

Levy, Daniel; Young, Andrew T.

Article — Accepted Manuscript (Postprint)

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Journal of Money, Credit, and Banking

Suggested Citation: Levy, Daniel; Young, Andrew T. (2004) : "The Real Thing:" Nominal Price Rigidity of the Nickel Coke, 1886-1959, Journal of Money, Credit, and Banking, ISSN 0022-2879, Ohio State University Press, Columbus, OH, Vol. 36, Iss. 4 (Special Issue), pp. 765-799, <https://doi.org/10.1353/mcb.2004.0065>

This Version is available at:

<https://hdl.handle.net/10419/206557>

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“The Real Thing:” Nominal Price Rigidity of the Nickel Coke, 1886–1959*

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JEL Codes: D40, E12, E31, L10, L11, L16, M10, M31, N1, N8

Key Words: Sticky Prices, Cost of Adjustment, Menu Cost, Retail Price Maintenance, Single-Coin Vending Machine, Customer Inconvenience Cost, Coca-Cola, Coke, Nickel Coke, Pepsi, Nickel and Dime Stores

Last Revision: February 4, 2004

* We are grateful to Steve Cecchetti, the discussant at the January 2001 American Economic Association Meetings in New Orleans, and to Anil Kashyap, the discussant at the November 14–15, 2003 *JMCB*-Federal Reserve Bank of Chicago James Tobin Symposium in Chicago, IL, for providing insightful comments and suggestions, to Bob Barsky, Mark Bergen, Matthew Shapiro, and Ken West for comments, numerous conversations and advice, and to the *Journal's* anonymous referee for comments. We also benefited from the comments and suggestions made by the participants at the above conferences as well as the participants at the July 2003 NBER Monetary Economics Workshop, in Cambridge, MA, and the March 2001 Midwest Macroeconomic Association Conference in Atlanta. In particular, we would like to thank Ben Friedman, Bob Gordon, Mark Hooker, Christina Romer, David Romer, Julio Rotemberg, Bob Solow, Anna Schwartz, and Janet Yellen. We also thank Susanto Basu, George Benston, Bob Chirinko, Dean Croushore, Leif Danziger, Stanley Fischer, Daniel Kahneman, Jacob Paroush, Ish Rosenblit, Will Roberds, and the participants of the Economics ~~s~~ as well as the Business Seminars at Bar-Ilan University, and the Economics Seminars at Emory University, University of Haifa, Hebrew University, and the University of Michigan for comments. We are grateful to the Coca-Cola Company Archive employees, and especially to Mr. Phil Mooney, the Archive Director, for kindly helping us locate many of the materials and data we needed for this project, for patiently answering our never-ending questions, and for comments on the final draft of the manuscript. Virginia Cain, Emory University Archivist of the Special Collections, helped us with the papers and correspondence material contained in the Robert W. Woodruff Collection at the Emory University Library. Lonnie Stegink of the Joods Historisch Museum of Amsterdam and Willeke Tijssen of the International Institute of Social History, also in Amsterdam, kindly helped us obtain historical information on HEMA (the “Dutch Uniform Price Company”). The first author also acknowledges the research assistance of Eleana Aguilar, Xia Liu, and Yihong Xia, and the URC Research Grant from Emory University. All errors are ours.

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Abstract

We report that the price of a 6.5oz Coke was 5¢ from 1886 until 1959. Thus, we are documenting a nominal price rigidity that lasted more than 70 years! The case of Coca-Cola is particularly interesting because during the 70-year period there were substantial changes in the soft drink industry as well as two World Wars, the Great Depression, and numerous regulatory interventions and lawsuits, which led to substantial changes in the Coca-Cola market conditions. The nickel price of Coke, nevertheless, remained unchanged. We find that this unusual rigidity is best explained by (1) a contract between the Company and its parent bottlers that encouraged retail price maintenance, (2) a single-coin vending machine technology, which limited the Company’s price adjustment options due to limited availability and unreliability of the existing flexible price adjustment technologies, and (3) a single-coin monetary transaction technology, which limited the Company’s price adjustment options due to the customer “inconvenience cost.” We show that these price adjustment costs are of a different nature than the standard menu cost, and their estimates exceed the existing estimates by an order of magnitude. A possible broader relevance of the nickel Coke phenomenon is discussed in the context of Nickel and Dime Stores, which were popular in the US in the late 1800s and the early 1900s.

“The price system works so well, so efficiently, that we are not aware of it most of the time. We never realize how well it functions until it is prevented from functioning, and even then we seldom recognize the source of the trouble.”

Milton and Rose Friedman (1990, p. 14)

“Coca-Cola is said to be the second most well-known phrase in the world; the most well-known is “OK.” So if you say “Coca-Cola is OK” you will be understood in more places by more people than any other sentence.”

Richard Tedlow (1990, p. 24)

Coca Cola’s path to nearly universal recognition as a consumer product began with a peddler of patent medicines in Atlanta, Georgia in the year 1886. This individual—one John Stith Pemberton—had an ingenious idea. Why sell 75 cent or dollar medicine bottles? This was a marketing strategy limited to the sick. Why not sell a single serving for a nickel? In the Deep South of the U.S. everyone could afford 5¢ for a cold invigorating soft drink. The nickel Coke was born. At the time, no one could have predicted that it would be almost 1960 before the nickel Coke was finally gone.¹

Today, if we scan the economic literature on price rigidity, we find documented cases on how some prices seem to be sticky for significant periods of time. For example, Cecchetti (1986) examines data on magazine prices and finds that their prices change about every 3–6 years. Using the Stigler and Kindahl (1970) transaction price data, Carlton (1986) finds that, “It is not unusual in some industries for prices to individual buyers to remain unchanged for several years” (p. 639). Kashyap (1995) studies catalog prices of 12 retail goods over a 35-year period and reports that the average time between price changes is about fifteen months. Blinder, et al. (1998), presenting detailed survey evidence from U.S. firms, conclude that the average lag of price adjustments following supply or demand changes is 3 months. Genesove (2003) studies apartment rental prices in the U.S. using the Annual Housing Survey data, and finds that over the period of 1974-1981, between 23 and 34 percent of the apartments had no change in nominal rent from one year to the next. The study by Bils and Klenow (2002) examines the frequency of price changes for 350 categories of goods and services covering about 70% of consumer spending and

¹ When not cited specifically due to their generality, some of the historical facts concerning the Coca-Cola Company are drawn from Allen (1994) and Pendergrast (1993) and from the sources cited therein. Additional information are drawn from factual publications provided by the Coca-Cola Company archives, including “Reviewing ‘A Proud History:’ 1886 to 1925,” “Always Coca-Cola: A Quick-Reference Chronology from 1886 to 1993,” “Fact Sheet: Product Pricing Structure of Coca-Cola USA,” “Fact Sheets Concerning the Nickel Price,” “Statement Showing Estimated Value of Advertising Matter Furnished to Bottling Companies,” “Sales of Coca-Cola,” “The Coca-Cola Company: Advertising Expenditures,” and other documents. For a more detailed account, see the expanded working paper version of this paper, Levy and Young (2002).

documents frequent prices changes, with half of prices lasting less than 4.3 months.²

On the other hand, the price of a serving of Coca-Cola did not adjust to supply or demand changes *for over 60 years*, and the nickel Coke did not entirely disappear from U.S. markets until 1959 – *over 70 years!* The contrast is of an order of magnitude to say the least!

Our goal in this paper is to study this unusual episode of price rigidity in detail and try to explain it. Understanding what appears to be one of the most long-lasting nominal price rigidity phenomena of the 20th century is valuable for several reasons. First, the Coca-Cola Company is one of the most successful and recognized producers of a consumer good in the world.³ Second, over most of the time period covered in this study, the soft drink industry was a non-negligible part of the U.S. economy. For example, as of 1945, the bottled nonalcoholic carbonated beverage industry had a nominal production value of \$579 million (Riley, 1946, p. 343), or 0.26 percent of the \$222 billion Nominal GDP.⁴ The Coca-Cola Company had a 50 percent market share of the industry, making its contribution alone economically significant, about 0.13 percent of the GDP.⁵ Third, the soft drink industry was a non-negligible source of public revenue over the period we study, e.g. in 1924 the soft drink industry paid a combined \$54 million in taxes, or 1.4 percent of U.S. federal budget receipts of \$3.9 billion.⁶ And fourth, the Coca-Cola rigidity is exceptional in being so clearly defined (no nominal price change whatsoever) and enduring (over 60 years). Such exceptional cases are useful for gaining insights that may be applicable to other cases.

² Some studies report more frequent price changes. For example, Warner and Barsky (1995) document weekly variation in the prices of consumer products. Barsky, et al. (2003), Chevalier, et al. (2003), Dutta, et al. (1999, 2002), Levy, et al. (1997, 1998, 2002), Chen, et al. (2002), and Müller, et al. (2001), document weekly price variation in retail supermarket and drugstore establishments. See also Davis and Hamilton (2004). For findings using data from high inflation economies, see Eden (2001) and studies cited therein.

³ Indeed, according to the 2002 *Business Week* ranking, Coca-Cola is the most valuable brand in the world, ahead of Microsoft, IBM, GE, Intel, etc.

⁴ Compare this to the U.S. iron and steel industry where the nominal production value (net billings) was \$5.8 billion, or 2.6 percent of nominal GDP (American Iron and Steel Institute, 1945, p.9). The soft drink industry was smaller, but the iron and steel industry was certainly one of the more important in the U.S. economy at the time, which suggests that the soft drink industry was, at least, non-negligible. Also, these numbers do not even include fountain and cup vending machine sales. Cecchetti (1986) documented price rigidity in magazines at newsstands. According to the 1992 U.S. Economic Census, news dealers and newsstands (SIC 5994) had \$704 million in sales. This amounts to 0.013 percent of the \$6.244 GDP. So, in terms of relative economic magnitude in the U.S. economy, the coverage in this case study is comparable to important empirical studies in the price rigidity literature.

⁵ Riley (1946, p. 343) states that per capita bottle consumption in the U.S. was 100.1 in 1940. A memorandum found in the Robert W. Woodruff Papers from George P. Jackson, Jr. (of the Coca-Cola Company) to H.W. Grindal (head of the Coca-Cola Research Department) dated May 10, 1944 lists Coca-Cola per capita bottle consumption in 1940 at 50, consistent with the 50 percent market share figure.

⁶ Federal budget receipt data come from the NBER historical macroeconomic data, series 15004. Soft drink tax amount comes from the Coca-Cola Company's (1925) *Proud History: 1886 to 1925*.

We were unable to identify one single factor that could alone explain the nominal price rigidity that lasted over 70 years. We offer a combination of three possible factors as an explanation for the Coca-Cola price rigidity. Two of these explanations are *technology-based*, while the third has to do with an unusual contract the Coca-Cola Company signed. First, we demonstrate that an installed base of vending machines with nickel-only capability, and the evolution of the technology that could accommodate multiple type coins and change making, imposed an important constraint on the ability of the Coca-Cola Company to adjust the Coke's price. Second, at the 5¢ price per serving, the smallest price increase compatible with the consumer still using a single coin was a 100 percent jump to 10¢. A *monetary transaction technology* for smaller price adjustment while keeping consumer "inconvenience costs" low in terms of the number of coins needed for purchasing a bottle of Coca-Cola, was not available. We discuss the available vending machine technology, and document statements and actions of the Company officers, as well as bottlers, suggesting that these two technology-based constraints played an important role in the Company's decision to maintain the nickel price.

It turns out that the price of the Coca-Cola syrup to bottlers was fixed by a contract, and therefore, the third explanation we offer is a simple model of monopoly under stages of processing with fixed upstream cost, which demonstrates a motive for adjusting only quantity given a constant syrup price. This explanation differs from the common fixed nominal contract story because it relies on an upstream price contract creating a retail price maintenance motive. We argue that the model can help explain the Coca-Cola price rigidity, but only until 1921, the year a new contract was signed with bottlers, which introduced flexibility in the Coca-Cola syrup pricing.

According to Blinder, et al. (1998, p. 21), price adjustment costs are "... one of the main strands of New Keynesian theorizing." Despite their theoretical importance, however, not much is known on their actual magnitude or their nature (Slade, 1998). We are able to provide some information on the magnitude and the nature of price adjustment costs the Coca-Cola Company was facing. First, we demonstrate that beginning in early 1940s, as more and more of the Company's sales were made through vending machines, the inability of existing machines to accommodate coins other than nickels, was forming a barrier to changing prices. The cost of replacing these vending machines, can therefore serve as a measure of price adjustment cost.

However, this cost is different from the standard menu cost. Menu cost is a “small” fixed cost incurred each time a price is changed. In contrast, the cost of replacing the vending machines in order to accommodate coins of other denominations is a one-time cost. That is, once machines with the new mechanisms are available, the price of Coca-Cola sold through the vending machine can be changed at zero marginal cost, by simply programming the vending machine mechanism’s buttons. Therefore, the nature of price adjustment cost we are documenting is different from the standard menu cost. Here, the cost of vending machine replacement captures the cost of gaining the ability to adjust prices in “small” increments such as 1-cent increments.

Second, the “consumer inconvenience cost” we document is also different from the standard cost of price adjustment argument. Instead, it is close to what Blinder, et al. (1988) call “the cost of antagonizing customers.” Rotemberg (2002, 2003) and Zbaracki, et al. (2004) also offer a perspective on “customer costs of price adjustment.” In Rotemberg’s model, customer’s adjustment cost takes the form of consumer anger over unfair price increases, which can lead to price rigidity. In Zbaracki, et al, consumer adjustment costs are the costs imposed on downstream customers because of the decision to adjust prices. In the specific setting they study, these costs comprise of the cost of communicating price change decisions to the customers, and the costs of negotiations and re-negotiations on the final price that result from these price change decisions.

We also consider the existing theories of price rigidity, and rule most of them out as inconsistent with the nickel coke price rigidity. In particular, the possibility that technological progress may have enabled the Coca-Cola Company to keep the marginal cost of production stable and thus justify the Coke’s constant nominal price despite the increase in the general price level, is inconsistent with the findings we report.

