New York Times from November 1, 1928 to October 31, 1929 are used in conjunction with daily stock price data (Dow Jones Industrial Average) to test whether “good tariff” news increased (Beaudreau, 1996, 2005) or decreased (Wanniski, 1978) stock prices. By “good” tariff bill news, it should be understood news that the Bill would *de facto* become law and/or would be more extensive. “Bad” tariff bill news refers to news that the Bill would be defeated and/or scaled down. The underlying logic is straightforward, namely that the various amendments and/or partial votes constitute signals/partial indicators of the overall probability that the bill would become law. For example, if a vote on an amendment to increase rates on radios was successful, then this would constitute good tariff bill news (for manufactures) and would signal a greater probability that the final bill would pass. According to Beaudreau (1996, 2005), stock prices would rise as a result. However, according to Wanniski, they would fall as a result as higher tariffs on manufactures would serve to increase the probability of (*i*) retaliation, (*ii*) a tariff war and *(iii*) the breakdown of world trade. The paper is organized as follows. To begin with, we present the two events (Thomas Recommittal Plan and the Reed Declaration). This is followed by a description of our methodology and the presentation of our results. Lastly, we extend our analysis to the post-Stock Market Crash period, notably from March to June 1930 when the Bill was signed into law. Two sub-periods are considered, namely March 4-25, 1920 when the Republican leadership regained control of the Bill, and April 4, 1930 to June 16, 1930 when the Bill was referred to Conference and was signed into law.

## 4.2 The Thomas Recommittal Plan, The Reed Declaration and The Stock Market Crash

Both Wanniski (1978) and Beaudreau (1996, 2005) view the Thomas Recommittal Plan as the key development in the first Stock Market Crash of October 23, 1929. The Thomas Recommittal Plan was an amendment tabled by Republican Senator Elmer Thomas of Oklahoma aimed at breaking the growing stalemate in the Senate by redefining/limiting the scope of the much-maligned Smoot-Hawley Tariff Bill of 1929. Republicans favored higher tariffs on manufactures, while Democrats and Insurgent Republicans (the majority) opposed the proposed tariff hikes, setting their sights on actually lowering existing Fordney-McCumber (1922) tariff rates on manufactures. The Democrat-Insurgent Republican Coalition invoked the promises made to the U.S. electorate in the 1928 general election, specifically the promise of more protection for the nation's farmers. Higher tariffs on manufactures, they argued, would lead to higher overall prices (on manufactures) and ultimately to lower farmer real income.

The amendment was as follows:

> I move that the bill (H.R. 2667) to provide revenue, to regulate commerce with foreign countries, to encourage the industries of the United States, to protect American labor and for other purposes, be recommitted to the Committee on Finance with instructions to eliminate therefrom the following described text: Beginning with line 5, on page 2, and including

> line 4, on page 121, and beginning with line 9, on page 146, and including line 23, on page 279: Provided, That the elimination of such text shall be without prejudice to the submission in the Senate of specific amendments to exiting law: And provided further, That, when the consideration of the said bill is completed in the Senate and before final passage, said finance Committee is hereby authorized and requested to amend section 648, relating to repeals, so as to make said section conform to the action of the Senate. (Congressional Record, October 21, 1929, 4716)

The amendment was defeated by a vote of 64 to 10. Its defeat, Wanniski (1978) argued, was instrumental in the events that would follow. Specifically, he argued that the defeat of the Thomas Recommittal Plan signaled a willingness on the part of the U.S. Senate to raise tariffs on manufactures and agricultural products, thus leading to the 21-point drop (6 percent) in the Dow Jones Industrial Average on October 23, 1929.

Beaudreau (1996,2005), on the other hand, argued that the defeat of the Thomas Recommittal Plan was the first of two salvos, resulting in the first Stock Market Crash (Wednesday, October 23, 1929), the other being the vote on the tariff on medicinal tannic acid on October 22, 1929. Empowered and emboldened by its victory (Thomas Recommittal Plan), the Democrat-Insurgent Republican coalition took aim at existing tariffs on manufactures, starting with medicinal tannic acid. On Tuesday, October 22, 1929, Senator Alben W. Barkley of Kentucky moved to cut the rate to 18 cents (from 20 cents). The motion passed by a margin of 12 votes with 45 for and 33 against. The New York Times reported: “The item on which the vote was taken was incidental, but the result showed that the coalition was nearly intact in its initial drive and also that it still held control in the Senate” (New York Times, October 23, 1929). The writing was on the wall: tariffs on manufactures would fall. The following day, the stock market crashed, losing 21 points (6 percent). The slide continued on Thursday, with the market losing another six points, for a combined, two-day total of 27 points (8 percent).

The trials and tribulations of the proposed tariff legislation irked both the Old-Guard Republicans (particularly Senator Reed Smoot) and members of the Insurgent Republican-Democrat coalition.[2] Sensing the growing polarization (and the resolve of the Democrat-Insurgent Republican

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[2] Of the twelve Insurgent Republicans that had voted in favor of the McMaster Resolution on January 15, 1928 (Senators Blain, Borah, Brookhart, Capper, Frazier, Howell, La Follette, McMaster, Norbeck, Norris, Nye and Pine), six voted against the Thomas Recommittal Plan (Borah, Brookhart, Capper, La Follette, Norbeck and Norris), while five voted in favor (Frazier, Howell, McMaster, Nye, and Pine).

coalition), on Sunday, October 27th, Senator Reed of Pennsylvania made what we refer to as the Reed Declaration, predicting that the Bill would die on the Senate floor.

The New York Times reported:

> Senator David A. Reed of Pennsylvania, speaking here last night at a dinner given in honor of the Pennsylvania delegation in Congress by the Metal Trades Council of the Philadelphia Navy Yard, declared that the present Hawley-Smoot tariff bill was dead. The Middle West cornbelt Senatorial bloc, he said, was its executioner. Senator Reed accused the Western block, only one of which, Senator Borah, he named, of a deliberate determination to boost every tariff provision touching agriculture and beat down every one touching on Eastern industry, "until we are on a level of common misery." (New York Times, October 27, 1929)

Smoot, however, was adamant: the Party would deliver the promised across-the-board tariff hikes, while the Insurgent Republican-Democrat coalition remained steadfast in its pledge to lower tariffs on manufactures. In the following two days of trading (October 28 and 29), the Dow Jones Industrial Average fell by 38 (13 percent) and 31 points (12 percent), respectively. The Reed Declaration and the uncertainty it engendered killed the bill in the eyes of investors.

Wanniski's interpretation of these events was straightforward: the fallout from the Reed Declaration signaled to the market that tariffs would invariably rise, ushering in a slowdown in world trade. In his words, "The crash of 29 was triggered by the recognition on the part of world markets that the United States was more likely at the end of the last week of October 1929 than it was at the beginning of the week to impose protectionist trade barriers on world commerce (Forbes 1988, 2)." Scott Sumner (1992), however, took issue with Wanniski, arguing that he "probably misinterpreted the transmission mechanism." Specifically, he pointed out that "there is a serious flaw in the thesis that Smoot-Hawley caused the October stock market crash. Wanniski failed to account for the fact that after the October 23 vote, the anti-tariff coalition grew progressively stronger......By November 10, the protectionist Republicans had been completely routed and there were expectations that the coalition might force reductions in tariffs on manufactured goods (Sumner 1992, 303)."

Beaudreau (1996,2005) provided an alternative interpretation of these events, one that is consistent with Sumner's rejoinder. Specifically, he maintained that the stock market crashed as the promised higher tariffs on manufactures looked increasingly unlikely, as did the anticipated higher sales, earnings and profits. The Republican party in general, and Senator

Reed Smoot in particular, had proposed a round of tariff hikes to "encourage the industries of the United States" which found themselves increasingly constrained on product markets (manufactures and agricultural goods), owing in large measure to the spread of mass production techniques. Higher tariffs would, according to Smoot, secure a greater share of the U.S. market for U.S. firms. Accordingly, the defeat of the Thomas Recommittal Plan and the specter of lower tariffs on manufactures lowered investor expectations.

Whereas Wanniski viewed the various responses to the Reed Declaration that the Bill would die on the Senate floor as evidence that tariffs would definitely rise, Beaudreau viewed it as evidence that they would most certainly fall, especially tariffs on manufactures which the Insurgent Republican/Democrat coalition wanted cut to levels below Fordney-McCumber rates. The Insurgent Republican-Democrat coalition had not been shaken by the earlier drop in the Dow Jones Industrial Average, and remained steadfast in its pledge to lower rates on manufactures.

Underlying these two opposing views is a corresponding theory of tariffs and stock prices. Wanniski maintained that higher tariffs would serve to depress stock prices owing to the ensuing fall in world trade. Beaudreau, on the other hand, argued that the failure to raise tariffs in the presence of generalized excess capacity would serve to depress stock prices as profits and dividends would not rise (as promised by Old-Guard Republican senator Reed Smoot). The former predicts that a "good" tariff bill news event would serve to depress stock prices as it would increase the probability of slower/lower world trade, while the latter predicts just the opposite as U.S. firms' domestic market share would rise. A "bad" tariff bill news event would do the reverse, increasing stock prices according to Wanniski, and lowering them according to Beaudreau. To discriminate between these two hypotheses, data on U.S. tariff bill news and stock prices for the period January 14, 1929 to October 29, 1929 were collected.

Specifically, the ProQuest Historical Newspaper Search Instrument for the New York Times was used to identify "tariff bill" congressional news events from January 14, 1929 to October 29, 1929.[3] A total of 105 tariff bill-related congressional news events/items were identified over this period (236 DJIA trading dates). These were then coded in two ways. First, "good" or "bad" news events were coded using a scale of minus 3 to plus 3 (NEWS-

[3] The New York Times and the Wall Street Journal are two of the most- used information sources in event studies, be they economic, financial, environmental, etc. See for example, John J. Binder (1985). Our choice of the New York Times was based on its representativeness, and its status as the premier source of information in the North-East. None of the news events included either of newspaper or contributor editorials.

I). Major events involving the Bill's proponents/opponents (Congress and Executive) were assigned a value of 3, while lesser events (e.g. voting on a particular rate or set of rates) were assigned lower values. Multiple tariff bill news-event days were coded on an additive basis (i.e. sum of individual news items). Non-tariff-related news event days were coded as zero. Second, "good" and "bad" news events were coded on a simple minus 1 and plus 1 basis, with the former corresponding to a "bad" news event, and the latter, a "good" news event (NEWS-II). Stock price variations (absolute and relative) were measured using the daily Dow Jones Industrial Average index.[4] Total daily DJIA gains on "good" tariff bill news summed to 149.71 points, while total losses on "bad" tariff bill news summed to 221.14 points, with a net difference of -71.43 points, which compares favorably with the overall fall in the DJIA from the beginning of the sample to October 30 of 73.99 points.[5]

**Table 4.1: Event Study Data**

Period: 1/14/1929 to 10/29/1929
Sample Size: 236 DJIA Trading Days
Beginning of Sample: January 14, 1929
End of Sample: October 29, 1929

| | | | |
|---|---|---|---|
| NEWS-I: | Good | Code | Frequency |
| | | (4) | 1 |
| | | (3) | 3 |
| | | (2) | 13 |
| | | (1) | 45 |
| NEWS-I: | Bad | Code | Frequency |
| | | (-5) | 2 |
| | | (-3) | 7 |
| | | (-2) | 21 |
| | | (-1) | 23 |

Total Good NEWS DJIA Gains: 149.71
Total Bad NEWS DJIA Losses: 221.14

The estimated correlation coefficients are presented in Table 4.2 for three samples. In the first sample, all 236 trading days (tariff-related news events and non-tariff-related news events) were included in the sample. In this case, the estimated correlation coefficient between the first tariff bill

[4] The data, as well as the coded "news events," are available from the author.
[5] The DJIA rebounded on October 31, only to return to the 230-point level three days later, where it stood for a few days before hitting its all-time low of 198 on November 13th, 1929.

news event index (NEWS-I) and the corresponding absolute DJIA daily return-price variation (ΔDJIA) is 0.4437, and 0.4372 when measured in percentage (%ΔDJIA).[6] The corresponding values using the second news event index (NEWS-II) are 0.3791 and 0.3663, respectively. The correlation coefficient between the two news event indexes (NEWS-I and NEWS-II) was 0.8883. The second sample consisted of the 165 trading days from April 15, 1929 when the Bill was introduced in the House of Representatives to October 29, 1929. It was felt that this was a more relevant sample as the news events in this period were "binding" as opposed to speculative (i.e. prior to the bill being introduced into Congress). Here, the estimated correlation coefficients are 0.4663 and 0.4588, respectively in the case of NEWS-I, and 0.4029 and 0.3885, respectively in the case of NEWS-II. Lastly, we narrowed the original sample down to the set of trading days with either "good" or "bad" tariff bill news, consisting of 105 observations. In this case, all non-tariff bill news dates were removed. Here, the relevant correlation coefficients were 0.4893 and 0.4785, respectively in the case of NEWS-I and 0.4380 and 0.4180, respectively in the case of NEWS-II. These results corroborate the Beaudreau view according to which investors reacted positively to "good" tariff bill news, pushing the DJIA up, and negatively to "bad" tariff bill news. The Thomas Recommittal Plan as well as the response to the Reed Declaration that the bill would die on the Senate floor were examples of "tariff bill-related bad news," and were met with the two massive price drops that together define the 1929 stock market crash.

These results suggest that stock prices were moving in response to tariff bill-related news, and that investors were "on-board" the Republican party's proposed upward tariff revision, pushing stock prices higher with every piece of "good" tariff news, and vice-versa. Higher tariffs, by further restricting access to the U.S. market, would increase market share, sales, profits and earnings. "Bad" tariff bill news in the form of the Thomas Recommittal Plan and the Insurgent Republican-Democrat response to the Reed Declaration dampened investors' expectations, ultimately depressing prices to their pre-1928 level.

[6] The daily DJIA was found to exhibit a unit root. The first difference (ΔDJIA) and daily rate-of-return (%ΔDJIA), however, were found to be stationary.

## Table 4.2: Correlation Coefficients

| Sample | ΔDJIA-NEWS-I | %ΔDJIA-NEWS-I | ΔDJIA-NEWS-II | %ΔDJIA-NEWS-II |
|---|---|---|---|---|
| Complete Sample<br>236 DJIA Trading Days<br>(1/14/1929-10/29/1929) | 0.4437* | 0.4372* | 0.3791* | 0.3663* |
| Medium Sample<br>165 DJIA Trading Days<br>(4/15/1929-10/29/1929) | 0.4663* | 0.4588* | 0.4029* | 0.3885* |
| Small Sample<br>105 DJIA Trading Days<br>(4/15/1929-10/29/1929) | 0.4893* | 0.4785* | 0.4380* | 0.4180* |

*p<0.0005

## Table 4.3: Event Study Regression Results (NEWS-I)

Complete Sample (236 DJIA Trading Days)

Dependent Variable: ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.2045 | -0.634 |
| NEWS-I | 1.9798 | 7.574 |

$R^2$: 0.1968

F(1,234): 57.36

Dependent Variable: %ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.0006 | -0.6421 |
| NEWS-I | 0.0062 | 7.436 |

$R^2$: 0.1911

F(1,234): 55.298

Medium Sample (165 DJIA Trading Days)

Dependent Variable: ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.2114 | -0.5043 |
| NEWS-I | 1.972 | 6.730 |

$R^2$: 0.2174

F(1,163): 45.29

Dependent Variable: %ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.0007 | -0.5442 |
| NEWS-I | 0.0062 | 6.593 |

$R^2$: 0.2105

F(1,163): 43.465

Small Sample (105 DJIA Trading Days)
Dependent Variable: ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.7410 | -0.1213 |
| NEWS-I | 1.940 | 5.694 |

$R^2$: 0.2394
F(1,103): 32.419

Dependent Variable: %ΔDJIA

| Independent Variable | Coefficient | t-statistic |
|---|---|---|
| Constant | -0.0023 | -1.182 |
| NEWS-I | 0.00616 | 5.531 |

$R^2$: 0.2289
F(1,103): 30.59

## 4.3 Event Study Regression Results

G. William Schwert (1981) and John J. Binder (1985) used stock market price movements to assess government policy changes.[7] Here, we use a similar methodology to assess the effects of tariff-bill related news on daily stock market returns (absolute and relative). Specifically, the daily stock market return (ΔDJIA and %ΔDJIA) was regressed against a constant and the tariff bill-related news (NEWS-I) using the same three samples (236, 165 and 105 trading days). The results are presented in Table 4.3, where we see that in all six cases, daily stock market returns were increasing in tariff bill-related news. In all cases, the results were statistically significant, with roughly nineteen to twenty-four percent of the overall variation ($R^2$) being explained. This suggests that (*i*) the proposed higher tariffs were expected to be good, and not bad, for stock prices because of protection, and (*ii*) investors were "on-board" the Hoover Administration's tariff policy initiative, bidding up share prices in anticipation of higher profits.

## 4.4 The Post-Stock Market Crash Period

From October to March, the Republican leadership (Smoot, Reed) lost control of the bill. The Insurgent Republican-Democrat coalition, working in the Senate Committee of the Whole, restored the agriculture-only character of the Bill. Hundreds of amendments, affecting all fifteen tariff schedules, were proposed and passed by the Insurgent Republicans-Democrats, increasing duties on agriculture and lowering them on other

[7] The type of analysis assumes that the market (investors as a whole) is informed of the policy change, thus yielding an unbiased assessment of the resulting "expectations."

products, especially those targeted as costs to farmers. The bill passed from the Senate Committee of the Whole to the Senate proper on March 4, 1930. As it did, the Republicans led by Reed Smoot mounted a counter-offensive to regain control of the bill and reverse the "damage" done by the Coalition, introducing a series of amendments aimed at restoring some of the tariff rates that had been reduced or eliminated when the Republican leadership had lost control. The success of the counter-offensive gave the impression that the across-the-board character of the bill was being restored. However, it is obvious from the record that certain strategic sectors were targeted and given priority. The Insurgent Republican-Democrat coalition scandalized the counter-attack, blaming it on a log-roll, sugar, timber, oil, cement and glass, organized by Smoot. By March 24, the Bill had passed in the Senate and was referred to Conference, where the House and Senate rates were to be reconciled. By June 17, the resulting rates (higher than those passed in the Senate) had been ratified by the Senate, the House and signed into law by the President.

In this section, we extend our analysis to the post-Stock Market period. Did the "tariff news-stock price" dynamic that had characterized the pre-Stock Market Crash period, characterize this period? Did stock prices rise with "good" tariff news and fall with "bad" tariff news once the Republicans had regained control of the bill (i.e. from March 4, 1930 to March 25, 1930)? Or did the Stock Market Crash, the deepening recession affect investors' beliefs/expectations. In a similar vein, did this same "tariff news-stock price" dynamic characterize the Conference proceedings (i.e. from April 4, 1930 to June 17, 1930) amid the continued deepening of the recession and the multiplication of threats of retaliation on the part of foreign governments?

### 4.4.1 The March 4-25, 1930 Sub-Period

This period witnessed the resurgence of the spirit of the original Smoot-Hawley Tariff Bill which called for higher across-the-board tariffs. As pointed out, the Republican leadership under the guidance of Senator Smoot, sought to restore industrial rates. Stock prices throughout this period increased from a level of 273.51 on March 4, 1930 to 280.5 on March 25, 1930. On the day following its passage (March 25, 1930), the Dow Jones Industrial Average increased by 1.38 points.

