

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

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Abstract

We study price rigidity of Coca-Cola during the 1886–1959 period. The price of a 6 ½ oz Coke was 5¢ starting on May 29, 1886, the day it was first introduced to the public at Jacob’s Pharmacy at 2 Peachtree Street in Atlanta, until about 1959. Thus we are documenting a nominal price rigidity that lasted more than 70 years! This is remarkable, and to our knowledge, no study has documented such persistent price rigidity. The case of Coca-Cola is particularly interesting because during the 70-year period there were substantial changes in the structure of the soft drink market, 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 price to customers did not reflect these changes, as traditional economic theory would predict: the company insisted that the price of Coke be held at 5¢. To explain this unusual puzzle, we use information provided by the Coca-Cola Company Archives and the Robert W. Woodruff Collection at Emory University. We combine this information with data collected from beverage industry trade publications and the Historical Statistics of the U.S. to provide some direct and indirect evidence on the actual quantitative magnitude of price, quality, and quantity adjustment costs for Coca-Cola. In addition, we demonstrate that the incredibly long period of the Coca-Cola price rigidity was accompanied by equally long-lasting Coca-Cola quality rigidity. These rigidities, we argue, can be best explained by the presence of long-term relationship and implicit contract of a rather explicit form between the Coca-Cola Company and the American public. Moreover, we demonstrate that the company systematically chose the option of quantity adjustment over price or quality adjustment. This, despite the fact that the cost of quantity adjustment was substantial. The implication is that, the perceived price and quality adjustment costs in this particular setting were far larger than the quantity adjustment cost. Placing a unique twist on the story, we also suggest three new explanations, two *technology-based*, and one based on a simple model of monopoly under stages of processing that likely played a role in the Coca-Cola price rigidity. We assess the existing theories of price rigidity by examining their empirical relevance for the case of Coca-Cola. We find that of the twelve theories we consider, nine of them can be ruled out as being inconsistent with the 70-year long price rigidity. A broadly defined cost of price adjustment notion is used to highlight common features of the theories we rule in. We demonstrate that the nickel coke was not really an exception in terms of the nature of its price rigidity, although it probably breaks any modern time record in terms of the longevity of the rigidity. We provide detailed historical evidence on the prevalence of widely used “customary, fixed prices” in the US as well as in Europe, and find that a non-trivial proportion of the retail trade was conducted at 5 and 10 cents for perhaps as long as 40 years. Finally, we argue that this study can be viewed not only as a study of unusually long price rigidity, but also as a study of a *non-price market-clearing mechanism*. In this particular case, we find that the adjustment was taking place through quantity.

“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)

I. Introduction

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 Smyth 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 United States 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.

Today, if we scan the economic literature on price rigidity, we find few 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 the magazines in his sample change their price 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 incredibly detailed survey evidence from U.S. firms, conclude that the average lag of price adjustments following supply or demand changes is 3 months.¹ Genesove (1999) studies apartment rental prices in the US using the US Annual Housing Survey data, and finds that over the period of 1974-1981, between 23 and 34 percent, with an average of 29 percent of the apartments had no change in nominal rent from one year to the next. A more recent 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 also documents frequent prices changes, with half of prices lasting less than 4.3 months.

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*

¹ A Few studies report even more frequent price changes. For example, Warner and Barsky (1995) document weekly variation in the prices of various consumer products. Barsky, et al. (2003), Chevalier, et al. (2003), Dutta, et al. (1999 and 2002), Levy, et al. (1997, 1998, and 2002), Chen, et al. (2002), and Müller, et al. (2001), document high-frequency, typically weekly, price variation in various large retail supermarket and drugstore establishments. For findings using data from high inflation economies, see Sheshinski, et al. (1981), Danziger (1987), Lach and Tsiddon (1992, 1996), Lieberman and Zilberfarb (1985), Tommasi (1993), and Eden (1994, 1995, and 2001).

70 years! The contrast is of an order of magnitude to say the least! In this paper we study this unusual episode of price rigidity in great detail and seek to explain it. This is valuable for several reasons.

First, the Coca-Cola Company is undeniably one of the most successful and recognized producers of a consumer good in the world. 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 (Gordon, 2000, Appendix A).² The Coca-Cola Company had a 50 percent market share of the industry at that time, making its contribution alone economically significant, about 0.13 percent of the GDP.³

Third, according to the Company's (1925) "*Reviewing 'A Proud History: 1886 to 1925,'*" in 1924 the soft drink industry paid a combined \$54 million in taxes, "a considerable part of our Government's total revenue" (p. 3), or 1.4 percent of U.S. federal budget receipts of \$3.9 billion.⁴ Indeed, the Company, which became a component of the Dow Jones Industrial Average in 1932, was of an economic magnitude and robustness that in 1934 only an \$800,000 advance from the Company kept its native city of Atlanta, GA, solvent in the face of increasing debt (Biles, 1990, p. 82). Then again in 1937, when Atlanta stood in \$3 million of debt, Mayor William B. Hartsfield was compelled to call on the Company to provide a loan of \$730,000 to cover a month's payroll for city employees (Biles, 1990, p. 82). In fact, the Coca-Cola Company was so robust even during the Great Depression that a 1938 *Barron's* article marveled that, "You could have bought Coca-Cola stock at the top price of 154 1/2 in 1929, ... sold it at the low this year and you would have had, including dividends, a profit of approximately 225 percent" (Tedlow, 1990, p. 85). It follows, therefore, that the Coca-Cola Company was part of an economically significant industry, and was both an economically significant and influential component of the U.S. economy in and of itself.

This study makes several contributions. First, by documenting and in-depth studying of this

² 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.

³ 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. 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.

⁴ Federal budget receipt data come from the NBER historical macroeconomic data available at www.nber.org, series 15004.

remarkable price rigidity, we contribute to, at least, two areas of the price rigidity and cost of price adjustment literature.

The first of these areas is motivated by early theoretical papers such as Mankiw (1985) and Blanchard and Kiyotaki (1987), who have shown that second-order costs of adjusting prices can result in first-order aggregate effects on economic welfare. A newly emerging literature on quantity adjustment and its cost is now suggesting that the “predictions of menu costs models hold only if the price adjustment costs are larger than the quantity adjustment costs” (Andersen and Toulemonde, 1999, p. 1).⁵ Intuitively it seems plausible that quantity adjustment costs are in many cases larger than price adjustment costs, but to our knowledge no one has really documented for a single firm (or a set of firms) the one type of adjustment cost relative to the other.

We demonstrate that for over 60 years the Company held the price of Coca-Cola unchanged, and instead chose to adjust to the changing market conditions by adjusting its quantity. Thus, the present case study documents an example where the perceived costs of adjusting price were not only larger than those of adjusting quantity, but they were *consistently* relatively large enough to prevent *any* adjustment in price over the long period.

In addition to arguing that high costs of adjusting price existed, we also demonstrate that costs existed in adjusting quantity. We are able to report a lower bound of these quantity adjustment costs. Specifically, we argue that among the quantity adjustment costs were advertising expenditure. Assuming that the Company adjusted along the least expensive margin available to it, data on advertising expenditures as a proportion of revenue imply price adjustment costs well in excess of anything documented in the literature. Again, the difference is of an order of magnitude: 10–20 percent of revenue as opposed to the largest estimates in the literature of about 4 percent.

The second of these areas concerns a theoretical source of price rigidity that has proven extremely difficult to identify, observe, and measure—implicit contracts. Okun (1975, 1981) popularized the “invisible handshake” concept, a form of long-term relationship between buyers and sellers, which can dictate the nature of the price behavior and lead to price rigidity.⁶ Ball and Romer (2003) formalize this idea by setting up a model in which prices serve as “information carriers” in addition to their more traditional allocative role. Ball and Romer demonstrate that in such a setting, a presence of long-term relationship between buyers and sellers gives the sellers incentive not to adjust prices frequently even if

⁵ Other recent studies featuring models with both price and quantity adjustment costs include Hansen (1996) and Danziger and Hansen (2000). Lindbeck and Snower (1999, p. 82) also suggest, that “... the cost of adjusting prices are dwarfed by the cost of adjusting employment,” but they provide no evidence.

⁶ See also Carlton (1982).

price adjustment costs are small.

Empirically, Kahneman, et al. (1986) provide limited but suggestive survey evidence that the related issue of “fair” prices is important for understanding consumer demand.⁷ In a more recent study, Kackmeister (2002) demonstrates the possible importance of long-term relationship in determining the degree of price rigidity. He compares price rigidity in three periods (1889–1891, 1911–1913, and 1997–1999) and finds an increase in the flexibility of prices in 1997–1999 compared to 1889–1891, which can be explained by the decline in the long-run customer relationships that has accompanied the transition from small mom and pop shops and grocery stores to large supermarket chains and department stores, and the mega stores.⁸ Blinder, et al. (1998), use survey evidence to directly tackle the question of implicit contracts. They find that implicit contracts exist in about two-thirds of the economy and that, within those two thirds, 51 percent of survey respondents believed that implicit contracts were “moderately” or “very” important in slowing down price adjustments. This survey evidence is the *only* evidence to our knowledge of the existence and possible importance of invisible handshakes.⁹ The main reason for this scarcity, as Blinder, et al. (1998, p. 9) note, is that implicit contract theory is an “extreme example in that direct econometric testing seems out of the question on conceptual grounds.” The contracts, “are tacit agreements that are not written down [and] the theory does not predict literal price rigidity, but only that prices are relatively insensitive to fluctuations in demand... it is hard to know just what the observable implications of the theory are...” (p. 152).

We agree that the applicability of traditional econometric techniques for studying implicit contracts is conceptually problematic at best. Due to the absence of useful data and observable implications, Blinder et al. (1998) adopt a survey methodology to explore how decision makers, such as pricing managers, view the idea of implicit contracts, and what they think about its importance for their price adjustment decisions. Our work complements Blinder, et al.’s in that we sacrifice a wide sample of producers (a virtue of Blinder et al.’s study) and gain, by focusing on this one exceptional historical episode, the ability to document the Company not only *saying* it has an important implicit contract with its consumers, but also *acting* upon it by adjusting quantity instead of price and thus incurring the costs of doing so.

This case study makes an additional and unique contribution to the study of implicit contracts. In our analysis we explore *quality* as a margin of adjustment available to Coca-Cola. We argue and

⁷ See Rotemberg (2002) for a model in which consumers concern about the fairness of the prices they pay leads to price rigidity.

⁸ See Oi (2001) for a fascinating historical account of the retail trade development in the US.

⁹ Hall, et al. (1997) apply Blinder, et al.’s (1998) methodology to the UK manufacturing firms and report similar findings.

present evidence in support of the view that the perceived implicit contract between Coca-Cola and its consumers included the promise of not only a constant nominal price but also a constant quality. We document a decided dedication to the 6 ½ oz serving and the syrup Secret Formula that dictated the flavoring of the contents.

Indeed, we provide evidence of merely six changes in the Secret Formula from 1886 to 1959. Moreover, we demonstrate that four of those changes in the Formula were *technological* changes. Of these six, two were changes in the mix of substitutable inputs rather than changes in quality. Two additional changes were necessitated to *ensure* identical quality for Coca-Cola at the fountain and in a bottle. The remaining two changes in the Formula were *mandated* by legal considerations. In these instances, constant quality was not within the Company's feasible decision set. For these reasons, the changes should not be viewed as deliberately made by the Company to avoid adjustment of its prices.¹⁰ We provide evidence supporting this interpretation of the factual data we gathered and report concerning the changes in the Secret Formula.

Another contribution of this paper is that we are able to offer an unusually detailed analysis of Coca-Cola quality adjustment costs. We take advantage of two documented episodes. In the first episode, which took place during the 1929–30 period, the Company chose to incur higher production/processing cost in order to prevent a potential change in the Coca-Cola quality that could occur due to insufficient supply of coca leaves. In this case the Company chose to incur a permanent shock to marginal cost instead of incurring a potential fixed cost in negative consumer reaction.

The second episode is the well-known decision of the Company to replace the old Coca-Cola with the New Coke in 1985. The episode, we demonstrate, can serve as a remarkable natural experimental case study, almost as if it was a controlled experiment. As we argue below, some costs of this “quality adjustment” experiment can be measured in dollar terms. We are able to report the \$ cost of the R&D the Company incurred for developing and field-testing the New Coke. We are also able to report the direct loss bottlers incurred as a result of this change. However, the biggest component of these costs, that of the lost goodwill caused by the elimination of the old Coke (currently sold under the Coca-Cola Classic label), is practically impossible to measure. We, however, are able to provide some detailed qualitative evidence on its magnitude.

Then, placing a unique twist on the story, we contribute to the existing price rigidity literature by

¹⁰ Interestingly, even in the cases where the change in the Secret Formula was mandated by legal authorities, we find evidence that Coca-Cola maintained quality via the substitutability of inputs. But perhaps most importantly, there is no evidence that consumers ever perceived a change in quality from 1886 to 1959.

offering three new possible explanations of price rigidity. The first two are *technology-based* and in our view played an important role in the price rigidity. First, an installed base of vending machines with nickel-only capability and the evolution of the technology to deal with multiple coin types and change making may have contributed to the price rigidity. Second, at the 5¢ price the smallest price increase compatible with the consumer still using a single coin was a 100 percent jump to 10¢. We argue that a *transaction technology* for adjusting price while keeping consumer “convenience costs” low was not available. We document statements as well as numerous actions of the Company leaders as well as bottlers suggesting that this transaction technology-based constraint played an important role in determining their actions.

As a third explanation we offer a simple model of monopoly under stages of processing. The model demonstrates a motive for adjusting only quantity given a constant syrup price. (The price of syrup to bottlers was fixed by a contract.) We argue that the model can explain the Coca-Cola price rigidity until 1921, the year a new contract was signed with bottlers.

Finally some historical evidence is presented suggesting that the sort of long-term price rigidity observed in the Coca-Cola episode was not an isolated incident. We discuss the prevalence of nickel and dime stores in the U.S. economy and at least one international analogue. Many traditional products may have experienced similar long-term price rigidity and we even document one U.S. brand-name product that seems to have mimicked Coca-Cola policies over a similarly long time period. This implies a potential broad importance of episodes similar to Coca-Cola.

The paper is organized as follows. Section II documents supply and demand shocks weathered by the Company from 1886–1959. Section III discusses the methods the Company used to ensure the nickel retail price of a 6 ½ oz Coke. Section IV documents the quality rigidity. Section V demonstrates that the Company was consistently using quantity as the margin of adjustment. Section VI documents evidence of price adjustment costs. This section includes a discussion of the potential contribution of vending machine technology to price adjustment costs. Section VII documents costs of adjusting quality. Section VIII provides evidence on the magnitude of quantity adjustment costs. Using a revealed preference kind of argument, we show that the incurred costs of quantity adjustment imply exceptionally large costs of adjusting price and/or quality. Section IX discusses the existing price rigidity theories that can be ruled out as inconsistent with the Coca-Cola episode. Section X provides a rationalization of the price and quality rigidities as being part of an implicit contract between the Coca Cola Company and its consumers. Section XI presents evidence of previously unexplored price adjustment costs associated with the existing monetary transaction technology and consumer

convenience. Section XII develops a simple model of monopoly under stages of processing to explain a possible motive the Company had for pursuing only quantity adjustment. We argue that the model can explain the price rigidity until 1921, the year the Company signed a new contract concerning syrup price with its bottlers. Section XIII summarizes the theories that we believe best explain the unusual price rigidity episode. In section XIV we provide some historical evidence on the prevalence of widely used “customary, fixed prices.” We conclude the paper in section XV with a brief summary of the main findings.