The paper is organized as follows. In section 1, we briefly describe various supply and demand shocks the Coca-Cola Company faced during the 1886–1959 period. In section 2, we discuss the methods the Company used to ensure that the retail price does not exceed a nickel. In section 3, we use a model of monopoly in stages of processing to assess the role of the fixed-price syrup contract the Company signed with its bottlers in its pricing decision. In section 4, we discuss the vending machine technology and the related monetary transaction technology constraints, and assess the nature and the magnitude of the price adjustment costs that arise from these constraints. In section 5, we briefly review two existing, and most promising, price rigidity

theories and assess their relevance for the Coca-Cola price rigidity, and offer a comparative analysis of the markup, market share and quality of Coke vs Pepsi. We conclude in section 6 with a brief assessment of the possible broader relevance of the Coca-Cola price rigidity for understanding the phenomena of Nickel and Dime Stores, which were prevalent during the late 1800s and early 1900s.

1. CHANGES IN MARKET CONDITIONS DURING THE 1886–1959 PERIOD

As Figure 1 demonstrates, the period 1886 to 1959 was not one when prices simply did not change much. The fluctuations in common consumer good prices are marked, especially in contrast to Coke's constant nickel price.

Insert Figure 1 about here

Further, this phenomenon was not limited to these few consumer goods. According to Figure 2, the general price level as measured by the GDP deflator has followed the same pattern. Furthermore, in mid-1940s inflation became a powerful factor.

Insert Figure 2 about here

Besides the general upward trend in prices, there were numerous positive as well as negative supply and demand shocks throughout the period. These were in addition to the two World Wars, the Great Depression, and other less remarkable business fluctuations.

Insert Figure 3 about here

The timeline in Figure 3 graphically summarizes some of the key events in the Coca-Cola history. Below we provide some details in chronological order:

1886: The nickel Coke is born. It is sold first time in Atlanta at Jacobs Pharmacy on Peachtree

Road.

- 1888:** Asa Candler acquires majority interest in the company.
- 1898:** Spanish-American War; a war tax is imposed on proprietary medicine; IRS declares that Coca-Cola is a medicine because it is being advertising not only as “refreshing,” but also as “relieving headache immediately.” The Coca-Cola Company is found liable for 1/8 cent on every nickel drink (Riley, 1946, p. 26).
- 1899:** The Company signs a bottling contract granting bottling rights to bottlers in New England and Texas. The bottling right at the rest of the continental U.S. is given to two Tennessee lawyers. The contract guarantees the right to buy syrup from the Coca-Cola Company at the nominal price of 92 cents per gallon *in perpetuity*.⁷
- 1901:** The contract between the Coca-Cola Company and the parent bottlers is amended. Parent bottlers will pay \$0.90 per gallon of syrup and \$0.10 per gallon for advertising materials.
- 1901:** Cocaine Lawsuit No. I – Georgia State Board of Pharmacy examiner declares that a detectable amount of cocaine is found in Coca-Cola. Candler admits under oath that Coca-Cola indeed contains traces of cocaine.
- 1907:** Coca-Cola sales are banned in canteen and post exchanges by the US War Department because of the revelation that Coca-Cola contains a minute amount of alcohol.⁸
- 1909:** American Bottlers Protective Association passes a resolution opposing to sale of any soft drink containing extracts of coca or kola or caffeine.
- 1911:** Cocaine Lawsuit No. II – Coca-Cola is charged for violating the Pure Food and Drug Act

⁷ We were unable to find any documented justification for this contractual arrangement in perpetuity. A possible explanation might be similar to the reasoning offered by Katz and Paroush (1984) to explain the fact that most contracts signed between creators and their sales agents (such as between authors and publishers, artists and agents, painters and galleries, etc.) are in terms of royalties and not in terms of profit shares: in markets with uncertain demand and risk-averse creators, partnership in the form of profit-sharing is not Pareto superior. The Coca-Cola Company, at the time it entered the contractual arrangement in perpetuity, had no way of predicting the future demand for its product. Thus, the company was indeed facing a great deal of uncertainty about the future demand for its drink. An additional reason may be a risk-aversion of the agents, the bottlers in this case. Consider the comments in the January 1951 article of the *Fortune* magazine (“The Nickel Drink is Groggy”): “Parents like Coke have no direct control over their bottlers except for control over sanitary and quality standards; they can’t get bottlers without giving them franchises in perpetuity, because a man won’t put his money up unless he has the feeling that it all belongs to him and no one can take it” (p. 131).

⁸ This was potentially very damaging to the Company as it advertised itself as “a harmless temperance beverage” that had “caused thousands of young men to give up the habit of drinking beer and other intoxicating liquors” (Young, 1983, p. 7).

for caffeine content and misbranding.⁹

1913: The tariff on Cuban sugar is reduced from 1.3840¢ per pound to 1.0048¢ per pound.¹⁰

1916: Standard 6 1/2 oz “hobble skirt” bottle is adopted nationwide.

1917: Sugar prices increase from 5¢ per pound to 8¢ per pound.

1917: Sugar rationing begins; ends in 1919.

1919: A 10% tax is imposed on soft drink syrup sales.

1920: Caffeine and caramel shortage.

1920: Prohibition begins.

1920: Howard Candler contracts for 4,100 tons of Java sugar at 20¢ per pound. In December the sugar price goes down to 9¢. The Company loses hundreds of thousands of dollars.¹¹

1920: The Company is losing \$29,000 per day (\$213,235 in 1992 prices) because of its inability to adjust the syrup price. Parent bottlers take Coca-Cola to court because of the Company’s intention to terminate the contract with bottlers.

1920: The Supreme Court Judge, Oliver W. Holmes, in ruling on the Coca-Cola Company’s trademark infringement lawsuit against Koke Company of America, declares that Coca-Cola is “... a single thing coming from a single source and well known to the community... The drink characterizes the name as much as the name the drink.”

1921: A new contract with parent bottlers sets the syrup price to \$1.17 per gallon. In addition, for every cent increase in the price of a pound of sugar above 7 cents, syrup price will increase by 6 cents. This gives the Coca-Cola Company the ability to adjust the syrup price to changes in the cost of one of the key ingredients.

1923: Robert Woodruff becomes the President of Coca-Cola; plays a decisive role in maintaining the nickel price policy. Also, insists not to change the Secret Formula, no matter what.

1928: Sales of bottled Coca-Cola surpass fountain sales.

⁹ Quite paradoxically, the use of the coca bean as part of the Coca-Cola name led the Department of Agriculture to claim that the Company was guilty of misbranding for *not containing cocaine* (Young, 1983, p. 12). It appears, therefore, that while the 1901 lawsuit alleged that Coca-Cola contained cocaine, the new lawsuit alleged that it did not contain cocaine!

¹⁰ See Genesove and Mullin (1997).

¹¹ To appreciate the magnitude of this blunder, note that, in 1925, the Coca-Cola Company reported that, “More than 100,000,000 pounds of sugar are used annually to make Coca-Cola” (Coca-Cola Company, 1925). If the Company were paying even \$0.10 above the market price, the cost would have been \$1 million (\$9 million in 1992 prices).

- 1933:** Prohibition is repealed.
- 1934:** Pepsi offers a 12 oz drink for a nickel.
- 1936:** Coca-Cola vending machines are introduced.
- 1942:** World War II sugar rationing begins.
- 1943:** On June 29, General Dwight Eisenhower sends a classified cable from Allied Headquarters in North Africa asking for ten Coca-Cola bottling plants and enough syrup to provide the US soldiers with six million bottles of Coca-Cola a month. Coca-Cola is served in all military training camps across the US. Sugar used for syrup sales to the military is available without limit upon the order of the Office of the Production Management.
- 1946:** Multiple coin and change making technology for vending machines is available.
- 1950:** *Time* magazine reports that Coca-Cola went for the first time to 6¢ in New York City.¹²
- 1951:** Coca-Cola Company stops placing “5¢” signs in advertising material.
- 1951:** The “Single Coin Plan” is developed.
- 1953:** Woodruff asks the Treasury Department to issue a 7 1/2 cent coin.
- 1955:** *Business Week* reports that Coca-Cola sells for 5¢, 6¢, 7¢, or even 10¢, depending on the area.
- 1959:** The last of the nickel Cokes is gone.

These events further underscore the unusual nature of the Coke’s nominal price rigidity.¹³ It is remarkable that the nickel price remained unchanged despite these changes in the market conditions.¹⁴ As can be seen from the 1928–1939 gallon sales versus real GDP in Table 1, the

¹² According to the Company, as of 1950, only 125 of the 1,100 bottlers (5 percent) had initiated wholesale price increase.

¹³ The Coca-Cola pricing is puzzling even during the first 25 years or so, despite that fact that the overall price level was stable during that time, as Figure 2 indicates. This is because cost is not the only factor that should affect the price. It is puzzling how various cocaine, caffeine, and alcohol lawsuits, sales prohibition at military outposts and canteens, 15-year long prohibition period, and other regulatory, legal, and market interventions, have not affected the Coke’s price. Also, Mark Bergen and Anil Kashyap have suggested the possibility that Coke price could be flexible downwards, perhaps, through promotions, bundling, etc. While we cannot rule out this possibility, we know that the retail market was not as competitive during the first half of the 20th century (Oi, 2001). We suspect, therefore, that such episodes were not common.

¹⁴ It should be noted that in 1923, the Company began selling a six-pack Coke for 25¢ (Tedlow, 1990), and that price has also remained unchanged until early 1950s. Along with its price rigidity, Coca-Cola was also characterized by its unusually long-lasting quality rigidity. It turns out that the company was very reluctant to make any change to its

Company was exceptionally robust even during the Great Depression.¹⁵

Insert Table 1 about here

2. RETAIL PRICE MAINTENANCE: HOW DID COCA-COLA ENFORCE THE NICKEL PRICE?

The Coca-Cola Company had *no explicit, legal recourse for controlling the retail price of Coca-Cola*. Yet, for all intents and purposes, the Company maintained the nickel standard across the U.S. Below we document a combination of methods used by the Company for retail price maintenance.

First, the Company employed negative incentives aimed at retailers, such as limiting promotional opportunities and withdrawing rebate programs. For example, in a letter dated August 6, 1946, and addressed to Cliff W. Hodgson, President of the Coca-Cola Bottling Company of Ohio, Felix W. Coste, a manager at the Company's New York office, addresses Hodgson's concern that some dealers in his area were increasing the Coke's price despite the fact that the bottler's wholesale price to retailers was unchanged at \$0.80/case:

“We will have some newspaper copy giving additional emphasis to the 5¢ price, if in your judgment and the combined judgment of the Parent Bottlers it would

“Secret Formula.” Indeed, according to Schaeffer and Bateman (1985), the company made only six changes to the Secret Formula during the 1886–1959 period. Of these, two were government mandated in order to eliminate any possible trace of cocaine, one was the addition of preservatives in order to make the syrup transportable to long distances without souring, one change was designed to ensure that the flavor of the bottled and fountain drinks were identical, one change was the replacement of powdered sugar with crystal sugar in order to reduce the amount of the moisture the sugar carried, and one change was the adoption of beet sugar instead of cane sugar, which ensured a wider and more continuous supply of sugar because beet could be grown in greater variety of areas and climates. None of these changes, however, were perceived by the public as a quality change. In fact, the public was not even aware of these changes. In addition to these changes, we discovered one undocumented temporary change in the Secret Formula. In 1942, as the sugar shortage and the resulting rationing created a shortage of Coca-Cola drink for civilian use, a small amount of substitute sugar was used in place of the rationed sugar. Coca-Cola president Robert Woodruff was reluctant: “Of course you know I am very leery about these things and much prefer not to do anything of the kind, except as a *matter of life and death*.” (Source: Robert W. Woodruff in a letter to Arthur Acklin, October 2, 1942, Robert W. Woodruff Papers, Special Collections Section, Emory University Library.)

¹⁵ A 1938 *Barron's* article marveled that, “You could have bought Coca-Cola stock at the top price of 154½ in 1929, ... sold it at the low this year and you would have had, including dividends, a profit of approximately 225%” (Tedlow, 1990, p. 85).

be advisable to schedule it in the current newspaper series. We do not advocate publicizing in any way the wholesale price of Coca-Cola, because we do not want to antagonize dealers and, further, because *there are better ways of controlling the dealer who gets out of line*. This is a merchandising problem rather than an Advertising problem, and I am sure that this is your thought in the matter” [our emphasis].¹⁶

Second, the Company used various forms of positive incentives such as providing strategies for merchandising and marketing Coca-Cola as well as providing advertising and promotional materials. The Company maintained strict control over its trademark. All equipment and promotional items (e.g. trucks, fountains, vending machines, signs, displays, and the Coke’s bottle design) were only available from the Company to bottlers and, therefore, retailers as well. Advertising items were an important concern to bottlers who could offer them to retailers to entice additional purchases of Coca-Cola.

Third, the Company included the nickel price in its advertising material and promotional items that were distributed nationally in large quantities. In addition to religiously advertising in newspapers, the Company placed full color ads in national magazines including *Life*, *The Saturday Evening Post*, and *National Geographic*, and later also in *Time*, *Newsweek*, etc. For example, according to Munsey (1972), during the second six months of 1926, the company used 1,140,000 lines (approximately 82,000 column inches) of newspaper space. In addition, the Company every year was distributing millions of promotional items. During 1913 alone, these included 5 million lithograph metal signs (from 6”×10” to 5”×8”), 2 million trays for soda fountains, 1 million Japanese fans, 1 million calendars, 10 million matchbooks, 50 million paper doilies, 144,000 pencils, 250,000 window displays, etc. The nickel price was included in almost every print ad and on a large portion of the promotional items.

The Company encouraged bottlers to pursue a similar strategy independently. Everett C. Murphy, the Vice President of the Western Coca-Cola Bottling Company, based in Chicago, reported in 1946 on his efforts to gather information on the use of the “5¢ Price Newspaper Advertising” in his region. According to his account, he “wrote all bottlers urging them to use the

¹⁶ Clearly, these kinds of practices take the Company into a legally murky area. Perhaps, that is why besides some

special nickel price advertisements wherever the situation warranted.” Based on 82 replies, he reports that:

“8 Bottlers ran 60 insertions in 45 papers for a total of 1,583 inches prior to the receipt of the special mats from The Coca-Cola Company. 48 Bottlers reported 138 insertions of the special mats in 100 papers for a total of 8,400 inches prior to Nov. 25. 48 Bottlers reported plans to run 212 insertions of the special copy for a total of 12,705 inches after November 25.”¹⁷

The strategy of nationally advertising the Coke’s nickel price on millions of print ads and promotional material made it impossible for any retailer to charge a price higher than 5¢. For example, according to the January 1951 issue of the *Fortune* magazine (“The Nickel Drink is Groggy,” pp. 78–79, 129–131), Paul A. Gilham, Coca Cola bottler at Alexandria, Louisiana (also described as “a price-for-profit tinkerer”), in 1947 increased the Coca-Cola per case price to his dealers from 80¢ (a case of Coca-Cola contained 24 6.5oz bottles) to \$1. But after just two months Gilham had to cut the price back to 80¢. According to the *Fortune* article, about 40 percent of the retailers tried to pass the higher costs on their customers, but the customers threatened to take *all* their business elsewhere, arguing: “Everybody knows Coke sells for a nickel—Look at the back of this week’s *Life*” (p. 129).