## Table 4.4: Event Study Data-Post-Stock Market Crash Sub-Periods

a) March 4-25, 1930 Sub-Period
Sub-Period: 3/4/1930 to 3/25/1930
Sample Size: 19 DJIA Trading Days
Beginning of Sample: March 4, 1930
End of Sample: March 25, 1930

| | | | |
|---|---|---|---|
| NEWS-I: | Good | Code | Frequency |
| | | (2) | 2 |
| | | (1) | 7 |
| NEWS-I: | Bad | Code | Frequency |
| | | (-1) | 2 |

b) April-June 1930 Sub-Period
Sub-Period: 4/1/1930 to 6/16/1930
Sample Size: 60 DJIA Trading Days
Beginning of Sample: April 4, 1930
End of Sample: June 17, 1930

| | | | |
|---|---|---|---|
| NEWS-I: | Good | Code | Frequency |
| | | (2) | 9 |
| | | (1) | 19 |
| NEWS-I: | Bad | Code | Frequency |
| | | (-2) | 9 |
| | | (-1) | 8 |

This raises the question, once the Republican leadership had regained control of the bill, was the same “tariff news-stock price” relationship in effect? In other words, did “good” tariff news increase stock prices (and vice-versa)? Having been “disappointed” by the Insurgent Republican-Democrat coalition's push to lower tariffs on manufactures, were investors prepared to “hope” again-that is, to believe again. To answer this question, we identified eleven news “events” in this period and tested for the relationship identified earlier. The results are presented in Rows 1 and 2 of Table 4.5a, where we see correlation coefficients that are similar to those reported in Table 4.2. More specifically, the correlation coefficient between ΔDJIA and NEWS-I was 0.4076, while that between %ΔDJIA and NEWS-I was 0.4063 for the complete sample, and 0.3999 and 0.3955 respectively for the tariff news-only sample. The correlation coefficients increase to 0.5510 and 0.5509, respectively for NEWS-II in the case of the whole sample, and 0.6230 and 0.6196, respectively for NEWS-II in the case of the reduced, tariff news-only sample.

**Table 4.5: Correlation Coefficients-Post Stock Market Crash Sub-Periods**

a) March 4-25,1930

| Sample | ΔDJIA-NEWS-I | %ΔDJIA-NEWS-I | ΔDJIA-NEWS-II | %ΔDJIA-NEWS-II |
|---|---|---|---|---|
| Original Sample 19 DJIA Trading Days (3/4/1930-3/25/1930) | 0.4076* | 0.4036* | 0.5510* | 0.5509* |
| Tariff News-Only Sample 11 DJIA Trading Days (3/4/1930-3/25/1930) | 0.3999* | 0.3955* | 0.6230* | 0.6196* |

*p<0.001

b) April-June 1930

| Sample | ΔDJIA-NEWS-I | %ΔDJIA-NEWS-I | ΔDJIA-NEWS-II | %ΔDJIA-NEWS-II |
|---|---|---|---|---|
| Original Sample 60 DJIA Trading Days (4/4/1930-6/17/1930) | 0.0087* | 0.0063* | 0.0385* | 0.0346* |
| Tariff News-Only Sample-47 DJIA Trading Days (4/4/1930-6/17/1930) | 0.0053* | 0.0035* | 0.0390* | 0.0358* |

*p<0.0005

## 4.4.2 The April-June 1930 Sub-Period

The Senate Bill called for tariffs that were, on average, 4.16 percent lower than the House rates, which were, on average, 8.54 percent higher than those contained in the Fordney-McCumber Tariff Act of 1922. On April 3, 1930, the Tariff Bill went to Conference where it stayed until mid-June, when it was passed by both the Senate and the House, and signed into law by President Hoover. In the meantime, America's predicament had worsened. Unemployment continued to climb, but more importantly, its trading partners began to retaliate. For example, France imposed a tariff on U.S. automobiles in retaliation for the higher U.S. tariff on lace.

As retaliatory tariff measures were either threatened or enacted abroad, the very nature of the debate in the U.S. changed. Leading the charge against the tariff was the automobile industry. All three companies publicly denounced the tariff bill. By June, the naysayers dominated the debate, the effects of which were felt on Wall Street. On June 15, after the passage of the Bill, stock prices fell 14.2 points, reportedly on the news of the "passage of the tariff." The headlines of the New York Times read: "Stock Prices Sag on Passage of Tariff; Viewed as Wall Street's Disapproval of the Bill."

With the specter of foreign retaliation and growing domestic disenchantment, how did Wall Street react to tariff "conference" news? Admittedly, the stakes were different as both the House and Senate had passed the bill. All that was left was finding a middle ground. To answer this question, we identified sixty "tariff bill" news events from April 4, 1930 to June 15, 1930. For the most part, these were upward tariff revisions to the Senate Bill (as the House rates were substantially higher). The results are presented in Rows 1 and 2 of Table 4.5b, where we see correlation coefficients of 0.0087 and 0.0063, respectively, for NEWS-I in the case of the complete sample, and 0.0385 and 0.0346, respectively, for NEWS-II. The results for the reduced, tariff news-only sample are comparable.

What is important to note is the fact that the relationship identified in Section 4.2, however negligible, was still present.

These results can be rationalized in a number of ways. First, it could be argued that the conference proceedings provided investors with no new information, which would explain the absence of any relationship. In other words, investors would have already factored in rates that lie somewhere between the House and the Senate's rates. Second, whatever "good" tariff news was followed/matched by equivalent "bad" tariff news in the form of retaliation. Hence, the two effects would have canceled each other out. In closing, while stock prices fell in the aftermath of final ratification (i.e. June 15-18), there is no evidence that "good" conference proceedings-based tariff news adversely affected stock prices while the Bill was in Conference. Put differently, investors were and remained "on-board."

## 4.5 Summary

In this paper, we set out to discriminate between two diametrically opposing views of the role the Smoot-Hawley Tariff Bill played in the Stock Market Crashes of October 23, 1929 and October 29, 1929. Specifically, tariff bill-news event data obtained from the New York Times from November 1, 1928 to October 31, 1929 were used in conjunction with daily stock price return data (Dow Jones Industrial Average) to test whether "good tariff" news increased (Beaudreau 1996,2005) or decreased (Wanniski 1978) stock prices. By "good" tariff news, it was understood news that the Bill would *de facto* become law and/or would be more extensive/comprehensive. "Bad" tariff news referred to news that the Bill would be defeated and/or scaled down. The underlying logic was straightforward, namely that the various amendments and/or partial votes constitute signals/partial indicators as to the overall probability that the bill would become law. According to Beaudreau (1996,2005), stock prices would rise as a result. However, according to Wanniski (1978), they would fall as a result as higher tariffs on manufactures would serve to increase the probability of (*i*) retaliation, (*ii*) a tariff war and (*iii*) the breakdown of world trade.

These results support Beaudreau's view according to which investors welcomed "good" tariff bill news, and reacted negatively to "bad" tariff bill news. Throughout the sample period, "good" tariff bill news pushed the DJIA higher, while "bad" tariff bill news did the reverse. The Thomas Recommittal Plan as well as the Reed Declaration were examples of "tariff bill-related bad news," and were followed, on Wall Street, by the two massive price drops that together define the 1929 stock market crash. The defeat of the Thomas Recommittal Plan in combination with the Insurgent Republican-Democrat coalition's victory in forcing a reduction in chemical rates was followed by a 20.66 point drop in the DJIA (October 23). The fallout from the Reed Declaration was followed by a 38.33 and 30.57 drop on October 28 and 29, respectively.

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# 5. Electrification, The Smoot-Hawley Tariff Bill and the Stock Market Boom and Crash of 1929: Evidence from Longitudinal Data[1]

Bernard C. Beaudreau

## Abstract

Electrification and the introduction of high-throughput, continuous-flow production techniques in the 1920s vastly increased America's capacity to produce wealth. Getting in the way, according to many, were weak product markets, prompting ranking Republicans Reed Smoot and Ellis Hawley, in the Party's 1928 presidential platform, to advocate yet another generalized upward tariff revision—the Smoot-Hawley Tariff Bill (SHTB). The stock market responded favorably, as prices increased throughout 1928 and most of 1929. They crashed, however, in October 1929 when it became evident that the proposed Smoot-Hawley Tariff Bill which called for across-the-board tariff would be defeated by an Insurgent-Republican Democrat coalition and replaced with substantially lower tariffs on manufactures. Using longitudinal analysis, this paper shows how stock prices of firms in industries most affected by electrification tracked these developments, rising in response to good tariff news, and falling in response to bad tariff news. Operationally, a tariff news proxy variable is developed and included in the three-factor Fama-French model of stock prices. Our hypothesis is then tested using daily stock returns for a subsample of nineteen DJIA firms. The results show a positive and significant effect of tariff news on all nineteen stock prices. Lastly, we show that good tariff news explains up to 76 percent of stock price appreciation in the 1928-1929 period of firms in industries most affected by electrification. These results suggest that the

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[1] Beaudreau, Bernard C. "Electrification, the Smoot-Hawley Tariff Act and the Stock Market Boom and Crash: Evidence from Longitudinal Data." Journal of Economics and Finance 42, (2018) 631-650.

stock market boom and crash of 1929 can be understood in terms of political developments set against a background of improved fundamentals.

## 5.1 Introduction

The stock market boom and crash of 1929 has garnered much attention over the last eight decades (De Long and Shleifer 1991, Rappoport and White 1993), with a resurgence of interest in 2004 when Ellen McGrattan and Edward Prescott presented evidence which supported Irving Fisher's view that the surge in stock prices could be justified by improving fundamentals. Despite being unable to identify a root cause (e.g. patents, organizational capital, technological change), their analysis generated estimates of new, intangible capital in the order of 23 percent of GDP. This paper draws on earlier work (Beaudreau 2014) to propose a variant and indeed a refinement of the Fisher-McGrattan-Prescott fundamentals view, namely that the stock market boom and crash of 1929 (and 1928) tracked the successes and failures of U.S. tariff reform in 1928 and 1929 (e.g. the proposed Smoot-Hawley Tariff Bill-SHTB) against a background of vastly improved electrification-based fundamentals. Specifically, by tracking the good and bad tariff-related news, we are able to rationalize both the increase as well as the decrease in stock prices.

In previous work, Beaudreau (2014) set out to discriminate between two tariff-based theories of the stock market crash (October 23 and October 28) using longitudinal event study data.[2]According to Wanniski (1978), the stock market crash came on the heels of the defeat of the Thomas Recommittal Plan on October 21, 1929, which would result in higher tariffs on manufactures, an ensuing breakdown of world trade and ultimately, a recession. The defeat of the Thomas Recommittal Plan and the first stock market crash were contemporaneous, or so they appeared. Beaudreau (1996,2005), however, offered an alternative account, one which combined tariff policy with macroeconomic fundamentals. In short, he argued that the stock market crashed on October 23 as the result of two, related events, namely the defeat of the Thomas Recommittal Plan and a vote in the Senate to reduce the tariff on medicinal tannic acid. The Thomas Recommittal Plan called for a fundamental change in the scope of the Smoot-Hawley Tariff Bill, specifically, of recommitting the bill to raising rates on agricultural goods only. The Insurgent Republican-Democrat coalition that controlled the Senate from July 23, 1929 proposed reducing rates on manufactures.

[2] Longitudinal event studies are mostly used in epidemiology and psychology to track subjects over time, identifying various causal events.

The following day, it reduced the tariff on medicinal tannic acid, prompting the first stock market crash (October 23-24). The second crash (October 28), he argued, came on the heels of the Reed Declaration, a speech by Pennsylvania Senator David E. Reed in Philadelphia in which he predicted that the SHTB would die in the current session. In other words, the anticipated increase in sales, profits and dividends promised by the Republicans under the banner of "Prosperity for All" would not materialize.

The key element in his argument was the role of fundamentals in the drafting of the SHTB. Drawing from various sources, he argued that the SHTB was, in large measure, a response on the part of the Republican Party to electrification-based excess capacity. By further restricting access to the U.S. market, domestic manufacturing firms stood to benefit from higher factory utilization rates, sales, profits and dividends. Longitudinal stock price data were used to test this theory. Specifically, using the U.S. Congressional Record, he coded tariff-related legislative news as either good or bad, with the former referring to news to the effect that the Bill would be passed or its scope expanded, and the latter referring to the reverse. As his data set was limited to legislative SHTB news, his sample period consisted of January 1, 1929 to October 30, 1929. His results showed that stock prices were highly positively correlated with tariff news, finding a correlation coefficient of 0.52. More importantly, he showed that the two stock market crashes could be attributed to bad tariff news–and hence, to a fundamental shift in investor expectations.

Implicit in his account of the events of October 21-29, 1929 (the two stock market crashes) is a theory of the stock market boom and crash of 1928-1929, one based on (*i*) the presence of excess capacity in U.S. manufacturing, the result of electrification and the introduction of high throughput continuous-flow production techniques (Fisher 1930) and (*ii*) the Republican Party's proposed tariff bill promising "prosperity for all." Firms finding themselves with excess capacity would stand to gain the most from the proposed greater market share resulting from higher external tariffs. In this paper, we test this hypothesis using individual stock price data. Specifically, we test the hypothesis that stock prices of firms in industries that electrified the most–and hence, would have experienced the greatest increase in their rated capacity–would have responded more to SHTB electoral news (prior to 1929), and legislative news in 1929. Implicit in this view is the idea that variations in stock market prices in these industries during the period June 1928-November 1929 would have been tracking/responding to tariff bill based electoral and legislative news. Using individual Dow Jones Industrial Average stock prices, we were able to replicate Beaudreau (2014)'s findings for individual shares, and more importantly, were able to show the presence of a statistically-significant relationship between the strength of individual firms share-price response to-tariff news (as measured by the estimated coefficient) and a measure of industry electrification, confirming Irving Fisher's view of the stock market boom was based on fundamentals.[3]

The paper is organized as follows. To begin with, we examine the role of electric power in U.S. manufacturing in the 1910s and 1920s. We then turn and examine the Republican Party' s response to weakening product and labor markets in late 1927/early 1928. In short, the Party under the guidance of ranking Republicans Reed Smoot, Joseph Grundy and John Fisher proposed another round of tariff hikes aimed at securing a larger share of the U.S. market for U.S. firms. Having won the 1928 presidential election on a platform of tariff reform and "Prosperity for All," the Party went ahead with tariff reform, introducing a new tariff bill in the House on January 7, 1929. By July 23, the Party had splintered over the proposed SHTB, with thirteen Senators (Insurgents) crossing the floor to vote with Democrats. By October, they had resolved that not only would tariffs not rise, they would fall. This tariff bill "about-face" constitutes the basis for the proposed theory of the stock market boom and crash of 1928-1929 as stock prices would have tracked tariff-based developments. This is then tested by applying a methodology similar to Beaudreau (2014) to a three-factor Fama-French model of stock prices‒specifically, of identifying SHTB related good and bad news, and then attempting to measure its impact on nineteen individual DJIA stock prices. We conclude by examining the implications of our findings for the debate over the origins of stock market booms and crashes.

## 5.2 The Stock Market in the late 1920s: Overvalued or Undervalued?

Some eighty years plus after the fact, the stock market boom and crash of 1929 continues to be the subject of debate among scholars and laymen. Briefly, the debate opposes the fundamentals view of Fisher (Fisher 1930, McGrattan and Prescott 2004) to the Keynesian speculative bubble view (De Long and Shleifer 1991, Rappoport and White 1993) according to

[3] Our analysis extends Fisher's original argument and McGrattan and Prescott's 2004 results by (*i*) providing a testable theory of the technology shock that prompted the stock market boom and (*ii*) a theory of stock-price appreciation and depreciation. McGrattan and Prescott were unable to address the question of why the market crashed.

which the boom was largely fueled by speculation, having no basis whatsoever in economic fundamentals. McGrattan and Prescott (2004) took issue with the latter view, arguing that not only was the market not overvalued, but it was possibly undervalued.

While plausible, their results suffer from a number of shortcomings. To begin with, their evidence is circumstantial. Like Fisher, they attribute the increase to fundamentals without identifying, nor providing measures of the precise causes. Reference is made to industrial research, to patents and monopoly rights and to organizational capital. Similarly, Fisher had alluded to a number of potential causes, including new management techniques, waste saving, and electrification. Ironically, despite bringing historical data and modern theory, to bear on the problem, McGrattan and Prescott were still unable to shed additional light on the exact technology shock. Another problem is the crash. If fundamentals were behind the boom, then this raises the question, why did stock prices crash in October 1929, returning to their original (pre-1928) level?[4] The inability of the fundamentals school to provide an empirically-consistent view of both the boom and crash has, as a result, given free rein to the "speculative bubble" school, according to which the crash owed to the internal mechanics of bubbles themselves. Specifically, that the market was overvalued by 30%.

## 5.3 The Republican Party, "Prosperity for All" and Tariff Revision

As noted, the electrification of the U.S. economy ranks as one of the greatest–and far-reaching–technology shocks of all time (Gordon 2004). Cast in physical terms, it amounted to a massive positive energy shock, unprecedented in history. For example, the effects of the introduction of the steam engine in early nineteenth-century Great Britain were restricted to the manufacturing and, to a lesser degree, the transportation sector. Agriculture was largely unaffected. Electrification on the other hand affected virtually every aspect of life in the early 20th century (Nye 1990).

Potential output had increased faster than income and expenditure, introducing a fundamental disequilibrium. Manufacturers and farmers were unable to find buyers for their products. Most agreed that widespread excess

[4] McGrattan and Prescott (2004) rhetorically asked: "If stock prices were not inflated beyond their fundamental values in October 1929, why did the market crash?" They then pointed out that: "Answering that question is not addressed here." (McGrattan and Prescott 2004, 992).

supply/capacity was the result of electrification and the introduction of high-throughput, continuous-flow mass production. Rated capacity on existing plant and equipment increased as a result. Governments were at a loss to explain this paradox. Electrification held out the promise of a better tomorrow. Output and wealth would increase as firms "electrified," the spoils of which would revolutionize life in general (modernity). Ironically, with the passage of time, the resulting greater labor productivity affected labor demand, negatively.

By 1928, the U.S. economy, especially the manufacturing sector, was characterized by over-capacity/oversupply, the chief culprits being higher imports and mass production. This became a recurrent theme in the debate over the proposed Smoot-Hawley Tariff Bill. For example, at Hearings in the House of Representatives on the proposed tariff bill in February 1929, over-production was raised. "Most of the petitioners for large basic industries have admitted states of over-production or over-capacity for meeting domestic demand. Some estimated excess facilities at as much as 25 percent (The New York Times, February 17, 1929)."

### 5.3.1 Tariffs and "Prosperity for All"

In the face of weakening labor markets and growing excess capacity, the Republican Party responded by calling for yet another upward tariff revision (six years after the Fordney-McCumber Tariff Act of 1922). Calls for higher tariffs on manufactures came, in large measure, from the industrialized North-East. Leading the charge was Joseph A. Grundy, President of the *Pennsylvania Manufacturers Association* and a longtime Republican. Grundy had played an instrumental role in Hoover's victory at the 1928 Republican National Convention in Kansas City. According to Harold U. Faulkner: "The Smoot-Hawley Tariff was an administrative measure put through the Party machine and no single person was more active than Joseph R. Grundy, president of The Pennsylvania Manufacturers Association, who became Senator in December 1929" (1950, 342). His political agenda was limited to one item: a general upward tariff revision including manufactures.

Other leading tariff protagonists included Pennsylvania Governor John S. Fisher and Samuel M. Vauclain, president of the Baldwin Locomotive Works of Philadelphia. On September 5, 1929, in a meeting with President Hoover, Fisher expressed his concerns over increasing pressure to amend the tariff bill. "Earlier in the day President Hoover heard Representative Albert Johnson of Washington vigorously oppose the Senate Tariff bill, while two others, Governor Fisher of Pennsylvania and John E. Edgerton of New York, president of the National Manufacturers Association, voiced protests against administrative features of the bill. Governor Fisher said that the American valuation plan was essential to a sound tariff bill and that protection could not be given to one group alone, but must be extended to the entire country. “During the campaign, we preached protection for the East, West and all parts of the country,” Governor Fisher said. “We in Pennsylvania are for a tariff that will afford protection for all of our industries. We expect agricultural protection, but we are not going to stand for recognition of any section to the disadvantage of another (The New York Times, September 6, 1929).”