II. Changes in Market Conditions during 1886–1959

On May 8th, 1886, in Atlanta, Georgia, John Smyth Pemberton, a pharmacist and aspiring profiteer in patent medicines, mixed-up sugary, dark syrup in a forty-gallon brass kettle. The mixture, stirred together with a wooden oar, would prove to be the basis of the most famous soft drink of all time: Coca-Cola.¹¹ Pemberton’s then partner, Frank M. Robinson, coined the name “Coca-Cola” from the dual “medicinal” ingredients included in the formula – the coca leaf and the kola nut – and, slightly afterwards, designed the script-lettered trademark that has lasted to this day. Originally designed as a patent medicine, Pemberton and Robinson had the idea to sell Coca-Cola by the glass. The idea was ingenious. As Allen (1994, p. 26) relates: “At 75 cents or \$1 a bottle, even the most popular patent medicines had a limited market and tended to appeal to those who were sick or thought they were. But almost anyone could afford a nickel for a soft drink, and the potential clientele included anyone who got thirsty during the frying-pan heat of Atlanta’s summer season.” Thus, starting at the Atlanta fountain of W.E. Venable, the nickel coke was born.

But that was in 1886, and as a historical anecdote it would have little or no interest to economists. However, the exceedingly interesting fact of the matter is that, while the nickel coke was born in 1886,

¹¹ When not cited specifically due to their generality, historical facts concerning the Coca-Cola Company are drawn from Allen’s (1994) and Pendergrast’s (1993) remarkably comprehensive histories of the Coca-Cola Company. We should also note that during our research we relied heavily on Allen’s and Pendergrast’s work in order to trace and locate many of the sources from which we drew many of the historical information we report in this study. Additional facts 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,” “The Coca-Cola Company Chronological History” (Various Versions), “Did You Know?” “Fact Sheets Concerning the Nickel Price,” Atlanta, GA: The Coca-Cola Company, Public Relations Department and The Coca-Cola Company Archive, “Statement Showing Estimated Value of Advertising Matter Furnished to Bottling Companies” (Various Years), “Sales of Coca-Cola” (The Coca-Cola Company, Statistical Department Estimates), “Distribution of Coca-Cola,” “Organization of the Coca-Cola Company & Its Subsidiaries,” “The Coca-Cola Company: Advertising Expenditures,” “The Coca-Cola Company-Brief History,” and other miscellaneous documents related to the Coca-Cola Company History. Many of the facts presented below represent one or a few of many related facts recorded during our research. The reader interested in a more detailed account is referred to our working paper version (Levy and Young, 2002).

it did not die until somewhere between 1958 and 1959 when the last of the nickel cokes (by that time mostly sold in 6 ½ oz bottles rather than at fountains) disappeared from American markets. Furthermore, until 1951, Coca-Cola bottlers and fountain retailers were, for all intents and purposes, uniform in their maintenance of the nickel price standard. What one observes is a case of nominal price rigidity lasting for over 70 years!

As Figure 1 clearly demonstrates, the time period from 1886 to 1959 was not a period when prices in general simply did not change much.¹² The fluctuations in other common consumer good prices are marked. The price of Coca-Cola, however, remained a nickel. Furthermore, beginning in the mid-1940s inflation became a powerful factor.¹³ The November 6, 1950 issue of *Time* magazine noted that, “While most Washington politicians were loudly talking of holding the line on prices, the Senate’s Small Business Committee found something too cheap. At 5¢ a bottle of Coca-Cola was under-priced [*sic*]” (p. 99). The Committee’s recommendation: a 100 percent increase to 10¢!

Besides the general upward trend in prices to which the nickel Coke appeared immune, there were numerous supply and demand shocks throughout the time period. In this section we provide a detailed account of these shocks and describe the events surrounding them.

In 1898, with the onset of the Spanish-American War, a war tax on proprietary medicine was instituted and the IRS declared that Coca-Cola was a medicine. This is not surprising. In that very year Coca-Cola was still claiming in its advertisements that, besides being “refreshing,” it also “relieve[d] headache immediately.”¹⁴ Coca-Cola was liable for 1/8 cent on every nickel drink (Riley, 1946, p. 26). Coca-Cola sued the government and eventually won in 1902, but it incurred the legal expenses and paid the tax in the interim amounting to \$29,502 over a three-year period.¹⁵ In 1992 dollars this was equivalent to a payment of approximately \$567,346.

The Company signed a contract in 1899 that would, over time, lead the soft drink’s distribution in

¹² The source of the price data displayed in Figure 1 is the *Historical Statistics of the United States: Colonial Times to 1970*, 1989 edition. All prices are in US\$/Lb except for Coke which is measured in \$/6.5oz, for potatoes, which is measured in \$/10 Lb, and for milk delivered, which is measured in \$/Qt.

¹³ Merritt (1948), in a *Cartersville [Georgia] Daily Tribune* editorial praising the constancy of the nickel Coke commented: “Look what has happened to other five-cent items in Coca-Cola’s nickel lifetime. Bread is 15 cents a loaf, in most places soap is 10 and 15 cents a cake, coffee and milk each cost a dime, at least in lots of places, or most places, and beer is fifteen to 30 cents we hear.”

¹⁴ This ad comes from an 1898 advertisement in the *Atlanta Police Department Bulletin*, p. 26, found in the Coca-Cola Company’s archives.

¹⁵ Source: Henry A. Rucker (Collector of Internal Revenue) v. The Coca-Cola Company, U.S. Circuit Court, District of Georgia (Trial and Appeal Record, Federal Records Center, East Point, Georgia). For perspective, the net worth of the Coca-Cola Company in 1902 was only \$492,723 and expenditures on merchandise for making syrup was \$293,347.

bottles towards greater and greater importance relative to fountain sales.¹⁶ By 1899, rights to bottle Coca-Cola had already been granted to bottlers in New England and Texas (Tedlow, 1990, p. 42). The rights to the rest of the continental U.S. would at that time be signed over the two Tennessee lawyers, Franklin Thomas and Joseph Whitehead. By 1928 sales of bottled Coca-Cola would surpass fountain sales (Pendergrast, p. 140).

The contract would turn out to be a source of continued headaches for the Company. Thomas and Whitehead were given the nearly national rights to purchase syrup and bottle Coca-Cola *for free*.¹⁷ According to the contract, Thomas and Whitehead were explicitly guaranteed the right to buy syrup from the Coca-Cola Company at the nominal price of 92 cents per gallon *in perpetuity*.^{18 19}

The original bottling company would split, in 1900, into two regional “parent bottlers” (northern and southern U.S.) and would then begin licensing bottling rights to smaller bottling companies. These smaller bottling plants numbered 397 by 1909. Soon the Company was shipping syrup directly to the bottling plants. This created an odd situation with the parent bottlers. According to Allen (p. 109): “The parent companies were left without a clearly defined role. Syrup was shipped from the Coca-Cola Company’s factories directly to the actual bottlers, so that the parent bottlers were not even acting as genuine middlemen. They simply sat back and took a royalty on every gallon, even though they never handled a drop. The parents paid Coca-Cola 92 cents a gallon for syrup, then turned around and ‘resold’

¹⁶ Though it is not clear as to when Coca-Cola was first bottled, the first entrepreneur to make a lasting enterprise out of bottling was Joseph A. Biedenharn in 1894 in Mississippi. Biedenharn would later recall that the soda water bottlers at the time, “didn’t want to bother with [Coca-Cola]; besides, they said, the price for Coca-Cola was too high” (Tedlow, 1990, p. 41).

¹⁷ Asa Candler, then president of the Coca-Cola Company, believed that the bottling of Coca-Cola would not prove profitable. Later in his life he recalled some remarks to the two lawyers at their first meeting: “[W]e have neither the money, the brains, nor the time to embark in the bottling business.” Source: Asa Candler’s deposition, *The Coca-Cola Bottling Company v. The Coca-Cola Company*, Fulton County Superior Court, 1920. Also *The Coca-Cola Bottling Company vs. The Coca-Cola Company*, U.S. District Court, Delaware, 1920.

¹⁸ The legitimacy of the perpetual nature of the contract was called into question during legal battles between Coca-Cola and the, by that time, two parent bottler companies (split from the single original in 1900). The bottlers perceived the original contract “as perpetual and unbreakable... [Coca-Cola] was legally obliged to sell them syrup at 92 cents a gallon” (c.f. *Bottling Case*, footnote 12). Asa Candler, on the other hand, swore under oath that he never intended the contract to be of a permanent nature.

¹⁹ While we were unable to find any documented justification for this kind of 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. 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). One assumes that the bottling equipment did not translate very easily into productive services beyond bottling soft drinks, and without the reputation of the Coca-Cola filling those bottles they might as well have filled them with water.

it to the actual bottlers at a generous markup, usually \$1.20 a gallon. It was all done on paper.”

The contract between Coca-Cola and the parent bottlers was amended in 1901 when the interests of Coca-Cola, the parent bottlers, and individual bottlers coincided. As related by Pendergrast (p. 82), the parent bottlers had been demanding one half of the bottlers’ profits. Bottlers felt that this could bankrupt them, and the parent bottlers seemed to agree. Also, the Company had been supplying free advertising to bottlers, a situation that quickly deteriorated into a tragedy of the commons. Furthermore, at the 92 cent-per-gallon price, the Company was having difficulties with excess demand from the bottlers. The result was an undated amendment to the original contract in which the Company agreed to sell syrup to the parent bottlers at \$0.90 per gallon plus a \$0.10 per gallon rebate for advertising materials.²⁰ So the parent bottlers basically paid \$0.90 per gallon for syrup and \$0.10 per gallon for advertising materials – a cost that they passed on to the bottlers. Also, parent bottlers changed their policy of taking half the bottlers profits and instead agreed on a straight 6 cent per case (quarter cent-per-bottle) royalty.

A flood of legal costs arose for the Company with the passing of the Pure Food and Drugs Act (PFDA) in 1906. In 1891 the Georgia State Board of Pharmacy examiner had declared that a detectable amount of Cocaine was in Coca-Cola. Before and after that declaration, the Company had gone to great efforts to rid its drink of Cocaine while still including extract from the coca leaf.²¹ However, the residual association of Coca-Cola with cocaine – along with the caffeine content of the soft drink – resulted in the prolonged investigation of the Company by Dr. Harvey Wiley, chief chemist of the U.S. Department of Agriculture. One result of this investigation was the banning of Coca-Cola at canteen and post exchanges by the U.S. War Department in the spring of 1907—a definite negative demand shock. This ban would not be lifted until the fall.²² Then in October of 1909 Wiley seized 40 barrels and 20 kegs of syrup from a railroad in Chattanooga, Tennessee. That same year, the American Bottlers’ Protective Association (ABPA), a trade association for the bottlers of carbonated beverages, passed a

²⁰ Source: Thomas Ben, letter to W.D. Boyce, November 15, 1901, “Benwood.”

²¹ These efforts were quite involved because the Coca-Cola Company feared that its protection of the *Coca-Cola* trademark would be threatened by removing one of the namesake ingredients entirely. This would become a non-issue in 1920 when the Supreme Court, in an opinion written by Justice Oliver Wendel Holmes, Jr., declared in a trademark infringement case involving a soft drink by the name of “Koke” that Coca-Cola was “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” regardless of the ingredients (Pendergrast, p. 143).

²² The ban was actually the result of a peripheral revelation of the scrutiny: minute alcohol content. “In the preparation of Coca-Cola syrup the essence of two ingredients was extracted in wine or in grain alcohol, and a minute amount of this alcohol found its way into the finished product” (Young, p. 7, 1983). This was very disturbing and potentially very damaging to the Coca-Cola Company which had been advertising 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, p. 7, 1983).

resolution opposing the sale of any soft drinks containing extracts of coca or kola or caffeine (Riley, 1946, p. 35). By 1911, Coca-Cola found itself in court under charges of violation of the PFDA for its caffeine content and misbranding.²³ Eventually this would end in a directed verdict in favor of Coca-Cola. By 1917 the Department of Agriculture had worked its way through multiple appeals and the Company decided to compromise – after pleading no contest – and reduce the caffeine content of its syrup by half while doubling the amount of (decocainized) coca leaf and Kola nut. In the end, the Coca-Cola Company had spent over \$250,000 on the case (Pendergrast, p. 124).²⁴ Using the 1917 GDP deflator this translates into \$2.8 million in 1992 dollars.

In the year 1913 the Company would see some cost relief in October when the tariff on Cuban sugar was reduced from 1.3840¢ per pound to 1.0048¢ per pound (Riley, 1946, p. 44). But the relief would be short lived. In 1917, previous to the U.S. declaring war on Germany, the federal government instituted sugar rationing. In May of that year sugar sold for 8 cents per pound, up from an average of 5 cents per pound that had held for many previous years (Pendergrast, p. 129). Then, effective February 1919, a 10 percent tax on soft drink syrup was imposed (Riley, 1946, p. 73). Around the same time the Company also experienced shortages of caffeine and caramel, other ingredients constituting the syrup. Furthermore, the company had to deal with the outflow of consumers during WWI as well as the inflation that followed the War.²⁵

Also during this time period the nickel Coke became a standardized size. When the parent bottler had split in two in 1900, Whitehead's southern company chose to utilize a 6-ounce bottle. Thomas' northern company opted for an 8-ounce bottle. Clearly this was *effective* price discrimination between the customers in the hot south and those in the colder north. Coca-Cola was then still perceived as a mainly summertime weather drink. In 1916 this effective price discrimination ended and a standard 6 ½ oz “hobble skirt” bottle was adopted nationwide. Besides a desire to standardize the product, this move also reflected the Company's desire to be seen as a year round beverage.

In 1920 Prohibition was enacted. This was undoubtedly a positive demand shock. The Company proudly advertised its product as the “Great National Temperance Beverage” (Pendergrast, p. 111).

²³ Quite paradoxically, the use of the coca bean as part of the Coca-Cola name led the Department of Agriculture to claim that the Coca-Cola 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 Coca-Cola did not contain cocaine!

²⁴ Part of the compromise included Coca-Cola paying all legal fees on both sides. Furthermore, Coca-Cola forfeited its 40 kegs of syrup (Young, 1983, p. 18).

²⁵ During this time directly after WWI, there were few incidents of some retailers charging 6 and 7 cents for a Coke. Also some bottlers, against their agreement with the Coca-Cola Company, perverted the syrup with sugar substitutes (Source:

However, in the same year the Coca-Cola made a terrible miscalculation when a sugar shortage caused the price of sugar on the world market to reach a record high of 28 cents per pound.²⁶ In an act aimed at maintaining a continuing supply, the Company signed a series of contracts with several large importers and refineries to ensure the delivery of 4,100 tons of Java sugar at price of \$0.20 per pound. Then, in August of the same year, the world sugar market collapsed, sending the price tumbling to 10 cents per pound, and then 9 cents in December. The upshot was that Coca-Cola was committed to buying \$8 million of sugar that was worth only half as much on the world market (Landers, 1950). By 1921:

After a severe commodity shakeout... that helped the bottler not at all, the prices of everything he bought moved against him. He didn't do very well at his current volume and neither did the parent company, ... In fact, the company, with its warehouses full of 22-cent sugar, which was then selling for 3 cents, was a lot worse off than he was—it was bankrupt (Fortune, 1951, p. 129).²⁷

To appreciate the magnitude of this blunder it is useful to note that, in 1925, the Company reported that, “More than 100,000,000 pounds of sugar are used annually to make Coca-Cola, we being the largest consumers of pure granulated sugar in the world” (Coca-Cola Company, 1925). If the Company was paying even \$0.10 above market price that would amount to a cost of \$1 million, or roughly \$9 million in 1992 dollars.