The fourth method the Company used was publicly announcing that it had not increased its wholesale price. This strategy made retail price increases difficult to justify. The Company aggressively identified bottlers who may have increased the wholesale price and/or the retailers who were charging above the nickel price. For example, in a July 19, 1946 letter to the Coca-Cola Bottling Company of Ohio in Chicago, IL, a manager at the Columbus plant of the Bottler, writes:

internal documents, not much was put into writing by the Company on this matter.

¹⁷ Source: A letter dated December 4, 1946 from Everett C. Murphy, Vice President of the Western Coca-Cola Bottling Company, Chicago, Illinois, to E. Delony Sledge, Jr., the Coca-Cola Company’s Advertising Director (the Coca-Cola Company Archive). The letter is accompanied by a two-page list of 82 bottlers of the above region, who have responded to the “5¢ Price Newspaper Advertising” initiative of D’Arcy, the Coca-Cola Company’s main

“... we have had numerous dealers in town increase the price of not only Coca-Cola but all soft drinks from 5¢ to 7¢ and 10¢. Some of the bottlers have increased their price of soda but I know of no case where the bottler has increased the price to more than 80¢. Reports have reached us that one off the bowling alleys that increased their price from 5¢ to 7¢ were telling the customers in answer to complaints that their increase was justified since the price [to retailers] of Coca Cola had been more than doubled, but the proprietor of this bowling alley denied the allegation when called upon. I would be in favor of running about a 30 inch add in *all* newspapers two or three times, notifying the consuming public that the price of Coca-Cola to the retail dealer had not been increased. This advertisement could be worded in such a way as if it was an answer to complaints we were receiving (emphasis and typing errors in original).”¹⁸

The fifth and final method we document the Company using is to educate bottlers and retailers on why a constant price was profitable to all. In a 1925 presentation to sales and advertising managers, the Company stressed: “Use the retailer’s figures to show him the profit on Coca-Cola,” “Show him how to push sales to increase profit on Coca-Cola,” “It is not the 5¢ so much as it is the 2,400,000,000 drinks per year that has made Coca-Cola sales reach the sum of \$120,000,000.00 annually,” and “It is this volume which enables us to offer the public, at a nickel, an absolutely pure soft drink – it is this volume which makes it unnecessary for us to compete by using synthetic ingredients.”^{19 20}

advertising agency, to push the special nickel price advertisement. According to the letter, the bottlers were asked to forward their tear pages and paid invoices to D’Arcy (presumably, for a reimbursement).

¹⁸ Source: Letter dated July 19, 1946 from H.W. Easterlin to Cliff W. Hodgson, Coca-Cola Bottling Company of Ohio, forwarded to Felix Coste, Coca-Cola Company New York headquarters (Coca-Cola Company Archive).

¹⁹ Source: “Reviewing ‘A Proud History:’ 1886–1925,” The Coca-Cola Company (1925), presented to Coca-Cola sales and advertising managers.

²⁰ Jeuland and Shugan (1983) show that total profits will be higher when channel members coordinate on marketing factors such as advertising, product quality, and *pricing*. The argument is based on externalities: with coordination, *total* profits are being maximized for the channel members, while without coordination the individual member profits are being maximized without regard to the external effects to other members. Shugan (1985) further demonstrates that, in the absence of explicit contract, implicit understanding achieved via learning will lead to higher profits for both a manufacturer and retailer.

3. OPTIMALITY OF A CONSTANT RETAIL PRICE UNDER MONOPOLY IN STAGES OF PROCESSING

An early desire on the part of the Coca-Cola Company to maintain a constant retail price may have been the consequence of the contract signed between the Company and its bottlers. The Company, its bottlers, and the retailers provided a differentiated product and, therefore, held the potential for exercising market power. However, the contract to sell syrup to the bottlers at a fixed price effectively constrained the Company's exercise of its market power. The bottlers and retailers, on the other hand, were free to exercise market power. According to standard economic theory, firms exercise market power by raising price and *restricting quantity*. The Coca-Cola Company, however, unable to raise the syrup price it charged because of the contract, could only increase profits by maintaining a positive profit margin and *increasing quantity*. A reasonable surmise, then, is that the Company could increase its own profits by taking pricing power away from bottlers and retailers by trying to hold on the nickel price for as long as possible.²¹

To model such a setting, consider two monopoly firms, one representing the Coca-Cola Company and one representing its bottlers. Let the firms face cost functions of the general form, $X_{CC} = \alpha(Q_{CC})$ and $X_B = \beta(Q_B)$, where X is total costs, Q is quantity produced and α and β are only assumed increasing in their arguments and nonnegative. Subscripts CC and B represent the Coca-Cola Company and the bottlers, respectively. The inverse demand function the bottlers face is given by $P_B = f(Q_B)$. The Coca-Cola Company is constrained to sell syrup to the bottlers at a pre-contracted price, $P_{CC} = \underline{P}_{CC}$. However, the bottlers are the Company's only customer for the syrup, and therefore $Q_{CC} = Q_B$.²² We assume the bottlers sell the soft drink to consumers directly and that $f' < 0$, so that the demand curve for bottled Coca-Cola is downward sloping.

The profit functions of the Coca-Cola Company and its bottlers are,

$$\pi_{CC} = \underline{P}_{CC}Q_{CC} - \alpha(Q_{CC}), \text{ and } \pi_B = P_B Q_B - \beta(Q_B), \text{ respectively.}^{23}$$

²¹ We thank George Benston for suggesting this idea.

²² This, for simplicity, ignores value added by the bottlers. However, this could be straightforwardly included by a scalar term (a one-to-one transformation). For ease of notation, we do not include a scalar here.

²³ This ignores the retailers between bottlers and consumers, as well as the distinction between parent bottlers and the rest of the bottlers. However, the inclusion of additional firms representing retailers and parent bottlers in the present analysis would not alter the results.

While the bottlers maximize profits by choosing P_B and Q_B , the Coca-Cola Company simply makes profits $[P_{CC}Q_{CC} - \alpha(Q_{CC})]$ by producing,

$$Q_{CC} = Q_B = Q, \quad (1)$$

or zero profits by choosing not to produce if losses are inevitable. Clearly, given the pricing constraint dictated by contract, the Coca-Cola Company would prefer that the bottlers produce as much as possible. To see this, examine the Coca-Cola Company's first-order condition for profit maximization in the absence of the constraint (1):

$$\frac{\partial \pi_{CC}}{\partial Q} = P_{CC} - \frac{\partial \alpha(Q)}{\partial Q} = 0. \quad (2)$$

This condition, (2), being fulfilled over time would be pure coincidence given that (1) is a constraint. This indicates that the corner solution for the Coca-Cola Company, given that price is greater than marginal cost, is to produce an infinite amount of syrup.

Another way to examine this issue is by rewriting the Coca-Cola Company profit function in terms of the bottlers' price,

$$\pi_{CC} = P_{CC}g(P_B) - \alpha(g(P_B)), \quad (3)$$

where g is the inverse of f . From (3) it follows that,

$$\frac{\partial \pi_{CC}}{\partial P_B} = \left[P_{CC} - \frac{\partial \alpha(g(P_B))}{\partial g(P_B)} \right] \left[\frac{\partial g(P_B)}{\partial P_B} \right]. \quad (4)$$

Making the standard assumption that $g' < 0$, the effect of an increase in P_B will be negative so long as,

$$P_{CC} - \frac{\partial \alpha(g(P_B))}{\partial g(P_B)} > 0. \quad (5)$$

This condition, (5), that the price charged by the Company to bottlers is greater than its marginal cost of production is necessary and sufficient for (4) to be negative. *Operating with a positive profit margin is necessary and sufficient for the Coca-Cola Company to benefit from bottler's upward price rigidity.*

Moreover, for the bottlers' profit maximization, we have the first-order necessary condition,

$$P_B = \frac{\partial \beta(g(P_B))}{\partial g(P_B)} - \frac{g(P_B)}{\frac{\partial g(P_B)}{\partial P_B}}. \quad (6)$$

This represents a markup over marginal cost since $g' < 0$. Note that the markup is increasing in $Q = g(P_B)$. The intuition behind (4) being negative can now be stated clearly. Assume that demand is an increasing function of time such that,

$$g(P_B, t) = Q, \quad (7)$$

and

$$\frac{\partial g(P_B, t)}{\partial t} > 0, \quad (8)$$

where t indicates the time period. This formulation allows us to capture in a simple way the fact that there was almost a continuous increase in the demand for Coca-Cola throughout the period covered in this study. Then, as demand increases over time, the bottlers want to absorb the increases through increases in both quantity *and* price, i.e. they want to exploit the market power towards maximum profits.

However, because the Coca-Cola Company cannot adjust the price, it only increases its profits through quantity increases as consumer demand grows. It is in the Coca-Cola Company's best interest, therefore, to prevent the bottlers from using the price margin to accommodate the increased demand. Instead, its best strategy is to satisfy the increased demand entirely by quantity increase.

This scenario is displayed graphically in Figure 4 where constant marginal cost (MC) and no fixed costs are assumed to simplify the graph. Subscripts “ A ” and “ NA ” denote values when

the bottlers adjust and do not adjust prices, respectively.

Insert Figure 4 about here

Figure 4 depicts a demand increase from period t to $t+1$. Note that in period t the Coca-Cola Company makes profits X . After the increase in demand, period t profits are $X+Y$ for the Company if the bottlers set price to maximize profits. However, if the Coca-Cola Company can influence the bottlers to maintain their original price to consumers, then profits for the Company will be $X+Y+Z$. In this case, clearly, it is worthwhile for the Coca-Cola Company to incur any cost less than Z to keep the retail price unchanged.

Substituting (7) into (3) yields

$$\pi_{CC} = P_{CC}g(P_B, t) - \alpha(g(P_B, t)), \quad (3)'$$

with

$$\frac{\partial \pi_{CC}}{\partial t} = \left[P_{CC} - \frac{\partial \alpha(g(P_B, t))}{\partial g(P_B, t)} \right] \left[\frac{\partial g(P_B, t)}{\partial t} \right] > 0. \quad (9)$$

Profits will increase for the Coca-Cola Company over time as demand increases but,

$$\frac{\partial^2 \pi_{CC}}{\partial t \partial P_B} = \left[P_{CC} - \frac{\partial \alpha(g(P_B, t))}{\partial g(P_B, t)} \right] \left[\frac{\partial^2 g(P_B, t)}{\partial t \partial P_B} \right] < 0. \quad (10)$$

The signing above assumes that the last term on the right hand side of the equation in (10) is negative (the rate of increase in consumer quantity demanded over time is less if P_B is rising).²⁴

²⁴ In deriving (10), we assumed constant marginal cost for expository simplicity, as in Figure 4. However, if that assumption is dropped, then (10) will include the additional right-hand-side term,

$-\left[\frac{\partial^2 \alpha(g(P_B, t))}{\partial g(P_B, t)^2} \right] \left[\frac{\partial g(P_B, t)}{\partial t} \right] \left[\frac{\partial g(P_B, t)}{\partial P_B} \right]$. This can be rewritten as $-\left[\frac{\partial^2 \alpha(g(P_B, t))}{\partial g(P_B, t)^2} \right] \left[\frac{\partial^2 g(P_B, t)}{\partial t \partial P_B} \right]$, and the general condition for (10) to be negative is $\left[P_{CC} - \frac{\partial \alpha(g(P_B, t))}{\partial g(P_B, t)} - \frac{\partial^2 \alpha(g(P_B, t))}{\partial g(P_B, t)^2} \left[\frac{\partial g(P_B, t)}{\partial t} \right] \left[\frac{\partial g(P_B, t)}{\partial P_B} \right] \right] > 0$. The third term on the left-hand-side

The assumption is plausible and implies, then, that the profit gains over time for the Coca-Cola Company are smaller when bottlers are raising price.

Perhaps a more meaningful way to interpret (10) is to rewrite the second derivative term,

$$\frac{\partial^2 g(P_B, t)}{\partial t \partial P_B}$$

as

$$\frac{\partial^2 g(P_B, t)}{\partial P_B \partial t}. \quad (11)$$

If negative, (11) signifies that demand is becoming less elastic over time. Then, referring back to (10), the interpretation is that *as Coca-Cola becomes more differentiated from other products by consumers over time, the Coca-Cola Company stands to lose an increasing amount of profit from bottler price increases*. In this way, the Coca-Cola Company's incentive to prevent bottler price adjustment would increase as the product became more popular and distinct to consumers.

While this simple model does a nice job at explaining the Coca-Cola price rigidity in the face of steadily increasing demand, it cannot express the sole important reason underlying the rigidity. For one thing, the model has no explanatory power for downward price rigidity. Consider consumer demand that does not increase steadily but rather is subject to shocks that, though on average positive, can possibly be negative:

$$g(P_B, \varepsilon) = Q, \quad (7)'$$

with

$$\frac{\partial g(P_B, \varepsilon)}{\partial \varepsilon} > 0, \quad (8)'$$

where ε is distributed $N(\mu, \sigma^2)$.

Bottlers will want to decrease the price when negative demand shocks occur. Taking the derivative of (6) with respect to ε after incorporating (7)' and (8)' yields

of this condition is a second-order property, and therefore, the condition only requires that the Coca-Cola profit markup be slightly larger than zero.

$$\frac{\partial P_B}{\partial \varepsilon} = - \frac{\frac{\partial g(P_B, \varepsilon)}{\partial \varepsilon}}{\frac{\partial g(P_B, \varepsilon)}{\partial P_B}} > 0. \quad (12)$$

From the Coca-Cola Company's point of view, [recalling (4)], such a price decrease is a good thing. Given that the price was indeed rigid, the syrup quantity decreases of 1931, 1932 and 1933 (see Table 1) suggest that the Great Depression was a persistent negative shock to consumer demand.²⁵

Also, again recall the optimal pricing policy for the bottlers, (6). Optimal price for the Bottlers is positively related to marginal cost. Therefore arguments similar to those above can demonstrate that the model has explanatory power for the case of nominal costs increasing over time due to inflation, but does not have explanatory power in the cases of negative cost shocks.