These statements mirrored the state of industry in Pennsylvania and in the U.S. as a whole throughout the 1910s and 1920s: increasingly productive and increasingly constrained on product markets. The electrification of U.S. industry had vastly increased potential GDP; insufficient markets (income and demand), however, prevented it from realizing this potential, a point made by Senator Smoot subsequently. According to Smoot biographer, Milton Merrill:

> On his return to Utah in August 1932, in preparation for his final battle in political life, Smoot advised his people that it had been the common attitude in 1930 to attribute the depression to unwise governmental policies, with the Smoot-Hawley act specified. Lest there were some obsessed with heresy, he declared, “To hold the American tariff policy, or any other policy of our government, responsible for this gigantic deflationary move is only to display one’s ignorance of its sweeping universal character.” He found that “The world is paying for its ruthless destruction of life and property in the World War and for its failure to adjust purchasing power to productive capacity during the industrial revolution of the decade following the war. (Merrill 1990, 340)”

### 5.3.2 The Kansas City Convention and Tariffs for All

America’s new greater capacity to produce wealth and need for more control over the domestic market through the use of tariffs was raised by Secretary of Labor, John J. Davis at the 1928 Kansas City Republican convention. For example, on June 11, 1928 he highlighted the successes and impending dangers facing U.S. industry. “Industrial competition among the countries of the world has caused fundamental changes in American industry that have vastly increased output and at the same time, relatively decreased the cost of production in practically all lines of endeavor. Thus, in meeting the competition from countries where lower standards of living obtain, the mechanization of industry has been brought about a practical industrial revolution in our country. The American workers are the highest paid in the world; the American standard of living surpasses that of any country; but even with this enviable record of progress, the mechanization of industry and the development of rapid power machinery processes have displaced many veteran workers and others, necessitating their engaging in other activities. To maintain high wages, it is absolutely necessary to have a high protective tariff, a tariff that protects (The Washington Post, June 12, 1928, p.4)."

At the Kansas City convention, Ranking Republican Charles E. Hughes praised the merits of an upward tariff revision against a background of greater efficiency, lower costs and greater output.

> I shall not review at any length the results of the Republican tariff policy. Mr. Hoover did that in his speech in Boston. Let me recall to you what he said. Every argument urged by our opponents against the increased duties in the Republican tariff act has been refuted by actual experience. It was contended that our costs of production would increase. Their prophecy was wrong for our costs have decreased. They urged that the duties which we proposed would increase the price of manufactured goods; yet prices have steadily decreased. It was urged that, by removing the pressure of competition of foreign goods, our industry would fall in efficiency. The answer to that is found in our vastly increased production per man in every branch of industry, which indeed is the envy of our competitors. (The New York Times, October 24, 1928,5)

The key is in the last sentence where Hughes invoked the "vastly increased production per man in every branch of industry." Put differently, higher tariffs, by increasing domestic firms' market share, would allow firms to "slide" down their new, lower average cost curve. Greater market share would lower costs and ultimately, prices.

Hence, the conundrum. The Party had set its sights on a major upward tariff revision on manufactures, against a background of what was a disillusioned and increasingly fragile agricultural sector. Raising rates on manufactures would have been morally and electorally indefensible. Rural America would have felt ignored, neglected and cheated (i.e. owing to higher prices). The solution: an omnibus tariff bill inclusive of agriculture‒in fact, one in which for political purposes the emphasis would be placed on agriculture. Tariffs in both industry and agriculture would as such be revised upwards—in short, a win-win situation.

With an eye to the upcoming election, the Republican National Conference decided on a limited tariff revision with an emphasis on agriculture. As it turned out, by proposing a limited tariff revision with an emphasis on agriculture, it *de facto* maximized its chances at the polls. For one, the policy was vague and non-committal. Tariff revision would be limited, without defining the limits. It would be up to the Ways and Means

Committee and the Senate Finance Committee, both dominated by Eastern interests, to elaborate the actual tariff hikes. And the advantage was that it was unassailable politically.

### 5.3.3 The Political Fallout

Electorally, the proposed limited upward tariff revision with an emphasis on agriculture was an unqualified success, with the Party winning both the House and the Senate as well as the White House in the 1928 general elections. As it turned out, this is when things began to unravel. As soon as the proposed bill was introduced in the Ways and Means Committee, its limited nature was, for all intents and purposes, abandoned. As Edward Kaplan remarked, in the first week of April, a congressional delegate from Pennsylvania pressured the Committee to raise rates on textiles, cement and chemicals. By the time the Hawley bill passed the House, Kaplan pointed out, "general tariff reform was an accomplished fact" (Kaplan 1996,23).

Opposition in rural America began to grow. There was a feeling that farmers had been misled, especially in light of the fact that higher tariffs in agriculture would have limited effects on farmers' well-being. Over the course of the next two months, a schism would be opened within the Republican Party, one opposing farm and non-farm interests, East versus West. Led by Midwestern Senators Borah, Norris and Nye, it called for change, specifically for lower, not higher tariffs on manufactures. The Party, however, held the course. Led by ranking Republican Senator Reed Smoot, it remained steadfast in its attempt at fulfilling the promises made at the Kansas City convention.

## 5.4 The Unraveling of the SHTB: Insurgency and Medicinal Tannic Acid

Strategically, the Republican Party, under the leadership of Senator Reed Smoot, had embarked on what was a Nash tariff strategy vis-à-vis the U.S.'s trading partners. A similar strategy had been employed in 1922 (Fordney-McCumber Tariff Act) with success. From July 1928 to July 1929, Smoot and other ranking Republicans were either unaware or unconcerned about possible reactions on the part of European countries. This however changed in the summer of 1929. France reacted swiftly calling for the creation of a "united front" against the United States. Gathering in Amsterdam on July 7, 1929, Europe's delegates to the *Assembly of World Business* denounced the Hawley Tariff Bill vehemently. As The New York

Times reported on July 8, 1929, "France and other European nations stood united in their determination retaliate." France called for the creation of international committees, one for each branch of industry doing business with the United States. According to *The New York Times,* these groups "would study how best to supplant American exports to Europe, either of domestic production or from purchases from other European countries." The committees would also study the question of finding markets to replace the American market.

Sensing the approaching storm, on July 18, 1929, the Senate Finance Committee suspended hearings. On July 22, Republican members of the committee, determined to achieve passage, began rewriting the Bill, paying particular attention to the farmers' demand for equity. The following day, however, the roof caved in: thirteen Republican Senators, led by Republican Senator William A. Borah of Idaho, announced that they had broken party rank and would work with the Democrats to defeat the Smoot-Hawley Tariff Bill. Throughout the months of August, September and October 1929, they stonewalled all attempts on the part of ranking Republicans, notably Senator Smoot to address their concerns. In fact, in time, they became more extreme in their positions. For example, when the Thomas Recommittal Plan, was an amendment tabled by Republican Senator Elmer Thomas of Oklahoma aimed at breaking the growing stalemate in the Senate by redefining/limiting the scope of the Tariff Bill, the Insurgent-Democrat coalition resoundingly defeated it. Republicans continued to favor higher tariffs on manufactures, while Democrats and Insurgent Republicans (the majority) opposed the proposed tariff hikes, setting their sights on actually lowering existing Fordney-McCumber (1922) tariff rates on manufactures. In short, the Insurgents had resuscitated the spirit of the McMaster Resolution—that is, lowering tariffs on the goods farmed used in production and consumed.

The amendment was defeated by a vote of 64 to 10. In their view, tariffs on manufactures would now be lowered. Empowered and emboldened by its victory (Thomas Recommittal Plan), the Democrat-Insurgent Republican coalition set its sights on manufactures, starting with medicinal tannic acid. On Tuesday, October 22, 1929, Senator Alben W. Barkley of Kentucky moved to cut the rate to 18 cents (from 20 cents). The motion passed by a margin of 12 votes with 45 for and 33 against. The New York Times reported: "The item on which the vote was taken was incidental, but the result showed that the coalition was nearly intact in its initial drive and also that is still held control in the Senate" (New York Times, October 23, 1929). The tide had changed: tariffs on manufactures would fall.

These developments irked both the Old-Guard Republicans.[5] Sensing the growing polarization (and the resolve of the Democrat-Insurgent Republican coalition), on Sunday, October 27th, Senator Reed of Pennsylvania predicted that the Bill would die on the Senate floor.

Table 5.1 presents the highlights of what we refer to as the SHTB life-cycle, with its many ups in 1928 and 1929, and its many downs from July 23, 1929 onwards (after the Insurgents joined the Democrats). It will be argued that these developments (news) fueled the stock market boom and crash of 1928-1929, with "good" tariff news leading to higher prices in industries most affected by electrification, and "bad" tariff news depressing prices.

**Table 5.1: Smoot-Hawley Tariff Bill-Electoral and Legislative Highlights**

| | |
|---|---|
| January 24, 1928 | Samuel Vauclain, leading Republican, advocates across-the-board tariff hikes. |
| March 27, 1928 | Republican Senator, and chair of the Senate Finance Committee Reed Smoot holds foreign imports as being responsible for the slowdown and unemployment in many industries. |
| June 11-15, 1928 | Kansas City Convention Platform-Tariffs and "Prosperity for All" |
| November 4, 1928 | Presidential Election-Herbert Hoover is elected on a platform of a limited upward tariff revision. |
| January 1929 | Tariff Bill is introduced in the House of Representatives |
| May 28, 1929 | Hawley Tariff Bill is passed by the House of Representatives |
| July 18, 1929 | Thirteen Insurgent Republicans cross the Senate floor and vote with the Democrats |
| October 21, 1929 | The Thomas Recommittal Bill is defeated. |
| October 22, 1929 | The tariff on medicinal tannic acid is reduced by a vote of 45 to 33. |
| October 27, 1929 | Republican Senator David E. Reed from Pennsylvania declares the Tariff Bill dead. |

## 5.5 Tariff News and Stock Prices 1928-1929: A Longitudinal Approach

As we have shown, the SHTB had a life of its own, with its origins in early-to-mid 1928, gaining momentum in the pre- and post-election period, and experiencing an unanticipated downfall in the late summer and early

[5] Of the twelve Insurgent Republicans that had voted in favor of the McMaster Resolution on January 15, 1928 (Senators Blain, Borah, Brookhart, Capper, Frazier, Howell, La Follette, McMaster, Norbeck, Norris, Nye and Pine), six voted against the Thomas Recommittal Plan (Borah, Brookhart, Capper, La Follette, Norbeck and Norris), while five voted in favor (Frazier, Howell, McMaster, Nye, and Pine).

fall when thirteen Insurgent Republican Senators broke rank with the Party and voted with the Democrats to lower tariffs on manufactures. In this paper, we argue that the stock market boom and crash of 1928-1929 tracked this cycle. Specifically, good tariff news against a backdrop of growing excess capacity served to increase stock prices, while bad tariff news had the opposite effect. Given the role of electrification in prompting the demand for tariff protection at the industry level (i.e. as the basis for excess capacity), our theory predicts the existence of a positive relationship between stock-price tariff news responsiveness (as measured by the estimated regression coefficient) and the extent of electrification as measured by the rate of growth of electric power consumption at the industry level. In other words, stocks of firms in industries most affected by the new technology *de facto* would have varied the most in the 1928-1929 stock market boom and crash.

To test this hypothesis, we proceeded as follows. To begin with, using a tariff news-augmented three-factor Fama-French model, we tested for the presence of a relationship between daily variations (measured in % terms) in nineteen Blue Chip Dow Jones Industrial Average (DJIA) stock prices (see Table 5.3) and SHTB-related tariff news.[6] Legislative SHTB-related tariff news for 1929 were taken from Beaudreau (2014), while 1928 legislative and electoral SHTB-related tariff news were generated using the same methodology (Beaudreau 2014), namely searching the New York Times (via ProQuest) using tariff-related keywords. The result was a series of 19 estimated regression coefficients, one for each Fama-French stock price equation. As not all stocks would have responded similarly to tariff-related news, we then proceeded to test for a relationship between stock-price sensitivity (as measured by the estimated Fama-French SHTA news regression coefficient) and the extent of electrification (measured by the rate of growth of electric power use per worker). In other words, stocks in industries which electrified the most—and hence, would have been more likely to find themselves with excess capacity—would be more responsive to SHTB tariff-bill related news, and vice-versa. To verify this, we tested for a relationship between the relevant estimated Fama-French regression coefficients and an industry measure of electrification.

[6] The choice of DJIA firms was based on Rappoport and White (1994). Retailing firms, Sears and Woolworths, as well as Paramount and Wright Aeronautical were excluded due to a lack of data on industry electrification.

### 5.5.1 Beaudreau (2014)'s Methodology

Beaudreau (2014) set out to discriminate between two opposing theories of the stock market crash using SHTB legislative news. The first (Wanniski 1978) maintained that the market crashed following the defeat of the Thomas Recommittal plan, which was interpreted as evidence that tariffs on manufactures would rise. The second (Beaudreau 1996,2005) maintained that it crashed owing to the joint occurrence of *(i)* the defeat of the Thomas Recommittal Bill and *(ii)* the Insurgent Republican-Democrat Senate victory in lowering the tariff on medicinal tannic acid. The defeat of the Thomas Recommittal bill, Beaudreau (1996,2005) argued should be understood as tariff bad news, signaling a shift in tariff policy in the U.S. to lower rate on manufactures. The Insurgent Republican-Democrat victory on medicinal tannic acid signaled the beginning of the tariff-reducing onslaught that was to last for the rest of 1929 and early 1930.

To discriminate between the two, he examined the relationship between good and bad SHTB legislative news and stock prices from the introduction of the tariff bill in the House, to the stock market crash (October 23, 1929). His results showed the existence of a significant positive relationship between SHTB legislative good news and the Dow Jones Industrial Average.

The ProQuest Historical Newspaper Search Instrument for the New York Times was used to identify tariff bill congressional good and bad news events from January 14, 1929 to October 29, 1929.[7]. A total of 105 tariff bill-related congressional news events/items were identified over this period (236 DJIA trading dates). These were then coded in two ways. In the first, good or bad news events were coded using a scale of minus 3 to plus 3 (Tariff News). Major events involving the Bill's proponents/opponents (Congress and Executive) were assigned a value of 3, while lesser events (e.g. voting on a particular rate or set of rates) were assigned lower values. Multiple tariff bill news-event days were dealt with on an additive basis (i.e. sum of individual news items). Non-tariff-related news event days were given a value of zero. Stock price variations (absolute and relative) were measured using the daily Dow Jones Industrial Average index.[8] Total daily

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[7] The New York Times and the Wall Street Journal are two of the most-used information sources in event studies, be they economic, financial, environmental, etc. See, for example, Binder (1985). The choice of the New York Times was based on its representativeness, and its status as the premier source of information in the North-East—and New York City. It bears noting that none of the new events involved either newspaper or contributor editorials.

[8] The data as well as the coded news events are available from the author.

DJIA gains on good tariff bill news summed up to 149.71 points, while total losses on bad tariff bill news summed up to 221.14 points, with a net difference of -71.43 points, which compares favorably with the overall fall in the DJIA from the beginning of the sample to October 30 of 73.99 points.[9] For our purposes, this procedure was replicated for the pre-legislative period (March 1928 to January 1929), which when combined with Beaudreau (2014)'s tariff-related data resulted in a total of 154 tariff-related news items/days over a period of two years (587 trading days). Referring to Table 5.2, we see that there were 45 good tariff news items of which one was coded (4), three (3), thirteen (2) and forty-five (2). On the other hand, there were 65 bad tariff news items, coded as follows: two (−5), seven (−3), twenty-one (−2) and twenty-two (−1).

### Table 5.2: Tariff News January 4, 1928-December 31, 1929 Data

Period: 1/4/1929 to 12/31/1929
Sample Size: 586 Trading Days
Beginning of Sample: January 4, 1928
End of Sample: December 31, 1929

| | | | |
|---|---|---|---|
| NEWS-I: | Good | Code | Frequency |
| | | (4) | 1 |
| | | (3) | 2 |
| | | (2) | 21 |
| | | (1) | 66 |
| NEWS-I: | Bad | Code | Frequency |
| | | (-5) | 2 |
| | | (-4) | 0 |
| | | (-3) | 7 |
| | | (-2) | 21 |
| | | (-1) | 22 |
| NEWS-II: | Good | Code | Frequency |
| | | (1) | 90 |
| NEWS-II: | Bad | Code | Frequency |
| | | (-1) | 72 |

[9] The DJIA rebounded on October 31, only to return to the 230-point level three days later, where it stood for a few days before hitting its all-time low of 198 on November 13th.

**Table 5.3: DJIA Sample Stocks**

| PERMCO | Company | Industry* |
|---|---|---|
| P6238 | Mack Truck | Automotive |
| P20220 | American Smelting and Refining | Primary Metals |
| P20227 | Atlantic Refining | Food |
| P20299 | Bethlehem Steel | Primary Metals |
| P20446 | Chrysler | Automotive |
| P20799 | General Motors | Automotive |
| P20973 | American Sugar | Food |
| P21265 | International Harvester | Machinery and Equipment |
| P21734 | Texas Corporation | Oil |
| P21795 | American Tobacco | Food |
| P21806 | Union Carbide | Chemicals |
| P21912 | Westinghouse | Machinery and Equipment |
| P22168 | Allied Chemicals | Chemicals |
| P22177 | American Can | Primary Metals |
| P22184 | Nash | Automobile |
| P22448 | North American Company | Oil |
| P22497 | RCA | New Industrial |
| P22552 | Texas Gulf and Sulpher | Oil |

*Rappoport and White (1994).

The nineteen DJIA stocks are listed in Table 5.3, along with their corresponding industry/sector. We estimated a tariff news-augmented three-factor Fama-French equation for each of these. However, because tariff news was found to have a statistically-significant systemic effect on the market rate of return as reported by Kenneth French (French 2015), a new measure was derived, namely $R_m^I$, the tariff news-independent market rate of return. Formally, the standard market rate of return was regressed against tariff news, leaving a set of residuals that were used in lieu of the original market rate-of-return. Table 5.4 presents the estimates of the tariff news-augmented three variable Fama-French equations for the nineteen individual stocks. We see that in seventeen of the nineteen cases, tariff news has a positive, statistically significant effect on stock prices, corroborating our basic hypothesis, namely that tariff bill-related electoral and legislative news exerted a significant effect on stock prices. Good tariff news increased stock prices, while bad tariff news lowered them.

Next, we tested the corollary, namely that tariff news sensitivity should be increasing in the extent of excess capacity, and hence, in the extent of electrification. It should be pointed out in that in many instances, electrification, by increasing operating speeds, increased capacity without a concomitant increase in investment/capital stock. For example, electrification could, by increasing machine speeds by 30 percent, increase overall capacity by an equivalent amount. As such, our theory predicts the existence of a positive relationship between firm electrification as proxied by the rate of growth of electric power consumption (Column 3 in Table 5.5) and its measured sensitivity to tariff news as proxied by its regression coefficient (see Table 5.5).[10] The estimated correlation coefficient was 0.3778, which indicates the presence of a non-negligible relationship between the firm's industry-specific experience with electrification and its stock price sensitivity to Smoot-Hawley Tariff Bill news.