In March of 1920, due to the above cost shock, the Company announced that it would terminate its contracts with the parent bottlers, arguing they were never meant to be in perpetuity. At this point Coca-Cola was losing \$29,000 per day (\$213,235 in 1992 dollars) due to the inability to change the price at which it sold syrup to bottlers (Howard Candler, *Bottler Case*, pp. 1608–1609). The parent bottlers obtained a temporary injunction blocking this action. However, quite obviously it was not in the parent bottlers—nor the bottlers—interest to bankrupt the Company. A temporary solution was reached allowing the Company to sell syrup to the parent bottlers for \$1.72 per gallon with a floating adjustment (a form of indexation) for sugar price changes (Pendergrast, p. 140). However, in November

“Sugar Substitutes,” *Coca-Cola Bottler*, June 1918, p. 22, “The Use of Saccharin,” *Coca-Cola Bottler*, September 1918, p. 16, and “Sugar and Its Substitutes,” *Coca-Cola Bottler*, December 1918, p. 16). These episodes, however, were isolated.

²⁶ See Genesove and Mullin (1997, 1999, and 2001) for a fascinating historical account of the sugar market in the US during the late 1800s and early 1900s.

²⁷ The *Fortune* article cites \$0.22 cents per pound as the price Coca-Cola paid for the sugar. Pendergrast (p. 142) states \$0.20 per pound and Allen (p. 119) simply states that, at the time of the sugar purchase the world market price was \$0.28 per pound and that Coca-Cola paid “exorbitant prices” locking in a continuous supply of sugar. In any case, the price the Coca-Cola Company paid was very high compared to what the world market price became.

the parent bottlers' contracts were ruled permanent in court.²⁸

Realizing, again, that it was not in their interest to see the Company go bankrupt, the parent bottlers were able to reach a more lasting agreement with Coca-Cola. Beginning on November 1, 1921, the Company sold syrup to the parent bottlers at \$1.17 per gallon, who then sold it to the bottlers at \$1.30 per gallon; also, for every cent a pound of sugar increased in excess of 7 cents, syrup price would increase by 6 cents (Pendergrast, p. 144). Also, from 1923 onward, the Company began a more direct solution to the contractual disagreements: buying failing bottlers.

During the Great Depression the Company witnessed changes in both market conditions and technology. The Great Depression was a negative demand shock. On top of that, an upstart soft drink company named Pepsi-Cola began to market a 12-ounce bottle for the same nickel price. During this time we see the Company resisting downward price pressure in the face of direct price competition and the general deflation that accompanied the Depression. Worthy of note was the negative stigma placed on price competition in the retail drug industry, the major outlet of fountain Coca-Cola sales, and also the food industry, a major outlet for the Company's bottle sales. Figure 2 demonstrates the general deflation (GDP deflator) experienced during the Depression years. However, in spite of—but also as a reaction to—this general deflation was a backlash in public opinion and political policy towards price-cutting.²⁹

Among Depression era technological changes, the refrigerator became a common household technology and sales of 6 packs suddenly became an important part of the market. In general, a trend away from daily shopping to staggered trips to supermarkets once or twice a week became the rule as “[t]he corner neighborhood grocer [became] nearly a museum piece” (Fortune, 1951, p. 131). This trend would continue and by 1955 the take-home market constituted between 35–52 percent of bottle sales depending on the area (*Business Week*, 1955, p. 45). Also, 1936–37 saw the introduction of coin-operated coolers (the earliest bottled soft drink vending machines). Red Coca-Cola coolers were already

²⁸ The sugar situation was so dire that fountain Coca-Cola drinks in Atlanta, Georgia temporarily rose to 8 cents. However, despite the fact that this occurred in Coca-Cola's own backyard, the incident was isolated to Atlanta (*Atlanta Constitution*, April 18, 1920, “Eight Cents a Glass: Coca-Cola Price Uniform 8 Cents at Founts Monday.”).

²⁹ Even as early as 1929 the Federal Trade Commission (FTC) issued a statement condemning the unfairness of competitive practices, typified by destructive price-cutting (Riley, 1946, p. 134). Spokespersons of this view found expression in 1933 and 1934 issues of *The Red Barrel*, a magazine published by the Coca-Cola Company: one by Harvey Henry, National Association of Retail Druggists chairman, and one by Fred Griffiths, president of the Pennsylvania Drug Company, respectively (Henry, 1933 and Griffiths, 1934). A similar view, concerning the food industry, also appeared in *The Red Barrel*, by Paul Willis, president of the Associated Grocery Manufacturers of America, advocating an end to price-cutting and a focus on volume and profit (Willis, 1932). Also, the price-cutting by Pepsi and other soft drink companies exerted enough pressure on producers that the American Bottlers of Carbonated Beverages (ABCB), a trade group, issued monographs on responsible “price practices” (Riley, 1946, p. 134).

a familiar sight to consumers at the grocery store. In 1936 the Vendo Company in Kansas City was formed for the express purpose of marketing vending tops for the coolers (Schreiber, 1961, p. 42).

Despite these technological and competitive changes in the soft drink market, and the repeal of Prohibition in December 1933, the Company maintained its nickel price and, as can be seen in the 1928–1939 gallon sales versus real GDP in Table 1, was exceptionally robust during the Great Depression. Coca-Cola was certainly not unaffected by the large negative demand shock associated with the Great Depression. However, it recovered strongly compared to the economy as a whole and even managed to avert negative sales growth as the economy experienced the “Roosevelt Recession” in 1937–38. Indeed a 1938 *Barron's* article marveled that, “You could have bought Coca-Cola stock at the top price of 154 1/2 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).³⁰

Another development during the Depression-era concerned the relation of the Company to its bottlers. The Great Depression saw many casualties in the form of bankrupt bottlers. The Company, as stated above, was pursuing a policy of buying these failing bottlers, including parents. By 1940, Coca-Cola had purchased 25 bottlers and all the parent bottlers save for the Thomas Company. Due to splits there were 6 of them at that point (Pendergrast, p. 186).

WWII introduced additional turbulence into the soft drink market. Again consumers became soldiers and left the country. Again sugar rationing was enacted. At the worst point producers were rationed 50 percent of their pre-war levels (Pendergrast, p. 201). In general, for a soft drink producer, “Shortages of crowns, sugar, bottles, case, gasoline, trucks, equipment, manpower, and of virtually everything else required for production and business operation were problems of everyday occurrence” (Riley, 1946, p. 86). Despite the increased cost and loss of consumers, the Company chose to incur additional costs implicit in a pledge: Coke would be made available to every member of the armed forces at a nickel a drink, no matter where they might be (Kahn, 1969, p. 84). The U.S. government lent a hand. Sugar used for syrup sales to the military was available without limit (Office of Production Management, Order M-55, December 13, 1941, Coca-Cola Company Archive). Besides overseas operations to deliver Coca-Cola to U.S. soldiers, the Company also served the huge training camps across the U.S. (see footnote 32). For these soldiers Coca-Cola not only sold nickel Cokes but also *sold nickels (at cost) to the soldiers!* (*Coca-Cola Bottler*, 1944a, p. 35).

Post-war inflation placed a building pressure on the nickel Coke. By the late 1940s, with

³⁰ Interestingly, President F.D. Roosevelt made more nickels available to consumers during the 1930s and, “Coca-Cola and the soft-drink business really spurted” (*Fortune*, 1951, p. 129).

production costs soaring, a handful of bottlers broke from the normal cost structures and charged \$0.90 to \$1.00 per case to retailers, rather than the usual \$0.80 (Coca-Cola, 1983). In reaction, the effected retailers had no choice but to break from the nickel. The 1950s indeed would mark the decade when the bell tolled for the nickel Coke. *Time* ((b), 1950, p. 12) observes that, even at that early date, "... [i]n New York City, bottled Coca-Cola broke loose from its nickel moorings for the first time and went to 6¢." However, according to the Company, as of 1950 still only 125 of the 1100 bottlers (5 percent) had initiated wholesale price increases (Coca-Cola Company, undated). In 1951, Coca-Cola dropped the placing of "5¢" in its advertising material. By 1955 *Business Week* (1955, p. 44) reports that "[a] bottle of Coke today sells for 6¢, 7¢ or even 10¢, depending on the area." In fact the Coca-Cola Company was even experimenting with the previously unheard idea of offering various bottle sizes for different prices: a 26 ounce "family-size" (2 for \$0.31 with a \$0.05 deposit per bottle) and a 10 ounce "king-size" (1 for \$0.07 or 6 for \$0.35 with a \$0.02 deposit per bottle) (*Business Week*, 1955, p. 45). By 1959 the last of the nickel Cokes were no more.

Above we have documented various supply and demand shocks to the Coca-Cola Company from 1886 to 1959. In Figure 3 we display the main events described above on the Coca-Cola time line.

III. Coca-Cola Nominal Price Rigidity

The Coca-Cola Company had *no explicit, legal recourse for controlling the price at which the Coke bottles sold at retail*. Yet, for all intents and purposes, the Company maintained and controlled the nickel standard across the U.S. Exactly how this was done is an interesting question. We find that the Company used a combination of several methods to enforce the nickel price at the retail level.

First, the Company employed negative incentives aimed at bottlers such as limiting promotional opportunities and withdrawing rebate programs for buying advertising. Because of the sensitivity of the matter, it turns out that not much was put in writing on this issue. However, some documents indicate the Company's determination to control the nickel price even if it meant confronting the retailers. 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 Coca-Cola 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 their wholesale price (the price the bottlers were charging them) has remained unchanged at 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 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).

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. Coca-Cola maintained strict control over its trademark, so that all equipment and promotional items (e.g. trucks, fountains, vending machines, signs, displays, and the Coca-Cola bottle design) were only available from the Company to bottlers and, therefore, retailers as well. Advertising items were an important concern to bottlers. These items could be offered to retailers to entice additional purchases of Coca-Cola from the bottlers. These were often a major part of the discussions in the articles contained in *The Coca-Cola Bottler*, a trade publication published by the Coca-Cola Company and distributed to the Company bottlers.

The third tool the Company used to indirectly control the retail price was by explicitly including the nickel price in various forms in its promotional and marketing ads and other advertising material that were distributed nationally in large quantities. As Munsey (1972, p. 161) notes, “Beginning with John. S. Pemberton’s first newspaper advertisement in the May 29, 1886 issue of *The (Atlanta) Daily Journal* and running consistently to the present, Coca-Cola has been religiously advertised in newspapers.” In addition, since its early days, the Company placed full color ads in national magazines, which included *Life*, *The Saturday Evening Post*, *Collier’s* and *National Geographic*, and later also included, *Time*, *Newsweek*, *Fortune*, and alike. While we do not have full details of the extent of Coca-Cola’s use of this medium, we have some snapshots. For example, according to Munsay (1972), during the second six month of 1926, the company used 1,140,000 lines (approximately 82,000 column inches) of newspaper space.

In addition to these advertisements, the Company every year was distributing, via bottlers to retailers, millions of promotional items. In Table 2, we list the advertising material distributed by the Company during 1913 alone, which include 5 million lithograph metal signs (from 6” X 10” to 5” X 8”), 2 million trays for soda fountains, 1 million Japanese fans, 1 million calendars, 10 million matchbooks, 50 million paper doilies, etc.

An important aspect of these incredibly extensive advertising and promotional material is that they often featured the nickel price as part of the advertisement. We find that the strategy of publishing the Coke’s nickel price in print ads received particular attention from the Company management during the late 1940s. The Company made extraordinary effort to try and convince regional bottlers to keep the

5¢ price an integral part of their advertising campaign. For example, Everett C. Murphy, the Vice President of the Western Coca-Cola Bottling Company, based in Chicago, Illinois, on December 4, 1946, reported to the Company's Atlanta Headquarters, on his efforts to gather information on the extent of the use of the "5¢ Price Newspaper Advertising" in his region, which at that time included Colorado, Idaho, Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Utah, and Wisconsin. According to his account, on November 25, 1946, he "... wrote all bottlers urging them to use the special nickel price advertisements wherever the situation warranted."³¹ Based on 82 replies he received by December 4, 1946 he reports the following: "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 November 25. 48 Bottlers reported plans to run 212 insertions of the special copy for a total of 12,705 inches after November 25." Note that all these newspaper ads contained the 5¢ price as the focal point.

This strategy of nationally advertising the Coke's nickel price on millions of print ads and promotional material made it almost 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 price to his dealers from 80 cents per case (a case of Coca-Cola contained 24 6 ½ oz bottles) to \$1 per case. But after just two months Gilham had to cut the price back to 80 cents. According to the *Fortune* article, about 40 percent of the retailers tried to pass the higher costs on their customers. Their 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).

Another mechanism the Company used to ensure the nickel price at the retail level was by publicly announcing that it has not increased its wholesale price. This strategy put the retailers in the defensive, as it made any price increase by them difficult to justify. For this the Coca-Cola Company was aggressively monitoring what the Company management called "the price situation" by identifying bottlers who may have increased the wholesale price and/or the retailers who were charging above the

³¹ 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 advertising agency, to push the

nickel price. We find numerous documents and correspondence discussing “the price situation” in various areas of the country and actions proposed and/or undertaken based on the findings. 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: “... 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).³²

Finally, the Company made substantial efforts to have sales managers *educate* bottlers and retailers on why a constant price was profitable to all. “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.”³³ There does exist theoretical work in the marketing literature making such a situation intelligible. 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 finding is based intuitively 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 contracting, implicit understanding achieved via learning will lead to higher profits for both a manufacturer and retailer.

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).

³² Source: Coca-Cola Company Archive. 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.

³³ These striking examples and more are found in “Reviewing ‘A Proud History:’ 1886–1925,” The Coca-Cola Company (1925), presented to Coca-Cola sales and advertising managers.

IV. Coca-Cola Quality Rigidity

One possible reason for nominal price rigidity may be quality adjustment (Stiglitz, 1987). The argument is that if quality is adjusted in direct response to changes in market conditions, while nominal price does not change, then prices are not necessarily “rigid” in the sense that the nominal rigidity does not necessarily imply inefficient allocation of resources. Therefore, it is important to demonstrate that during the Coca-Cola price rigidity period, no quality adjustment was made willingly in a direct response to changes in market conditions.

In this section we briefly document the history of changes made to the “Secret Formula” that might be interpreted as quality changes. We show, however, that these changes did not really involve a quality change. Some of the changes we list below were necessitated by the technological need to reformulate the product or its production process in order to make it more portable and more storable. Other changes that were made were forced onto the Company by government regulators. But most importantly, *none of these changes were perceived by the public as a change in quality*. Thus, we argue, none of the documented changes in the Secret Formula could be replaced by some “equivalent” price change. We discovered only one short and temporary episode of what could be described as a minor quality adjustment of Coca-Cola, and even that was made reluctantly, only after the Company failed to find another, more preferable solution.

According to Schaeffer and Bateman (1985), there are six documented occasions of Secret Formula alterations during the period 1886–1960.³⁴ Below we detail each one of these six “quality change” episodes and describe the circumstances that led to each.