But perhaps more importantly, the fixed syrup price contract was amended in 1921, allowing the Coca-Cola Company to adjust the syrup price according to the increase in the sugar price. The contract, therefore, explains the Company's motive to keep the nickel price fixed only up to 1921.

4. VENDING MACHINES AND MONETARY TRANSACTION TECHNOLOGY CONSTRAINT

To study the Coca-Cola price rigidity during the later period, we focus on two potentially important sources of price rigidity, both technology related. These factors, we argue, were particularly important in the late 1940s and early 1950s when inflation concerns may have prompted an otherwise-faster abandonment of the nickel standard. The first concerns the large installed base of nickel-only Coca-Cola vending machines and technological constraints on multiple coin/change-making capabilities. The second concerns a transaction cost that abandonment of the single-coin-nickel-price would impose on consumers, and the lack of a transaction technology to alleviate this cost.

4.1 *Vending Machines: Nickel Only*

In 1936–37 the Company introduced coin-operated coolers, the earliest introduction of Coca-Cola soft drink vending machines with lasting effects.²⁶ Red Coca-Cola coolers (manufactured by the Cavalier Co. and the Westinghouse Co. and introduced in 1935), filled with ice and 6.5oz bottles were already common at grocery stores (Marshall, 1954, pp. 8–9). In 1936 the Vendo Co. was formed for the express purpose of marketing coin-operated vending tops for the coolers (Schreiber, 1961, p. 42). The Vendolator Co. did likewise (Marshall, 1954, p. 9). By 1937, 8,000 coin-operated Coca-Cola coolers could be found in public areas.²⁷ By 1945, “Coca-Cola bottlers had blanketed the nation with machines selling soft drinks in bottles. The familiar red cooler was firmly planted in crossroads general stores, gasoline stations and big industrial plants” (Schreiber, 1954, p. 15).

During the 1930s and 1940s the soft drink industry adopted vending machine technology on a large scale. By 1950 soft drink machines accounted for 24.6 percent of vending machine sales—18.3 percent bottle and 6.3 percent cup (Marshall, 1954, p. 105). In 1950, vending machines accounted for approximately 18 percent of soft drink sales (Marshall, 1954, p. 15). By 1953 that number had increased to approximately 25 percent (Schreiber, 1954, p. 13). This adoption was disproportionately affected by the Coca-Cola Company: by 1950 there were about 400,000 Coca-Cola vending machines (Marshall, 1954, p. 9). The soft drink industry, as a whole, operated approximately 460,000 machines at that time (Schreiber, 1954, p. 14). Thus, while the Company represented about 50 percent of soft drink production, it accounted for about 87 percent of the industry’s bottle vending machines. In fact, with the exception of Coca-Cola, “no large company pioneered in the field of vending until after World War II” (Marshall, 1954, p. 10). Because vending machines accounted for about 25 percent of soft drink sales, and Coca-Cola disproportionately utilized vending machines, it is likely that considerably more than 25 percent of Coca-Cola sales were accounted for by vending machines by 1950.

In 1950, most of the Coca-Cola’s 400,000 vending machines were capable of accepting a

²⁵ With the caveat that Pepsi was not a perfect substitute for Coca-Cola, it is still interesting to note that Pepsi competed against Coca-Cola with a 12oz bottle for a nickel: an effective price 50 percent that of Coca-Cola’s.

²⁶ The first Coca-Cola vending machine was actually marketed in 1909, but the concept did not catch on. Source: *The Coca-Cola Bottler* (May, 1909, p. 6).

²⁷ “Merchandising Magic,” *Coca-Cola Bottler*, April 1959, pp. 134–136.

nickel only. Exactly what percent was nickel only is hard to say. However, the earliest evidence we found of a Coca-Cola vending machine capable of accepting multiple coins and making change was an ad in the April 1946 edition of *The Coca-Cola Bottler* (p. 49) for a Mills Industries' vending machine with a "built-in change maker [that] operates with nickels, dimes, or quarters." At that time, the majority of vending machine advertisements still did not mention such features. It is likely, therefore, that a considerable majority of the 400,000 machines were nickel-only machines in 1950.

We have a good idea on the purchase price of these machines. A September 1947 ad from *The Coca-Cola Bottler* (pp. 14–15) lists F.L. Jacobs Co. 143-bottle and 67-bottle capacity models for \$272.00 and \$161.50, respectively. Another ad from *The Coca-Cola Bottler* in November 1947 (p. 72) for a Vendolator Co. 242-bottle model lists the price at \$385.00. Concerning older models, we have used machine prices. In "The Trading Post" section of the February 1944 issue of *The Coca-Cola Bottler* (p. 47), a cooler with Vendo top that accepts nickels was being offered for \$85.00. The April 1944 issue (p. 35) listed used Vendo machines for \$125.00–\$150.00. And the July 1944 issue (p. 36) listed used Mills machines at \$150. These figures represent a real price range of \$714.29 to \$2,251.46 in 1992 prices, which imply that the value of the existing 400,000 machines was between \$286 million –\$900 million in 1992 prices, which seems substantial.

Thus, if the majority of the machines were nickel-only, then considerable value would be made obsolete by a change in the nickel price.²⁸ This suggests that the limitations of the existing vending machine technology were a barrier to Coca-Cola price adjustment and thus, an important

²⁸ A technology was available as early as in 1946, for updating existing vending machines with multiple coin acceptance and change making abilities. However, the Coca-Cola Company considered their penny handling mechanisms unreliable. Indeed, an internal 1951 Company memo stated that vending machines with penny mechanisms "...reduce sales as compared to single-coin operation,... create heavy and permanently continuing expense in the form of additional service calls,...they are nuisance to outlets and to our consumers as the necessary change is less frequently available in the pocket of the consumer,... they create expense for all concerned in counting and handling such a large volume of pennies,...they do not work as well as single coin mechanisms... cause loss of consumer confidence in coin coolers," and ultimately they "reduce sales as compared to single-coin operation" (Source: "Single Coin Plan," by Eugene Kelly, dated September 21, 1951, The Coca-Cola Company Archives). Schreiber (1954, p. 50) states that, "*Since 1950*, the trend has been to incorporate change making [sic] features ... " (our emphasis). The four-year period until the wide scale adoption might have been a time when the technology was highly imperfect. This would help explain the lack of advertised Coca-Cola vending machines with change-making features. Also, the 1950 start date for the trend would coincide with the beginning of the nickel Coke's demise. Finally, we cannot rule out the possibility that the net present value of multiple coin/change-making adaptors, net of

source of price rigidity. A likely broad importance of this conclusion is underscored by the observation made by Marshall (1954, p. 53) that, prior to multiple coin and change making technology, “most operators [of vending machines] sold goods with well-established ‘popular’ retail prices.”

The conclusion that vending machine technology may have been a source of price rigidity is consistent with the findings reported recently by Bills and Klenow (2002), who study the frequency of price changes for 350 categories of consumer goods and services during the 1995–1997 period. Ranking the prices in the 350 categories from the most rigid to the most flexible, they find that the category of “Coin-Operated Apparel Laundry and Dry-cleaning” ranks *first as having the most rigid prices* with 79.9 month mean duration between price changes. The category of “Coin-Operated Household Laundry and Dry-cleaning” ranks 4th, with 46.4 month mean duration between price changes. Two other categories that rely on the use of coins or coin-operated devices in their transaction, “Intra-city Mass Transit,” and “Vehicle Tolls,” also rank in the top 10, with 40.2 (ranked 5th) and 31.2 (ranked 8th) month mean duration between price changes, respectively.²⁹ Thus, even during modern times, vending machines and other coin-operating devices seem to be forming barriers to price changes of the goods and services sold through them.

4.2 *Monetary Transaction Technology Constraint and Coca-Cola Price Rigidity*

Having proposed the costs associated with single-coin vending machine technology as a source of price rigidity, we now propose a source of price rigidity also associated with a single coin but associated with a different technology. This technology concerns consumer convenience and, interestingly, can be considered a single coin in and of itself – a *monetary transaction technology*.

The Coca-Cola Company viewed the consumers’ ability to purchase Coca-Cola with a single coin as critically important. For example, the Company was concerned about the

purchasing price, may have been negative. According to the “Single Coin Plan,” “It will cost over \$200,000.00 to equip the coin coolers used by one concern in a certain very large city;” vague, but suggestive.

²⁹ Another example of price rigidity that is related to the use of a coin-operating mechanism is the 10¢ pay phone. According to a recent CNN report (www.cnn.com/US/9710/11/briefs/dime.calls/index.html), the pay phone rate in Arkansas, Vermont, Massachusetts, and New Hampshire was 10¢ from 1953 to 1997.

possibility of a drop in sales if a shortage of nickels was to develop.³⁰ Some evidence suggests this concern was legitimate. As reported by January 1951 issue of the *Fortune* magazine, the soft drink business really spurted in 1930s after President Franklin D. Roosevelt made more nickels available to the public.³¹ This increase in the supply of nickels was due to the 1933 shift of the U.S. from the gold standard to fiat currency.³²

The ability to purchase a bottle of Coca-Cola with a single coin has reduced the “transaction cost” or the “inconvenience cost” a consumer had to incur in buying a Coke to a minimum. Doubling the price of Coca-Cola from a nickel to a dime, i.e. 100 percent increase, was out of question.³³ However, a less than 100 percent increase in the price would require the public to use anywhere between 2 to 5 coins to buy a Coke, which could lead to “logistic nightmare” (Allen, 1994, p. 301).³⁴ Woodruff considered this single coin issue a matter of such significance that he began exploring the possibility of having the minting of a new 7 1/2-cent coin authorized by the U.S. Treasury Department. According to Kahn (1969) and Allen (1994), Woodruff submitted a request in 1953 to the newly elected President Dwight Eisenhower (his hunting companion and friend) himself, to get the U.S. Department of Treasury mint a new 7 1/2-

³⁰ The importance of coins’ availability for vending machine operators is relevant in modern times also. For example, according to Dean Croushore of the Federal Reserve Bank of Philadelphia (personal correspondence), flows of net pay (“net pay” measures change in coin demand) depend on things like the use of vending machines. Moreover, whenever there is any discussion about changing the types of coins in use, the people involved (at the Fed and at the Mint) always discuss those changes with vending machine producers and users. The new Sacagawea gold dollar is exactly the same size as the Susan B. Anthony dollar, so that vending machines that were configured for the Susan B. would not need to be changed to accommodate the new golden dollar. See also Croushore and Stark (2002).

³¹ According to Riley (p. 343), annual production of soft drink industry decreased in 1934 by 2.9 percent, but increased by 17.1 percent in 1935 and by 48.9 percent in 1936. Correspondingly, the total annual gallon sales increase of Coca-Cola syrup has jumped from 14.5 percent in 1935 to 26.3 percent in 1936, and then to 18.2 percent in 1937.

³² According to Will Roberds of the Federal Reserve Bank of Atlanta (personal correspondence), during the gold standard period up to 1933, the U.S. Treasury policy was to keep the “official price” of small change below the “market price” (i.e., the commodity value of the metal in coins was less than the denomination of the coins), and therefore to “ration” the issue of small-denomination coins. The switch to fiat standard in 1933 made the rationing of small change unnecessary. Consequently, there was an increase in the supply of small denomination coins, including nickels.

³³ According to Allen (1994, p. 301) and the January 1951 *Fortune* magazine, Woodruff was terrified from the possibility of a dramatic sales drop if the price was doubled: consumers may be willing to pay 10 cents for a 12oz Pepsi but not for 6.5oz bottle of Coca-Cola. (Note: by 1951, Pepsi has doubled its price for a 12oz bottle from nickel to dime.)

³⁴ Recently, it has been reported that in many European Union Countries that have adopted the Euro, the public (buyers as well as sellers) seems to exhibit resistance to the use of 1-cent and 2-cent denomination coins because of the inconvenience their use entails: “They’re small, nearly valueless—and a nuisance to millions of Europeans. The tiny denomination 1- and 2-cent Euro coins are annoying shoppers and disrupting business from Paris to Milan” Eric

cent coin. Eisenhower forwarded the request to the Treasury Department officials who did not like the idea. A handwritten note made by Robert W. Woodruff on his letter dated October 22, 1951 and addressed to Ralph Hayes (Robert W. Woodruff Papers, Special Collections, Emory University Library), suggests that Woodruff also contemplated a 3-cent coin. This would “enable” the Company to increase the price of Coke to 6¢, so that with vending machines, and otherwise, the public would only need to use two coins of a single denomination.

Consistent with our interpretation is also the development of an ingenious plan called the “Single Coin Plan,” by the Coca-Cola Company’s pricing team. Under the plan, the vending machines’ customers would pay a higher price (for example, 5.625 cents, or 6 cents, or 7 cents, etc), but still use only nickels. The plan, worked as follows:

“Instead of offering one ‘Coke’ for 6¢ the coin cooler offers 8 ‘Cokes’ for 45¢, which is only 5.625¢ (5 5/8¢) per bottle. [The] coin cooler [delivers] either an empty bottle or no bottle at all for one nickel in every nine deposited. This absence of ‘Coke’ is called an official blank. Please be warned that, if you fail to deposit nine nickels, at worst you will strike the blank and have to deposit another nickel for your ‘Coke.’ At best you will miss the blank (8 times out of 9) and your ‘Coke’ will cost only a nickel, but as stated, on the average ‘Coke’ sells for 5.625¢ per bottle—the only price at which it is offered” (Kelly, Eugene: “Single Coin Plan,” September 21, 1951, Coca-Cola Company Archives).³⁵

Because of concerns about penny mechanisms reliability, the above argument is compatible with the vending machine installed base story of section V. However, reasons (1) and (4) from Kelly’s memo above suggest that an additional concern was related to the fact that any increase in the price of Coke that was less than 100 percent would require the public to handle multiple coins in order to purchase a Coke—a *constraint of the monetary transaction technology*.

Pfanner, “Euro quandary: It’s no small change,” *International Herald Tribune*, Tel-Aviv Edition, Friday, March 22, 2002, p. 1. See also Chen, et al. (2002), and Bergen, et al. (2003).

³⁵ According to Eugene Kelly (September 28, 1951, Toronto, Ontario, signed telephone conversation transcript, Coca-Cola Company Archive), the single coin plan was experimentally used in Canada, and perhaps also in Chicago. However, we do not know for how long. Given the fact that the plan was designed to set the *average* price, it is not surprising that it was eventually abandoned.