**Table 5.4: Tariff News-Augmented Three-Factor Fama-French Estimated Coefficients 1928-1929**

| PERMCO | Company | Constant | $R^I_m$ | SMB |
|---|---|---|---|---|
| | HML | Tariff News | $R^2$ | F(4,286) |
| P6238 | Mack Truck | −0.00057 | 0.00962 | 0.00198 |
| | | (-0.9602)* | (21.1884) | (2.2242) |
| | −0.00142 | 0.00547 | 0.52617 | 161.0179 |
| | (-1.1545) | (7.5117) | | |
| P20220 | American Smelting | −0.00070 | 0.00912 | 0.00293 |
| | | (−0.5565) | (9.4329) | (1.5435) |
| | 0.00117 | 0.00511 | 0.16500 | 28.65420 |
| | (0.4436) | (3.2914) | | |
| P20227 | Atlantic Refining | −0.00006 | 0.01347 | 0.00072 |
| | | (−0.4048) | (11.8222) | (0.3255) |
| | 0.00465 | 0.00516 | 0.22692 | 42.56150 |
| | (1.4995) | (2.8269) | | |
| P20299 | Bethlehem Steel | 0.00043 | 0.01032 | −0.00458 |
| | | (0.6719) | (21.0596) | (−4.7539) |
| | 0.00526 | 0.00620 | 0.53011 | 163.5827 |
| | (3.9411) | (7.8834) | | |
| P20446 | Chrysler | −0.00033 | 0.01306 | 0.00660 |
| | | (−0.3910) | (20.0788) | (5.1631) |
| | −0.00136 | 0.00668 | 0.48198 | 134.9155 |
| | (−0.7677) | (6.3986) | | |
| P20678 | Standard Oil | 0.00068 | 0.01063 | −0.00179 |
| | | (1.1668) | (23.9845) | (−2.0552) |
| | 0.0021 | 0.00642 | 0.58768 | 206.6745 |
| | (1.7438) | (9.0273) | | |
| P20799 | General Motors | −0.00177 | 0.01081 | −0.00581 |
| | | (−1.4754) | (11.8236) | (−3.2360) |

[10] Specifically, the rate of growth of electricity consumption per wage earner was computed using U.S. Bureau of the Census, Annual Survey of Manufactures data on electric horsepower (installed and purchased) by industry as well as the corresponding number of wage earners. For example, electricity use per worker in the tobacco industry (American Tobacco) increased by 14 percent, while it increased by 392 percent in the oil refining industry (Texas Corporation).

| | | | | |
|---|---|---|---|---|
| | −0.00479 | 0.00546 | 0.31621 | 67.05531 |
| | (−1.9219) | (3.7242) | | |
| P20973 | American Sugar | 0.00003 | 0.01587 | −0.00232 |
| | | (0.0204) | (11.7891) | (−0.8765) |
| | 0.00398 | 0.00910 | 0.25032 | 48.41718 |
| | (1.0841) | (4.2126) | | |
| P21265 | Int'l Harvester | −0.02045 | 0.02479 | 0.00328 |
| | | (−2.4305) | (3.8781) | (0.2617) |
| | 0.01011 | −0.00737 | 0.02972 | 4.44201 |
| | (0.5802) | (−0.7190) | | |
| P21734 | Texas Corporation | −0.00005 | 0.00718 | 0.00074 |
| | | (−0.1162) | (20.9778) | (1.1080) |
| | 0.00493 | 0.00473 | 0.48080 | 134.2770 |
| | (5.2813) | (8.6194) | | |
| P21795 | American Tobacco | −0.00006 | 0.00789 | −0.00365 |
| | | (−0.1439) | (22.5183) | (−5.2974) |
| | 0.00087 | 0.00390 | 0.58017 | 200.3840 |
| | (0.9157) | (6.9468) | | |
| P21806 | Union Carbide | −0.00063 | 0.01286 | −0.00789 |
| | | (−0.4833) | (12.9051) | (−4.0278) |
| | −0.00414 | 0.00747 | 0.35766 | 80.73825 |
| | (−1.5254) | (4.6745) | | |
| P21912 | Westinghouse | 0.00063 | 0.01281 | −0.00479 |
| | | (1.0476) | (27.6361) | (−5.2658) |
| | −0.00461 | 0.00683 | 0.70069 | 339.4475 |
| | (−3.6526) | (9.1879) | | |
| P22168 | Allied Chemicals | −0.01266 | 0.01179 | 0.00349 |
| | | (−1.8226) | (2.2345) | (0.3368) |
| | 0.00935 | 0.00292 | 0.00888 | 1.29947 |
| | (0.6499) | (0.3458) | | |
| P22177 | American Can | 0.00052 | 0.01181 | −0.00595 |
| | | (0.8665) | (25.7544) | (−6.6054) |
| | 0.00130 | 0.00468 | 0.64222 | 260.2827 |
| | (1.0425) | (6.3682) | | |
| P22184 | Nash | −0.00081 | 0.01230 | 0.00302 |
| | | (−1.2909) | (25.7899) | (3.2225) |
| | −0.00108 | 0.00659 | 0.61321 | 229.8823 |
| | (−0.8355) | (8.6060) | | |
| P22448 | North American Co. | 0.00094 | 0.01438 | −0.00314 |
| | | (1.2656) | (25.4069) | (−2.8262) |
| | −0.00639 | 0.00615 | 0.65345 | 273.4104 |
| | (−4.1431) | (6.7716) | | |
| P22497 | RCA | −0.00078 | 0.01983 | −0.00495 |
| | | (−0.3023) | (10.1213) | (−1.2860) |
| | −0.00438 | −0.00086 | 0.20965 | 38.39747 |
| | (−0.8213) | (0.2753) | | |
| P22552 | Texas Gulf & Sulpher | −0.00050 | 0.01115 | 0.000879 |
| | | (−0.9608) | (27.7038) | (1.1111) |
| | 0.00032 | 0.00386 | 0.63451 | 251.7343 |
| | (0.2919) | (5.9760) | | |

*t-statistic.

**Table 5.5: Tariff News-Augmented Three-Factor Fama-French Estimated Coefficients and Electrification**

| PERMCO | Company | Tariff News 1928-1929 | Tariff News 1929 | DELELEC |
|---|---|---|---|---|
| P6238 | Mack Truck | 0.00547478 | 0.00608844 | 3.066022861 |
| P20220 | American Smelting | 0.00511 | 0.00584823 | 4.071826978 |
| P20227 | Atlantic Refining | 0.00516916 | 0.01058090 | 4.922699462 |
| P20299 | Bethlehem Steel | 0.00620214 | 0.00686466 | 3.300055733 |
| P20446 | Chrysler | 0.00668051 | 0.00743785 | 3.066022861 |
| P20799 | General Motors | 0.00546397 | 0.00603365 | 3.066022861 |
| P20973 | American Sugar | 0.00910434 | 0.01057070 | 3.612128798 |
| P21265 | International Harvester | -0.0073761 | 0.00454308 | 1.613633078 |
| P21734 | Texas Corporation | 0.00473755 | 0.00545863 | 4.922699462 |
| P21795 | American Tobacco | 0.00086699 | -0.00306237 | 1.174564136 |
| P22552 | Texas Gulf and Sulpher | 0.00386284 | 0.00487188 | 1.948720810 |

## 5.5.2 Reduced Sample: 1929 Only Legislative-Based Tariff News and DJIA Stock Prices

Most of the SHTB-related legislative news (as reported in the NYT) occurred in 1929. In light of this, the above analysis was repeated using 1929 data alone (as in Beaudreau 2014). The results are presented in Table 5.6. Again, we estimated the correlation coefficient between tariff-news sensitivity as measured by the estimated regression coefficient and the extent of excess capacity as measured by the rate of growth of electric power at the industry level. This was found to be 0.5153 which suggests an even stronger relationship between electrification and tariff-related stock price movements.

## Table 5.6: Tariff news-augmented three-factor Fama-French estimated coefficients-1929 only

| PERMCO | Company | Constant | [Rm − Rf]* | SMB |
|---|---|---|---|---|
| | HML | Tariff | $R^2$ | F(4,286) |
| | News | | | |
| P6238 | Mack Truck | −0.00044 | 0.00956 | 0.00235 |
| | | (−0.4744)* | (15.2223) | (2.0637) |
| | −0.00221 | 0.00608 | 0.61816 | 115.7527 |
| | (−1.1911) | (6.9241) | | |
| P20220 | American Smelting | −0.00031 | 0.00960 | 0.00208 |
| | | (−0.3564) | (16.4428) | (1.9606) |
| | 0.00326 | 0.00584 | 0.60164 | 107.9866 |
| | (1.8877) | (7.1533) | | |
| P20227 | Atlantic Refining | −0.00092 | 0.01371 | 0.00205 |
| | | (−0.8978) | (20.0177) | (1.6519) |
| | 0.00684 | 0.01058 | 0.69801 | 165.2634 |
| | (3.3765) | (11.0359) | | |
| P20299 | Bethlehem Steel | −0.00015 | 0.00877 | −0.00642 |
| | | (−0.1892) | (15.6878) | (−6.3172) |
| | 0.00351 | 0.00686 | 0.67631 | 149.3938 |
| | (2.1293) | (8.7760) | | |
| P20446 | Chrysler | −0.00254 | 0.01149 | 0.00642 |
| | | (−2.2545) | (15.2828) | (4.6944) |
| | −0.00314 | 0.00743 | 0.61121 | 112.4079 |
| | (−1.4142) | (7.0682) | | |
| P20678 | Standard Oil | 0.00097 | 0.01129 | −0.00152 |
| | | (0.9819) | (17.1154) | (−1.2711) |
| | 0.00376 | 0.00719 | 0.65055 | 133.1105 |
| | (1.9275) | (7.7870) | | |
| P20799 | General Motors | −0.00471 | 0.00963 | −0.00829 |
| | | (−2.0176) | (6.1971) | (−2.9328) |
| | −0.00350 | 0.00603 | 0.29187 | 29.47090 |
| | (−0.7625) | (2.7727) | | |
| P20973 | American Sugar | −0.00051 | 0.01663 | −0.00270 |
| | | (−0.3412) | (16.4954) | (−1.4750) |
| | 0.00720 | 0.01057 | 0.62807 | 120.7435 |
| | (2.4150) | (7.4914) | | |
| P21265 | Int'l Harvester | −0.00078 | 0.00906 | −0.00656 |
| | | (−0.6892) | (11.9955) | (−4.7745) |
| | −0.00315 | 0.00454 | 0.58443 | 100.5552 |
| | (−1.4109) | (4.2965) | | |
| P21734 | Texas Corporation | −0.00028 | 0.00713 | 0.00118 |
| | | (−0.4585) | (17.0735) | (1.5663) |
| | 0.00533 | 0.00545 | 0.60624 | 110.0863 |
| | (4.3203) | (9.3403) | | |
| P21795 | American Tobacco | 0.00001 | 0.00747 | −0.00429 |
| | | (0.0020) | (13.9227) | (−4.3933) |
| | 0.00101 | 0.00453 | 0.60972 | 111.7029 |
| | (0.6385) | (6.0306) | | |

| | | | | |
|---|---|---|---|---|
| P21806 | Union Carbide | −0.00160 | 0.01272 | −0.00933 |
| | | (−0.6191) | (7.3983) | (−2.9856) |
| | −0.00477 | 0.00847 | 0.36155 | 40.49135 |
| | (−0.9392) | (3.5226) | | |
| P21912 | Westinghouse | 0.00057 | 0.01201 | −0.00588 |
| | | (0.6122) | (19.0773) | (−5.1348) |
| | −0.00616 | 0.00797 | 0.78204 | 256.5530 |
| | (−3.3104) | (9.0457) | | |
| P22168 | Allied Chemicals | −0.02755 | 0.01336 | 0.00245 |
| | | (−1.9506) | (1.4228) | (0.1435) |
| | 0.01800 | 0.00192 | 0.00770 | 0.55483 |
| | (0.6482) | (0.1516) | | |
| P22177 | American Can | 0.00001 | 0.01098 | −0.00735 |
| | | (0.0089) | (17.0296) | (−6.3160) |
| | 0.00001 | 0.00502 | 0.71030 | 175.3142 |
| | (0.0123) | (5.6114) | | |
| P22184 | Nash | −0.00090 | 0.01202 | 0.00391 |
| | | (−0.9064) | (18.0237) | (3.2244) |
| | −0.00251 | 0.00770 | 0.68880 | 158.2573 |
| | (−1.2732) | (8.2592) | | |
| P22448 | North American Co. | 0.00102 | 0.01469 | −0.00391 |
| | | (0.772) | (16.7827) | (−2.4932) |
| | −0.00713 | 0.00700 | 0.70718 | 172.6827 |
| | (−2.7557) | (5.7191) | | |
| P22497 | RCA | −0.00772 | 0.01696 | −0.00939 |
| | | (−1.5850) | (5.2442) | (−1.5975) |
| | −0.00932 | −0.00306 | 0.20010 | 17.82457 |
| | (−0.9749) | (−0.6756) | | |
| P22552 | Texas Gulf & Sulpher | −0.00054 | 0.01114 | 0.00126 |
| | | (−0.6825) | (21.1062) | (1.3131) |
| | 0.00029 | 0.00487 | 0.73221 | 195.5063 |
| | (0.1905) | (6.5957) | | |

*t-statistic.

## Table 5.7: Nineteen DJIA stocks: minimum price, maximum price, overall gain, tariff news-based gain

| PERMCO | Company | (1) Share Price-Min | (2) Share Price-Max | (3) %Gain | (4) %Gain Tariff | (5) %Exp. |
|---|---|---|---|---|---|---|
| P6238 | MackTruck | 58.75 | 114.625 | 0.95 | 0.44 | 0.46 |
| P20220 | American Smelting and Refining | 62.87 | 284 | 3.51 | 0.41 | 0.36 |
| P20227 | Atlantic Refining | 35 | 231.5 | 5.61 | −0.02 | −0.01 |
| P20299 | Bethlehem Steel | 52.87 | 139.25 | 1.63 | 0.56 | 0.34 |
| P20446 | Chrysler | 27 | 139 | 4.14 | 0.17 | 0.04 |
| P20678 | Standard Oil of NJ | 37.87 | 82 | 1.16 | 0.73 | 0.63 |
| P20799 | General Motors | 36.12 | 222.87 | 5.16 | 0.50 | 0.34 |
| P20973 | American Sugar | 26 | 267 | 9.26 | 0.70 | 0.15 |
| P21265 | International Harvester | 65.87 | 382 | 4.79 | 0.48 | 0.10 |
| P21734 | Texas Corporation | 50.12 | 74.25 | 0.48 | 0.36 | 0.76 |

| | | | | | | |
|---|---|---|---|---|---|---|
| P21795 | American Tobacco | 133.25 | 259.75 | 0.94 | 0.40 | 0.42 |
| P21806 | Union Carbide | 60.25 | 264.5 | 3.39 | 0.65 | 0.30 |
| P21912 | Westinghouse | 89.12 | 289 | 2.24 | 0.58 | 0.26 |
| P22168 | Allied Chemicals | 146.75 | 354 | 1.41 | 0.53 | 0.37 |
| P22177 | American Can | 71 | 182.5 | 1.57 | 0.45 | 0.29 |
| P22184 | Nash | 45 | 116.75 | 1.59 | 0.40 | 0.25 |
| P22448 | North American Co. | 59.37 | 184.62 | 2.10 | 0.60 | 0.28 |
| P22497 | RCA | 28.75 | 461 | 15.03 | −0.26 | −0.04 |
| P22552 | Texas Gulf and Sulpher | 42.87 | 84.5 | 0.97 | 0.06 | 0.06 |

## 5.6 Explaining Stock Price Appreciation: The Role of Tariff Bill-Related Good News

We hypothesized that tariff-related good news-based stock price appreciation could potentially explain a substantial proportion of the gains shares experienced in the stock market boom of 1928-1929. Furthermore, these gains would be uneven and would vary according to the sector, specifically with regard to firms in the sector's experience with electrification. To test this variation of our main hypothesis, we began by calculating the maximum gain (in percent) over the course of the June 1928-September 1929 period, defined as the maximum share price over this time interval minus the minimum price over the same interval. These are reported in Columns 1-3 in Table 5.7. We see significant variation across stocks, ranging from a high of 73 percent to a low of -26 percent. Next, we calculated the cumulative good-news stock-based price appreciation for each share, consisting of the simple sum of daily good-news rates of stock appreciation. These are reported in Column 4. By taking the ratio of these two, we obtained the percentage of stock appreciation explained by SHTA-related good news. Specifically, we are able to establish that SHTA-related good news explains up to 76 percent of the stock's (i.e. Texas Corporation) overall gain in the June 1928-September 1929 period. This then raises the question: is there a relationship between the percentage of price appreciation that is explained by SHTA good tariff news and the industry's experience with electrification? To address this question, we estimated the relevant correlation coefficient which was found to be 0.3602, which suggests the presence of a statistically-significant relationship between the percentage of stock price appreciation explained by tariff-related good news and electrification. In other words, firms in industries that electrified the most were more likely to see their stock prices increase in response to tariff bill-related good news.

## 5.7 Summary and Conclusions

In the aftermath of the stock market crash, Yale economics professor Irving Fisher steadfastly maintained that fundamentals had driven the market. Specifically, "the stock market rose after the war above the pre-war level by 50-100 percent because of war inflation and that since, it has doubled because of increasing prosperity from less unstable money, new mergers, new scientific management and the new policy of waste saving." Missing was a convincing narrative of why prices collapsed in October, against what were unchanged fundamentals. This paper has attempted to provide the missing link, in the form of the Republican Party's choice of tariff policy as a macroeconomic policy instrument. The fundamentals that Fisher referred to were validated–and invalidated–so to speak by a tariff policy aimed at providing more room in U.S. markets for domestic firms. In this paper, we argued that the stock market boom and crash can be understood as having tracked the trials and tribulations—in short, of the life-cycle—of the SHTB in 1928 and 1929, against a background of Fisher's improved fundamentals, specifically of electrification. Applying Beaudreau (2014)'s methodology within the context of the three-factor Fama-French model of equity prices, we were able to confirm the presence of a statistically- significant positive relationship between tariff-related good news and stock-price appreciation in 1928-1929. As not all firms/industries benefitted from the same degree of electrification, it stood to reason that this relationship would vary across industries. To test for this, we developed a measure of the degree of electrification by industry and used it to generate a series of tariff-news regression coefficients. Firms in industries most affected by the new technology were more sensitive to tariff-based news.

These findings are important for a number of reasons. First, they corroborate at the individual firm level the results of Beaudreau (2014) to the effect that tariff news was a statistically significant factor affecting share prices in the stock market boom and crash period (1928-1929). Second, they provide the missing link to Fisher's otherwise accurate account of the role of fundamentals in the stock market boom. Third, they provide an empirically-consistent fundamentals-based theory of the stock market boom and crash. Lastly, they provide a rationale for what would appear to be excess stock price volatility (Shiller 1981), at least in far as the stock market boom and crash is concerned. Specifically, stock prices in 1928-1929 were responding to SHTB-based investor expectations against a background of higher factory productivity, itself the result of electrification. The Republican Party had campaigned and had been elected on tariffs and prosperity for all. Higher tariffs would in all likelihood raise factory utilization rates, thus increasing revenue, profits, dividends and ultimately, stock prices.

They complete—and complement—Fisher's analysis, by providing the missing link in the form of the anticipated capital utilization rate, itself intimately tied to the rise and fall of the Republican Party's tariff initiative. Stock prices throughout 1929 were responding to changing fundamentals via legislative-based changes in anticipated tariff-based earnings. The latter followed a life cycle of their own, increasing for most of 1929, but falling dramatically in October 1929, the result of the Insurgent Republican-Democrat push for lower, not higher tariffs on manufactures.

They also provide a rationale for Fisher's view that the stock market was possibly undervalued at its peak. In other words, the anticipated tariff-based gains in earnings and dividends (as reflected in stock prices) could quite possibly have been below their full-employment level. Put differently, investors could quite possibly have felt that the higher tariffs proposed in the Smoot-Hawley Tariff Bill, while promising, would be insufficient to close the output gap described in the paper.

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# 6. Measures of Change in Mechanization[1]

## Harry Jerome

### 6.1 Introduction

In preceding chapters, we have sketched the observed tendencies towards increasing mechanization, first in selected manufacturing industries, then in the non-manufacturing industries and finally in the handling of materials, which is more or less common to all. The reader has doubtless gained the impression that mechanization in the post War decade proceeded along many lines and with somewhat exceptional rapidity. Can we state this tendency towards mechanization in a more generalized form than by describing the developments peculiar to each industry, and in a form reasonably comparable from industry to industry and from period to period? Just how fast and in what ways has mechanization progressed? Can we measure it or at least delineate its mainlines of advance?

For purposes of measurement, the concept of mechanization requires a more precise denotation. Here we are limiting it to power mechanization, that is, to processes and methods utilizing generated power. So limited, we find several possible ways of measuring its extent. First, we may take the amount of power used, or the more readily available figure of rated horsepower capacity of power equipment. But this measure does not give us a ratio of machine work to non-machine work. To obtain such a ratio we may turn to the proportion of product that arises from mechanical as compared with manual methods, and this machine output ratio1s obviously significant in the few instances where it is available. But even this figure does not correctly indicate the proportion of workers engaged in the mechanized process, for 75 per cent of an industry's output might be produced by 25 per cent of the workers if they were equipped with highly productive machinery and the other 75 per cent were using antiquated hand

[1] Jerome, Harry. Mechanization in Industry. New York, NY: National Bureau of Economic Research, 1934.

methods. It will be noted that the machine labor ratio based upon the proportion of machine workers to the total labor force is a measure of mechanization that facilitates a comparison of the degree of mechanization between two processes in the same industry (see Ch. VII).