The first documented change in the Secret Formula occurred in 1889. The company was swamped with complaints from soda fountain operators that the syrup turned rancid in storage. Because it lacked an adequate preservative, Coca-Cola syrup was highly unstable; for example, it had a tendency to begin fermenting. Glycerin was added. Also, certain ingredients were added and taken out to further ensure that the ingredients were more “compatible” (Candler, 1950, 1952). This change was needed to ensure that an identical product could reach all segments of a broader market.

The second documented change in the Coca-Cola Formula has to do with the difference between the syrup that was used for fountain Coca-Cola as opposed to that which was used for bottles. In 1899 it

³⁴ More recently, there were two more changes in the secret formula: one in 1980, when the company began using high fructose corn syrup 55 (HFCS-55), as 50 percent of the sweetening agent in Coca-Cola, and the second, the introduction of the New Coke in 1985. The latter is discussed in some detail in section VII, where we try to assess the cost of adjusting Coca-Cola quality.

was decided to prepare two different syrups—one for the fountain and one for the bottles. The two syrups differed in the exact amount of sugar, caffeine, caramel, citric acid and phosphoric acid they contained (Allen, 1994, p. 9). These differences were designed to adapt the drink to two different settings, bottle vs. fountain, in order to guarantee that the two drinks had an identical taste – in order to ensure identical quality of the end products.

The third change in the Secret Formula came in response to government’s effort to impose a tax on Coca-Cola as part of a larger plan to collect a stamp tax on medicine effective July 1, 1898. The Company was forced to pay \$29,502 in taxes. The Company later sued the government and recovered the tax payments. However, during the trial Company president Asa Candler had to admit under oath that Coca-Cola contained “a very small trace” of cocaine.³⁵ The company was forced to relegate the preparation of “Merchandise No. 5,” the ingredient containing the coca and kola extracts, to an outside contractor to ensure that no cocaine slipped through the manufacturing process. This change was exogenously imposed on the Company by the court system and government regulators. It could not be replaced by a price adjustment and therefore, does not constitute a quality change.

The fourth change concerned the fact that, since the beginning, the Company was using a grade of sugar known as “Confectioner’s A,” which is in a powdered form unlike the ordinary “granulated” table sugar. Because of its powdered form, Confectioner’s A sugar carries some moisture, causing a tendency to sour (Candler, 1950, pp.123-124). The company’s sugar refiners had repeatedly urged a change to regular granulated sugar. The switch was made in 1904 to avoid paying freight on the moisture in the sugar as it was transported from refineries to the syrup factories. Since we find no evidence of perceived change in the quality, it seems reasonable to think of the two types of sugar as perfect substitutes in the production process. The reason for the change was clearly technological, although a cost of production argument was effectively used by the refiners. Therefore this change does not really constitute a change in quality.

The fifth change was a direct result of a March 13, 1909 lawsuit brought by the U.S. Department of Agriculture against the Company under the National Food and Drug Act of 1906. According to the lawsuit, “The government had two main charges against Coca-Cola: It was ‘misbranded’ because its name promised the presence of coca and cola [*sic*] when it contained little if any of either, and it was ‘adulterated’ by the addition of caffeine.”³⁶ On April 20, 1918 the Company finally agreed to a

³⁵ Source: Henry A. Rucker (Collector of Internal Revenue) v. The Coca-Cola Company, U.S. Circuit Court, District of Georgia (Trial and Appeal Record, Federal Records Center, East Point, Georgia).

³⁶ Source: United State v. Forty Barrels and Twenty Kegs of Coca-Cola, 241 U.S. 265, 289. Record of appeal from the Federal Records Center, East Point, Georgia. It seemed as if Wiley [the Chief Chemist of the U.S. Department of

settlement. It would reduce the caffeine content by almost two-thirds. Again, since this change was exogenously imposed upon the Company it could not be replaced by an equivalent price adjustment.

The sixth change in the Secret Formula was linked to the sugar shortages and consequent government rationing from WWI. The Company stockpiled sugar at a cost of 28¢/lb, almost four times its pre-war price. As mentioned in section II, within a short period of time, the price plummeted and the Company found itself committed to spending over \$8 million on sugar that was suddenly worth less than half of that. To avoid this blunder from ever occurring again, the Company developed a “syrup concentrate”—a form of syrup with considerably less sugar than regular syrup. This concentrate could then be used in any production plant just by adding sugar to it. Up until that time, cane sugar had been the only source of sugar used in Coca-Cola production, and it could only be produced in tropical and sub-tropical regions. The Company hired a German scientist, an expert in sugar development, who along with Company chemists successfully developed a beet sugar without compromising the quality of the drink (taste, flavor, etc.). Because beets were grown more widely, the use of beet sugar made it easier to assure the continuous supply of Coca-Cola during war times and other sugar shortage periods. Again, this is best viewed as a change in the mix of substitutable inputs.

In addition to the above documented changes, we discovered one episode of an undocumented temporary change in the Secret Formula. This happened in 1942 as the sugar shortage and the resulting rationing due to the WW II created a substantial 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*.”³⁷ Additionally, at that time there was a shortage of caffeine, as its inventory was down to less than a month’s supply and its price shot up from \$1.50 per pound to more than \$7.50 per pound.³⁸ The Company approved a temporary cutback in the amount of caffeine and coca-leaves (also hard to obtain at the time). Woodruff’s admonition to the Company chemists: “to be *very* [emphasis in original] careful not to change the flavor.”

We found overwhelming evidence that indicates the extent to which the Company went to ensure no perceived change in the quality of its product. Below we provide a partial list of that evidence.

For example, consider this unusual exchange that took place on December 28, 1899, during a

Agriculture], having failed in his determined efforts to discover cocaine in Coca-Cola, now wished to punish the company for not having cocaine and for using caffeine in its place.”

³⁷ Source: Robert W. Woodruff in a letter to Arthur Acklin, dated October 2, 1942, Robert W. Woodruff Papers, Special Collections Section, Emory University Library

³⁸ Ralph Hayes’ letter to Robert W. Woodruff, May 5, 1954, Robert W. Woodruff Collection, Emory University Library.

meeting Asa Candler held in Atlanta with a group of top salesmen, branch managers, home office personnel, and “other intimate and helpful friends.” According to Candler (1950, p. 139), one issue that came up during the meeting was cocaine: “Everywhere they went, the salesmen were encountering more and more rumors about how Coca-Cola led to cocaine addiction. Even the temperance women, who should have been on Coca-Cola’s side, were turning against the drink. Finally, someone asked the heretical question: ‘Couldn’t we just take out the cocaine? Does it really make that much difference?’ ” Candler’s response: “So you want me to change the formula of the country’s favorite beverage because of some hysterical women? Do you really want us to change Coca-Cola, the purest, most healthful drink the world has ever seen? ... Never! There is *nothing* [emphasis in original] wrong with Coca-Cola. If there was anything the matter with it, do you think we would have such a problem keeping everyone supplied with it? No, Coca-Cola has been good to me, and I will not change it. That’s the end of this discussion.”

Likewise, consider a shortage of coca leaves that occurred at the end of 1929. Narcotics laws in the U.S. prohibited any importation of coca leaves to the US. The exceptions were two companies, Maywood and Merk & Company, which were allowed to import them and manufacture cocaine for medical and scientific purposes. Coca-Cola was buying the coca leaves extract from these companies, after the companies had filtered the cocaine out. By the end of the 1920s the two companies were unable to manufacture enough coca leave extract to meet the Company’s needs. The Company, therefore, began lobbying in Washington, leading to the introduction of an amendment to the proposed 1930 Porter Bill. The bill was designed to toughen U.S. narcotics laws. Both houses of Congress approved an exemption to the federal law for the Company, provided they would destroy any cocaine and other byproduct alkaloids under the supervision of the newly established Bureau of Narcotics. However, the calculated cost of manufacturing Merchandise No. 5 would now, due to new taxes and processing expenses, increase to \$1.11 per pound.³⁹ The Company decided to incur this increased cost.⁴⁰

The Coca-Cola Company clearly exhibited a resistance to any change in the quality of its product. Further, 6 out of 7 changes in the Secret Formula should not even be viewed as quality changes. Even further, we find no evidence that consumers ever perceived a change in quality. These conclusions are supported by the Company’s stubborn reluctance to any change in the Secret Formula, and efforts to

³⁹ Source: Memo from Harrison Jones, vice president for sales, to Robert Woodruff, dated July 28, 1930, The Coca-Cola Company Archives.

⁴⁰ We have not been able to discover what the cost of coca leaves increased *from*. However, it is worth noting that, being the result of legislation, this was a *permanent* shock to *marginal* cost. The Company chose to incur this increase rather than

keep consumers unaware of the changes that did occur. Also, the changes were temporary whenever possible.

Finally, we note for skeptics that even if the cases of Secret Formula changes are interpreted as quality changes (i.e., as a form of a non-price adjustment mechanism), making our above arguments unconvincing, we still observe on average decade-at-a-time quality-adjusted nominal price rigidity – still at least twice as long as the longest documented price rigidity in the literature.

V. Coca-Cola Quantity Flexibility: The Improbable Margin of Adjustment

The most famous detective in all of fiction, Sherlock Holmes, is known once to have said to Watson that, “If we eliminate the impossible, then what remains, no matter how improbable, must be the truth.” We have documented above that the Coca-Cola Company weathered numerous and substantial supply and demand shocks without adjusting price or quality. Yet the Company must have adjusted to market conditions. If we ask how, the evidence presented clearly puts the margins of price and quality as answers in the category of impossible. What’s left is the improbable: the Coca-Cola Company made the choice to adjust entirely for over 60 years along the margin of *quantity*. See Figure 4.

Indicative of this is a set of historical review bulletins distributed by the Company during the spring of 1925 to regional managers, regional outdoor advertising managers, branch managers, district sales managers, salesmen, service section employees, sign painters and decorators for the Company. These bulletins, which were distributed under the title, *Reviewing “A Proud History:” 1886 to 1925*, discussed and analyzed Coca-Cola’s business strategy. The central themes were the importance of (1) preserving quality, (2) maintaining the price at 5¢, and (3) adjusting quantity to meet increased demand. In bulletin 5 the Company claimed that, “It is this volume [quantity] 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 using synthetic ingredients.” The 11th bulletin stated quite explicitly that, “We [Coca-Cola] have a one price policy.” And *each and every* bulletin featured, in large bold letters at the bottom of each page, the motto, “Show him [the retailer] how to push sales to increase the profit on Coca-Cola.”

Quantity was the margin of adjustment even when other producers competed with Coca-Cola directly on the margin of price. Pepsi-Cola, during the Great Depression when price would seem to be of increased importance to consumers, introduced a 12-ounce bottle for a dime. Royal Crown Cola

accepting a potential one-time *fixed* cost shock in the form of negative consumer reaction. This is addressed again in section VII.

followed with an identical size/price offer (Pendergrast, p. 193). Coca-Cola's response: same price, same quality, and new ad campaign. "The result was the 'Back to Normal' series of magazine ads [showing] people's faces as masks of dull fatigue that could be whisked off after a sip of Coca-Cola" (Allen, p. 208). Despite the Depression and cheaper competitors, "everyone could find a nickel to 'bounce back to normal,'" as the Coca-Cola slogan promised (Pendergrast, p. 178).⁴¹

Later on, in a 1942 insert in a retail trade journal,⁴² the Company urged retailers concerning the nickel price to, "LOOK AT IT THIS WAY. Coca-Cola magnifies the nickel to real importance in your store. When you look at Coca-Cola in terms of what you sell in a year, you see a *big* profit from a 5¢ sale." The message: Take the price as a given and look at Coca-Cola in terms of what you sell.

The consistent marketing strategy of focusing on increasing demand and adjusting quantity is striking throughout Coca-Cola materials. In *Reviewing "A Proud History,"* The Company looked back on its growth as entirely demand driven. "The demand had grown to such an extent by 1897," recounted the second bulletin, "that it was necessary to open an additional factory at Philadelphia." They adjusted quantity. That bulletin was even titled, "*And the Demand Still Grows.*" In the following bulletin, the Company stated its philosophy succinctly: "Quantity and quality—Coca-Cola has both, but the quantity comes because of the quality—and the push."

During the time period we see common themes of quantity adjustment. First, advertise heavily to consumers to entice purchases from them. Second, convince retailers and bottlers that price and quality should be constant and profitability is through quantity. For example, consider a 1942 advertisement directed to retailers featuring a line of beauty pageant queens. The advice: "Just look at the figures!⁴³ Coca-Cola costs you \$0.80 a case. At 5¢ a bottle, you sell it for \$1.20 a case. Your gross profit is \$0.40 a case. If you average... one case a day, you make \$125.00 a year gross profit..."⁴⁴ In both of these themes, as we have seen above, advertising played a major role. Below we argue that advertising expenditures for the Company represented a lower bound of the variable cost of quantity adjustment.

VI. Cost of Adjusting Coca-Cola Price

Having documented the nominal price rigidity, we turn to the question of how costly adjusting

⁴¹ According to a colleague of ours, when he was a young boy, his mom used to serve her guests Coca-Cola bottles filled with Pepsi, suggesting that Coca-Cola was perceived as a higher quality product for social consumption. See, Bergen, et al. (2002).

⁴² Reproduced in Coca-Cola's Advertising Copy Collection, 1942, 01724 ARS, Coca-Cola Archives.

⁴³ Pun absolutely intended in a much less politically correct era.

⁴⁴ Reproduced in Coca-Cola's Advertising Copy Collection, 1942, 01724 ARS, Coca-Cola Archives.

price and/or quality would have been? In this section we explore what direct evidence exists of price adjustment costs. Also in this section we explore an additional, technology-based, source of price adjustment costs and present evidence of how it may have contributed to price rigidity in the 1940s and 1950s.

We turn our attention to the beginning of the 1950s, as the nickel Coke began to fade away. Some isolated incidents lend at least limited insight into the price elasticity faced by retailers of Coca-Cola. *Fortune* magazine (1951, p. 128) reports—albeit without citing explicitly the derivation of the statement—that, “the first result of such a retail-price increase [to \$0.10] is just too much to take: volume drops 30 to 60 percent.” This suggests price elasticity in the range of negative 0.3 to 0.6 around the neighborhood of the nickel. In a specific example (p. 128) the article cites a bottler in Louisiana who, in late 1950, urged retailers to charge a dime for the soft drink, increasing the wholesale price from \$0.80 to \$1.00 per case.⁴⁵ His case sales dropped off 40 percent: implied elasticity negative 0.4 in the neighborhood of the nickel. Interestingly, the bottler had tried the same pricing change in 1947 and found that “60 percent of his dealers kept the nickel price, but lost interest in pushing Coke” (p. 128). At the time the *Fortune* article was published, the Louisiana bottler was still charging \$1.00 per case but retailers were charging a nickel again.

In the late 1940s and early 1950s there is evidence of price adjustment costs associated with an installed base of vending machines, a majority of which were of a vintage only equipped for the nickel price. In 1936–1937 the Company introduced coin-operated coolers, the earliest introduction of Coca-Cola soft drink vending machines with lasting effects.⁴⁶ Red Coca-Cola coolers filled with ice and 6 ½ oz bottles were already common at the grocery store. They were introduced in 1935 and were manufactured by the Cavalier Company in Chattanooga, TN and the Westinghouse Company (Marshall, 1954, pp. 8–9). In 1936 the Vendo Company in Kansas City was formed for the express purpose of marketing coin-operated vending tops for the coolers (Schreiber, 1961, p. 42), and the Vendolator Company in Fresno, CA, did likewise (Marshall, 1954, p. 9). By 1937, 8,000 coin-operated Coca-Cola coolers could be found in public areas.⁴⁷ 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

⁴⁵ This \$0.80 per case wholesale price had been the standard since at least 1917.