Thus, this monetary transaction technology constraint, that is, the inability to increase the Coca-Cola price while the consumer is still using a single coin so that the consumer's "inconvenience costs" is minimized, helps explain, at least partially, the Coca-Cola price rigidity we have documented here, especially in the later periods, during late 1940s and early 1950s.³⁶ This source of price rigidity may have interacted with the previous nickel-only vending machine barrier to price adjustment. The Company's "Single Coin Plan" listed eight important objections to vending machines accepting pennies. Of these eight, two are directly related to single-coin consumer convenience: (1) "They are a nuisance to the outlets and to our consumers as the necessary change is less frequently available in the pocket of the consumer"; and (2) "They create expense for all concerned in counting and handling such a large volume of pennies."³⁷ Between the vending machine and monetary transaction technologies, abandonment of the nickel price during the rising inflation of the 1940s and 1950s may have been postponed significantly.

4.3 *The Nature and the Magnitude of Price Adjustment Costs*

There is an important difference between the nature of the costs we have identified as barrier to the Coca-Cola price adjustment and the costs usually considered in the theoretical cost of price adjustment literature. The theoretical "menu cost" literature typically considers these costs as a small fixed cost that must be incurred by the price setter each time a price is changed. This cost may be independent of the size of price change, as in Mankiw (1985), for example, or it may be convex so that larger price changes are more costly, as in Rotemberg (1982) or Cecchetti (1986), for example.

The two price adjustment costs we have identified are quite different from these menu costs. The cost of replacing the old single-coin vending machines with newer, multiple-coin operating machines would have to be *incurred only once*. Thereafter, the company could easily change the price by a simple programming of the coin-changing mechanism at almost zero

³⁶ Consistent with the idea of single coin convenience is the fact that Coca-Cola was selling for a nickel in Canadian markets also, from the beginning of its introduction in 1906, till at least early 1950s. (The pricing schemes adopted in other countries were different, however, varying from country to country.) Consistent with our interpretation is also one South Carolina bottler's creative, but unsuccessful attempt to increase its Coke price to 8¢ while keeping the "consumer inconvenience cost" to a minimum: he taped two pennies to the bottom of his bottles and tried to sell them for a dime each. According to Allen (1994, p. 301), the experiment fizzled miserably.

³⁷ The second of these objections also implies a retailer inconvenience cost in terms of having to physically handle more coins than would be the case when purchases were made using a single coin.

marginal cost. Therefore, the cost of replacing these vending machines would provide the Company with the ability to adjust prices to their optimal level more flexibly. This *fixed* cost, thus, can be thought of as the *cost of “acquiring the ability to adjust prices”* (Zbaracki, et al., 2004).

The customer inconvenience cost that would result from increasing the Coke’s price by less than 100 percent would necessitate the use of more coins (i.e., pennies) in purchasing Coca-Cola. The cost, however, would be incurred by *both, the buyers and the sellers*. Moreover, this cost would be incurred *for each unit purchased* (as long as the transaction did not involve other goods/services, which is the case when purchasing from a vending machine). Therefore, this price adjustment cost has a *variable* component, and captures *customer costs of price adjustment*, which is related to what Blinder, et al. (1998) and Rotemberg (2002, 2003) call “cost of antagonizing customers.”

Finally, we can offer an estimate of one component of the price adjustment cost, by computing the cost of replacing the old, nickel-only vending machines, with multiple coin-capable vending machines. According to Marshall (1954, Appendix A), General Vending Co. was in 1950 offering two models, with capacities 90 and 45 bottles, at the price of \$259.00 and \$189.00, respectively, that accepted 5 cents, 10 cents, and 6 cents. With this price range, the cost of replacing all 400,000 Coca-Cola vending machines would be between \$ 413.1 million to \$566.1 million in 1992 prices. As a proportion of the Company’s revenue, that would comprise between 30.65 percent and 42.00 percent, which seems prohibitively expensive.³⁸ We should

³⁸ The recent transition of the European countries to the Euro provides today’s perspective on the problem the Coca-Cola Company was facing during the 1940s and 50s. According to reports, the European vending machine industry had to replace 2.2 million food and drink vending machines at a cost equaling more than 10 percent of the industry’s annual turnover. A recent *CNN* report suggests the number of the vending machines to be even higher, 3.5 million (<http://europe.cnn.com/SPECIALS/2001/euro/stories/euro.costs/>). In Europe there are also about 6–7 million machines covering transport tickets, car parks, cigarette, and gaming machines (<http://www.guardian.co.uk/euro/story/0,11306,626411,00.html>). While we do not know the total turnover of the entire industry, a certain Belgian vending machine operator (a Belgian subsidiary of the Dutch company Maas International) with 3,000 machines and annual turnover of \$7.3 million, paid \$800,000.00 for the necessary labor and hardware. And this does not include the management’s time, which spent the last 2 1/2 years preparing for this transition. Interpolating this turnover-to-machines ratio to the entire industry we estimate that the industry-wide turnover of the European vending machines operators is over \$5,353,000,000.00, which implies a replacement cost of over \$535 million (Source: “Currency Switch Kicking In: Vending Machines Likely to Frustrate Buyers,” by Jeffrey Ulbrich, *The Morning News*, September 2, 2001, p. 5D). According to the *Wired* magazine, the Y2K-style refit of the 2.2 million vending machines costs in the range of \$240.00–\$445.00 per unit, to accommodate the new currency. This amounts to a total of \$528–\$979 million (http://www.wired.com/wired/archive/10.01/mustread_pr.html). The report in *Time* magazine suggests that the

note that these cost estimates are not directly comparable with the existing price adjustment cost estimates, which range between 0.70 percent and 4.00 percent of revenues (Levy, et al., 1997, 1998; Slade, 1998; Dutta, et al, 1999; Konieczny and Skrzypacz, 2003; Willis, 1999, 2003; and Zbaracki, et al., 2004). This is because the latter cost estimates measure a one-time, *marginal* adjustment cost (either, the menu cost, the managerial cost, or the customer cost). In the case of Coca-Cola, however, the price adjustment cost figures measure the *fixed* cost of obtaining the ability to adjust the price at zero marginal cost.

5. ASSESSING THE RELEVANCE OF THE EXISTING PRICE RIGIDITY THEORIES³⁹

We first considered all twelve theories studied by Blinder, et al. (1998), but we ruled out ten of them as inconsistent with the Coca-Cola price rigidity. Below we discuss the two remaining theories, followed by a discussion of the role of markups, quality and market share in the cola market.

5.1 *Psychological Price Points*

This theory, proposed by Kashyap (1995), predicts that some nominal prices, such as prices ending with \$.99, have a psychological effect on consumers, and sellers will be reluctant to increase their price above the price point for the fear that the resulting decrease in volume will make the price increase unprofitable. Only if the change in market conditions (e.g. costs) is large enough will sellers adjust the price upward to cross the price point. The theory predicts that buyers will be particularly sensitive to price changes near the pricing points. The difficulty with this theory in the case of nickel Coke is that we only have one price, 5 cents, a single observation, and therefore, it is not clear how the theory can be assessed based on that. It also is not obvious that the 5-cent price constitutes a price point in the psychological sense, as proposed by Kashyap. Also, when the Coca-Cola nickel price policy was finally abandoned by the Company, Coke was

replacement of older models of vending machines may cost as much as 750 Euros per unit (<http://www.time.com/time/europe/eu/magazine/0,13716,191131-2,00.html>).

³⁹ In writing this section, we took Blinder, et al.'s (1998) list of 12 price rigidity theories as comprehensive, although some of these theories are more applicable to aggregate price rigidity than individual product level price rigidity.

selling for 6¢, 7¢, 10¢, etc, depending on the area (*Business Week*, 1955, p. 44), rather than uniformly moving to the next price point, which in this case perhaps was 10¢. It is possible that price point psychology was behind the Coca-Cola nickel price strategy for some period. It would be difficult, however, to argue that it caused the 70-year long price rigidity during a period of almost continuous increase in nominal costs. Thus, we are unable to rule in, nor rule out the theory of psychological price points.

5.2 *Productivity Growth: The Most Popular Non-Explanation*

During our research and its presentations, the most common potential explanation offered by fellow economists for the constant nominal price of Coca-Cola was productivity growth.⁴⁰ What if, during this period, the Company was experiencing productivity gains that made price adjustment unnecessary despite the aggregate price increase? If the production technology was evolving quickly relative to the rest of the economy, then perhaps the real marginal cost of production was falling fast enough to make a constant nominal price consistent with real price equaling real marginal costs.

It is true that numerous impressive technical innovations took place in the carbonated beverage industry during the 1886–1959 period, which would be indicative of productivity improvements in the production of Coca-Cola. For example, power-operated fillers and crowners were developed. Chain-type bottle conveyors were developed automating the handling of bottles from washers to fillers. Carbonating processes were also improved by adopting “pre-mix carbonating” methods. There were innovations in intra-plant transportation of materials and produce, such as powered platform lift trucks and electric forklift trucks. Automatic casers, and mechanical mixers, case un-packers, and reliable bottle inspection and cleaning devices and methods were also developed.

However, the above is silent as to whether the technologies in the soft-drink industry were progressing quickly enough relative to the rest of technologies economy-wide. Could Coca-Cola productivity have been growing *relative* to the general economy-wide productivity fast

⁴⁰ The initial suggestion of productivity growth, prompting us to address the issue, came from Steve Cecchetti in his comments as the discussant of this paper at the January 2001 American Economic Association Meetings in New Orleans. Some discussion in this section, therefore, draws heavily from those comments.

enough to justify the constant nominal price of the Coke?⁴¹ Measures of Coca-Cola productivity are difficult to obtain. However, it is reasonable to assume that, over the long time period, technology transferred freely enough to make the soft-drink industry in general indicative of the specific Coca-Cola case. Under this assumption, data from the U.S. *Census of Manufacturers* (1963, Table 1, p. 20G-6) suggest that this hypothesis is incorrect. For Industry SIC Code 2086, Bottled and Canned Soft-Drinks, nominal labor productivity, calculated as “Value of Shipments” divided by “Total Number of Employees,” was 2.27 in 1899 and 10.42 in 1951. Using the GDP deflator (base 1992) as reported by Gordon (2000, Appendix A-1), this amounts to real labor productivity of 42.83 in 1899 and 53.16 in 1951: an increase of *about 24 percent* over the first half of the 20th century. Compare the above to the increase of real labor productivity of *190 percent* over the same time period for the U.S. as a whole.⁴²

Also, the “Value of Shipments” to “Cost of Materials” ratio (*Census of Manufacturers*, 1963, Table 1, p. 20G-6) was 2.72 in 1899 and 2.38 in 1951: a 12 percent *decrease*. Unfortunately the *Census of Manufacturers* does not have data on capital stocks but Riley (1957, Statistical Table 3) reports that “Value of Production per Plant” to “Capital per Plant” ratio was 1.18 in 1990 and 0.94 in 1950. For the purpose of discussing a 50-year time period, the one-year shift does not seem unreasonable. Over that period the ratio experiences a 21 percent *decrease*. Given the decreases in these ratios, and the small growth rate of industry labor productivity reported above, we believe that a high growth rate of Coca-Cola productivity relative to the general economy is an implausible explanation of the price rigidity.

As an additional analysis of this idea, consider the following thought experiment. Suppose that the only option the company had was to double the price from 5¢ to 10¢, a 100 percent increase, as the company in the end concluded. How many years would it take in that case for the real price of Coke to be 1/2 of its 1886 value? According to Figure 5 (solid line), that would happen during 1919–1929 and then from 1942 and on. That is, in such circumstances a

⁴¹ We should note that productivity growth in absolute terms (i.e., not relative to general economy), as an explanation for the Coca-Cola price rigidity is inconsistent with the observation made by Figure 1 that the prices of all other foodstuff have been increasing. This is because it would mean that there were no productivity gains in the production of these food items. However, if there were productivity gains in production of Coca-Cola, then ruling out similar improvements in production of other foodstuff (which also includes milk and coffee) would be difficult to defend, especially for a 70+ year period.

⁴² According to Gordon (2000, Appendix A-1), the real labor productivity in the US was 15.6 in 1899 and 45.3 in 1950.

nominal price doubling would have to take place at least *17 years (and perhaps even 40 years) before* its actual occurrence.

Insert Figure 5 about here

What about number of years it would take for the real price to drop to 3.33¢, i.e., to 67 percent of its 1886 value, which would justify a nominal price increase to 7 1/2¢ (corresponding to issuing a 7 1/2-cent coin plan)? According to Figure 5, the Coke's nominal price would have to be increased to 7 1/2¢ in 1917, *36 years before* Robert W. Woodruff actually submitted the request to President Dwight Eisenhower. Finally, what about the number of years it would take for the real price to drop to 4.17¢, i.e., to about 83 percent of its 1886 value, which would justify a nominal price increase to 6¢? According to Figure 5, the Coke price would have to be increased to 6¢ *in 1915*.

These calculations, however, are based on the *actual* productivity growth that occurred during this period. As a thought experiment, let us ask: what must have been the Coca-Cola productivity growth rate *relative* to the aggregate economy-wide productivity, for the real price to reach 1/2 of its 1886 value in 1959 (the year the Coca-Cola price was finally doubled)? We calculated and found that this would require average annual growth rate of 0.97 percent (averaged over 73 years). On Figure 5 we plot the real price of Coke under this hypothetical situation. According to the figure, under such circumstances the real price of Coke would reach 3.33¢, 67 percent of its 1886 value, briefly during 1919–1920 and from 1947 and on, about 6 years before Woodruff's actual attempt to have 7 1/2-cent coins issued. Similarly, the real price of Coke would reach 4.17 cents (necessitating a nominal price increase to 6¢) in 1917, and 2 1/2¢ (necessitating a nominal price increase to 10 cents) in 1959.

How do the actual Coca-Cola productivity growth figures compare with this hypothetical situation? The required average annual growth rate of 0.97 percent implies a cumulative productivity growth of about 71 percent. As discussed above, however, the real labor productivity growth during the 1899–1951 period was about 24 percent, which if interpolated for the entire 73-year period, would mean a cumulative productivity growth of about 34 percent, less than half of the required total productivity growth. The conclusion is that, the Coca-Cola

productivity growth was insufficient to justify holding the nominal price of the Coke constant during the entire 73-year period.

5.3 *Coca-Cola versus Pepsi: Markup, Quality, and Market Share*

An important question, in light of the discussion in the previous section, therefore, is: how was the Coca-Cola Company able to hold on the 5¢ price for such a long period of time, especially during the WW I and post-WW II inflations, and still remain so profitable?