A second possible measure of this type is the ratio of expense for labor to the total cost of production. The ratio of wages to value added by manufacture (as a rough measure of the labor expense ratio) can be determined from census data by industries, but not for the several processes in an industry. However, if sufficiently detailed cost accounting records were available, it is conceivable that ratios of labor expense to total expense could be computed for each process and used as rough measures of relative mechanization. The labor expense ratio, it will be noted, is affected not only by the number of wage earners, but also by relative wage rates and hence by the grade of labor in so far as wage rates are determined by differences in the type of labor. Another possible measure is the equipment ratio—the dollar value per worker of the power equipment in use.[2]

The horsepower ratio, the machine output ratio, the machine labor ratio, and the labor expense ratio are all more or less general measures of mechanization in that they are applicable (assuming appropriate data are available) to all industries. In contrast are various specific measures which indicate the extent of use of specified labor-saving devices and are consequently limited in their application to the particular industries in which such devices are used.

The several general measures of mechanization do not give precisely the same result when the degree of mechanization between industries or at different periods in the same industry is compared, partly because they refer to somewhat different aspects of the phenomenon of mechanization, and partly because of the inadequacy of the data and complicating factors whose influence cannot be eliminated. There is no adequate single quantitative measure of the extent of the increasing substitution of machines for human effort. We must resort to the composite picture afforded by several phenomena. Though no one of these alone tells the whole story, jointly they throw much light on the trend in mechanization.

Of the several measures mentioned, the most readily available is the rated capacity of prime movers and motors operated by purchased power,

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[2] Colonel M. C. Rorty remarks that a very interesting, but still not wholly significant, figure might be K. W. hours per unit of output from year to year for a given establishment or industry; and that intensified illumination is probably a not unimportant element in increasing power consumption.

expressed in terms of horsepower.[3] Rated horsepower statistics are published in considerable detail, particularly for manufacturing. But the statistics of horsepower, though useful and important, are, as will be explained more fully in subsequent paragraphs, inadequate in two respects: first, they do not give a perfect record of the changes in power used or even of installed power equipment; second, the changes in power per worker, even if precisely measured, are not a complete story of the changes in mechanization. In fact, some important mechanical improvements actually result in a decrease rather than an increase in power requirements. Consequently, it is appropriate to supplement our analysis of the capacity of installed power equipment with such other evidence as is available to indicate the changing degree of mechanization.

We are concerned in this chapter with measures that facilitate comparisons of change in mechanization—of the degree of mechanization at different periods—rather than comparisons as in Chapter VII of differences in the degree of mechanization at a given time between industries, processes or producing areas. The general measures available for chronological comparisons are not so numerous or adequate as those usable for comparisons of currently existing differences. The ratio of wages to value added by manufacture is available but is of somewhat limited usefulness. The growth of the machine producing industry is itself a clue to the changing importance of the machine. Also, in addition to the general measures, there are available for particular industries or processes various indicators of change in the use of specified labor-saving devices. For a few processes, such as coal undercutting in mining, the year to year changes in the proportion of output produced by mechanical equipment are on record; for others the proportion of operators equipped with specified labor-saving devices. The annual records of the number of specified labor-saving devices sold, or of the total number in use, afford some additional evidence of changing mechanization. Data of this type for numerous series are given in the several tables in Appendix A.

## 6.2 Growth in the Use of Power

The most generally available and most frequently used measure of increasing mechanization is horsepower per worker.[4] While some useful

[3] Prime movers are steam engines and turbines, internal combustion engines, and water wheels and water turbines.

[4] Horsepower as used in the Census of Manufactures refers to the rated capacity of prime movers and motors driven by purchased current and not to the amount of power consumed.

information is available for several other industries, such as agriculture, mining and transportation, horsepower statistics are most complete for manufacturing.

### 6.2.1 Limitations of Power Data

Power equipment and the number of wage earners in manufacturing have been compiled in the census of manufactures for 1869, 1879, 1889, 1899, 1904, 1909, 1914, 1919, 1923, 1925, 1927 and 1929. Before examining the statistics of horsepower per wage earner computed from these data, we should note their limitations:

1. The scope of the Census of Manufactures has changed in such a way that for neither wage earners nor rated horsepower are available data strictly comparable from period to period.
2. The increasing use of electric power is probably accompanied by a decreasing ratio between the machines operated by power and the rated capacity of power equipment.
3. Rated capacity is at best an imperfect index of power actually used.
4. Even power actually used would not be an entirely adequate measure of mechanization.

### 6.2.2 Changes in the Scope of the Census

Prior to 1904, the Census of Manufactures covered not only the factory system proper but also various hand and neighborhood industries. In 1904 and subsequent censuses the hand and neighborhood industries have been excluded. The census for 1919, and the earlier censuses, included all establishments with annual products valued at $500 or more; after 1919 the lower limit was $5,000. As data for 1899 are available both with and without the inclusion of the hand and neighborhood industries, and for 1919 both with and without establishments with products valued under $5,000, we may divide the entire period into three segments for close comparisons, namely:

1. 1869-1899, with data covering both factory and hand and neighborhood industries, for establishments with annual product valued at not less than $500.
2. 1899-1919, with data covering factory industries only, for establishments with annual product valued at not less than $500.

3. 1919-1929, with data covering factory industries only, for establishments with annual product valued at not less than $5,000.

These three periods have been observed in compiling Table 6.15. Various minor adjustments (indicated in the footnotes to Table 6.15), some of which are necessarily estimates,[5] have been made in order to render the data for the several censuses in each of the three periods comparable for the period. The scope of the power census has also varied somewhat with respect to equipment covered, being restricted to steam and water power only in 1869 and 1879. Some later discrepancies have been ironed out in the preparation of Table 6.14. The proportion of the hand and neighborhood industries increased in the census of 1889, largely owing to greater care in canvassing this group. The ratio of power to wage earners was probably lowered thereby but no attempt has been made to correct for this bias.

### 6.2.3 The changing significance of rated horsepower

During the last two decades, a rapid increase has occurred in the use of purchased electric power (Table 6.24). In 1909 electric motors driven by purchased electric power represented only 9 per cent of the rated capacity of manufacturing plants; in 1919, 32 per cent; in 1929, 53 per cent. Dr. Willard Thorp points out that this marked increase in the use of electric power has changed the significance of rated power.[6] When power is produced by steam or water power engines or turbines in the reporting establishment, even if delivered to dynamos and transformed to electric

[5] Some additional causes of discrepancy have not been eliminated. While these do not, we believe, seriously impair the usefulness of the data, it may be well to note them. In the censuses of 1869 and 1879, the inquiry called for 'hands employed', and it may be that some workers other than wage earners were included, though the Census Bureau has stated that it does not believe salaried employees were as a rule included. In 1889 employees were separately designated as (1) officers, firm members and clerks; (2) operatives, skilled and unskilled, and piece workers. The data used for 'wage earners' exclude the first group. In all subsequent censuses 'wage earners' have been separately reported as such. Furthermore, in the census of 1899 and subsequently "the average number of wage earners for the year was computed by adding the numbers reported for the several months and dividing the sum by twelve. . . . If a factory employed, say, a hundred wage earners, but was in operation only six months during the year, the method of calculation would show an average of 50 wage earners employed for the year. At the census of 1889 and possibly for prior censuses, such a factory would have been counted as employing 100 wage earners." Thirteenth Census of the United States, VIII, 20.

[6] Ref. 21, pp. 379 85.

power, the rated capacity given in the Census of Manufactures is the rated capacity of the steam or water power prime movers rather than that of the electric motors driven by the current generated in the plant; but when current is purchased from the outside, rated capacity refers to the rated capacity of the electric motors. Now, there are essential differences between the rated capacity of steam or water power prime movers and the rated capacity of electric motors driven by current generated by these prime movers."

In the first place, the rated capacity of steam and water power engines and turbines "is generally the maximum load which they can carry." On the other hand, it is possible to run electric motors for short periods at considerably more than rated capacity.

Second, improvements in the transmission of power, chiefly by the substitution of electric power transmission within the plant for the old belt and shaft method, tend to reduce the primary power required to accomplish a given amount of work.

Third, when electric motors are driven by current generated in the establishment the rated capacity of the motors is likely to exceed considerably the rated capacity of the prime movers, because all motors in the establishment do not run at the same time or at full capacity. Likewise, when purchased electric current is substituted for water power or steam prime movers the rated horsepower of the plant, in this case based on the electric motors, is likely to show an increase even though no change is made in the work done. In a subsequent section on the growth of electrification, we have used, as a rough approximation, an estimate that 100 horsepower of electric motors in factories require prime movers with rated capacity of 72 horsepower (Table 6.24).

Thus, with the increasing use of electric power, two factors—the possibility of running motors with an overload and the improvements in transmission of the individual motor drive over the mechanical belt and shaft system—tend to lower the required capacity without changing the amount of work that can be accomplished. Another factor, probably more important than the first two, tends to increase rated capacity without a corresponding change in work done. No accurate balance can be struck between these factors, but it should be recognized that they limit the comparability of the statistics of horsepower.

Rated capacity, even if consistently measured, maybe a variable index of the actual use of power. In some ways, a better index of mechanization would be power used in terms of kilowatt-hours or their equivalent.

### 6.2.4 Power an inadequate measure of mechanization

While the increase in the use of power in industry is doubtless a fair, rough indicator of increasing mechanization, it is clearly not a precise measure. What we need to measure is not rated capacity or even the quantity of energy the machine employs, but rather its producing capacity and its effect on the quantity and quality of attending labor required. For example, in the glass industry the sheet machine and the cylinder machine vary much more in skill displacement than in horsepower employed. It requires little or no more power to draw up a sheet of glass with the sheet machine, and yet the sheet is ready for cutting, while the cylinder must be flattened by skilled flatteners. Likewise, the high-speed warper in cotton spinning mills, operating as it does under a lighter tension than the old-style warper, probably requires less power, but through its greater speed makes a substantial reduction in the labor required (see Ch. III). A conveying system, utilizing chutes and gravity roller bearing sections, may require little or no power and yet represent substantial replacement of manual labor by equipment. Doubtless in numerous instances the increase in power used or in rated horsepower is not commensurate with the actual increase in the use and effectiveness of mechanical equipment. That horsepower per worker is not always an adequate index of the degree of mechanization is suggested by consideration of the typical cotton goods factory. A cotton mill is filled with whirring machinery, and our sample indicates that a large proportion (over four-fifths) of cotton mill workers are engaged in tending machines or in work auxiliary to their operation. Yet in 1929 the horsepower per worker in cotton goods was only 5.28 as compared with 8.41 in butter and cheese, 13.14 in the sugar industry, and 33.47 in the manufacture of ice. Such apparent inconsistencies arise in part from the large amount of power required by industries that work heavy materials and also from the use of power for refrigerating and other processing as well as for driving machinery.

## 6.3 Proportion of Establishments using Power[7]

The changes in the proportion of manufacturing establishments reporting the use of power afford some indication of the extension of power

[7] As used in the Census of Manufactures, the term ‘establishment’ usually signifies a single plant or factory. “In some cases, however, it refers to two or more plants operated under a common ownership and located in the same city, or in the same county but in different municipalities or unincorporated places having fewer than 10,000 inhabitants. On the other hand, separate reports are occasionally obtained for

manufacturing. Only about one-third of the total number of establishments reported power in the censuses of 1879, 1889 and 1899 (Table 6.14). However, the early censuses included various hand and neighborhood industries, and when these are excluded from the census of 1899 the percentage of power reporting establishments rises to 64. By 1919 the percentage had risen to 82 (86 when the small plants with value of product under $5,000 are excluded), and by 1929, 92 per cent of all manufacturing establishments reported the use of power.

### Table 6.14: Proportion of Manufacturing Establishments Reporting Power and Average Horsepower Per Establishment[1]

| CENSUS YEAR | TOTAL NUMBER | NUMBER REPORTING POWER | PERCENTAGE REPORTING POWER | HORSEPOWER PER ESTABLISHMENT REPORTING POWER [2] |
|---|---|---|---|---|
| Hand and neighborhood industries included | | | | |
| *1879* | 253,852 | 85,923 | 33.8 | 41.4 |
| *1889* | 321,584 | 98,943 | 30.8 | 59.2 |
| *1899* | 470,005 | 157,862 | 33.6 | 67.6 |
| Factory industries only, with product $500 or more | | | | |
| *1899* | 207,514 | 133,418 | 64.3 | 74.5 |
| *1904* | 216,180 | 134,481 | 62.2 | 100.3 |
| *1909* | 268,491 | 185,042 | 68.9 | 100.9 |
| *1914* | 275,791 | 205,590 | 74.5 | 109.1 |
| *1919* | 290,105 | 237,854 | 82.0 | 124.0 |
| Factory industries, with product $5,000 or more | | | | |
| *1919* | 214,188 | 184,225 | 86.0 | 158.5 |
| *1923* | 196,182 | 173,415 | 88.4 | 190.8 |
| *1925* | 187,981 | 168,282 | 89.5 | 212.8 |
| *1927* | 191,866 | 174,118 | 90.7 | 223.0 |
| *1929* | 210,474 | 193,603 | 92.0 | 221.7 |

[1] Compiled from the Census of Manufactures in the United States. A few industries have been eliminated in order to increase the comparability among the census periods. The 1899 data are given first with hand and neighborhood industries included, for comparison with 1879 and 1889, and then with these industries excluded, for comparison with 1904 and subsequent periods. Likewise, the 1919 data are given first for establishments with product valued at $500 or more, for comparison with previous censuses, and then for establishments with value of product of $5000 or more, for comparison with subsequent censuses. In arriving at the revised

different industries carried on in the same plant, in which event a single plant is counted as two or more establishments" (1929, I,3).

1919 figures, it was estimated that of 65,485 establishments with products valued at less than $5000, the number reporting power was 43,000.
[2] The total horsepower data are in Table 6.15.

It is probable that some irregularities in the changes shown in Table 6.14 are due to greater efforts at some censuses to cover the smaller establishments, to incomplete reporting of power, and to the impossibility of a perfect adjustment for changes in the scope of the census in 1904 and 1919.

The change in scope in 1904 and 1919 brought sharp declines in the number of manufacturing establishments. But even in the period 1919—29—with no major changes in scope—the number declined from 214,188 to 210,474.

Meanwhile, the horsepower per establishment reporting power increased rapidly—from 41 in 1879 to 67 in 1899 (75 after excluding the neighborhood industries), to 124 in 1919 (159 if establishments with value of product less than $5,000 are excluded), and by 1929 to 222 horsepower per establishment. Doubtless the elimination of many small plants, the expansion of existing plants and the transition from hand to machine work without an equivalent plant expansion, have all contributed to the marked increase in horsepower per establishment in the half-century covered by Table 6.14.

## 6.3.1 Increase in Total Horsepower

Since the Civil War, there has been a continuous increase in the installed capacity of primary horsepower in manufacturing, both in the aggregate and in terms of horsepower per worker. The data for each census period are summarized in Table 6.15. To lessen the degree of non-comparability arising from changes in scope previously described the statistics are presented in three period groups. For Group A (1869-99) the data cover the hand and neighborhood industries as well as factories whose annual value of product is $500 or more; for Group B (1899-1919) they pertain to factories only, with value of product $500 or more; for Group C (1919-29) only factories with an annual product valued at $5,000 or more are included. The index numbers are chained together at the transition points so as to make them as comparable as possible from 1869 to 1929.

## Table 6.15 Increase in Rated Horsepower Capacity in Manufacturing[1]

| Census Year | Wage earners (thousands) | Total horsepower (thousands) | Horsepower per wage earner | Index numbers 1919=100: Wage earners | Total horsepower | Horsepower per wage earner | Geometric mean rate of growth per year since preceding census: Total horsepower (per cent) | Horsepower per wage earner (per cent) |
|---|---|---|---|---|---|---|---|---|
| **Group A** Hand, neighborhood and factory industries | | | | | | | | |
| *1869* | 2,028 | 2,314 | 1.14 | 20.2 | 7.3 | 36.2 | ... | ... |
| *1879* | 2,772 | 3,560 | 1.28 | 27.6 | 11.2 | 40.6 | 4.4 | 1.2 |
| *1889* | 4,171 | 5,857 | 1.40 | 41.5 | 18.5 | 44.4 | 5.1 | 0.9 |
| *1899* | 5,209 | 10,670 | 2.05 | 51.8 | 33.7 | 65.1 | 6.2 | 3.9 |
| **Group B** Factories with $500 or more product | | | | | | | | |
| *1899* | 4,713 | 9,942 | 2.11 | 51.8 | 33.7 | 65.1 | ... | ... |
| *1904* | 5,468 | 13,488 | 2.47 | 60.1 | 45.7 | 76.2 | 6.3 | 3.2 |
| *1909* | 6,615 | 18,675 | 2.82 | 72.7 | 63.3 | 87.0 | 6.7 | 2.7 |
| *1914* | 7,036 | 22,437 | 3.19 | 77.4 | 76.0 | 98.5 | 3.7 | 2.5 |
| *1919* | 9,096 | 29,505 | 3.24 | 100.0 | 100.0 | 100.0 | 5.6 | 0.3 |
| **Group C** Factories with $5,000 or more product | | | | | | | | |
| *1919* | 8,998 | 29,209 | 3.25 | 100.0 | 100.0 | 100.0 | ... | ... |
| *1923* | 8,777 | 33,092 | 3.77 | 97.5 | 113.3 | 116.0 | 3.2 | 3.8 |
| *1925* | 8,390 | 35,807 | 4.27 | 93.2 | 122.6 | 131.4 | 4.0 | 6.4 |
| *1927* | 8,350 | 38,826 | 4.65 | 92.8 | 132.9 | 143.1 | 4.1 | 4.4 |
| *1929* | 8,831 | 42,918 | 4.86 | 98.1 | 146.9 | 149.5 | 5.1 | 2.2 |

[1]Compiled from the Census of Manufactures, with adjustments to make the data within each group as comparable as possible, namely: lead pig, quartz milled, and raw cane and sorghum sugar and molasses were subtracted from the original census figures for 1869; in 1879 additions were made for wage earners and horsepower in petroleum refining, for estimates by the writer of wage earners in bottling, gas. and car repairing, and estimates (by W. L. Thorp, Ref. 21) for horsepower in bottling, gas, car repairing, coke, dyeing and finishing textiles, distilled liquors, malt liquors, shipbuilding and glass. Electric light and power was subtracted from data for 1879 and 1889. Druggists' preparations, dressmaking, cotton ginning, and millinery custom work were subtracted from both 1889 and 1899, and trimming and finishing of coffins and burial cases, hay and straw bailing, teasels, and mechanical dentistry from 1889. The 1899 horsepower figure was corrected by subtracting 311,016 horsepower of electric motors, and, when used in Group B, a further correction of 157,125 for industries included in the original

census in 1899 but not in 1904. For Group C, poultry killing and dressing was excluded from 1919, 1923, 1925 and 1927; and an estimate for coffee and spice grinding and roasting added to 1925. Data for 1919 were also corrected by excluding automobile repairing, purchased power other than electricity (94,432 horsepower), an arbitrary sum of 15,000 for water motors, and 41,251 wage earners and 100,000 horsepower (estimate) for plants with less than $5,000 value of product.

### 6.3.2 Rate of Increase

In which period has the rate of mechanization been the fastest? The apparent answer is afforded by the geometric rates of increase in the last two columns of Table 6.15, computed for the interval between each census date. The annual increase in total horsepower was greatest in the five-year period 1904-09, and least in the post War period. However, for horsepower per wage earner the showing is quite different. In no period since 1900 has the rate of increase been as great as in any one of the post War periods other than 1927-29, the most rapid gain being from 1923 to 1925, or 6.4 per cent per year.

To some extent, this rate of increase must be discounted to allow for the increasing use of purchased electric power discussed above. Allowing, however, for the respects in which rated horsepower does not furnish a complete account of the tendency in the use of machinery, it still seems reasonable to interpret the data for horsepower in manufacturing as indicating a relatively rapid mechanization since the World War.

## 6.4 Increases in Power Equipment per Wage Earner, by Industries

Appendix C gives the horsepower per worker ratios for each of 141 individual industries or industrial groups at each census from 1899 to 1929. For 100 of the individual industries and for the industrial groups we also computed the percentage increase in the horsepower ratio from 1899 to 1925. These ratios of increase for the major industrial groups, and also for the 10 industries having the smallest increases and the 10 having the largest percentage increases, are presented in Table 6.16.