⁴⁶ The first Coca-Cola vending machine was actually marketed in 1909, but the concept did not catch on. *The Coca-Cola Bottler* (May, 1909, p. 6, June, 1909, p. 6, and March, 1910, p. 14).

⁴⁷ “Merchandising Magic,” *Coca-Cola Bottler*, April 1959, pp. 134–136.

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 machine sales accounted for approximately 18 percent of soft drink sales according to 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. In particular, by 1950 there were about 400,000 fully automatic Coca-Cola bottle vending machines (Marshall, 1954, p. 9). The soft drink industry, as a whole, operated approximately 460,000 bottle machines at that time (Schreiber, 1954, p. 14). So while 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 approximately 25 percent of soft drink sales, and Coca-Cola disproportionately utilized vending machines, this suggests that considerably more than 25 percent of Coca-Cola sales were accounted for by vending machines in 1950.

This disproportional adoption of vending technology by the Company from 1936–1950 is made intelligible by the compatibility of the technology with the profits through increased quantity marketing strategy. Though accurate data for the time period are hard to obtain, we can see evidence of this compatibility in data from the Operating Ratio Study (ORS) of the National Automatic Merchandising Association (NAMA), a trade association, covering the 1948–1950 experience of vending specialist corporations. Much analysis of data collected is reported in Schreiber (1954, ch.14).⁴⁸ One of the corporations included in the ORS, American Canteen Company of America, was a vendor of soft drinks. As reported, the variable costs—equipment, labor, product and other operating costs—as a percent of sales were approximately 125 percent at a 1,500 drinks per 4 week period, 80 percent at 3,000 drinks, and 55 percent at 10,000 drinks (p. 163). So there was a minimum volume to achieve profitability, and then increased profitability after that point.

The above numbers relate to variations in output-per-time period for a given stock of vending machines and are not to be mistaken for economies of scale per se. What is important for the above numbers is “the amount of sales each machine produces in a given period” (Schreiber, 1954, p. 162). On the other hand, operating profit as a percentage of sales seems to have been a *decreasing* function of firm size. The ORS found that operating profit as a percentage of sales was on average 7.19 for firms

⁴⁸ Only three publicly owned vending specialists existed at that time: ABC Vending Corporation, Automatic Canteen Company of America, and the Rowe Corporation. These were the only publicly released data, the rest compiled from at most 66 firms (Schreiber, 1954, p. 157) by the Ernst & Ernst accounting firm for NAMA (Marshall, 1954, p. 103).

with sales of \$100,000 or less, 2.88 for sales between \$100,000 and \$500,000, and 1.96 for sales exceeding \$500,000 (Marshall, 1954, p. 107). So vending specialist firms experienced decreasing returns to scale, but, for a given stock of vending machines, the path to profitability was through *increased volume*.

As stated above, Coca-Cola, by 1950, had “blanketed” the nation with 400,000 bottle vending machines. Many of these machines were only capable of accepting a nickel. How many exactly is hard to say. The earliest evidence we found of a Coca-Cola vending machine capable of accepting multiple coins and making change was an advertisement in the April 1946 edition of *The Coca-Cola Bottler* (p. 49) for a Mills Industries, Inc. vending machine with “built-in change maker [that] [O]perates with nickels, dimes, or quarters.” At that time, the majority of vending machine advertisements still did not mention such features. So it is probable that a considerable majority of the 400,000 machines were nickel-only machines.

In regards to what magnitude of an investment these machines represented for the Company, we have a good idea of the purchase price of these machines. A September 1947 advertisement from *The Coca-Cola Bottler* (pp. 14–15) for an F.L. Jacobs Co. 143 bottle capacity refrigerated vending machine lists a price of \$272.00. The same advertisement lists a 67-bottle model for \$161.50. Another advertisement from *The Coca-Cola Bottler* in November 1947 (p. 72) for a Vendolator Co. 242 bottle vending machine lists the price at \$385.00. Concerning older models we have listings of prices for vending machines selling second-hand. In “The Trading Post” section of a February 1944 issue of *The Coca-Cola Bottler* (p. 47) a cooler with Vendo top to accept nickels was being offered for \$85.00. Also an April 1944 issue (p. 35) in “The Trading Post” listed various second-hand Vendo models for either \$125.00 or \$150.00; and a July 1944 issue (p. 36) lists second-hand Mills vending machines at \$150. Using the GDP deflator as reported in Appendix A of Gordon (2000), the above numbers represent a real price range of \$714.29 to \$2,251.46 in 1992 dollars. So the investment was of considerable value.

If the majority of the 400,000 Coca-Cola vending machines were nickel-only, then an investment of considerable value would be made obsolete by a change in the price of a bottle of Coca-Cola. This is suggestive that the vending machine technology could have been an important source of price rigidity. In addition, Marshall (1954, p. 53) observed that, prior to multiple coin and change making technology, “most operators [of vending machines] sold goods with well-established ‘popular’ retail prices.”

However, there are some criticisms that might be raised in response to such a technology-based price rigidity story. Firstly, depreciation costs were probably not small. While we do not have depreciation data from the Company itself, the ORS, again reporting for American Canteen Company

of America, listed equipment depreciation as 20.5 percent of direct operating expenses (Schreiber, 1954, p. 164).⁴⁹ This might be taken to suggest that abandoning the nickel-only machines would not have been overly painful for the Company as the investment quickly depreciated in its own right.

Furthermore, technology was available for updating existing vending machines with multiple coin acceptance and change making abilities. At least as early as June 1947, as evidenced by an advertisement from *The Coca-Cola Bottler* (p. 60), National Rejectors, Inc. was offering adapters for vending machines that would accept multiple coins, make change, and reject “slugs” as well. The late 1940s was the time when inflation pressure was beginning to build to a great extent behind the nickel price. Why, if the installed base of vending machines was a major source of price rigidity, was not the price rigidity simply alleviated by the new technology? Furthermore, it is interesting to note that National Rejectors, Inc. was marketing a “combination coin mechanism-rejector-changemaker [*sic*] that accept[ed] pennies, nickels, dimes and quarters in any combination and sequence” (Schreiber, 1954, p. 50-5, our italics). Yet an advertisement in *The Coca-Cola Bottler*, September 1947 (p. 51) implies that the model offered to the Coca-Cola clientele only worked with nickels, dimes, and quarters. Again, if price rigidity was arising because the installed base of vending machines, and the price change that would be desirable otherwise was 1 or 2 cents (as evidenced by Robert W. Woodruff’s asking President Eisenhower to request a 7.5 cent coin from the U.S. Treasury (Kahn, 1969, p. 133)), then why would National Rejectors not be advertising a non-penny-capable model in *The Coca-Cola Bottler*?⁵⁰ The Mills machine, for that matter, did not accept pennies either.⁵¹

These criticisms are valid but do not rule out an important role for a technology-based source of price rigidity. For one thing, it is possible that the multiple coin and change making technology was not effective and reliable at that stage. In fact, an internal memo from 1951 from the Company stated that, at least for vending machines with penny mechanisms, “they do not work as well as single coin mechanisms [and thus] cause loss of consumer confidence in coin coolers,” and ultimately they “reduce sales as compared to single-coin operation.”⁵² Despite the fact that change-making technology was

⁴⁹ Of course, accounting definitions of depreciation cannot be mistaken for the economic concept. Still, such a large number is at least suggestive that economic depreciation rates might have been high.

⁵⁰ Furthermore, according to Appendix A of Marshall (1954), Mills was selling a vending machine, with the capacity 120 units, at the price of \$395.00, which only accepted 5-cent and 10-cent coins, while another firm, General Vending, was 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.

⁵¹ Vending technology for dealing with pennies in and of itself was not lacking nor was it prohibitively expensive. Penny vending machines were some of the earliest vending machines to be utilized in the U.S., dating back to the 1890s (Marshall, 1954, p. 7). By 1950, despite the devaluing of the penny over time, 1-cent vending machine sales still accounted for 0.06 percent of total vending machine sales (Marshall, 1954, p. 105).

⁵² Source: “Single Coin Plan,” by Eugene Kelly, dated September 21, 1951, The Coca-Cola Company Archives.

available from at least 1946, 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 a change-making feature other than the above-mentioned Mills model. Also, the 1950 start date for the trend would coincide with the beginning of the nickel Coke’s demise.

Also, while depreciation seems to be significant, one cannot ignore that the used vending machine price documented above range from \$85.00 to \$150.00. This is a range of \$714.29 to \$1260.50 in 1992 dollars, so considerable value was maintained in the secondhand machines. The perceived net present value of vending machines with multiple coin, change making capabilities, also net of purchase price, may very well have still been less than the perceived net present value (NPV) in the already installed nickel-only machines. Along the same lines, the NPV of an adaptor, net of purchasing price, such as that offered by National Rejectors, might have been negative.⁵³

There is at least informal evidence that concern on the part of the Coca-Cola Company for the consumer convenience of needing only a single coin played an interactive role with the vending machine technology. As stated above, the Coca-Cola Company did not seem interested in technologies involving pennies.⁵⁴ Instead, Robert Woodruff was petitioning the U.S. Treasury for 7.5-cent pieces. Also, in 1952, at least one retailer, when he finally decided to change the price of a Coca-Cola bottle to 8 cents, decided to utilize a vending machine accepting dimes and stock the machine with bottles that had 2 pennies taped to the bottle bottoms. According to Allen (1994, p. 301), the experiment, which was designed to minimize the price adjustment cost, “... fizzled miserably.”

Finally, we can provide a rough estimate of the magnitude of the cost of price adjustment involved in replacing the older, nickel-only vending machines with newer, multiple-coin capable vending machines. Using \$714.29–\$2,251.46 as the price range in 1992 dollars for a single new vending machine, then replacing all 400,000 old vending machines in 1947 would cost the Coca-Cola Company somewhere in the range of \$285.72 million–\$900.60 million in 1992 dollars, undoubtedly a

⁵³ Purchase prices for the Mills vending machine and the National Rejectors adaptor clearly would be useful evidence for or against these suppositions. As of yet we have not been able to obtain these prices. However, the memo by Kelly (1951) states that “It will cost over \$200,000.00 to equip the coin coolers used by one concern in a certain very large city;” vague, but also suggestive.

⁵⁴ Or, at least, vending machine companies and adaptor companies did not perceive the Coca-Cola Company as being interested.

significant amount of money.⁵⁵

Our conclusion that the increased sale of Coca-Cola through vending machines made its price change expensive, and thereby contributed to the nickel Coke's price rigidity, is consistent with findings reported recently by Bills and Klenow (2002), who study the frequency of price changes for 350 categories of goods and services covering about 70% of consumer spending 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 Drycleaning” 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 Drycleaning,” 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, “Intracity 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.⁵⁶ Thus, even during modern times, vending machines and other coin-operating devices may be playing a role in forming barriers to price changes of the goods and services sold through them.

⁵⁵ A recent transition of the European countries to the Euro produced a similar situation, providing today's perspective on the problem the Coca-Cola Company faced during the 1940s and 50s. According to the media 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. Source: “Costs of the Change,” <http://europe.cnn.com/SPECIALS/2001/euro/stories/euro.costs/>. According to another report, in Europe there are also about 6–7 million machines covering transport tickets, car parks, cigarette, and gaming machines. Source: “From Shops to Machines: How Ready is Europe?” *The Guardian*, January 1, 2002, <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 of the Associated Press, *The Morning News*, Sunday, September 2, 2001, Nation and World Section, p. 5D, <http://www.nwaonline.net/pdfarchive/2001/September/02/9-2-01%20D5.pdf>). 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 (Source: http://www.wired.com/wired/archive/10.01/mustread_pr.html.) The report in *Time* magazine suggests that the replacement of older models of vending machines may cost as much as \$750 per unit (Source: <http://www.time.com/time/europe/eu/magazine/0,13716,191131-2,00.html>). See also the 14th Report of the United Kingdom Parliament Committee on Trade and Industry (<http://www.parliament.the-stationery-office.co.uk/pa/cm199900/cmselect/cmtrdind/755/75509.htm>).

⁵⁶ Another example of price rigidity that could be related to the use of a coin-operating mechanism is the 10¢ pay phone. Pay-telephone rates in many states remained a dime since about 1953–54 for over 40 years. For example, according to a recent CNN report (CNN Interactive, US News Story Page, October 11, 1997, available at <http://www.cnn.com/US/9710/11/briefs/dime.calls/index.html>), the pay phone rate in Arkansas was 10¢ from 1953 to 1997. According to the same report, the pay phone rate was 10¢ in Massachusetts, Vermont, and New Hampshire from 1954 to 1997.

VII. Cost of Adjusting Coca-Cola Quality

Now consider the cost of adjusting quality. As discussed in section III, the Company was persistent in its attempts to ensure the constant quality of its drink. Thus, the cost of adjusting quality cannot be really observed directly if the company never adjusts. However, below we examine two episodes. The first is from the relevant time period and describes a cost incurred to *avoid* adjusting quality. The second is from more recent history and examines the cost incurred when quality *was* actually changed.

The first episode, mentioned in section III, involved government imposed changes in the coca leaves processing methods due to the 1930 Porter Bill. As mentioned above in section IV, the U.S. Narcotics laws prohibited any importation of coca leaves with the exception of two companies, Maywood, and Merk & Company, which were allowed to import them and manufacture cocaine for medical and scientific purposes. Coca-Cola was buying the coca leaves extract from these companies, after the companies had filtered the cocaine out. However, by the end of the 1920s, the two companies were unable to manufacture enough coca leave extract to meet the Coca-Cola Company's needs. The Company, therefore, began lobbying in Washington, leading to the introduction of an amendment to the proposed 1930 Porter Bill. The bill was designed to toughen U.S. narcotics laws. Both houses of Congress approved an exemption to the federal law for the Company, provided they would destroy any cocaine and other byproduct alkaloids under the supervision of the newly established Bureau of Narcotics. However, the cost of manufacturing Merchandise No. 5 would now increase to \$1.11 per pound due to the new processing expenses. While we do not know what the cost of manufacturing was at the time, we know that the Company decided to incur this increased cost. Thus, the Company chose to incur a *permanently higher marginal cost* for manufacturing Merchandise No. 5 rather than incurring a *one-time fixed cost* in the form of changing the Coca-Cola quality. Even if the increase in the marginal processing cost was small, this suggests that the cost of adjusting quality, at least as perceived by the Company management, must have been significant.