A possible answer to this question is that the markup on Coca-Cola was very high during the early stages, which allowed the company to remain sufficiently profitable during the later periods despite the erosion in the markup brought by the post-WW II inflation.⁴³ This possibility is supported by the fact that beginning in 1934, Pepsi was selling 12oz bottle cola for a nickel. If the costs of producing Pepsi and Coca-Cola were similar, and if Pepsi could offer twice as much as Coke for the same price, then it follows that the markup on Coca-Cola must have been higher.⁴⁴

According to Pendergrast (1993, pp. 64–65) and the Coca-Cola Company's 1895 Annual Report, in 1895 the Company produced 76,244 gallons of Coca-Cola syrup. The cost of production that year included the cost of ingredients in the amount of \$44,247.00 (58¢/gallon), the cost of advertising in the amount of \$17,744.00 (23.3¢/gallon), and other expenses including salaries in the amount of \$12,054.00 (15.8¢/gallon). The total average cost of producing a gallon of syrup (which, when used in right proportion, yields 128 6.5oz servings), therefore, was 97¢/gallon (0.76¢ per 6.5 oz serving drink).

Now, as Pendergrast (1993, p. 65) speculates, if the Company sold the drink directly to the final customers at 5¢/serving, then the markup would be huge because a gallon of syrup yielded \$6.40 in revenues (128 servings at \$0.05 each), and using 97¢ as an estimate of marginal cost, that would yield a markup of $6.40/0.97=6.60$. However, the company chose “to spread the profits among distributors and fountain owners, who would sell for the company. In each

⁴³ We thank Anil Kashyap and Julio Rotemberg for suggesting this idea.

⁴⁴ Indeed, according to Tedlow (1990), “The leader [Coca-Cola Company] was so profitable—its price umbrellas was so high—that a competitor could afford to sell twice as much cola for the same price and still make a considerable profit.”

territory, it sought out jobbers (usually candy or drug wholesalers) with whom it could set up a long-term, trusting relationship.”

Instead, therefore, the Company sold the syrup to the jobbers for a mere \$1.29/gallon, yielding a markup of $1.29/0.97=1.33$.⁴⁵ The jobbers, in turn, sold the syrup to retailers for \$2.00/gallon, at a markup of $2.00/1.29=1.55$. Finally, the retailers sold the drink made from gallon syrup for \$6.40, at a markup of $6.40/2.00=3.20$.⁴⁶ Thus, it appears that the retail price was several times higher than the production cost. These “excess profits,” however, have been deliberately spread by the Company among the channel members.⁴⁷ From 1923 onward, however, the Company began buying back its bottlers and by 1940, it had purchased 25 bottlers and all the parent bottlers save for the Thomas Company (Pendergrast, p. 186), giving the Company higher markups by eliminating some of the middlemen, and thus enabling it to remain profitable.

From 1940 and on, however, cost pressures began building up, as indicated by Figure 2. The jobbers’, the distributors’, and the retailers’ costs began increasing because of the increase in the cost of labor, transportation, rents, etc. This, despite the fact that the Coca-Cola Company kept its wholesale price of syrup unchanged. Given the rigid retail price of 5¢, this led to substantial decrease in the distributors’ and retailers’ markup on Coca-Cola.

We have similar data for Pepsi for 1933. According to Tedlow (1990), Pepsi was selling a 24-bottle case to jobbers for \$0.50 (2.08¢/bottle). The jobbers charged the retailers \$0.75/case (3.1¢/bottle), yielding a markup of $3.1/2.08=1.49$. At the retail price of 5¢/bottle, the retailer’s markup, therefore, was $5.0/3.1=1.61$. Thus, comparing Pepsi to Coke, we find that the jobbers’ markup was of the same order of magnitude, but the retailer markup on Coca-Cola was twice as much as on Pepsi, 3.20 versus 1.61.⁴⁸

⁴⁵ According to Allen (1994, p. 72), the Company charged the jobbers \$1.50/gallon, which would mean a markup of 1.55.

⁴⁶ The Coca-Cola retail markup in Canada was of a similar order of magnitude. With the 5¢ retail price of Coca-Cola, and syrup cost of \$2.55 to Canadian fountain operators, the markup was $6.40/2.55=2.51$ (Source: Profit on Fountain Products, Canada, 1938, p. 7, Coca-Cola Company Archives).

⁴⁷ Still, the Company’s relatively small profit margin translated into huge influxes of cash as the sales rose steadily.

⁴⁸ Because we do not know the cost of producing Pepsi syrup, we cannot estimate Pepsi’s direct markup on syrup. We do know, however, that in 1933 Pepsi was selling gallon syrup for \$1.00. In contrast, by 1933, the Coca-Cola Company’s selling price of gallon syrup was between \$1.50 and \$2.00, depending on the quantity purchased (Tedlow, 1990). For comparison, it is worth noting that according to Barsky, et al. (2003, Table 7A.2), the average retailer markup for the Chicago area supermarket chain, Dominick’s, during the 1989–1997 period, for the same products, Coca-Cola Classic and Pepsi Cola, was 1.15 and 1.06, respectively. Thus, even in modern days, the retailer

This is not the whole story, however. We know that Pepsi was selling 12oz bottle for 5¢, while Coca-Cola was selling 6.5oz bottles for the same price. However, according to Pendergrast (1993, p. 193), “The additional cost of the actual twelve-ounce drink was minimal, since most of the expense involved bottling machinery, bottles, distribution, and advertising.” Thus, the marginal cost of the additional 5.5 ounces of cola Pepsi was giving to its consumers, was negligible if not zero.

The analysis above assumes, however, that Coca-Cola and Pepsi were of a comparable quality. The existing evidence, however, seems to suggest that was not the case. According to all accounts, Pepsi was considered a low quality and cheap substitute for the “Real Thing.” For example, according to Tedlow’s account (1990), “...Pepsi was in 1950, well known as the bargain cola. It was the brand served to children. People actually bought Pepsi and secretly poured it into Coke bottles in the kitchen before serving it to guests.”⁴⁹

A comparison of the market share figures between Coca-Cola and Pepsi reveals that the fountain market was entirely controlled by Coca-Cola. Even as recently as in early 1980s, Coca-Cola maintained over 80 percent of the US fountain market (Allen, 1994). In the bottled cola market, Coca-Cola had 50 percent market share in 1940 (see footnote 5), while Pepsi had less than 20 percent (Pendergrast, 1993, p. 260). In terms of the breakdown of Coca-Cola sales between bottled and fountain drinks, we know that in 1920, 40 percent of the Coca-Cola syrup sold was for bottling operations (Allen, 1994, p. 105). Coca-Cola bottle sales first exceeded fountain sales in 1928.

In sum, the data indicate that Coca-Cola controlled the lion share of the cola market. Further, the evidence suggests that the perceived quality differences between Coca-Cola and Pepsi have enabled the Company to differentiate its product for extended period of time. We also find that the retailer markup on Coca-Cola was twice as high as on Pepsi. At first, the Company chose to share its “excess profit” potential with its distributors, jobbers, and sellers. By 1940s, however, it has purchased most of its parent bottlers, enabling it to maintain its profitability by

markup on Coca-Cola exceeds the markup on Pepsi. The magnitude of both, however, are substantially lower in comparison to the earlier period.

⁴⁹ Pendergrast (1993, p. 259) offers a similar account: “Pepsi, Steele [Pepsi’s Chairman during the late 1940s and early 1950s] recognized, was plagued by its past image as a lot of drink for little money—oversweet belly-wash for kids and poor people. In the South, racist whites considered it a ‘nigger drink,’ and even in the rest of the country people preferred to pour Pepsi into glasses and serve it as Coke.”

reaping the benefits of the increased markups that resulted from the elimination of the middlemen. Finally, it appears that the inflationary pressures of 1940s and 1950s, along with the fixed retail price of 5¢, have indeed led to a decrease in the markup of Coca-Cola's distributors and retailers.

6. CONCLUSION: POTENTIAL BROADER RELEVANCE OF THE COCA-COLA PRICE RIGIDITY

In this paper we study price rigidity of Coca-Cola during the 1886–1959 period, by documenting a nominal price rigidity that lasted more than 70 years. What makes this unusual episode of price rigidity so remarkable is the fact that during the 73-year period there were substantial variations in the structure of the soft drink market. In addition, the 1886–1959 period witnessed two World Wars and the Great Depression along with less remarkable economic fluctuations as well as numerous regulatory interventions, which led to substantial changes in the demand and supply conditions. Yet, the actual retail price of Coca-Cola did not reflect these changes in market conditions, as the traditional economic theory would predict: the price of Coke remained 5¢.

We find that this unusual rigidity is best explained by (i) a contract between the Coca-Cola Company and its parent bottlers (which was particularly relevant until 1921), (ii) a single-coin vending machine technology, and (iii) a single-coin monetary transaction technology.⁵⁰

We find that the price adjustment costs the Company faced differed from the standard menu cost. In particular, we show that the vending machine replacement cost was a one-time fixed cost that could give the Company the ability to adjust prices at zero marginal cost, while the customer inconvenience cost would be incurred by both the buyer and the seller, for each unit purchased. Further, we find that quantitatively, the estimated cost of price adjustment we report exceeds the existing price adjustment costs by an order of magnitude.

Finally, we should comment on a potential broader relevance of the Coca-Cola pricing practices for understanding the phenomenon of “customary fixed prices” of the late 19th and the

⁵⁰ Another factor that seems to have played an important role in the Coca-Cola Company's nickel price strategy is an unusual form of implicit contract the company has over the years established and nurtured with the American public. See Levy and Young (2004). See also Ball and Romer (2003), Kackmeister (2002), and Okun (1981).

early 20th centuries. For example, many food items (e.g., a cup of milk, a cup of coffee, soap, a loaf of bread, a mug of beer, Hershey's candy-bar, Wrigley's bubble gum, etc.) were selling for a nickel for many years. When these prices were increased, they were usually set equal to a dime, and later on, to 15¢ or 25¢. For example, KC Baking Powder was selling for a fixed price of 25¢ for over 50 years!⁵¹

More importantly, there were many chain stores in the US, called "Nickel Stores" (the predecessors of today's "Dollar Stores"), which were selling everything (from sandwiches, soda, sundries, candies, to toys, Christmas ornaments, craft and sewing supplies, greeting cards, novelty items, to clothes, house-wares, school and party supplies, soap and shampoo, sheet music, to underwear) for a nickel. Later on, these stores turned into "Nickel and Dime Stores," or "Dime Stores," or even "5¢, 10¢, and 25¢ Stores." Woolworth was the first Nickel Store in 1879.⁵² Other Nickel and Dime chain stores included K-mart (under the name "The Kresge Company"), Wal-Mart, Sprouse-Reitz, TG&Y, Mott's, etc.

The sales figures of these chains appear impressive. For example, the Kresge Company (Nickel and Dime chain) had by 1912 expanded to 85 stores with annual sales of \$10,325,000.00 (over \$158.8 million in 1992 prices).⁵³ At the time it was still selling thousands of items for 5¢ and 10¢.⁵⁴ According to Pitrone (2003, pp. 23–24), Woolworth by 1895 was operating 28 Nickel and Dime Stores with sales over \$1 million (over \$19.2 million in 1992 prices). By 1900, the sales of the chain reached \$5 million (over \$92.5 million in 1992 prices). By 1911, it was operating 286 stores in Pennsylvania, New Jersey, Delaware, and Connecticut, with 9,000 employees (Pitrone, 2003, p. 17). By 1912 the chain was operating 600 stores in the US and Europe.⁵⁵

By 1910, the number of 5¢ and 10¢ chain stores operating numbered in thousands, about 5,000 according to one estimate.⁵⁶ According to the US Bureau of Census, in 1935 there were

⁵¹ Source: *Grocer's Want Book*, a pamphlet distributed by the Jaques Mfg. Co., Chicago, IL, the maker of the K.C. Baking Powder, to the retail grocers for their use to manage and keep track of the inventories, (undated). Levy and Young (2002) discuss the pricing and the marketing strategy of K.C. Baking Powder, and its resemblance to the case of Coca-Cola.

⁵² J.C. Penney opened its first store in Kemmerer, Wyoming in 1902, selling everything for a penny (Pitrone, 2003, p. 3).

⁵³ Source: http://www.kmartcorp.com/corp/story/general/corporate_history.stm.

⁵⁴ Source: *Kresge Katalog of 5¢ & 10¢ merchandise*, 1913 (NY: Random House, 1975).

⁵⁵ As another example, in 1929 McCrory was the fifth-largest Dime-Store chain, with about 240 stores in the eastern and southern US and gross sales of \$44 million (over \$385.9 million in 1992 prices).

⁵⁶ Source: "Cheers to 100 years... 20th Century Timeline," *Retail Traffic*, December 1, 1999. These also included Sears-Roebuck, Marshall's, Hudson's, Nordstrom, Macy, Neiman Marcus, Spiegel, etc.

127,482 chain stores operating in the US. It follows, therefore, that a non-trivial proportion of the retail trade was conducted at fixed, nickel and dime, prices for about 40 years or perhaps even more, from the mid 1880s, to the mid 1920s and early 1930s. Moreover, the phenomena of Nickel and Dime Stores were not limited to the US. A Dutch chain store HEMA (Hollandsche Eenheidsprijzen Matschappij, which in English means “Dutch Uniform Price Company”) opened in 1926 after the success of the English and the American “uniform price stores” was recognized. HEMA, where everything was priced at either DFL 0.25 or DFL 0.50, became a success, especially during the depression period.

Thus, the fixed price strategy was not limited to the Coca-Cola Company. We find that a nontrivial proportion of the transactions were conducted at the nickel, dime, and other similarly fixed “customary” prices for long periods of time, not only in the US, but also in Europe. Studying and understanding the economics of these fixed price practices raise interesting and important issues that future research should address.