## Table 6.16 Percentage Increases in Horsepower per Wage Earner, Manufacturing Industries: 1899-1929[1]

| | Group | Percentage Increase |
|---|---|---|
| A. | Major industrial groups ‘ | |
| | Food and kindred products | 22.6 |
| | Lumber and its remanufactures | 39.4 |
| | Textiles and their products | 78.7 |
| | Paper and printing | 110.8 |
| | Leather and its finished products | 114.1 |
| | All industries combined | 130.3 |
| | Iron and steel and their products' | 157.8 |
| | Rubber products | 183.1 |
| | Miscellaneous industries | 220.5 |
| | Tobacco manufactures | 229.4 |
| | Non-ferrous metals and their products | 257.9 |
| | Chemicals and allied products | 276.1 |
| | Stone, clay and glass products | 299.5 |
| | Vehicles for land transportation, including railroad repair shops | 317.7 |
| B. | Ten individual manufacturing industries with smallest percentage gains | |
| | Wire | 7.6 |
| | Flour mill and grain mill products | 13.9 |
| | Paper and wood pulp | 15.1 |
| | Butter and cheese | 22.2 |
| | Sugar, beet and cane | 26.7 |
| | Knit goods | 27.9 |
| | Fancy articles | 28.3 |
| | Boots and shoes, rubber | 40.2 |
| | Lumber and timber products, nec. | 42.3 |
| | Shirts | 47.4 |
| C. | Ten individual manufacturing industries with largest percentage gains | |
| | Bread and other bakery products | 378.3 |
| | Steam fittings and steam and hot water heating apparatus | 395.7 |
| | Glass | 406.0 |
| | Steam railroad repair shops | 430.9 |
| | Confectionery, chewing gum, and ice cream | 456.9 |
| | Carriages and wagons | 483.1 |
| | Structural and ornamental ironwork | 512.7 |
| | Gas, manufactured, illuminating and heating | 795.7 |
| | Coke | 833.2 |
| | Cigars and cigarettes | 1,075.0 |

1 It is suggested by Colonel M. C. Rorty that each successive increase in horsepower per worker may (and perhaps should) show a decreasing rate of increase in productive efficiency. Computed from ratios of horsepower to wage earners given in Appendix C. nec.: not elsewhere classified.

In the three decades 1899-1929, none of the industries listed in Table 6.16 declined in horsepower per worker, though the gain was relatively slight for the food and lumber groups and for several constituents of these groups. The individual industries range from a 7.6 per cent increase for wire to a 1,075 per cent increase for cigars and cigarettes. The median increase for the 100 individual industries listed in Appendix C is 158 per cent, and about half show an increase of between 100 and 250 per cent. Doubtless some of the observed peculiarities in the ranking may be due to inadequacies of the data, especially for 1899, and to changes in classification not fully allowed for.

Another picture of the upward drift in horsepower per wage earner is afforded by Table 6.17, which portrays the frequency distributions of horsepower per worker for those industries for which data are available at each census from 1899 to 1929. That the shift towards increasing horsepower per wage earner from census to census has been more or less common to the individual industries will be evident from an examination of the several distributions in Table 6.17. Though the modal class remains at 0 to 0.99 horsepower per wage earner from 1899 to 1914, inclusive, it is evident from the successive distributions in Table 6.17 that even in this period the zone of concentration is gradually shifting towards the higher ratios of horsepower per wage earner. In 1919, despite the fact that, with a large increase in the number of wage earners, horsepower per wage earner declined in many industries, the center of concentration has shifted sufficiently to bring the modal class into the 1.00-1.99 group, and thereafter the concentration becomes increasingly less, as numerous industries move into the upper ratio ranges. In fact, an examination of the detail in Appendix C will reveal that of the 934 year to year changes in horsepower per worker there recorded for individual industries, only 184 are declines. The rate of progress in the several industries has varied, but most have grown in mechanization in each census period.

**Table 6.17 Frequency Distributions of Ninety-Nine Industries, By Horsepower per Wage Earner, Census Periods: 1899-1929**[1]

| HORSEPOWER PER WAGE EARNER | 1899 | 1904 | 1909 | 1914 | 1919 UNAD-JUSTED | 1919 AD-JUSTED[2] | 1923 | 1925 | 1927 | 1929 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0— .99 | 52 | 45 | 35 | 31 | 26 | 26 | 19 | 18 | 18 | 17 |
| 1.00—1.99 | 22 | 25 | 30 | 27 | 32 | 32 | 28 | 22 | 20 | 20 |
| 2.00—2.99 | 10 | 11 | 11 | 15 | 13 | 13 | 16 | 16 | 17 | 15 |
| 3.00—3.99 | 5 | 7 | 11 | 6 | 6 | 7 | 12 | 12 | 12 | 14 |
| 4.00—4.99 | 2 | 1 | 2 | 7 | 8 | 6 | 5 | 10 | 9 | 8 |
| 5.00—5.99 | 1 | 2 | 1 | 3 | 3 | 5 | 6 | 4 | 4 | 5 |
| 6.00—6.99 | 2 | 1 | 3 | 1 | 4 | 3 | 2 | 4 | 3 | 3 |
| 7.00—7.99 | .. | 3 | .. | 2 | 2 | 2 | 1 | 2 | 4 | 2 |
| 8.00—8.99 | 1 | .. | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| 9.00—9.99 | .. | .. | .. | 2 | .. | .. | 2 | 2 | 1 | 2 |
| 10.00 or more | 4 | 4 | 5 | 4 | 4 | 4 | 6 | 8 | 10 | 11 |

1 Computed from data in Appendix C.
2 The 1919 'unadjusted' figures cover plants with value of product $500 or more, and include rented power other than electric; the 1919 'adjusted' figures cover plants with value of product $5,000 or more, and exclude rented power other than electric. The 'unadjusted' figures are comparable with those for the earlier censuses; the 'adjusted', with the subsequent censuses.

## 6.5 Power in the Non-Manufacturing Industries

The detail in which data are available has enabled us to discuss at length the growth of power in manufacturing. However, it must not be inferred that growth has been restricted to manufacturing. It has been at least as great in other industries. Estimates for all but a few of the industries making extensive use of power have been compiled by Mr. Carroll R. Daugherty for the decennial census years beginning in 1849, also for 1923.[8] These estimates of the total horsepower available in other industries, for 1899, 1909, 1919 and 1929, together with horsepower data compiled from the Census of Manufactures, are recapitulated in Table 6.18.

[8] See references cited in footnotes to Table 6.18

**Table 6.18 Estimated Rated Capacity of Power Equipment in Selected Industries: 1899-1929[1]**

| | (unit: 1,000 horsepower) | | | |
|---|---|---|---|---|
| INDUSTRY | 1899 | 1909 | 1919 | 1929 |
| Total, primemovers[2] | 64,081 | 112,856 | 176,143 | 401,000 |
| Prime movers and motors run by purchased power[3] | | | | |
| Productive' automobiles | 4 | 256 | 10,964 | 162,483 |
| Steam railroads | 20,900 | 45,400 | 72,300 | 109,331 |
| Agriculture | 23,519 | 31,107 | 43,722 | 69,639 |
| Electric central stations | 1,200 | 5,225 | 15,250 | 43,000 |
| Manufacturing | 9,942 | 18,675 | 29,209 | 42,918 |
| Mines and quarries | 2,868 | 4,609 | 6,723 | 10,500 |
| Ships | 1,819 | 3,155 | 6,402 | 9,017 |
| Electric railroads | 1,079 | 3,718 | 6,327 | 8,550 |
| Work animals not on farms | 3,055 | 3,405 | 1,979 | 1,400 |
| Irrigation and drainage | 120 | 361 | 816 | 1,383 |

1 Data for manufacturing from Table 6.15; for other industries, from Carroll R. Daugherty, Horsepower Equipment in the United States, 1869-1929, American Economic Review, September 1933, pp. 428-40, especially p. 434; See also Ref. 31.
2 Prime movers include steam engines and turbines, internal combustion engines, waterwheels, wind power and work animals, but not electric motors run by purchased current. Pleasure automobiles are excluded. The total for prime movers includes those installed in all the industries listed in Table 6.18 and also 3,091,000 horsepower in commercial aircraft in 1929.
3 There is some duplication in these figures in that apportion of the current generated by central electric stations is used to operate motors installed in manufactures, mines and quarries, agriculture, irrigation and drainage and electric railroads. Also, auto trucks are included under both agriculture and 'productive' automobiles.
4 No data available.

Both agriculture and steam railroads were more extensive users of power than manufacturing at each of the four dates for which estimates are recorded in Table 6.18. Also, by 1929 the rated horsepower of 'productive' or non-pleasure automobiles, as estimated by Daugherty, exceeded the rated capacity of power equipment in any one of the three fields: agriculture, railroads or manufacture. To some extent the interpretation of the increase in the use of power by the non-manufacturing industries is clouded by the fact, previously noted in connection with power in manufacturing, that there has been an increasing use of electric motors driven by purchased power, and this increase is not necessarily accompanied by an equivalent increase in the total equipment driven by power.

In some industries the observed increases in the total horsepower available arise in part from the expansion of the industry as well as from increasing mechanization; but that increases in mechanization have been very substantial is indicated by the estimates in Table 6.19 of horsepower per worker for four major industries in 1909, 1919 and 1929.

In manufacturing, the horsepower per worker increased 15 per cent from 1909 to 1919, and nearly 50 per cent in the following decade. In steam railroads, the increase per employee was about 25 per cent from 1909 to 1919 and nearly three times as great in the period 1919-29. In agriculture and mining the increase exceeded 50 per cent in both decades. These estimates are not strictly comparable in all respects, but we do not believe that strictly comparable records would make an essentially different showing.[9]

**Table 6.19 Horsepower per Worker in Selected Industries: 1909-1929**

| | HORSEPOWER PER WORKER | | | PERCENTAGE INCREASE | |
|---|---|---|---|---|---|
| INDUSTRY | 1909 | 1919 | 1929 | 1909-19 | 1919-29 |
| Manufactures[1] | 2.82 | 3.25 | 4.86 | 14.9[5] | 49.5 |
| Agriculture[2] | 2.51 | 4.10 | 6.65 | 63.3 | 62.2 |
| Mines and quarries[3] | 3.64 | 5.52 | 8.85 | 51.6 | 60.5 |
| Steam railroads[4] | 30.21 | 37.79 | 65.82 | 25.1 | 74.2 |

1 From Table 6.15.
2 Horsepower per person in agricultural pursuits as given in Census of Occupations, 1930; power data from Table 6.18.
3 Horsepower per wage earner in mining, exclusive of petroleum and natural gas and sand and gravel (Census of Mines and Quarries, 1929).
4 Horsepower per employee; power data from Table 6.18; number of employees from Interstate Commerce Commission, Statistics of Railways. The data for 1909 cover employees of all operating railroads, except switching and terminal companies, for the year ending June 30, 1909; for 1919 and 1929 they cover employees on Class I railroads (except switching and terminal companies), in calendar years.
5 1n computing percentage change, 1909-19, horsepower per worker in 1919 is taken as 3.24 (see Table 6.15).

It is unnecessary to recount here in detail the many changes which in the aggregate account for the marked increases in the use of power in the non-manufacturing industries, but a few major developments may appropriately be mentioned.[10] Of the total rated horsepower of mine equipment in 1929, over a third was of the mobile type. In some part, this is a reflection of the continued expansion of mechanical undercutting and mechanical transportation, and in part of the start made in the development of mechanical loading in the decade of the twenties. The major portion of the increased use of power on farms consists in mechanical power furnished by tractors and motor trucks. The number of tractors on farms increased from 246,083 in 1920 to 920,021 in 1930, or nearly fourfold. The number of motor trucks on farms increased from 139,169 to 900,385, and in the same

[9] For elements of non-comparability, in addition to the increasing use of electric motors run by purchased power, see footnotes to Table 6.19.
[10] See Ch. IV and V for further detail.

period, there were large sales of stationary gas engines and a substantial increase in the use of electricity on the farm.[11] The marked increase in horsepower per worker in steam railroads is caused mainly by an increase in the average tractive power of locomotives from 35,789 pounds in 1919 to 44,801 in 1929, in conjunction with a decline in the number of railroad employees.

## 6.6 Other Measures of Changing Mechanization

Because the statistics on horsepower, though available in considerable detail, do not give an entirely adequate picture of the developments in mechanization, it is pertinent for us to examine other measures of the extent to which industry is becoming more completely mechanized.

### 6.6.1 Ratio of Wages to Value Added by Manufacture

The more highly mechanized a plant is, the greater the proportionate expenditure for maintenance and repair, materials, power and such items of overhead as interest; hence it would seem a reasonable presumption that with increasing mechanization a smaller proportion of total expenditures will for wages. If this be true, the ratio of wages to value added by manufacture should afford a supplementary measure of changing mechanization.[12] In fact, however, the changes in the ratio of wages to value-added, presented in Table 6.20 for the period 1869-1929, do not appear to be a sensitive measure for the changes in mechanization, at least not of their long-time trend. The wage ratio was 44.5 in 1869, 41.6 in 1899, and 42.6 as late as 1923. Evidently, other factors, such as differences in the movement of wage rates and unit prices of manufactured products have acted to conceal "the effect of mechanization upon the wage ratio."[13]

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[11] Indicated by the fact that in 1920 only 452,620 farm dwellings were lighted by electricity while by 1930 the number had risen to 841,310. The 1930 Census of Agriculture shows 386,191 electric motors and over a million stationary gas engines in use on farms.

[12] As used in the Census of Manufactures 'value added' is the increment generated by the manufacturing process.

[13] Colonel M. C. Rorty comments: There is some evidence, notably that afforded by the increasing rates of obsolescence and replacement for machine tools (charges on this account being to expense, rather than for use of capital), to support the hypothesis that, the more highly mechanized an industry becomes, the lower may be the proportion of its value added that accrues to capital. A particular effort of the highly organized and mechanized industries is to increase their rates of capital

However, the ratios for 1927 and 1929 show appreciable declines; and that the wage ratio is correlated with changing mechanization is supported by a closer examination of the data by industries in the period 1923-25. If we may trust our horsepower data and other evidence, these two years were characterized by rapid mechanization, and we find not only that the wage ratio for all industries declines from 42.6 to 40.1, but also that this decline is common to all the sixteen major industrial divisions of manufacturing except lumber. Moreover, when we examine the 347 individual industries for which the wage ratio can be computed for both 1923 and 1925, we find that 221 decline from 1923 to 1925.

**Table 6.20 Ratio of Wages Paid to Value Added by Manufacture: 1869-1929[1]**

| CENSUS YEAR AND SCOPE OF CENSUS | | RATIO (Percent) |
|---|---|---|
| Hand and neighborhood industries and factories, with $500 or more product | | |
| | 1869 | 44.5 |
| | 1879 | 48.1 |
| | 1889 | 44.9 |
| | 1899 | 41.0 |
| Factories only, with $500 or more product | | |
| | 1899 | 41.6 |
| | 1904 | 41.5 |
| | 1909 | 40.2 |
| | 1914 | 41.3 |
| | 1919 | 42.1 |
| Factories only, with $5,000 or more product | | |
| | 1919 | 42.2 |
| | 1921 | 44.7 |
| | 1923 | 42.6 |
| | 1925 | 40.1 |
| | 1927 | 39.3 |
| | 1929 | 35.4 |

1 Computed from statistics of total wages paid and value added by manufacture in 1919 Census of Manufactures, p. 14; 1927, p. 16, and 1929, I, 15.

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turnover, i.e., the ratio of gross output to capital employed. Furthermore, in many cases, the highly elaborated machine costs less than the crude machine per dollar of annual output. It should be noted, also, that the ratio of wages to value added was so seriously affected, during the 1920-29 period, by the readjustment of real corporation interest and dividends to normal levels at the end of 1928 (after a previous 33 1/3 per cent decline) that any effects of mechanization must have been obscured.

It is evident that the wage ratio is influenced by mechanization but cannot be relied upon for precise evidence concerning the rate at which mechanization has advanced in various periods.

### 6.6.2 Proportion Produced by Machine Methods

One measure of mechanization that is quite significant, though ordinarily not obtainable, is the proportion of output that is prepared by machine methods rather than hand methods in specific phases of producing operations. Such data are available for the undercutting and loading processes in coal mining and for a few manufacturing processes such as the casting process in pig iron production (Appendix A). They furnish realistic measures of changing mechanization—measures the meaning of which can be readily interpreted—and it is unfortunate that similar data are not available for a large number of important manufacturing processes.

The United States Geological Survey compiles figures of the proportion of soft coal which is 'machine mined', that is, undercut by machine. Similar data are presented for anthracite coal. The detailed statistics for recent years appear in Table 40. The proportion of bituminous coal undercut by machine has increased steadily from only 5.3 percent in 1891 to 24.9 per cent in 1900, 41.7 per cent in 1910, 59.8 per cent in 1920, and 75.4 per cent in 1929. The percentage of anthracite coal undercut by machine is relatively small, between 1 and 2 per cent.

Machine undercutting has probably about reached the saturation point, but machine loading is apparently still in its infancy. The proportion of bituminous coal loaded with self-feeding loading devices, while yet small, has shown a substantial increase from only 0.3 per cent in 1923 to 3.6 per cent in 1929.

In pig iron production the percentage of total merchant furnace output that is machine cast increased from 45 in1911 to 85 in 1926, but was as low as 31 in 1915.

Machine made cigars constituted less than 10 per cent of total prior to 1924, but by 1930 about 47 per cent of long filler cigars were machine made.

Likewise, the rapid advance of the automatic glass bottle machine is indicated by the estimate that in 1917 only 50 per cent of glass jars and bottles were blown on automatics; in 1924, 90 per cent.[14]

[14] See Ch. II, Glass, which also gives an estimate for the percentage of window glass made by the hand process.

### 6.6.3 Proportion of Users Equipped with Specified Device

Closely akin to statistics of the proportion of output produced by machine methods are statistics of the proportion of users equipped with a given device. The best illustration of this method of charting the progress of mechanization is afforded by estimates of the percentage of wired homes equipped with various labor-saving devices (Appendix A). It is estimated that from 1924 to 1930 the percentage equipped with ironing machines rose from 1.6 to 3.3, with electric irons, from 77.0 to 97.8, with electric vacuum cleaners, from 37.7 to 44.4, and with electric washing machines, from 26.4 to 35.1.

Somewhat similar data are available for the telephone industry. In 1919 only 1.7 per cent of the total number of Bell owned stations were served by automatic switchboards. By 1929 this percentage had risen to 26.0.

### 6.6.4 Proportion if New Equipment that is Power Driven

Another closely allied measure of changing mechanization is afforded by statistics of the proportion of new equipment that is operated by mechanical power. Thus, one of the significant movements in the mechanization of agriculture is indicated by the rapid rise in the ratio of the value of harvesting combines (all power driven) to the total value of harvesting machinery sold—from only 11.7 per cent in 1920 to 33.2 per cent in 1926, and 51.9 per cent in 1929.[15]

### 6.6.5 Number of Machines in Use

Another indicator of mechanization is afforded by statistics of the number of machines of a given type in use, although this measure does not give directly a mechanization ratio. It merely measures progress in absolute numbers; it does not indicate whether the given procedure is gaining ground relatively to hand methods or less mechanized equipment. In this class of evidence concerning the advance of mechanization we may include such items as the following. The registration of motor trucks has increased from only 85,600 in 1914 to 1,006,082 in 1920, and 3,379,854 in 1929. In 1924 the number of tractors on farms was reported as 505,933; in 1929 as 920,000. The number of semiautomatic glass blowing machines in use declined from 459 in 1916 to only 26 in 1927, yielding to the advance of the full automatic type. The number of Bell-owned stations served by automatic

[15] For further statistics of this type, see Table 6.2

switchboard increased from only 130,000 in 1919 to 4,014,000 in 1929. The estimated number of electric washing machines in use rose from 3,500,000 in 1924 to 7,185,000 in 1930. The number of undercutting machines in bituminous coal mining was reported as 16,507 in 1914; it increased to 21,299 in 1923, but has not held its own since. The decline (to 14,731 in 1929) has been offset by an increasing production per machine. These and other illustrations of measuring the growth of mechanization by changes in the number of equipment units of a given type in use appear in Chapters III, IV and V and in the tables in Appendix A.