The second episode was an actual change in the Secret Formula, the introduction of the New Coke that was made with huge fanfare in New York City on April 23, 1985. It can be viewed as a natural experiment, an independent episode of a quality adjustment that was undertaken in response to changes in market conditions. On this episode we have almost complete information. We know the reason for the quality change; what were the differences between the two products; we have some data on the cost of R&D that the Company incurred with the new formula; and there is a huge amount of "data" on the "real" cost of this quality adjustment – hundreds of thousands of letters sent and phone

calls made to the Company from the US and across the world by angry customers. A brief look at these customers' reaction to the formula changes is sufficient to recognize that the cost of this particular quality adjustment was paid in terms of lost customers and in terms of lost goodwill with remaining customers.⁵⁷

Let us briefly review the reasons behind and details of the formula change. Research on reformulating the Secret Formula began in early 1980s as the Company management learnt that the Coke's market share was declining while Pepsi's market share was rising. Large numbers of blind taste-tests comparing Coke to Pepsi revealed people preferred Pepsi by margins as high as 10 to 15 points. The Company chemists began experimenting with the Secret Formula by making and assessing countless changes until the point where they believed they had perfected a new formula. Indeed, with a \$4 million investment and a battery of 190,000 tests, with respondents from every age group and every region of the country, the New Coke beat Pepsi by 6 to 8 points. The New Coke also beat regular Coke.^{58 59}

Clearly the \$4 million the Company spent on the development and testing constitutes a part of the quality adjustment cost. In addition, bottlers incurred a loss of \$30 million in the form of unsold inventories of the New Coke.⁶⁰ However, this \$34 million is arguably insignificant in comparison to the larger cost incurred in altering a century old sacred formula, and by doing so altering the "quality" of the product. The New Coke was not "genuine," it was not "the real thing."

It is difficult to directly measure the size of "customer betrayal" costs. To appreciate its magnitude, however, consider the following "sociological" facts. Within a week over 1,000 calls were

⁵⁷ The description of the unprecedented public uproar that followed the introduction of the New Coke draws heavily on Allen (1994), Pendergrast (1993), and the reports of *Atlanta Journal and Constitution*.

⁵⁸ The introduction of the New Coke may have Granger-caused Robert W. Woodruff's death. Consider Pendergrast's (1993, p. 356) account based on his interview with Roberto Goizueta: "Over the Christmas holidays of 1984, Roberto Goizueta, Don Keough, Brian Dyson, and Ike Herbert decided unanimously to change the world's best known product just short of its hundredth anniversary. First, however, they needed the Boss's [Robert W. Woodruff's] blessing... On New Year's Day, Goizueta made the pilgrimage down to Ichauway. Alone with the old man, the Cuban CEO kept his story short and simple, reviewing the rationale for the formula modification—dwindling market share coupled with a superior new taste. In the end, Woodruff agreed, convinced that Goizueta was right and that tastes had shifted. It was more important that Coca-Cola be the best-tasting drink in the world than to cling to an outmoded formula. Strangely, though, the Boss couldn't eat his dinner that night. The next morning, he refused his customary huge breakfast. An era was ending, and Robert Woodruff would end his life with it. The Boss demonstrated the remarkable power of his will one last time. He simply stopped eating." Woodruff died on March 7, 1985 at the age of 95, about a month before the official introduction of the New Coke.

⁵⁹ There were several differences between the Old Coke and the New Coke. The biggest difference was that the New Coke contained less phosphoric acid, more citric acid, and more sugar, increasing the drink's sweetness. Other changes included adjustments in the amounts of caramel, caffeine, and vanilla, and the elimination of Merchandise No. 5 containing the extract of coca and kola. Merchandise No. 7x, the super-secret blend of flavoring oils, was also modified. Given so many changes in the Secret Formula, it is clear that the drink has underwent a substantial change in "quality."

⁶⁰ Source: Glenn Collins, "Ten Years Later, Coca-Cola Laughs at 'New Coke'," *The New York Times*, April 11, 1995, Thursday, p. C4.

being made to the Company's headquarters each day, almost all of them expressing shock, anger, and outrage at New Coke (Allen, 1994). By the beginning of June, the number of calls received increased to 8,000 a day. The Company was also bombarded by 40,000 letters of protest (Pendergrast, 1993). According to a consulting psychologist for the Company the letters and phone calls contained emotions "similar to those of grief-stricken parents mourning the death of favorite child." The main complaint was almost always the same: Coca-Cola had betrayed them.⁶¹ As we argue in section X below, the Company had an implicit contract with its consumers that included quality – the Secret Formula. The Company had broken a promise.

Company officials recognized they had a crisis on their hands. The Company management admitted that they had miscalculated. On July 11, 1985 the Company announced the return of the original beverage under the name Coca-Cola Classic. Don Keough [Vice President for Operations], speaking at Coca-Cola USA Building in Atlanta, summarized the lesson the Company learned. "The simple fact is that all the time and money and skill poured into consumer research on the New Coca-Cola could not measure or reveal the deep and abiding emotional attachment to original Coca-Cola felt by so many people... The passion for original Coca-Cola—and that is the word for it: passion—was something that caught us by surprise... It is a wonderful American mystery, a lovely American enigma, and you cannot measure it any more than you can measure love, pride, or patriotism" (Allen, 1994, p. 416).

The qualitative evidence above is presented to emphasize the incredibly large cost the Company incurred for merely changing the proportions of few ingredients in the recipe of its Secret Formula. While the social phenomena described in the last few paragraphs about the negative public reaction to the New Coke may be better suited for a study by sociologists, it is clear that it has a very real economic dimension: the idea of eliminating the old Coke and replacing it with the New Coke was an economic act with a marketing disaster and public relations nightmare. The act violated the implicit contract consumers had with Coca-Cola. By breaking its promise and violating this contract, the Company almost completely destroyed the goodwill it took to build almost 100 years.

⁶¹Consider some excerpts from the letters. "Changing Coke is just like breaking the American dream, like not selling hot dogs at a ball game." "Millions of dollars worth of advertising cannot overcome years of conditioning. Or in my case, generations. The old Coke is in the blood. Until you bring the old Coke back, I am going to drink R.C." "Would it be right to rewrite the Constitution? The Bible? To me, changing the Coke formula is of such a serious nature." "There are only two things in my life: God and Coca-Cola. Now you have taken one of those things away from me." "Changing Coke is like God making the grass purple or putting toes on our ears or teeth on our knees."

VIII. Cost of Adjusting Coca-Cola Quantity

Advertising is most commonly thought of by economists as serving the functions of conveying information about product features, signaling quality, and differentiating one product from another (Carlton and Perloff, 1994). However, the fact that the Company advertised during this time period, *whatever the function*, meant that the advertising expenditure was a cost of adjusting quantity. Our claim is *not* that advertising is always a cost of adjusting quantity. For example, a firm might hold output constant and use advertising to differentiate its product and adjust price upward. However, in this case price and quality were rigid, so the only thing the Company could have been seeking to change (adjust) by advertising was the quantity it sold.

We find evidence that this was the Coca-Cola Company's interpretation also. According to a Company's insert in *Drug Trade Journal* (1916),⁶² "Some said: 'Raise the price to the retailer.' Some said: 'Lower the quality.' Some said: 'Cut the advertising appropriation.' That is the summary of advice we have received during the past year from people who knew how greatly our cost of making Coca-Cola has been advanced owing to extravagant rises in costs of *all* ingredients. We said: 'Price, quality and advertising will remain the same.' ... It is ridiculous, to our way of thinking, even to suggest cutting down on the advertising. Our advertising is as much a part of our selling force as are our salesmen. Advertising plays its big part in keeping soda-fountains busy serving Coca-Cola. We might as well fall down in keeping them supplied with the syrup as to fail to keep our implied promise to keep them supplied with the demand for Coca-Cola" [emphasis in original]. Thus, the Company also viewed advertising expenditures as means of increasing sales, i.e., adjusting quantity.

Indeed, we can see in Figure 5 that the Company aggressively advertised. In 1911 advertising expenditures exceeded \$1 million for the first time. By 1946 advertising expenditures were in excess of \$14 million. Figure 6 demonstrates that, from 1882 to 1944, advertising expenditures as a percent of revenue were in the approximate range of 10 to 20 percent. If advertising is a cost of adjusting quantity and the Company was choosing to adjust along its least costly margin, then this implies that *the perceived costs of adjusting price and quality were even higher*. Zbaracki et al. (2003), using data from a large U.S.-based industrial manufacturer and its customers, find that the physical cost of adjusting prices, i.e., the menu cost, is 1.23 percent of the company's revenue. Willis (1999), using Cecchetti's (1986) magazine price data, estimates cost of adjusting prices to be about 4 percent of revenue. Slade (1998) finds a similar number when studying the cost of adjusting prices of Saltine crackers in a retail supermarket industry. If drawing the above conclusion is valid, then the Company faced price

adjustment costs of an order of magnitude greater than anything documented in the literature.

Furthermore, the advertising expenditures underestimate the actual quantity adjustment costs, for they do not include other costs of adjustment such as the work of the sales personnel and the cost of increasing capacity. We do have some figures on the latter in the form of the fixed costs of setting up bottling plants. According to Munsey (1972), the cost of equipping an average size soda-water bottling plant (which according to Pendergrast (1993) and Allen (1994) included a carbonator, bottling table, washing machine, settling tanks, washing tubs, bottles, cases, a horse, and a wagon) was about \$5,000.00 in 1899, which is equivalent to \$94,340.00 in 1992 prices. Similar figures are reported by Pendergrast (1993, p. 77). Allen (1994, p. 107). Riley (1958, Table 3) reports the value of capital in place per bottling plant, for the years 1850 to 1955. According to these figures the cost of setting up and equipping a production plant was \$7,140.00 in 1900,⁶³ which is equivalent to \$132,222.00 in 1992 prices, \$75,000.00 in 1940, which is equivalent to \$742,574.00 in 1992 prices, and \$225,000.00 in 1955, which is equivalent to \$1,086,956.00 in 1992 prices. Further, the Company began setting up production plants in large quantities beginning in late 1900s. For example, in 1902 alone, the Company opened more than two-dozen bottling plants in the Southern and Western US states. In 1903 they opened additional 32 plants, in 1904—47 plants, and in 1905, 80 plants. By 1909, the Company was operating 397 bottling plants across the US. See Table 3. While most of this cost was incurred by individual bottlers, the Coca-Cola Company probably paid some of it in various forms of aid and assistance such as designing the plants, properly equipping them, etc.

IX. Price Rigidity Theories that May Be Ruled Out

In this section we briefly review existing theories of price rigidity that in our opinion cannot explain the Coca-Cola nominal price rigidity.⁶⁴ We considered 12 theories and were able to rule out nine of them as inconsistent with the Coca-Cola price rigidity. The remaining three theories, which we believe jointly, provide the best explanation for the price rigidity in combination with three new explanations we offer, are discussed in sections XI and XII. Of the theories we dismissed, six were dismissed simply because they were grossly incompatible with the length of the price rigidity studied here. The other three theories we rejected are given attention below as to why.

⁶² Source: *Advertising Copy Collection, 1916–1919*, Vol. 5, 00502 ARS (Coca-Cola Company Archive).

⁶³ The difference between the two figures, \$5,000.00 and \$7,140.00 for about the same period likely reflects the value of the building in which the production was taking place.

⁶⁴ In writing this section we took Blinder, et al.'s (1998) list of 12 price rigidity theories as comprehensive, although it should be noted that some of these theories are more applicable to aggregate price rigidity than individual product level price rigidity.

1. *Nominal Contracting*

As discussed in section II, in 1899 a contract was signed between the Coca-Cola Company and the first parent bottling company (owned by Thomas and Whitehead) that fixed the price the parent bottlers paid to the Company for the syrup at 92 cents per gallon. While the initial contract was in perpetuity, in 1901 the parties signed an amendment changing the contract terms so that the new price was 90 cents per gallon plus 10 cents per gallon charge for advertising material supplied by the Company. In 1921, the price was increased further to \$1.17 per gallon. The new contract also included a form of indexation: for every cent a pound of sugar increased above 7 cents, the syrup price would increase by 6 cents. Moreover, the Company began purchasing the parent bottlers as well as bottling plants. By 1940 the company owned five of the six parent bottlers.

Thus, despite the fact that there was nominal contracting, it fixed the price for short periods of time relative to the price rigidity period. But more importantly, the contract fixed prices from the Company to the bottlers, but it did not fix the price of bottlers to retailers, nor the price of retailers to consumers. And the rigidity of the nickel price charged to consumers by retailers is the primary focus of interest.

Still, the nominal contracting up until 1921, when indexing was incorporated, might have been a source of price rigidity. In section XII below present a model of monopoly with stages of processing that is compatible with such being the case.

2. *Psychological Pricing Points*

This theory, proposed by Kashyap (1995), states 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 pricing 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, crossing the pricing point. The theory predicts that buyers will be particularly sensitive to price changes near the pricing points. The difficulty with this theory is that we only have one price, 5 cents, a single observation, and it is not clear how the theory should be assessed. Further, it is not obvious that the 5-cent price constitutes a pricing point in the sense proposed by Kashyap. Even if pricing point argument is valid, it is difficult to argue that it caused the 70-year long price rigidity during a period of apparently continuous increase in nominal costs. We rule out this theory as well.

3. *Constant Marginal Cost*

An alternative explanation to the Coca-Cola price rigidity may be productivity improvements. What if, during this period, the company was experiencing productivity gains that made price adjustment unnecessary despite the aggregate price increase? As demonstrated in section II, the nominal costs of materials used in production of Coca-Cola were, in general, increasing over time. However, if the production technologies used in the processing of Coca-Cola were evolving quickly relative to the rest of the economy, then it is possible that the real marginal costs faced by the Company were falling fast enough to make a constant nominal price consistent with real price equaling real marginal costs

Could Coca-Cola productivity have been growing *relative* to the general economy-wide productivity?⁶⁵ 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. Perusing *A History of the American Soft-Drink Industry*, Riley (1957, especially chapters 20–25), the technological developments witnessed by the soft-drink industry over the first half of the 20th century appears impressive. Around 1910, a power-operated “filler and crowner,” to fill and cap bottles, could handle up to 600 cases (14,400 bottles) a day. By 1920 the capacity was 20–30 bottles *per minute*. As well, around 1920, a major innovation occurred. Among technological hindrances, “the principal [was] manual operation of transferring the bottles from the washer to the bottling machine, and the hand feeding of them into the filler” (p. 165). The advent of the chain-type bottle conveyor finally automated the handling of bottles from washer to filler, releasing the speed of production from the constraint of human hand speed. Thus filler speeds increased until, by 1940, capacities were up to 300 bottles per minute; 400 by 1950.

Carbonating procedures also appear to have exhibited brisk evolution. Around 1900, maximum capacity was approximately 500 gallons per hour (gph). By 1930 it was 1,000 gph; by 1946, 2,000 gph. The year 1938 witnessed a major innovation in combining filling and carbonating procedures as well. Up until that point, water was carbonated and then added to a bottle where syrup had already been deposited after having cooled from the high temperatures at which it was brewed. With the arrival of “pre-mix carbonating,” syrup and water could be mixed together in the bottle first, speeding up cooling of the syrup, and then the combined mixture was carbonated.

⁶⁵ 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 improvements in the production of Coca-Cola, then ruling out similar improvements in

Innovations in intra-plant transportation of materials and produce were also notable. Around 1920, powered platform lift trucks became available, along with electric forklift trucks. These were followed by gasoline powered forklift models between 1924 and 1928. Intra-plant transportation was especially important considering the trend towards larger plants (Riley, 1957, p. 191).

Other miscellaneous innovations over the first half of the century included mechanical mixers and automatic “casers” (putting bottles from the fillers into cases) in 1930s, reliable “inspection devices” (inspected bottles for foreign objects after filling) and “case unpackers” (removed bottles from cases into the washers) in 1940s. All in all, Riley (1957, p. 189) remarks that, compared to the largely manual operations at the turn of the century, “[a] typical plant of the mid-century is fully motorized in its delivery and sales-routine operations.”