LITERATURE CITED

- Allen, Frederick (1994). *Secret Formula: How Brilliant Marketing and Relentless Salesmanship Made Coca-Cola the Best-Known Product in the World*, New York, NY: Harper Business.
- American Iron and Steel Institute (1945). *Annual Statistical Report*, New York, NY.
- Ball, Laurence, and David Romer (2003). "Inflation and the Informativeness of Prices." *Journal of Money, Credit and Banking* 35, 177–196.
- Barsky, Robert, Mark Bergen, Shantanu Dutta, and Daniel Levy (2003). "What Can the Price Gap between Branded and Generic Products Tell Us about Markups?" In *Scanner Data and Price Indexes*, edited by Robert Feenstra and Matthew Shapiro, pp. 165–225. Chicago: National Bureau of Economic Research and the University of Chicago Press.
- Bergen, Mark, Haipeng Chen, and Daniel Levy (2003). "Making Sense of Ignoring Cents: Another Implication of Rational Inattention." Manuscript, presented at the October 10–11, 2003 Central European University Workshop on "Microeconomic Pricing and the Macroeconomy," Budapest.
- Bils, Mark and Peter Klenow (2002). "Some Evidence on the Importance of Sticky Prices." National Bureau of Economic Research, Working Paper No. 9069.
- Blinder, Alan S., Elie R.D. Canetti, David E. Lebow, and Jeremy B. Rudd (1998). *Asking About Prices: A New Approach to Understanding Price Stickiness*. New York, NY: Russell Sage Foundation.
- Carlton, Dennis (1986). "The Rigidity of Prices." *American Economic Review* 76, 637–658.
- Cecchetti, Steven G. (August 1986). "The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazine." *Journal of Econometrics* 31, 255–274.
- Census of Manufacturers (1963). *1963 Census of Manufacturers, Volume II: Industry Statistics, Part I: Major Groups 20–28*. Washington, DC: U.S. Department of Commerce.
- Chen, Haipeng, Mark Bergen, and Daniel Levy (2002). "Asymmetric Price Adjustment in the Small: An Implication of Rational Inattention." Manuscript, presented at the January 2002 North American Meeting of the Econometric Society, Atlanta.
- Chevalier, Judith, Anil Kashyap, and Peter Rossi (2003). "Why Don't Prices Rise During Peak Demand Periods? Evidence from Scanner Data." *American Economic Review* 93, 15–37.
- Coca-Cola Company (1925). *Reviewing 'A Proud History: 1886 to 1925'*. Atlanta, GA.
- Coca-Cola Company (Various Years). *The Coca-Cola Bottler*, Atlanta, GA (May 1909a, June 1909b, March 1910, June 1918a, September, 1918b, January 1944a, April 1944b, July 1944c, April 1946, June 1947a, September 1947b, November 1947c, and April 1959).
- Coca-Cola Company (1983). *Fact Sheet: Product Pricing Structure of Coca-Cola USA*. Consumer Information Center, Atlanta, GA.
- Coca-Cola Company (1993). *Always Coca-Cola: A Quick Reference Chronology from 1886 to 1993*.
- Coca-Cola Company (Undated). *Did You Know?* Atlanta, Public Relations Department.
- Coca-Cola Company (Undated). *Fact Sheets Concerning the Nickel Price*. Atlanta, Public Relations Department.
- Croushore, Dean, and Tom Stark (2002). "Forecasting Coin Demand." Federal Reserve Bank of Philadelphia, Working Paper No. 02-15.
- Davis, Michael, and James Hamilton (2004). "Why Are Prices Sticky? The Dynamics of

- Wholesale Gasoline Prices.” *Journal of Money, Credit and Banking* 36, 17–37.
- Dutta, Shantanu, Mark Bergen, Daniel Levy, and Robert Venable (1999). “Menu Costs, Posted Prices, and Multi-Product Retailers.” *Journal of Money, Credit, and Banking* 31, 683–703.
- Dutta, Shantanu, Mark Bergen, and Daniel Levy (2002). “Price Flexibility in Channels of Distribution: Evidence from Scanner Data.” *Journal of Economic Dynamics and Control* 26, 1845–1900.
- Eden, Benjamin (2001). “Inflation and Price Adjustment: An Analysis of Micro Data.” *Review of Economic Dynamics* 4, 607–636.
- Fortune Magazine* (1951). “The Nickel Drink is Groggy.” January, 78–79, continued on 129–133.
- Friedman, Milton and Rose (1990). *Free to Choose: A Personal Statement*. New York: Harcourt Brace.
- Genesove, David (2003). “The Nominal Rigidity of Apartment Rents.” *Review of Economics and Statistics* 85, 844–853.
- Genesove, David and Wallace P. Mullin (1997). “Predation and Its Rate of Return: The Sugar Industry, 1887–1914.” National Bureau of Economic Research, Working Paper No. 6032.
- Gordon, Robert J. (2000). *Macroeconomics*. 8th Edition. Reading, MA: Addison-Wesley.
- Jeuland, Abel P. and Steven M. Shugan (1983). “Managing Channel Profits.” *Marketing Science* 2, 239–272.
- Kackmeister, Alan K. (2002). “Has Retail Price Behavior Changed Since 1889? Evidence from Microdata.” Ph.D. Dissertation, University of California, Berkeley.
- Kahn, E.J. Jr. (1969). *Robert Winship Woodruff*. Atlanta, GA: The Coca-Cola Company.
- Kashyap, Anil K. (1995). “Sticky Prices: New Evidence from Retail Catalogues.” *Quarterly Journal of Economics* 110, 245–274.
- Katz, Eliakim, and Jacob Paroush (1984). “Royalty Vs. Partnership Agreement in the Creative Arts.” *Atlantic Economic Journal* 12, 41–46.
- Konieczny, Jerzy D., and Andrzej Skrzypacz (2003). “A New Test of the Menu Cost Model.” Manuscript, presented at the October 10–11, 2003 Central European University Workshop on “Microeconomic Pricing and the Macro-economy,” Budapest.
- Levy, Daniel, Mark Bergen, Shantanu Dutta, and Robert Venable (1997). “The Magnitude of Menu Costs: Direct Evidence from Large U.S. Supermarket Chains.” *Quarterly Journal of Economics* 112, 791–825.
- Levy, Daniel, Shantanu Dutta, and Mark Bergen (2002). “Heterogeneity in Price Rigidity: Evidence from a Case Study Using Micro-Level Data.” *Journal of Money, Credit, and Banking* 34, 197–220.
- Levy, Daniel and Andrew Young (2002). “The Real Thing: Nominal Price Rigidity of the Nickel Coke, 1886–1959.” Manuscript, Bar-Ilan University and Emory University.
- Mankiw, N. Gregory (1985). “Small Menu Costs and Large Business Cycles: a Macroeconomic Model of Monopoly.” *Quarterly Journal of Economics* 100, 529–539.
- Marshall, Martin B. (1954). *Automatic Merchandising*. Cambridge, MA: Riverside.
- Müller Georg, Daniel Levy, Shantanu Dutta, and Mark Bergen (2001). “Holiday Price Rigidity and Cost of Price Adjustment.” Presented at the American Economics Association Meeting and the NBER-CRIW Conference, Working Paper No. 3-2002, Bar-Ilan University.
- Munsey, Cecil (1972). *The Illustrated Guide to the Collectibles of Coca-Cola*. New York, NY: Hawthorn Books, Inc. Publishers.

- Oi, Walter Y. (2001). "Retail Trade in a Dynamic Economy." Manuscript, University of Rochester.
- Okun, Arthur M. (1981). *Prices and Quantities: A Macroeconomic Analysis*. Washington, DC: The Brookings Institution.
- Pendergrast, Mark. (1993). *For God, Country and Coca-Cola: The Unauthorized History of the Great American Soft Drink and the Company that Makes It*. New York, NY: Simon and Schuster.
- Pitrone, Jean Maddern (2003). *F.W. Woolworth and the American Five and Dime: A Social History*. New York, NY: McFarland and Company,.
- Riley, John J. (1946). *Organization in the Soft Drink Industry: A History of the American Bottlers of Carbonated Beverages*. Washington, DC: American Bottlers of Carbonated Beverages.
- Rotemberg, Julio J. (1982). "Sticky Prices in the United States." *Journal of Political Economy* 90, 1187–1211.
- Rotemberg, Julio J. (2002). "Customer Anger at Price Increases, Time Variation in the Frequency of Price changes and Monetary Policy." National Bureau of Economic Research, Working Paper No. 9320.
- Rotemberg, Julio J. (2003), "The Benevolence of the Baker: Fair Pricing under Threat of Customer Anger." Manuscript, presented at the October 10–11, 2003 Central European University Workshop on "Microeconomic Pricing and the Macro-economy," Budapest.
- Schaeffer, Randy S. and William E. Bateman (1985). "The Formula for Coca-Cola: The Old... The New." *The Cola Call*, 4–6, Coca-Cola Company Archives.
- Schreiber, G.R. (1954). *Automatic Selling*. New York, NY: John Wiley & Sons.
- Schreiber, G.R. (1961). *A Concise History of Vending in the U.S.A.* Chicago, IL: Vend.
- Shugan, Steven M. (1985). "Implicit Understanding in Channels of Distribution." *Management Science* 31, 435–460.
- Slade, Margaret E. (1998). "Optimal Pricing with Costly Adjustment: Evidence from Retail-Grocery Prices." *Review of Economic Studies* 65, 87–107.
- Stigler, George J. and James K. Kindahl (1970). *Behavior of Industrial Prices*. New York, NY: University of Chicago and National Bureau of Economic Research.
- Tedlow, Richard S. (1990). "The Great Cola Wars: Coke vs. Pepsi." In *New and Improved: The Story of Mass Marketing in America*, pp. 22–111. New York, NY: Basic Book Publishers.
- U.S. Census Bureau (1961). *Historical Statistics of the United States: Colonial Times to 1957*. Washington, DC.
- Warner, Elizabeth and Robert Barsky (1995). "The Timing and Magnitude of Retail Store Markdowns: Evidence from Weekends and Holidays." *Quarterly Journal of Economics* 110, 321–52.
- Willis, Jonathan L. (1999). "Estimation of Adjustment Costs in a Model of State-Dependent Pricing." Ph.D. Dissertation: Boston University.
- Willis, Jonathan L. (2003). "General Equilibrium of a Monetary Model with State Dependent Pricing." Manuscript, presented at the October 10–11, 2003 Central European University Workshop on "Microeconomic Pricing and the Macro-economy," Budapest.
- Young, James H. (1983). "Three Southern Food and Drug Cases." *Journal of Southern History* 49, 3–36.
- Zbaracki, Mark, Mark Ritson, Daniel Levy, Shantanu Dutta, and Mark Bergen (2004). "The

Managerial and Customer Costs of Price Adjustment: Direct Evidence from Industrial Markets.” *Review of Economics and Statistics*, forthcoming.

TABLE 1
GALLONS OF COCA-COLA SYRUP SOLD IN THE US AND REAL GDP

Year	Gallons of Syrup (U.S.)	Percent Change	Real GDP (\$1992 Billion)	Percent Change
1928	23,226,092	-	894.2	-
1929	25,704,674	10.6	951.7	6.4
1930	26,322,820	2.4	862.1	-9.4
1931	25,101,423	-4.6	788.8	-8.5
1932	20,551,973	-18.1	682.9	-13.4
1933	19,376,587	-5.7	668.6	-2.1
1934	24,101,485	24.4	719.8	7.6
1935	27,482,431	14.0	778.2	8.1
1936	34,798,464	26.6	888.2	14.1
1937	40,652,790	16.9	932.5	5.0
1938	44,022,545	8.3	890.8	-4.5
1939	50,909,998	15.6	961.1	7.9

Sources: "Sales of Coca-Cola: Sales 1886 through 1939," Coca-Cola Company, and Gordon (2000, Appendix A).

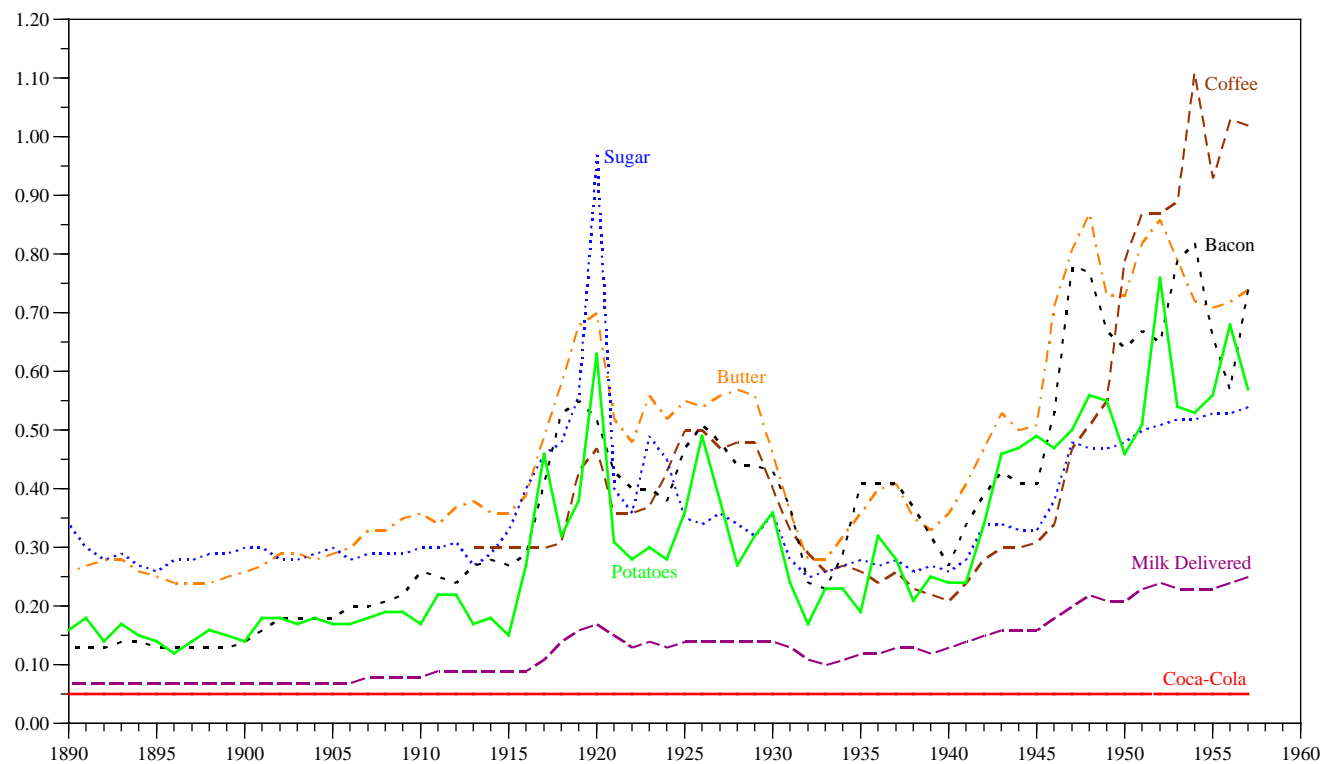


FIG. 1. Retail Price of 6 1/2 oz Coca-Cola vs Retail Prices of Other Foodstuff, 1890–1957

Source: *Historical Statistics of the United States: Colonial Times to 1970, 1989 Edition*.