## 6.7 Growth of the Machine Producing Industries

With the growth in mechanization indicated by the other indexes examined, have the machinery industries outstripped the other manufacturing industries? By referring to the data in Table 6.21 we note that from 1899 to 1929 the number of wage earners in the machine producing industries, exclusive of transportation equipment, increased from 414,000 to 1,091,000, or from 8.8 to 12.4 per cent of the total number of wage earners in manufacturing. The nearly one million wage earners in the machinery industries in 1919 represents the high point previous to 1929 both in absolute numbers and in percentage of the total number of wage earners in manufacturing.

The majority of the machine producing industries are included under the designation ‘Foundry and machine shop products not elsewhere classified’. From this parent group one special machinery industry after another has been separated at the successive censuses. To maintain comparability both the parent group of ‘Foundry and machine shop products’ and the several separately classified machinery industries are included in the totals for the machinery industries in Table 6.21. The nature of the ‘Foundry and machine shop’ group is indicated by the following quotation from the 1927 Census of Manufactures:

> “This industry embraces the manufacture of those products of boiler shops, foundries, and machine shops which are not assigned to special classifications. The foundry, as the term is ordinarily defined, is an establishment in which metal is cast into various shapes, and the machine shop is an establishment in which work is done by means of machine tools; that is, power-driven tools used in cutting and shaping metals..... many foundries and machine shops manufacture a great variety of products.” This classification “embraces, so far as practicable, those lines of manufacture which employ foundry and machine—shop processes but which cannot be clearly segregated from one another. Nevertheless, despite its comprehensiveness, a great deal of

overlapping occurs between this classification and a number of others" (p. 1,074).

## Table 6.21 Growth of the Machine Producing Industries[1] (Exclusive of transportation equipment)

*Thousands of Wage Earners*

| INDUSTRY | *1899* | *1904* | *1909* | *1914* | *1919* | *1921* | *1923* | *1925* | *1927* | *1929* |
|---|---|---|---|---|---|---|---|---|---|---|
| Total, machinery industries [2] | 414 | 478 | 568 | 615 | 998 | 662 | 908 | 859 | 886 | 1,091 |
| Percentage ratio to wage earners in all manufacturing industries | 8.8 | 8.7 | 8.6 | 8.7 | 11.0 | 9.5 | 10.3 | 10.2 | 10.6 | 12.4 |
| Foundry and machine-shop products, n.e.c.[3] | 297 | 332 | 379 | 358 | 483 | 321 | 449 | 398 | 398 | 454 |
| Electrical machinery, apparatus and supplies | 42 | 60 | 87 | 118 | 212 | 161 | 235 | 240 | 242 | 329 |
| Engines, turbines, and water wheels | [4] | [4] | [4] | 30 | 78 | 36 | 48 | 51 | 54 | 61 |
| Machine tools | [4] | [4] | [4] | [4] | 53 | 21 | 33 | 31 | 35 | 47 |
| Agricultural implements | 47 | 47 | 51 | 48 | 54 | 30 | 31 | 29 | 33 | 42 |
| Textile machinery and parts | [4] | [4] | [4] | [4] | 32 | 31 | 36 | 28 | 26 | 27 |
| Pumps (hand and power) and pumping equipment | 1 | 1 | 2 | 8 | 16. | 12 | 15 | 18 | 19 | 23 |
| Typewriters and supplies | 4 | 6 | 10 | 11 | 16 | 13 | 15 | 15 | 17 | 17 |

1 Compiled from the Census of Manufactures for the several censuses,1899-1929.
2 The totals were computed from the original figures before they were reduced to thousands.
3 The following industries included in the earlier censuses in 'Foundry and machine shop products' have been excluded by us, partly by estimate: Locomotives and stoves and furnaces in 1899; cast iron pipe, 1899 and 1904; automobile repairing, 1904 and 1909; steel barrels, drums, and tanks, and tempering and welding of iron and steel, 1899 to 1914.
4 Included in 'Foundry and machine shop products' at the census periods for which these industries are not separately listed in this table.
5 Prior to 1927 included in 'Electrical machinery' or 'Foundry and machine shop products'.

Something of the diversity of the products of the 'Foundry and machine shop' group is indicated by the fact that in 1914 a "partial list" of the principal products reported on the manufacturer's schedule by establishments assigned to this industry included 642 items, 402 of which were machines designated for use in the several branches into which the census divides manufacturing, 19 articles each, chiefly machines, for use in mining and agriculture, 70 products intended for use in diverse manufactures and 132 intended for general use. Even these last two groups include many types of machine.

For a broad index of the growth of mechanization there is much to be said for the inclusion of the industries grouped by the Census of Manufactures under the title 'Transportation Equipment, Air, Land, and Water', or at least that portion of these industries assignable to the production of locomotives and commercial vehicles. For this industry as a whole the number of wage earners in 1921 was 405,773. In 1923 it was 606,328. It declined in 1925 to 559,578, and in 1927 to 494,905, but recovered to 583,355 in 1929. By far the larger proportion of these wage earners is in the two subgroups designated as 'Motor vehicles not including motorcycles' and 'Motor vehicle bodies and motor vehicle parts'. The number of wage earners engaged in the production of locomotives and commercial vehicles is not' given separately, though a rough estimate might be made from the reported value of these special products. In any event, it is a striking fact that the industries engaged in the production of transportation equipment have employed approximately a half million men in the post War period, or more than half as many as in the other machine producing industries combined.[16]

## 6.8 Measurable Tendencies Contributing to the Progress of Mechanization

Several of the less obvious ways in which mechanization is facilitated are common to so many industries that it is appropriate to call attention to them at this point. We refer to indirect mechanization through the substitution of one process or product for another, the elimination of inefficient plants, regional shifts in industry which involve changes in the average of mechanization. and productivity, the increasing capacity of machine units through greater physical size or higher running speeds, the increasing electrification of power equipment, and a group of non-

[16] For further discussion of the volume of the machine producing industries see Ch. VIII.

mechanical changes which may conveniently be designated as economies in the use of men and equipment. The latter are not strictly speaking changes in mechanization, but they are significant in studies of changing labor requirements.

## 6.9 Changes Indirectly Affecting the Degree of Mechanization

The degree of mechanization in an industry is frequently influenced by changes which do not directly affect the ordinary indexes of mechanization. New industries are constantly arising which, because of their newness and lack of standardization, may have a relatively low degree of mechanization, though the industries which they tend to displace may be applying mechanical devices steadily to more and more operations. Likewise, within any given industry a less mechanized process may partly replace a more mechanized process, or vice versa, and thus change the general average of mechanization in the industry as a whole although possibly the degree of mechanization in neither the old nor the new process has undergone any essential change.

For example, an increasing proportion of all bituminous coal mined is by the highly mechanized process of stripping with power shovels.[17] Likewise, the degree of mechanization in pig iron production is raised by the tendency to physical integration of the blast furnace and the steel making plant, thus virtually eliminating the casting process. The percentage of steel-making pig iron used by makers that is cast in molten condition increased from less than 80 in 1913 to almost 92 by 1931. In themselves, the above illustrations of indirect changes are of relatively minor importance, but the general phenomenon which they illustrate—the growth or decline of mechanization through the substitution of one process or product for another—is an important phase of changing mechanization.

### 6.9.1 Elimination of Inefficient Plants and Regional Shifts to High Productivity Areas

The rising man-hour productivity of the post War years is ascribable in part to the elimination of inefficient plants or at least to the Shifting of a larger proportion of production to the high—productivity units in the

[17] See Appendix A for statistics on the percentages of both bituminous and anthracite coal mined by stripping.

industry. Such changes may raise the level of productivity without necessarily modifying the productivity of individual plants.[18]

The merchant blast furnace industry furnishes a striking example of this tendency, though other developments have also acted to raise its productivity. Most lakeside plants of the Great Lakes District, for example, "are of the most modern type equipped with complete labor-saving machinery." The plants in New York, Pennsylvania and the South on the other hand, have a relatively low productivity per man hour, for various reasons: for example, the "plants in the South are operated mostly by negro labor", and "the plentiful supply of this labor tends to prevent the introduction of improved machinery, thus keeping productivity at a low level". In the period 1917-18 to 1926 there was a "rapid decline of these low productivity areas" and an "increasing production in the high productivity areas, such as the Great Lakes", which tended to "increase the average productivity of the industry."[19]

Between 1912-14 and 1926 the number of active merchant furnaces had been more than halved, despite the building of new stacks. "The period 1923 to 1926 was featured by the abandonment of old plants in Pennsylvania and the construction of new ones in New York and New England."

In general,

> "one of the most important causes of the great improvement in output per man-hour [in the merchant blast furnace industry] has been the abandonment of many of the inefficient low productivity plants. In 1921 the average output per man-hour in merchant blast furnaces was very much higher than in the previous year because the depression forced out many of the weaker plants, leaving mostly high-productivity plants in operation. During the prosperity of 1923 many low productivity plants came back into the industry, but the keener competition of the steel works blast furnaces since then has driven a great number of them out of business. Less than three-fourths of the merchant plants operating in 1923 remained active until 1926, and the high productivity average of the later year is due in no small degree to the closing down of inefficient plants" (Bul. 474, Ref. 37, p. 1).

Unfortunately, data on causes of changes in productivity as adequate as those for the merchant blast furnace industry are not readily available for

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[18] Part of the total gains in productivity are, of course, the result of improvements in individual plants. Examples may be cited from the experience of groups of identical establishments included in our output per hour surveys (Ref. 20c). From 1919 to 1927 productivity per hour increased 34. 1 per cent in 5 identical Douglas fir lumber mills, and 46.5 per cent in 5 identical beet sugar plants.

[19] B. L. S., Bul. 474, Ref. 37, notably pp. 9-15.

other industries, but there is considerable reason to believe that in many industries changing mechanization and changing productivity are in substantial part due to the abandonment of inefficient plants and the construction of new more efficient plants, or a rise, even when plants are not entirely abandoned, from a greater relative use of the more efficient plants and shifts in the relative volume of production from areas of low productivity to areas of high productivity. We have noted, for example, that even in the localized industry of brick manufacture, the number of establishments has diminished markedly, especially in the smaller, less modernized plants (Ch. III).

An examination of the movement in various industries towards a reduction in the number of establishments tends to confirm the hypothesis that the elimination of relatively inefficient plants is a large factor in increasing mechanization and increasing productivity.

### 6.9.2 Decline in Number of Manufacturing Establishments[20]

If allowance is made for changes in the scope of the enumeration, the number of establishments engaged in manufacturing showed an increase at each census up to 1919 inclusive (see Table 6.14). But the census of 1921 showed an 8.5 per cent drop in number, the next census very little change, and 1925 a further drop of 4.5 per cent. The censuses of 1927 and 1929 showed percentage gains of 2.4 and 10.0 respectively. The net result of these changes is that between the census of 1919 and 1929 the total number of establishments in all industries combined decreased 3,714. But this is far from an adequate indication of the number that passed out of the industrial picture in this decade. The losses in number in the declining industries are neutralized in large part by increases in the expanding industries. And even within a single industry, old plants may be abandoned and new ones put into operation without changing the total number reported in the census. Full information upon the number of abandoned plants is not available, but helpful clues can be obtained by a closer examination of the changes in the individual manufacturing industries.

Table 6.22 presents the change from 1919 to 1929 in the number of establishments in each of the 12 industries in which the decline in number exceeded 200. If the industries listed were classified in more detail the decreases would doubtless be shown as even greater than is suggested by

[20] The 1919 Census of Manufactures included establishments with annual product valued at $500 or more, whereas all subsequent censuses have been limited to those with products valued at $5,000 or more. In this section, establishments with value of product less than $5,000 have been eliminated from the statistics for 1919.

the total, 18,408, for one part of an industry may be expanding while another part is declining. For example, in the dairy products group of the food industries, from 1919 to 1929 the number of establishments shows a loss of 624, but in this group the cheese industry alone had a loss of 638, and butter of 121, while condensed and evaporated milk showed a gain of 135.

Even if we utilize a quite minute classification of the industries, the recorded decline often understates the number of establishments in an industry which have gone out of business since the previous census, for in the same period new establishments enter the industry. Thus, there were 103 fewer establishments in 'Boots and shoes other than rubber' in 1927 than in 1925, but 283 concerns went out of business between the census of 1925 and that of 1927. Likewise, in 'Motor vehicles' there was a decline of 33 establishments, 36 went out of business.

**Table 6.22: Industries in Which the Number of Establishments Decreased 200 or More: 1919-1929[1]**

*(ranked in order of losses)*

| INDUSTRY | NUMBER OF ESTABLISHMENTS [2] | | DECREASE 1919–29 | |
|---|---|---|---|---|
| | *1919* | *1929* | NUMBER | PER CENT |
| Total, 12 industries | 77,195 | 58,787 | 18,408 | 23.8 |
| Flour and other grist-mill products | 9,209 | 4,022 | 5,187 | 56.3 |
| Lumber and timber products | 16,016 | 12,915 | 3,101 | 19.4 |
| Cigars and cigarettes | 4,336 | 1,636 | 2,700 | 62.3 |
| Marble, granite, slate and other stone products | 3,296 | 1,881 | 1,415 | 42.9 |
| Copper, tin and sheet-iron work | 3,522 | 2,161 | 1,361 | 38.6 |
| Bread and other bakery products | 21,988 | 20,785 | 1,203 | 5.5 |
| Motor-vehicle bodies and parts | 2,123 | 1,154 | 969 | 45.6 |
| Saddlery and harness | 1,045 | 260 | 785 | 75.1 |
| Cheese | 3,396 | 2,758 | 638 | 18.8 |
| Foundry and machine-shop products | 9,323 | 8,880 | 443 | 4.8 |
| Clay products and non-clay refractories | 2,113 | 1,749 | 364 | 17.2 |
| Cooperage | 828 | 586 | 242 | 29.2 |

1 Computed from data in Census of Manufactures.
2 Excluding establishments with value of product less than $5,000.

The declines, 1919-29, in the number of establishments were proportionally heavier in some of the smaller industries than in those shown in Table 6.22. For example, among industries which show declines of between 100 and 200 establishments, the losses exceeded 50 percent in ‘vinous liquors’, ‘carriage, wagon, sleigh and sled materials’, ‘feathers and plumes’, and ‘pianos.’

Declines in the number of establishments from one census period to another may be due to permanent abandonment of plants, temporary idleness through the census year without permanent abandonment, transfer of individual establishments from one industrial classification to another,[21] decline in total value of product below $5,000, or possibly to variations in the thoroughness with which the census is taken. As 1919 and 1929 were both decennial censuses, and 1929 an active year, it seems plausible that temporary idleness or change in scope does not account for many of the declines evidenced from 1919 to 1929. Some of them may be due in part to changes in classification of individual plants but the shrinkages are so great in many industries that it is difficult to escape the conclusion that in many lines of manufacturing there is a persistent tendency in recent years towards a decrease in the number of establishments.

The question arises, are the observed decreases in the number of establishments only in the decadent industries, or do they indicate tendencies even in the expanding industries. The four small industries with losses of over 50 per cent in the number of establishments; mentioned above, were all industries in which the average number of wage earners declined sharply from 1919 to 1929. Also, of the 12 industries with declines of 200 or more in the number of establishments set forth in Table 6.22, 7 show declines also in the average number of wage earners. But the remaining 225 industries[22] gained in the number of wage earners despite the decrease in the number of establishments. The net result, of course, is an increase in the average number of wage earners per establishment.

[21] Each establishment as a whole is assigned, on the basis of its productor group of products of chief value, to someone industrial classification; hence if a plant produces more than one product a shift from one census to another in the proportions among the several products may change the classification to which the industry is assigned.

[22] Marble, granite, slate and other stone products; copper, tin and sheet iron work; bread and other bakery products; motor vehicle bodies and parts; and clay products.

### 6.9.3 Size of Establishments

A tendency towards larger plants does not necessarily mean increased mechanization, for a large plant may conceivably have a greater proportion of hand work than a small plant. However, large scale production ordinarily facilitates the economical use of expensive machinery, and hence an increase in the average size of establishments maybe interpreted to indicate at least an opportunity for greater mechanization.

In 1899 the average number of wage earners per establishment was 22.7; in 1909, 24.6, and in 1919, 31.4. These figures cover all establishments with annual product valued at $500 or more. In later censuses the minimum has been set at $5,000. If the establishments with annual product valued at less than 355,000 are excluded from the 1919 census data to make them comparable with 1929, the average number of wage earners per establishment in all manufacturing industries combined is 42.0 in both 1919 and 1929. Evidently, the tendency for the size of establishments to increase which was exhibited in the first two decades of the century is not clearly evident in the 1919-29 period, at least not for all industries combined.[23]

There are still many small manufacturing establishments, though the number of establishments employing between 6 and 20 wage earners declined slightly from 54,317 in 1919 to 53,524 in 1929. 25 slight gains were shown in the number of establishments with over 250 wage earners, which increased from 6,366 in 1919 to 6,558 in 1929. But it is evident that

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[23] Recent Economic Changes (National Bureau of Economic Research,1929), the change in size of establishments in individual industries from 1914 to 1925 is analyzed. Eighteen industries at least doubled their average number of wage earners in this period. A few of these, such as aircraft and the motor vehicle bodies and parts, are industries which expanded greatly. Others increased their average number of wage earners chiefly by reducing the number of establishments. On the other hand, some industries declined in average size. The 15 industries reporting the greatest decline in the number of wage earners per establishment, 1914-25, were mostly industries which had suffered from loss of markets with the result that they reported decreases also in the total number of wage earners. Likewise, in Economic Tendencies in the United States, pp. 305-6, Dr. F. C. Mills computes the average annual rate of change, 1923-29, in average number of wage earners per establishment in each of 60 industries. Increases ranging from 0.1 to 9.8 per cent occurred in 35 industries. In 25, there was no change, or there were declines of from 0.1 to 12.7 per cent. The average for the 60 industries was an annual increase of 0.4 per cent. Establishments with 5 or fewer wage earners declined from 166,315 in 1919 to 103,913 in 1929, but a large part of this decline arises from the fact that in 1919, although not in 1929, establishments with product of $500 but less than $5,000 were included and most of these would be in the group with 5 or fewer employees.

for any marked indications of a tendency towards increasing concentration of production in large units we must turn to an analysis of individual industries rather than the aggregate of manufacturing establishments.

### 6.9.4 Increasing Capacity of Machine Units

One generally observable trend in the character of mechanized equipment is the enlargement of the capacity of the machine unit, either by increasing the physical size of the machine or the speed at which its parts function. As such changes are frequently accompanied by less than proportionate increases in the operating crew and thus change the ratio of equipment to workers, they may appropriately be described as increases in the mechanization of industry.

In Table 6.23, we have assembled several series of statistics which indicate the changing size of specified types of equipment from 1909 to 1929. The accompanying text in some instances cites earlier data from the same source. Rarely does the unit size decrease in the later periods; rather as a rule, it increases as the years go by.

In railway transportation the trend towards larger equipment units is striking. The average capacity of freight cars has increased from 29.4 tons in 1903 to 35.3 in 1909, and 46.3 in 1929. Likewise, the average tractive power of locomotives has increased from about 22,000 pounds in 1903 to nearly 45,000 pounds in 1929.

In the blast furnace industry, the tendency towards larger stacks is indicated by the rapid increase in daily capacity per stack from 230 in 1907 to 570 in 1929. The increase in manhour productivity in merchant blast furnace operation has been ascribed in large part to the increase in average daily stack output, and this in turn chiefly to the increasing size of the stacks (B.L.S., Bul. 474, Ref. 37, pp. 32-41).