However, the above is silent as to whether the technologies in the soft-drink industry were progressing quickly relative to the rest of technologies economy-wide. Data from the U.S. *Census of Manufacturers* (1963, Table 1, p. 20G-6) suggest that this was *not* the case. 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 (Gordon, 2000, Appendix A-1).⁶⁶

Also, *Census of Manufacturers* (1963, Table 1, p. 20G-6) data reveal that the “Value of Shipments” to “Cost of Materials” ratio 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 time period 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.

the production of other foodstuff (which also include milk and coffee) would be difficult to defend, especially for a period of over 70 years.

⁶⁶ Real labor productivity was 15.6 in 1899 and 45.3 in 1950.

As an additional analysis of this idea, consider the following thought experiment.⁶⁷ 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 7 (solid line), that would happen briefly during 1919–1921 and then from 1942 and on. That is, in such circumstances a nominal price doubling would have to take place 17 years before its actual occurrence. What about number of years it would take for the real price to drop to 3.33 cents, i.e., to 67 percent of its 1886 value, which would justify a nominal price increase to 7 1/2 cents (corresponding to issuing a 7 1/2-cent coin plan)? According to Figure 7, ideally, the Coke’s nominal price would have to be increased to 7 1/2 cents 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 cents, i.e., to about 83 percent of its 1886 value, which would justify a nominal price increase to 6 cents? According to Figure 7, the Coke price would have to be increased to 6 cents in 1915.

These calculations, however, assume that the Company enjoyed no productivity growth during this entire time period. As a thought experiment, suppose that the company was experiencing productivity growth over time. Then we could 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 7 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 cents, 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 cents) in 1917, and 2 1/2 cents (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

⁶⁷ The idea of productivity gains as an alternative or additional explanation to the Coca-Cola price rigidity puzzle was suggested by Steve Cecchetti in his comments as the discussant of this paper at the January 2001 American Economic Association Meetings in New Orleans. Consequently, in writing the last part of this section, we drew heavily from those comments.

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.

X. Implicit Contract between the Coca-Cola Company and America

As discussed in the introduction, one of the difficulties in testing Okun's (1975) implicit contract theory of is that it is not clear what are the testable predictions of the theory. The only theoretically observable prediction of the theory is that prices are expected to be more rigid in comparison to markets where such contracts are absent, *ceteris paribus*. This prediction, however, is hard to test.

In the case of the Coca-Cola Company, we are able to document the existence of an incredibly strong form of implicit contract and long-term relationship because of the *explicit* way the Company chose to communicate the content of this contract to consumers. In collecting and documenting the information on pricing practices of the Company, we discovered that the company was engaged in building a long-term relationship with consumers almost from the beginning of its existence. This relationship buildup was accompanied by a massive advertising campaign designed to inform consumers of the Company's commitment to provide it with a bottle or a glass of Coca-Cola, "*The Real Thing*," with the Coca-Cola quality, at 5¢, anywhere.

This commitment was made explicitly by including these and similar guarantees and assurances in millions of print ads, displays, signs, promotional giveaway items, etc. Moreover, assurances of quality and price were often included together, in one package.

Below we provide some examples of conveyances of the implicit contract by the Company to consumers. In order to give the reader an accurate idea, we present most of the material in original form, literally, by simply quoting them. As we demonstrate, one of the main reasons for the Company's remarkable success was precisely the investment it undertook in establishing, building, and nurturing this long-term relationship and resultant goodwill.

On Coca-Cola quality and price guarantee:

According to a Company insert in *Drug Trade Journal* (1916), reproduced in the Company's *Advertising Copy Collection, 1916–1919*, Vol. 5, 00502 ARS (Coca-Cola Company Archive):

"Some said: 'Raise the price to the retailer.' Some said: 'Lower the quality.' Some said: 'Cut the advertising appropriation.' That is the summary of advice we have received during the past year from

people who knew how greatly our cost of making Coca-Cola has been advanced owing to extravagant rises in costs of *all* [emphasis in original] ingredients. We said: 'Price, quality and advertising will remain the same.' Mr. Clerk and Mr. Retailer—you have helped us to make our success. We do not forget this fact for one minute. Then we would be mighty poor specimens if we tried to make the druggist carry the load of our increased costs by cutting down your profits on Coca-Cola. The burden is ours—we have gladly assumed it. As to lowering the quality of Coca-Cola—its quality is what has established it as a success. Quality is the great big thing we have been preaching for years. We would ruin our business and hurt yours if we were so short sighted as to try to sell dollars in good will for pennies in profit. We will leave that kind of business to makers of so-called imitations of Coca-Cola. It is ridiculous, to our way of thinking, even to suggest cutting down on the advertising. Our advertising is as much a part of our selling force as are our salesmen. Advertising plays its big part in keeping soda-fountains busy serving Coca-Cola. We might as well fall down in keeping them supplied with the syrup as to fail to keep our implied promise to keep them supplied with the demand for Coca-Cola. Therefore, though this is our leanest year from the standpoint of profits in dollars, we are determined to make it a fat year from the standpoint of keeping faith with dealers and the public. All we ask of dealers is the *natural and human* [emphasis in original] reciprocity of serving only the genuine and serving it properly. (Mr. Drug Clerk: When you have read this, please show it to your employer.)”

For example, a Company ad that appeared in the December 1941 issue of *Boys' Life*, December 1941 issue of *National Geographic*, December 6, 1941 issue of *Collier's*, December 8, 1941 issue of *Life*, December 13, 1941 issue of *Saturday Evening Post*, and December 15, 1941 issue of *Time*, states the price of Coca-Cola, 5¢, along with the assurance “You trust its quality. Each time you taste ice-cold Coca-Cola, you are reminded that there is the quality of genuine goodness. Experience... a refreshing experience...”

Similarly, a Company ad that appeared in many retail trade publications, reproduced in Coca-Cola Company's *Advertising Copy Collection, 1942*, 01724 ARS (Coca-Cola Company Archive) states: “There's a seven-letter word for it: QUALITY... the quality of genuine goodness. That's what your customers recognize in Coca-Cola. When you display and suggest Coca-Cola to your customer, you know you are offering the best, because nothing beats the quality of Coca-Cola... it's the real thing. [Underlined in original] 5¢. You trust its quality.”

A Company ad in a 1932 issue of *Emory Alumnus*, reproduced in *Coca-Cola Company's Advertising Copy Collection, 1932*, 01137 ARS (Coca-Cola Company Archive) states: “Drink Coca-Cola, Delicious and Refreshing, 5¢, PURE AS SUNLIGHT. The proof of its *purity* [emphasis in original] is in the testing. Twenty-two scientific tests for purity, covering every step in its preparation, safeguard this drink of natural flavors.”

According to the Coca-Cola Company's and Springfield Coca-Cola Bottling Company's Advertisement No. S-1, 1945, reproduced in Coca-Cola Company's *Advertising Copy Collection*,

Special Newspaper Ads, 1945, 02148 ARS (Coca-Cola Company Archive): “One big reason for the Coke shortage... is that there’s a world-wide sugar shortage caused by the disorder and confusion of war. And of course the less sugar we get, the less Coke we get. But there’s one fact you can count on—the quality of Coca-Cola never changes. The Coca-Cola you get is the real thing—the quality is the same today as you have always known.”

Similarly, according to the Coca-Cola Company’s and Springfield Coca-Cola Bottling Company’s Advertisement No. S-3, 1945 (reproduced in Coca-Cola Company’s *Advertising Copy Collection, Special Newspaper Ads, 1945*, Coca-Cola Company Archive): “Where’s all the Coke gone, anyway... the answer is: there’s a world-wide sugar shortage... Sugar shortage means Coke shortage because Coca-Cola never compromises with quality. Today, yesterday, tomorrow—Coca-Cola means Coca-Cola, the same quality as always.”

The Company made every effort to inform its resellers, jobbers, retailers, etc. that the Company made all the effort to assure the world the quality of its product. For example, one ad (which is rather typical) published in August 1942 issue of *Chain Store Age, Grocery Managers’ Edition*, reproduces the ad from the *Saturday Evening Post*, May 30, 1942 (reproduced in Coca-Cola Company’s *Advertising Copy Collection, 1942*, 01683 ARS (Coca-Cola Company Archive): “Quality carries on. Drink Coca-Cola, Delicious and Refreshing. 5¢,” and then states: “We make this pledge for YOU: In national magazines, in newspapers, on posters, and over the radio, we’re telling the world that the unmatched quality of Coca-Cola remains the same even though the quantity is limited by Government order. Now, as always, you—and your customers—can trust the quality of Coca-Cola.”

According to the Company’s insert in the March 1919 issue of *Pictorial Review*, “Victory’s Reward Means Volume Restored” reproduced in Coca-Cola Company’s *Advertising Copy Collection, 1916–1919*, Vol. 5, 00588 ARS (Coca-Cola Company Archive):

“To every American business which, at the expense of quantity, maintained the full quality of its product throughout the war, peace brings restoration of normal volume. When conservation cut our allotment of sugar in two, we cut down our output of Coca-Cola one-half in order to maintain its quality at 100 percent. Nothing changed, cheapened, nor diluted; Coca-Cola remained ‘all there’ from the beginning of the war to the end. Pending readjustment of the world’s sugar supply, our output of Coca-Cola will remain limited until the need of conservation shall no longer exist. Meanwhile Coca-Cola will live up to its past, and we, in common with other American business, look hopefully to restoration of the happy normal.”

A Trade Paper insert, 1923 (Coca-Cola Company Archives): “5¢—The Right Price”: “5¢ is a

price people pay without stopping to think they are spending money. It is the price they expect to pay for Coca-Cola, because it is established by years of custom. It gives you a good profit on every sale, but it gives you most profit by giving you more sales—volume. It's the price that keeps your cash register ringing, and that's the music that builds business. 5¢ gets the crowds.”

On imitation products and Coca-Cola quality:

Imitation of the “Real Thing” was so common that fighting it became part of an on-going advertisement campaign. For example, according to a 1912 ad, reproduced in Coca-Cola Company's *Advertising Copy Collection*, 00349 ARS (Coca-Cola Company Archive), the Company was warning:

“Beware!!! of Imitations. For your own protection beware of any beverage masquerading as Coca-Cola. If a thing is good it doesn't have to be sold as an imitation of some-*ing* [sic] else—that's common sense. Imitations are made for the sake of illegitimate profit making and to deceive you, not to please you. Demand the Genuine Coca-Cola, the beverage that has made the making of imitations a regular business. That's proof enough how delicious, refreshing and thirst-quenching it is. If *anybody* [emphasis in original], anywhere, tries to sell you as the genuine Coca-Cola, any imitation in name or appearance, refuse it and do your buying elsewhere. Demand the Genuine—Refuse Substitutes.”

To protect its trademark, the Company relentlessly fought these imitators until they were driven out of business. To fight the numerous imitation products that flooded the U.S. market throughout the 1886–1959 period, the company pursued two strategies. The first was legal by taking the imitators to the court. These cases usually ended with the Company's quick success simply because as Allen (1994, p. 122) notes, “Trademark cases were a matter of common sense: a product could not be made and marketed with the intent of creating and exploiting confusion with another product.” The second strategy was a consistent differentiation of its product from the imitators' products.

According to a Company insert in May 17, 1916 issue of *Drug Trade Journal*, reproduced in Coca-Cola Company's *Advertising Copy Collection, 1916–1919*, Vol. 5, 00496 ARS (Coca-Cola Company Archive), during 1915, “A dozen or more manufacturers of imitations of Coca-Cola were either put out of business or went out of business with the aid of the sheriff.”

The problem of imitation surfaced also among bottlers and resellers. Because it was much cheaper to produce the imitation products, as they did not contain some of the expensive natural and exotic ingredients, some bottlers were tempted to substitute the fake syrup for the Secret Formula.

According to a Company insert in a 1916 issue of *Drug Topics*, reproduced in *Coca-Cola Company's Advertising Copy Collection, 1916–1919*, Vol. 5, 00502 ARS (Coca-Cola Company

Archive):

“Over a Million Dollars a Year—spent to send people to soda-fountains to ask for the *genuine* Coca-Cola. When you serve the genuine Coca-Cola and serve it *properly* according to directions you are profiting in two ways: In money, because the actual profit is a big one. In the reputation of your fountain and store, because every buyer will say—‘Here’s a place where I can get Coca-Cola at its best.’ Such a reputation brings people to your store. The dealer who fails to serve the genuine, for the sake of a little more profit, saves at the spigot and wastes at the bunghole. Those customers who know Coca-Cola readily recognize the deception—they desert that fountain and suspect the whole store’s integrity. Why lose your own self-respect, the confidence of your customers and the bigger profit of a larger trade, by serving an imitation or a substitute? Get your share of the business that will be created this year by our million-dollar advertising campaign—it is a solid foundation on which to build soda-fountain prosperity. Serve the genuine Coca-Cola [emphasis in original].”

On Coca-Cola goodwill:

The 1924 Annual Report (The Coca-Cola Company, February 26, 1924, p. 4) stated: “All of our equipment might be replaced more easily than could our goodwill, which has been cultivated through 38 years of consistent effort. A corporation which does not lay a firm foundation for the future cannot build goodwill of lasting nature—truth is the basis of all stable good will. Intrinsic worth of the product, good service in distribution and a vision for the future in management, are the safeguards of this good-will.”

In a letter to Robert Woodruff, president of the Company, dated May 26, 1948, Duke Merritt, editor of the *Cartersville* [Georgia] *Daily Tribune*, reproduced one of his editorials (Merritt, 1948). According to Merritt, the editorial was written “... in appreciation of the fact that Coca-Cola is the one unchanged friend of childhood, still the same good taste at the same nickel price, and in appreciation of the genius of Coca-Cola’s management that has kept it thus.” The editorial is indeed praise for the Company’s provision of a constant quality at a constant price:

“It is often enjoyable to think that a Coca-Cola still costs only a nickel. Thoughts about the stability of Coca-Cola’s price truly provide ‘The Pause That Refreshes.’ As far back as we can remember, Coca-Cola has sold for a nickel, while everything else in this world... has changed. [Along with Coca-Cola] a loaf of bread was a nickel, soap was a nickel... and coffee and milk were a nickel each, for a cup or a glass, ... And we have read and heard that another beverage, beer, was also five cents a glass then... How nice it is that one thing in this mad world has not changed. That is very refreshing about Coca-Cola. *Coca-Cola has changed neither its price nor its quality* [our emphasis] ... Look what has happened to other five-cent items in Coca-Cola’s nickel lifetime. Bread is 15 cents a loaf, in most places, soap is 10 and 15 cents a cake, coffee and milk each cost a dime, at least in lots of places, or most places, and beer is fifteen to 30 cents, we hear. But our old friend Coca-Cola still remains the same, merely five cents... [Coca-Cola is] *keeping faith with the working man, and all the rest of us*, [our

emphasis] in its truly marvelous stability in prices, and in providing us with an unchanging friendship.”

Robert Woodruff responded to Merritt in a letter dated May 29, 1948: “Your comment regarding our product and our Company describes exactly what it has been our desire... In the recent era of rationing and the subsequent period of high—and rising—costs, the maintenance of the 5¢ price has not been devoid of difficulty, but the compensations that arise from doing so, as exemplified by your friendly remarks, are many and not least of them is the good will embodied in such expressions as these in your editorial.”