Units: Coca-Cola (\$/6.5oz), Milk Delivered (\$/Qt), Coffee (\$/Lb), Butter (\$/Lb), Sugar (\$/Lb), Bacon (\$/Lb), and Potatoes (\$/10 Lb).

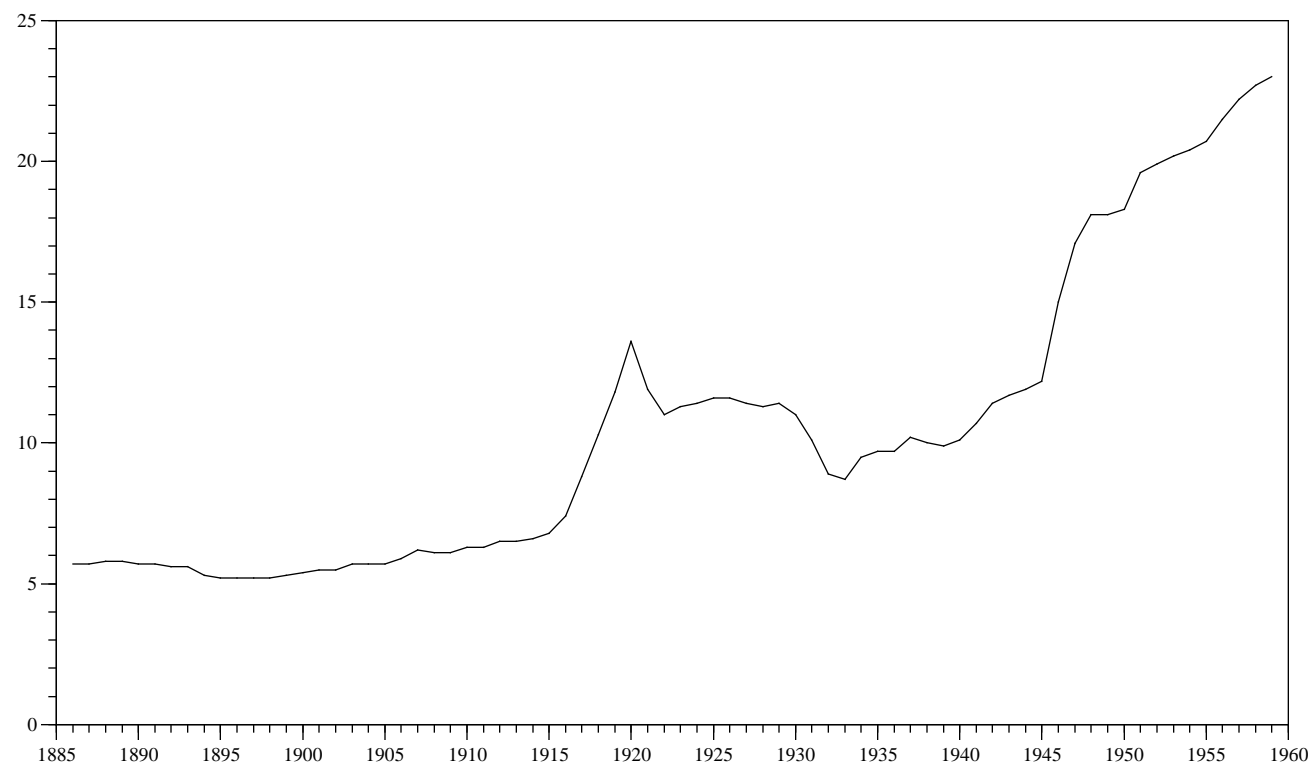


FIG. 2. GDP Deflator, 1886–1959 (1992 = 100)

Source: Gordon (2000), Appendix A.

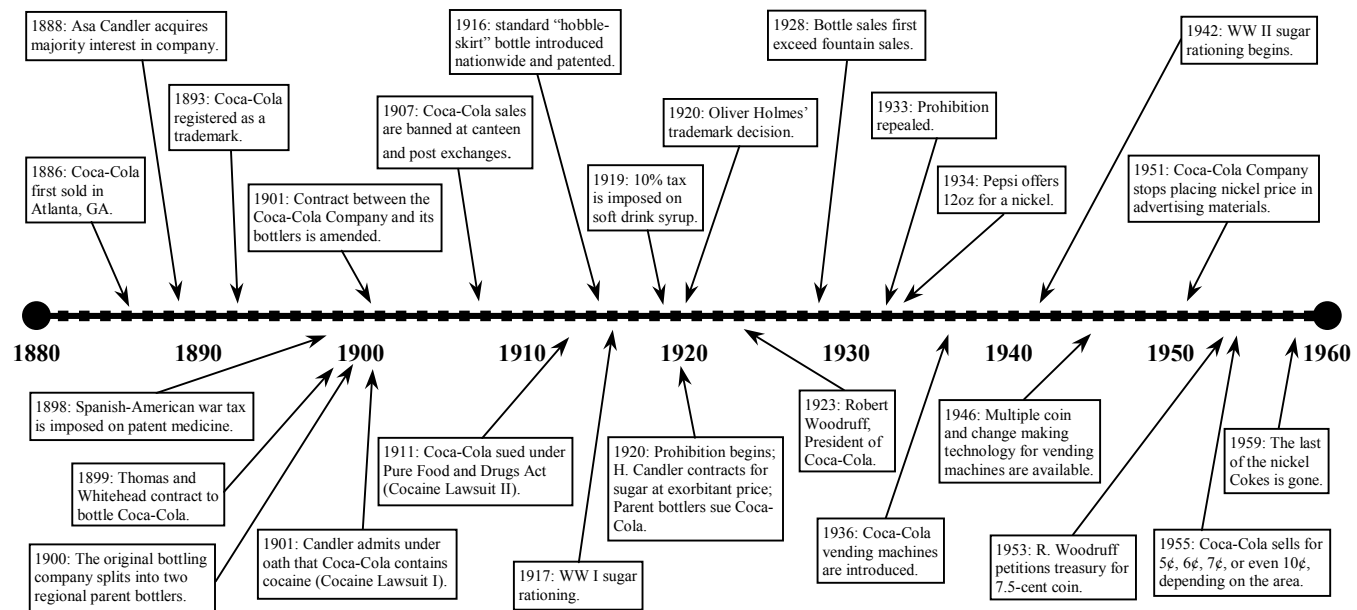


FIG. 3. Coca-Cola Timeline, 1886–1959

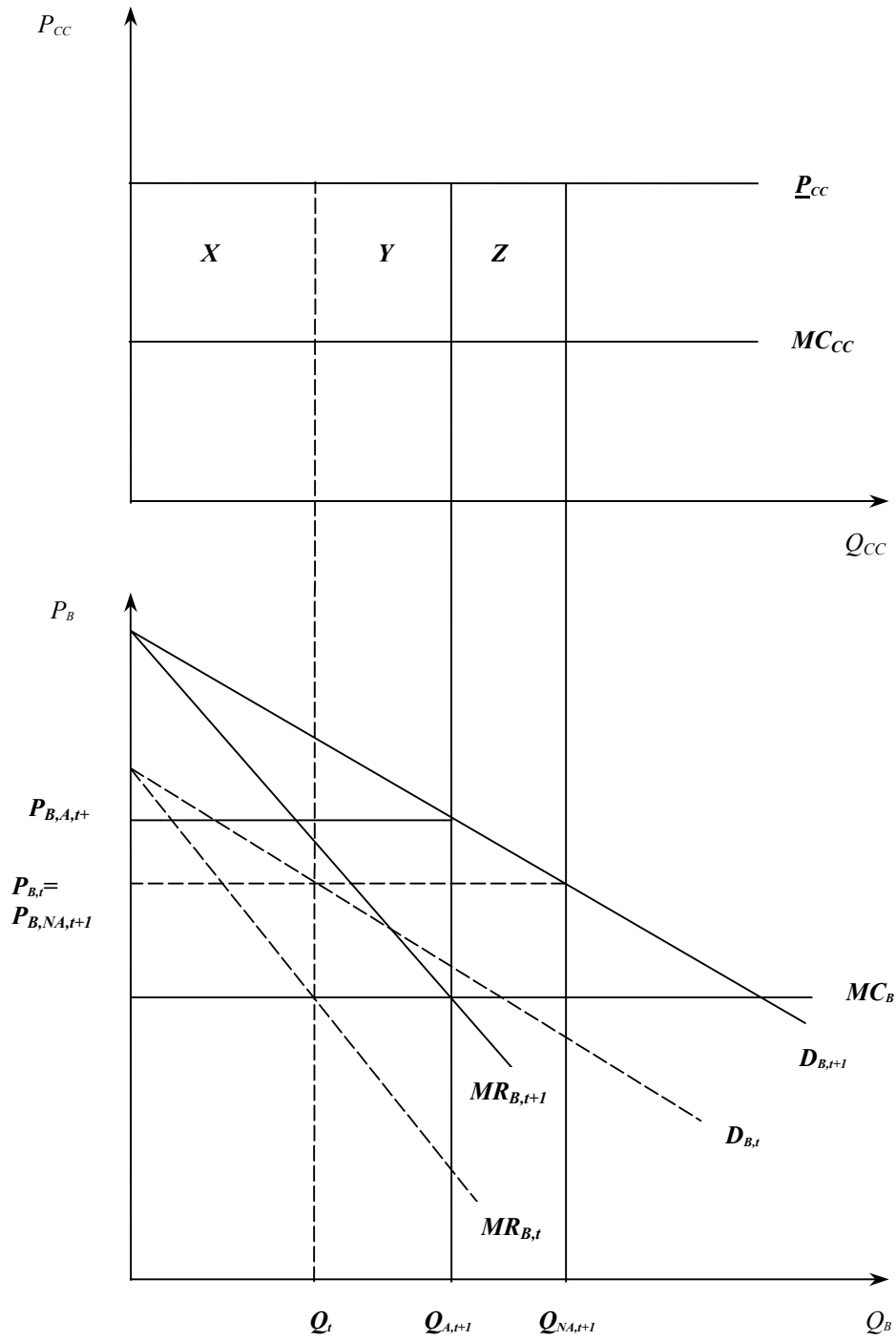


FIG. 4. Optimality of Fixed Retail Price for a Monopolist with a Fixed Contract Price

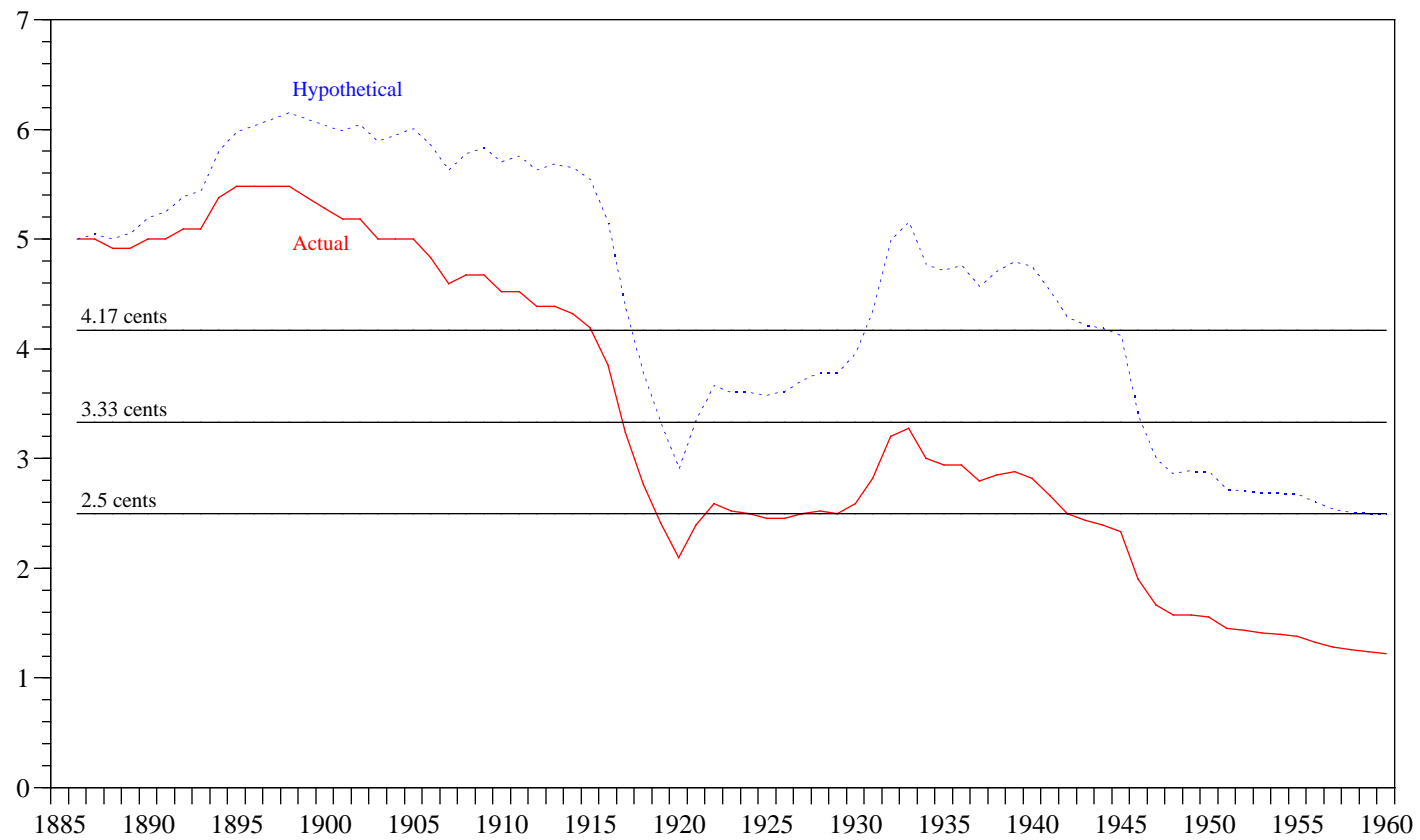


FIG. 5. Real Price of Coca-Cola in 1886 Prices (in cents): Actual (Productivity Growth = 0, Relative to the Economy) vs Hypothetical (Productivity Growth = 0.0097, Relative to the Economy)