**Table 6.23: Illustrations or Tendencies in Capacity for Individual Equipment Units**

| TYPE OF EQUIPMENT | 1909 | 1914 | 1919 | 1923 | 1925 | 1927 | 1929 |
|---|---|---|---|---|---|---|---|
| Freight cars, average capacity in tons 1 | 35.3 | 39.1 | 41.9 | 43.8 | 44.8 | 45.5 | 46.3 |
| Steam locomotives, average tractive power in thousands of pounds 1 | 26.6 | 31.0 | 35.8 | 39.2 | 40.7 | 42.8 | 44.8 |
| Average annual capacity of cement kilns 2 (1000 bbls.) | 93 | 137 | 186 | 204 | 223 | 252 | 283 |
| Average daily output, in tons, of active blast furnaces 3 | 263 | 332 | 343 | 397 | 459 | 507 | 570 |
| Average horsepower of power units in factories 4 | | | | | | | |
| Steam engines and turbines | 92.7 | 113.7 | 139.1 | 185.4 | 205.9 | 230.6 | 224.8 |
| Internal-combustion engines | 21.9 | 26.3 | 40.8 | 77.9 | 82.6 | 92.4 | 109.3 |
| Water wheels and turbines | 8.6 | 10.1 | 12.6 | 19.4 | 21.5 | 21.1 | 23.9 |
| Electric motors driven by purchased power | 8.8 | 8.6 | 9.5 | 9.4 | 9.2 | 8.9 | 8.4 |
| Electric motors driven by power generated in the same establishment | 16.2 | 15.4 | 14.3 | 14.3 | 13.3 | 14.2 | 14.5 |

1 Compiled from Interstate Commerce Commission reports on Statistics of Railways in the United States.
2 Computed from statistics of annual capacity as given in United States Geological Survey, Mineral Resources of the United States.
3 Computed from data published in Iron Trade Review.
4 Computed from statistics of horsepower and number of units in Census of Manufactures for 1919, p. 122, and 1927, p. 1270.

### 6.9.5 Rotary cement kilns

One feature of the rapid development of the cement industry in the present century has been an increase in the size of the rotary kilns.[24] In 1910, of the 845 kilns for which lengths are specified in the directory of the cement industry the mean length was 92 feet, the modal length 60 feet. In 1922,

[24] The statistics in this paragraph have been compiled, unless otherwise indicated, from the directories of the cement industry, published annually in recent years by Cement, Mill and Quarry.

only 12 years later, the average length of 644 kilns for which dimensions are given was 118 feet, with the modal length 125 feet (127 kilns). In 1906 only 7 per cent of the kilns in active plants were 125 feet or more in length; by 1910 the percentage had risen to 21; and by 1917 to 43, where it remained for several years.

The same tendency is evidenced by a study of the length of kilns in new plants. Of the 7 kilns in plants reported as producing for the first time in 1913 the longest was 170 feet; of 14 new kilns in 1916, 3 were 200 feet or longer, while of 28 new kilns added in the active year 1927 half were over 200 feet long, one of these being 300 and another 343.

Length is closely associated with capacity. In 1922 the average stated capacity was 196 barrels for 60-foot kilns, 623 for 125 foot, 1,125 for 175 foot, 938 for 200 foot, and 1,400 for 240—foot kilns. Hence it seems reasonable to assign the increasing length of kilns as one cause of the increase in the average annual capacity of cement kilns (given in Table 6.23) from 93,000 barrels in 1909 to 283,000 in 1929.

### 6.9.6 Power units in factories

As shown in Table 6.23 the average size of steam engines and turbines, internal combustion engines, and water wheels and turbines has increased steadily from 1909 to 1929. On the other hand, there has been relatively little change in the horsepower of electric motors, whether driven by purchased power or by power generated in the plant using the motors. Apparently, the increasing use of individual electric motors for small machine units has more than offset the tendency of the increasing size of many types of power-driven equipment to require larger electric motors.

Numerous other instances of the increasing physical size of machine units have come to our attention in studying the nature of the labor-saving changes in the plants included in our survey or as described in the technical literature. In highway construction the introduction of caterpillar tread has furthered an increase in the size of cement mixers (Ch.IV). In the glass bottle industry, the capacity of the Owens automatic bottle machine has increased with the later models. In the cement industry not only has the length of the kiln tended to increase, as noted above, but also larger and more powerful crushers have been developed (Ch. III). In the milling process in the rubber industries the introduction of larger rolls without an equivalent increase in the force of machine tenders has been a major factor because much of the work of the tender is merely waiting for the machine; to do its part (Ch. III). In paper making the paper machine has steadily increased in both width and running speed, and likewise in the pulp making department the digesters and grinders have substantially greater capacity than formerly (Ch. III, Table 4). In the brick industry the brick machines that had been recently installed had larger capacities than the displaced machines.

The increase in the physical size of factory machinery has been furthered by the development of mechanical handling devices capable of lifting and moving materials or product in larger units than could be readily handled by manual methods.

In farming the sales of large harvester and thresher combines, for example, rose suddenly in 1923, as compared with the small machines. In 1921 a total of 4,610 combines with a width of cut 10 feet or less were sold, and only 417 with cut over 10 feet. In 1923 the situation was reversed, 219 being 10 feet or less, and 3,793 over 10 feet. Similar data are not given in the later statistics of farm machinery sales.

## 6.10 Increasing Capacity through Greater Speeds

The capacity of a machine may be enlarged by making the machine run faster rather than increasing its physical size. For example, the capacity of the auger type of brick molding machine has been enlarged without resorting to "design of larger dimensions of barrel." These machines have almost exclusively rotary movements, and more capacity has been obtained by greater speed or number of revolutions. "An auger shaft speed of 25 to 30 revolutions per minute in 1914 is now often from 40 to 50 revolutions per minute, without undue breakage of parts."[25]

Such an acceleration of running speed has been made possible by the more durable machine parts and better lubricating systems. Interchangeability of parts in machines produced in large quantities has also contributed to the acceleration in actual running speed by reducing stoppages for repairs. A quotation from a letter from a veteran manufacturer of brick machines illustrates this development:

> "The signer of this has been since May 1871 (57 years) connected in various capacities with foundry and machinery concerns that served brick manufacturers. During the first 20 years the service rendered was wholly taking parts for and keeping in repair machinery of various makes which, without exception, produced a minimum of both quality and quantity at maximum cost of both cash and lost time for upkeep. The brick manufacturer who tried to carry a stock of parts from the manufacturer of his machines frequently found their foresight of no avail because the parts

[25] Letter to writer from president of a leading brick machine company, April 16, 1928.

were not interchangeable, so the roads between brickyard and our shop were kept hot while the gang loafed."

We noted in Chapter III that an outstanding development in woodworking machinery in recent decades has been accelerated lineal speeds of such machines as flooring machines and molders. In the garment making industry various establishments reported labor reductions through the purchase of more rapid sewing machines. In paper pulp making, the manufacturer has reduced labor costs by running, machines faster without increasing the number of tenders. The paper machine manufacturer writes: "a machine running at three or four hundred feet per minute will require approximately the same amount of help in the machine rooms as a machine running eight hundred or a thousand feet per minute or over." One manufacturer of corrugated fiber-board products reported to us that by increasing the speed of his machines he had been able to "triple production since 1920 with approximately the same number of employees."

The superintendent of a beet sugar factory states: "We have done more in increasing the speed of the existing machinery by little odds and ends, each one more or less insignificant in itself, by all working together to increase the speed and by training the crews to quicker and snappier work."

A knitting mill reported that it was introducing new knitting machines which would run 20 per cent faster, make 24 stockings at once instead of 18, and, as were the slower machines, be tended by one man.

English cotton mills are said to make up in part for fewer looms per weaver by running looms at a higher speed. In the warping process in American mills the new type high-speed warper is said to run something like eight times as fast as the old-style warper, though the saving in labor is not so great as this ratio might imply (Ch. III).

## 6.11 Electrification of Factory Power Equipment

Because of its cleanliness and flexibility, electrification facilitates the more general application of power in industry; hence the pronounced trend towards the electrification of manufacturing plants, clearly brought out by Table 6.24 is a significant aspect of increasing mechanization. From 4 per cent in 1899 the percentage of power equipment which is electrified has increased to about 30 in 1914, and to about 70 to 75 in 1929.

## Table 6.24 Increasing Use of Electric Power in Manufacturing [1]

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| | RATED HORSEPOWER (THOUSANDS) | | | | | | |
| CENSUS YEAR | *Total primary power* (B+C) | *Other than electric* [2] | *Electric motors driven by purchased power* | *Electric motors driven by current generated in reporting plant* | RATIO OF ELECTRIC MOTORS DRIVEN BY PURCHASED POWER TO TOTAL PRIMARY POWER (C ÷ A) | ELECTRIFICATION RATIOS Method I [3] $\left(\frac{C+.72D}{A}\right)$ | Method II [4] $\left(\frac{C+D}{C+1.39B}\right)$ |
| 1899 | 10,098 | 9,915 | 183 | 310 | .02 | .04 | .04 |
| 1904 | 13,488 | 13,046 | 442 | 1,151 | .03 | .10 | .09 |
| 1909 | 18,675 | 16,926 | 1,749 | 3,068 | .09 | .21 | .19 |
| 1914 | 22,437 | 18,540 | 3,897 | 4,939 | .17 | .33 | .30 |
| 1919 | 29,324 | 20,041 | 9,283 | 6,969 | .32 | .49 | .44 |
| 1923 | 33,092 | 19,728 | 13,364 | 8,821 | .40 | .60 | .54 |
| 1925 | 35,767 | 19,902 | 15,865 | 10,255 | .44 | .65 | .60 |
| 1927 | 38,826 | 19,693 | 19,132 | 11,220 | .49 | .70 | .65 |
| 1929 | 42,931 | 20,155 | 22,776 | 12,376 | .53 | .74 | .69 |

1 Compiled from Census of Manufactures: 1919, VIII, 122; 1927, p.1270, and 1929, p. 112. Unlike the data in Table 6.15 these data are not adjusted or changes in the Scope of the census of manufactures.

2 Includes steam engines, steam turbines, internal combustion engines, water wheels and water turbines, in the reporting plant; also, for 1899—1914, operated power other than electric. Some of this non—electric power is used to generate current to drive electric motors; hence, to avoid duplication, the horsepower of electric motors driven by current generated in the reporting plant (shown in column D) is not included directly in the total for primary power in column A.

3 In Method I, which is used by the Bureau of the Census to estimate the proportion of 'Electrification' of "Factory Power Equipment", the horsepower of electrified equipment is taken as the sum of electric motors driven by purchased current plus the estimated capacity of prime movers used to actuate motors operated by prime movers owned by the reporting factory. It is assumed "that the ratio of the capacity of these prime movers to that the motors operated by them is 72 per cent". The denominator of the ratio is total primary power; Commerce Yearbook (1929), I, 292.

4 In Method II, the numerator of the ratio is the total of electric motors in the factory, both those operated by purchased power and those operated by power generated in the factory; and the denominator is the estimated total of electric motors if the plants were all completely electrified. In making this estimate we have followed the Bureau of Census in assuming that horsepower of prime movers will be used to drive 100 horsepower (e

A precise determination of the degree of electrification is made difficult by the fact, noted above, that the horsepower of electric motors driven by purchased power is not logically comparable with the horsepower of prime mover used to drive machinery directly or to generate power for electric motors in the same establishment. In computing the degree of electrification, we have assumed that 72 horsepower of prime movers will be used to drive 100 horsepower electric motors, and have computed the degree of electrification by two slightly different methods, as explained in the footnotes to Table 6.24. The estimate in column F follows the method used in the Commerce Yearbook and yields an electrification ratio for 1927 of 70 per cent. The slightly more conservative method in column G yields an estimate of 6 per cent. Using a still different method of estimate, Mr. I.P. Alford reaches a figure of 78 per cent for 1927.[26] By all three methods, the degree of electrification is shown to have at least doubled from 1914 to 1927.

Since 1914 there has been a large increase in the number of electric motors operated by power generated in the same establishment, but the increase in the use of purchased power has been even more marked—from less than 4 million horsepower in 1914 to over 20 million in 1929.

The increase in the use of electric power has been common in many industries. A few specific illustrations may be cited. In the rolling mill branch of the steel industry the greatest change in the last ten or fifteen years has been associated with the electrification of main roll drives and incidental controls, which is the method of automatic production.[27] Electrification has been especially rapid since 1923 in several of the rolling mill processes. Electrification furthers the use of individual drives. In machine tools, to illustrate, there is a marked tendency towards the substitution of group or individual motor drives for pulley drives. For example, the American Machinist, in its summary for1ew machine tool equipment for the second half of 1927, pointed out that "self-contained motor drives are now the rule rather than the exception, and pulley drives are usually optional."[28] The same issue of the *American Machinist* also calls attention to the "large number of portable electric drills" put upon the market.

Some of the reasons for the growing popularity of electric power in factories are suggested by the following quotation from the 1910 Census of Manufactures (VIII, 331).

> "Electric power is largely applied by means of relatively small motors distributed throughout the manufacturing establishment, some of which aren't general use while others are required only at infrequent intervals. As the electric power can be used or cut off at will, it proves both convenient and economical, especially for the operation of machinery which is in use

[26] Recent Economic Changes, p.126.
[27] See Ch. III and Appendix A.
[28] January 19, 1928, p. 77.2 54

only a part of the time; and the cleanliness and quietness of the electrical motor as compared with other sources of power also give it manifest advantages in certain industries, such as the clothing industries. . . . The electric motor run by purchased current furnishes power for manufacturing with a minimum of trouble or attention on the part of the operator."

## 6.12 Economy of Men and Equipment

Our major concern in this survey is with the changes in the type and quantity of machinery used. Lest this preoccupation with the trends in mechanization make it appear that we are overlooking non-mechanical changes, let us reiterate that there are also in progress in American industry various non-mechanical changes in organization and methods operation, not readily susceptible of measurement with respect to their extent and rapidity of introduction but nevertheless of significance in the past history and for the future development of industry. We have in mind all those techniques included under the none too clearly defined term scientific management, with its time and motion studies, also improved methods of wage payment, and increasing sub-division of labor, such as sometimes accompanies the 'stretch out' system in textile mills—in short, all efficient measures which represent a more effective use of the available machinery and man-power rather than changes in the equipment itself.[29]

[29] See Ch. II, section on Non-mechanical Changes; also Ch. III, particularly sections dealing with Cotton Yarn and Cloth, Newspaper Print in Leather, and Beet Sugar.

# 7. New Levels in the Stock Market[1]

## Charles Amos Dice[2]

### 7.1 The Electrical Age

The present time is often spoken of as the beginning of the electrical age. We have passed through the stone age, the bronze age, and the iron age. The steel age is slowly passing and we are now entering upon the electrical age. So runs the chronology, according to some writers. Whether this be true or not, the fact remains that we are on the threshold of a time when the development and use of electrical power in the fields of transportation, manufacture, advertising, amusement, and medicine will be of dominant interest.

Whether the countryside will become dotted with small factories surrounded by the homes of the employees and affording farmers extra earning power, remains to be seen. It is certain that the electrification of our transportation systems will add greatly to the efficiency of transportation; that the work of the home will be revolutionized, whether in city or country; and that industry will be less narrowly restricted as to location.

Here is a great movement in progress. The investor will do well to take account of it. One of the secrets of large earnings on investment funds is that the investor shall locate the big currents that run like gulf streams across the whole business and economic organizations and to stay with them. The movement toward electrification and the use of electrical power and equipment is such a current and investors will do well to take advantage of it.

With the progress of electrical development, the copper and chemical industries will necessarily go arm in arm. These industries were hard hit by the World War but are now in the midst of a phenomenal development. The smaller copper companies have been brought to a high degree of efficiency

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[1] Dice, Charles Amos. New Levels in the Stock Market. New York, NY: McGraw-Hill Book Company, 1929.

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and will most probably be merged into several great organizations. The copper industry, therefore, seems in the midst of a great advance.

As for chemicals, the sky seems to be the limit. That the market leaders think so is evidenced by the advance in price of Allied Chemical and Dye, from a low of 146 in 1928, to a high of 346 made in July, 1929.

The steel industry is about to catch up with its excessive capacity built during and after the World War. A determined campaign of elimination of waste and replacement of obsolescent machines and processes has been waged for 5 years or more with millions of new capital invested. The small steel companies have engaged in this campaign as well as the large ones. Mergers are in process and, when completed, the industry will be in position for rapid progress.

The public utilities, especially those supplying light and power will profit greatly by the electrification of the railroads, industries, farms, and homes. That the leaders expect great things of the operating companies is evidenced by the tremendous holding companies that have been organized in the last decade.

Here is one of the most remarkable industrial phenomena of our time. Stocks of the utilities have doubled, tripled, and quadrupled in price discounting in advance of the expected larger stability and earnings. It is most probable that the utilities are in the midst of a transition period moving from a lower to a substantially higher plane of activity.

The radio industry is but in its infancy. Television is about to be put on a commercial basis. The moving picture is about to be revolutionized. The prices of the stocks of the leading companies are not mere results of wild speculation. They are discounting, possibly somewhat too early, the tremendous possibilities.

And what of the airplane? Look over the list: electrical equipment, chemical industries, iron and steel, copper and other nonferrous metals, the public utilities, radio, the airplane, the railroads. Was there ever such a combination of circumstances so pregnant with outstanding developments?

# 8. Summary and Conclusions

The proverbial cloud that has hung over the head of the economics profession and of capitalism in general since the stock market crash has, for all intents and purposes, never lifted, leading some like Yale University economics professor Robert Shiller to invoke the notion of irrationality, more specifically the idea of irrational exuberance. In other words, after more than a half-century of analysis, the best the profession could come up with was "irrationality" and "exuberance" to describe the events of the late 1920s.

This volume presented an alternative, one grounded in economic fundamentals, and one that provides a bout-by-bout account of both the boom and the crash. In so doing, it provides the missing pieces in Irving Fisher's 1930 and McGrattan and Prescott's 2004 defense of the fundamentals bases of the stock market boom.

As Fisher first pointed out, and McGrattan and Prescott reiterated, the single most important technology shock was electric unit drive, which led to the introduction of new, more productive plant layouts. According to McGrattan and Prescott:

> Fisher (1930) also cites "managerial engineering" as a reason for increased stock values. What Fisher means by this is the introduction of methods for better coordination of production and sales and for better planning of plant layout and subdivision of tasks. Fisher refers to this as "Fordizing" of business. (McGrattan and Prescott 2004, 1000).

Without referring to it by name, what they are describing are the effects of electric unit drive. The gains, however, were not coordination based, but rather owed to greater machine speed, which increased output per unit of capital (machinery and equipment). Irving Fisher (1930) opined:

> Civilization was based on power, but it was distinctly urban. Up to twenty years ago the burden of the world's work had, it is true, been largely shifted from the backs of men to machines by power generated by the burning of fuel or the force of waterfalls. Then came mobile electric transmission. Along with it came the speeding of transportation of men and materials on railroads and by means of automobiles. A vast accession of usable power, accelerating every business transaction and means of human intercourse, is

now being distributed at the point where it can be used most economically. (Fisher 1930, 133)

Managerial engineering was about planning and coordinating the new, high-speed sub-processes.

The result was an increase in the value of the existing stock of capital. With greater machine speeds, existing machinery and equipment could generate more output, and thus a greater return. The latter was captured in McGrattan and Prescott's analysis by what they referred to as intangible capital (estimated at 60 percent of tangible capital). In short, it can be attributed to the fact that corporate tangible capital was simply more productive as a result.

The three approaches to the stock market boom presented here are, as such synoptic in their view of the underlying causes of the boom. Where they differ is with regard to the mechanics of the boom and of the crash/bust. Fisher, McGrattan and Prescott simply argue that rational investors bid up the value of stocks in response to technological "good" news. Beaudreau, on the other hand, provided a more compelling argument, one that is based on these same fundamentals, but one which adds another layer, namely that of realizing greater earnings and profits which he tied to the proposed Smoot-Hawley Tariff Bill. More productive machinery and equipment requires more buyers, and more buyers is exactly what the Republican's tariff initiative promised to deliver.

Beaudreau showed that by juxtaposing the Smoot-Hawley legislative life-cycle against improved Fisher-McGrattan-Prescott fundamentals, one gets a convincing, empirically-consistent narrative of both the stock market boom and bust. Far from being irrational, investors behaved perfectly rationally, bidding up stock prices in response to tariff good news, and vice-versa in response to tariff bad news. With perfect information on the underlying fundamentals, investors reacted positively to the possibility of greater market share, greater sales, revenue and profits. On October 22, 1929, the Insurgent Republican-Democrat coalition made good on its promise to lower tariffs on manufacturing, triggering the crash, a finding that is consistent with Irving Fisher's prominent and perspicacious banker, who "ascribes the Wall Street crash largely to the blocking of the Tariff Bill in Congress (Fisher 1930, xi)"

Last, the findings of this volume should be seen as being complementary to and consistent with Peter Garber's pioneering work on uncovering the underlying fundamentals of what appear to be irrational price bubbles. The stock market boom of the late 1920s was not a bubble, and the crash, far from being random, was the result of an internecine struggle within the Republican Party against a backdrop of vastly improved fundamentals.