During WWII the Company furthered the guarantee of its implicit contract in the most patriotic of ways. Woodruff pledged that, “We will see that every man in uniform gets a bottle of Coca-Cola for five cents, wherever he is and whatever it costs our company”(Pendergrast, 1993, p.199). The Company went so far as to sell nickels (at cost) to soldiers at training camps (*Coca-Cola Bottler*, 1944a, p.35).

Also, by giving away millions of various memorabilia (clocks, trays, watches, etc.), and using popular artists like N. Rockwell, H. Sundblom, and N.C. Wyeth, the Coca-Cola Company’s advertising campaign made Coke a familiar, inescapable element of everyday American life.⁶⁸

On Coca-Cola as an American Icon:

The Supreme Court Justice, Oliver Wendell Holmes, in a famous legal case involving The Coca-Cola Company v. Koke Company of America (254 U.S. 143, 41 Supreme Court 113, 120) called Coca-Cola “a single thing coming from a single source, and well known to the community... It hardly would be too much to say that the drink characterizes the name as much as the name the drink.”

The quality and price assurances formed a certain bond between Coca-Cola and its American consumer. The existence of a lone copy of the original recipe, locked in a vault at the Trust Company of Georgia, unavailable to anyone for any reason except by formal vote of the company’s board of directors, was part of the nation’s folklore. For U.S. consumers, the nickel Coke was truly as American as a hotdog and a baseball game.

XI. Monetary Transaction Technology Constraint and Coca-Cola Price Rigidity

In this section we propose two (but related) new explanations for the Coca-Cola price rigidity that are based on an aspect of a monetary transaction technology constraint the Company faced, especially

⁶⁸ The Coca-Cola Company’s ads even shaped the way Americans (and now whole world) imagine Santa Claus: Sundblom invented the round, ruddy fellow in a red suit with fleecy white piping in 1931 for a series of Christmas ads for Coke (“The Image of Santa Claus,” *Cola Call*, December 1985, pp. 4–6).

during the late 1940s and early 1950s. This explanation has to do with the transaction cost that certain price changes may impose on the consumers and retailers.

As documented above, the post-WW II inflationary pressures of late 1940s forced many Coca-Cola bottlers and resellers to push the Company towards dropping the nickel price policy. Soon they were joined by Coca-Cola bottlers associations, various bottlers trade publications such as *Bottling Industry*, established to advance the bottlers' cause,⁶⁹ and even congressional committees acting under intense lobbying efforts of the Company's numerous competitors – e.g. Pepsi, Royal Crown, Dr Pepper (Pendergrast, 1993, p. 256). For example, according to the 1951 Report of Senate Committee on Small Business (*Crisis in the Soft Drink Bottling Industry*, Coca-Cola Company Archives), Coca-Cola Company was accused of monopolizing the soft drink market. The committee demanded that the Company officials should “release their stranglehold on the industry and let bottlers set their own price on a competitive basis.” Although the media and the public sided with Coca-Cola in their support of the nickel coke,⁷⁰ the pressure was building from an increasing number of retailers and bottlers.

Slowly it became clear to the Company that the nickel price could not be held any longer. While there were several ways for proceeding towards the unavoidable price increase, it turns out that Company president Woodruff disliked each one of them. If Coca-Cola price were doubled from a nickel to a dime, the sales volume would drop drastically, as experienced by several Louisiana bottlers that experimented with this idea (see the discussion above in section V on costs of price adjustment). Consumers may be willing to pay 10 cents for a 12oz Pepsi, but seemingly not for 6-1/2oz bottle of Coca-Cola. Thus, 100 percent increase in the price of Coke was out of question.

Our interpretation of the historical documents and various price change episodes we were able to discover and locate suggests that two issues were of great concern to the Company. The first was related to the mechanical limitations of the existing vending machines (see section V above for a discussion on this issue). If the new price was set somewhere between nickel and dime, say 6, 7, or 8 cents per bottle, then the logistics would be a nightmare because more and more sales were being made

⁶⁹ For example, *Bottling Industry* forcefully put its editorial voice behind the need to increase Coca-Cola prices starting in the late 1940s. The magazine has since that time till 1959 published over 30 editorials just on this one subject. For example, the editorial dating February 8, 1949 begins with “Still Need Higher Prices... In the face of continued high costs, we stick to our guns for a general wholesale price increase in beverages. We feel that selling a case of beverages for 80 cents does not require good salesmanship. It requires a good initial bank account and a barrel of aspirins.” According to April 7, 1959 *Bottling Industry*, at one point the nickel-Coke protesters have even established the “Price-for-Profit” movement.

⁷⁰ For example, according to the February 6, 1951 *Pittsburgh Post-Gazette* editorial (“Coke’s Valiant Fight,” Coca-Cola Company Archive), the Coca-Cola Company and its bottlers deserved “a medal instead of a lawsuit” for being able to undersell the competitors despite the fact that prices of everything were increasing.

through vending machines which at that time were unequipped to handle pennies.⁷¹ According to Eugene Kelly, head of Canadian operations, the Company's management had several specific reasons for objecting to the use of vending machines with penny mechanisms, that is vending machines that would accept nickels as well as pennies, which would be necessary if the price was increased to, say, 6 or 7 cents.⁷² The list below is quoted from Kelly's memo cited in the last footnote:

1. "Penny mechanisms reduce sales as compared to single-coin operation."
2. "They cost money. It will cost over \$200,000.00 to equip the coin coolers used by one concern in a certain very large city."
3. "They create heavy and permanently continuing expense in the form of additional service calls."
4. "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."
5. "Mechanically, they do not work as well as single coin mechanisms and thus cause loss of consumer confidence in coin coolers."
6. "They create expense for all concerned in counting and handling such a large volume of pennies."
7. "The consumer price cannot be set in fractions of one cent where the price to the dealer makes this desirable and fair."
8. "They irritate outlets."⁷³

To resolve the problem, the Coca-Cola Company's pricing team, under the leadership of Eugene Kelly, developed an ingenious plan called the "Single Coin Plan," under which 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, as described by the Coca-Cola Company in its notice to Coke Drinkers, worked as follows (Source: "Single Coin Plan," by Eugene Kelly, September 21, 1951, Coca-Cola Company Archives):

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

⁷¹ As mentioned in section V above, there was a technology available as early as 1947 that would enable vending machines to accept more than one type of coin. The problem the Coca-Cola Company faced was that the vending machines its bottlers and resellers operated were equipped to handle a single coin, nickels, only.

⁷² Source: "Single Coin Plan," by Eugene Kelly, dated September 21, 1951, Coca-Cola Company Archives.

⁷³ If the rationale behind listing point 7 as a reason to avoid penny mechanism escapes the reader, rest assured that it escapes the authors as well. Internal memos do not have the advantage of useful comments from referees before circulation.

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.⁷⁴

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*.

The single coin issue was indeed important for the Company. For example, the Company was clearly concerned about the possibility of a drop in sales of Coca-Cola if a shortage of nickels was to develop. Consistent with this view are two facts. First, as reported by January 1951 issue of the *Fortune* magazine (“The Nickel Drink Is Groggy,” p. 78), the soft drink business really spurred in 1930s after President Franklin D. Roosevelt made more nickels available to the public. This increase in the supply of nickels was due to the 1933 shift of the U.S. from the gold standard to fiat currency. During the gold standard period 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, which led to a substantial increase in the soft drink sales. 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 (“Total Gallon Sales — Coca-Cola, The Coca-Cola Company, Coca-Cola Company Archives) has jumped from 14.5 percent in 1935 to 26.3 percent in 1936, and 18.2 percent in 1937.

A single coin reduced to a minimum the “transaction cost” the public had to incur in buying a Coke. A less than 100 percent increase in price would require the public to use anywhere between 2 to 5 coins.⁷⁵ Robert Woodruff considered this single coin issue a matter of such significance that he began

⁷⁴ 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.

⁷⁵ This pennies-related transaction cost resembles the “1¢ nuisance” cost caused by the need to obtain one-cent stamp to be added to the standard first class mail stamp after each upward adjustment in the price of the first class mail by 1¢ (Rubin, 1999). More recently, it has been reported that in many European Union Countries that have adopted the Euro, the public

exploring the possibility of having the minting of a new 7 1/2-cent coin authorized by the US Treasury Department. This would allow for a single coin purchase without a 100 percent price increase. 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-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.

Thus, this monetary transaction technology constraint may help explain, at least partially, the Coca-Cola price rigidity we have documented here, especially in the later periods, during late 1940s and early 1950s.

XII. Quantity Adjustment and Stages of Processing under Monopoly

One possible reason for a desire on the part of the Company to maintain a constant retail price may lie in the contract between the Company and its bottlers (see section II). 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 Company, unable to raise the syrup price it charged, 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.⁷⁶

To entertain this hypothesis, consider two monopoly firms – one representing the Coca-Cola Company and one representing its Bottlers. Assume that the firms face cost functions of the general form,

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

$$(1) \quad \begin{aligned} X_{CC} &= \alpha(Q_{CC}), \\ X_B &= \beta(Q_B), \end{aligned}$$

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,

$$(2) \quad P_B = f(Q_B).$$

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 syrup and therefore $Q_{CC} = Q_B$.⁷⁷ We assume the Bottlers sell the soft drink to consumers directly and that $f' < 0$, such that the demand curve for bottled Coca-Cola is downward sloping.⁷⁸

By the above assumptions, the profit functions for the Coca-Cola Company and its Bottlers are,

$$(3) \quad \begin{aligned} \pi_{CC} &= \underline{P}_{CC}Q_{CC} - \alpha(Q_{CC}), \\ \pi_B &= P_B Q_B - \beta(Q_B). \end{aligned}$$

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

$$(4) \quad Q_{CC} = Q_B = Q,$$

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 (4).

⁷⁶ We thank George Benston for suggesting this idea.

⁷⁷ 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.

$$(5) \quad \frac{\partial \pi_{CC}}{\partial Q} = \underline{P}_{CC} - \frac{\partial \alpha(Q)}{\partial Q} = 0.$$

This condition, (5), being fulfilled over time would be pure coincidence given that (4) 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,

$$(6) \quad \pi_{CC} = \underline{P}_{CC}g(P_B) - \alpha(g(P_B)),$$

where g is the inverse of f . From (6) it follows that,

$$(7) \quad \frac{\partial \pi_{CC}}{\partial P_B} = \left(\underline{P}_{CC} - \frac{\partial \alpha(g(P_B))}{\partial g(P_B)} \right) \frac{\partial g(P_B)}{\partial P_B}.$$

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

$$(8) \quad \underline{P}_{CC} - \frac{\partial \alpha(g(P_B))}{\partial g(P_B)} > 0.$$

This condition, (8), that the price charged by the Coca-Cola Company to Bottlers is greater than its marginal cost of production is necessary and sufficient for (7) to be negative. *Operating with a positive profit margin is necessary and sufficient for the Coca-Cola Company to benefit from Bottler prices being rigid upward.*

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

⁷⁸ This ignores the retailers between bottlers and consumers. However, the inclusion of a third firm representing retailers in the present analysis would not alter the results.

$$(9) \quad P_B = \frac{\partial \beta(g(P_B))}{\partial g(P_B)} - \frac{g(P_B)}{\left(\frac{\partial g(P_B)}{\partial P_B} \right)}$$

This represents a markup over marginal cost since $g' < 0$. Note that the markup is increasing in $Q = g(P_B)$. The intuition behind (7) being negative can now be stated clearly. Assume that demand is an increasing function of time such that,

$$(10) \quad g(P_B, t) = Q,$$

and,

$$(11) \quad \frac{\partial g(P_B, t)}{\partial t} > 0,$$

where t indicates the time period. 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 price it only increases its profits through quantity increases as consumer demand grows. It is in the Coca-Cola Company's best interests to prevent the Bottlers from using the price margin to absorb increased demand instead using entirely quantity increases.

This scenario is displayed graphically in Figure 8 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. Figure 8 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 cause price rigidity.

Now recall (6) and incorporate (10) to get,

$$(6) \quad \pi_{CC} = P_{CC}g(P_B, t) - \alpha(g(P_B, t)),$$

and then note that,

$$(12) \quad \frac{\partial \pi_{CC}}{\partial t} = \left(P_{CC} - \frac{\partial \alpha(g(P_B, t))}{\partial g(P_B, t)} \right) \frac{\partial g(P_B, t)}{\partial t} > 0.$$

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

$$(13) \quad \frac{\partial^2 \pi_{CC}}{\partial t \partial P_B} = \left(P_{CC} - \frac{\partial \alpha(g(P_B, t))}{\partial g(P_B, t)} \right) \frac{\partial^2 g(P_B, t)}{\partial t \partial P_B} < 0.$$

The signing above assumes that the second derivative term on the right hand side of the equation in (13) is negative (the rate of increase in consumer quantity demanded over time is less if P_B is rising). 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 (13) is to rewrite the second derivative term,

$$(14) \quad \frac{\partial^2 g(P_B, t)}{\partial t \partial P_B} \quad \text{as} \quad \frac{\partial^2 g(P_B, t)}{\partial P_B \partial t}.$$

If negative, (14) signifies that demand is becoming less elastic over time. Then, referring back to (13), 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.

$$(10)' \quad g(P_B, \varepsilon) = Q,$$

and,

$$(11)' \quad \frac{\partial g(P_B, \varepsilon)}{\partial \varepsilon} > 0,$$

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

Bottlers will want to decrease price when negative demand shocks occur. Take the optimal pricing policy for the Bottlers, (9), and take the derivative with respect to ε after incorporating (10)' and (11)'.

$$(15) \quad \frac{\partial P_B}{\partial \varepsilon} = - \frac{\left(\frac{\partial g(P_B, \varepsilon)}{\partial \varepsilon} \right)}{\left(\frac{\partial g(P_B, \varepsilon)}{\partial P_B} \right)} > 0.$$

From the Coca-Cola Company's point of view (recall (7)) such a price decrease would be a good thing. Given that the price was indeed rigid, the syrup quantity decreases displayed in Table 1 for 1931, 1932 and 1933 suggest that the historical episode of the Great Depression was a persistent negative demand shock to consumer Coca-Cola demand.⁷⁹

Also, again recall the optimal pricing policy for the Bottlers, (9). 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.

XIII. Price Rigidity Theories that May Be Ruled In: A Summary

It is unlikely that a single theory will explain a price rigidity that lasted such a long period.

⁷⁹ 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 12 ounce bottle for a nickel: an effective price 50 percent that of Coca-Cola's. Coca-Cola never, to our knowledge, fell below a nickel for 6.5 ounces in a single bottle or cup (at the fountain).

Indeed, our interpretation of the data suggests that a combination of an unusual form of implicit contract combined with three other explanations (two monetary transaction technology-based discussed in section XI, and the other based on nominal contracting in stages of processing, discussed in section XII) we offer, seem to provide the best explanation for the Coca-Cola *price and quality rigidity* and its *quantity flexibility*.

Broad Notion of Cost of Price Adjustment

These explanations can all be grouped into a cost of price adjustment argument. It is important to emphasize, however, that by “cost of price adjustment” we mean hear a *broad notion* of cost of price adjustment, broader than what the literature usually considers as the “menu cost,” i.e., a “small” fixed cost the price setter has to incur each time a price is changed. We believe that the relevant cost of price adjustment in the case of Coca-Cola included the cost of potential loss of consumer goodwill due to violation of the implicit contract the company had with the American people.

These costs also included the cost in the form of the riskiness of a price change due to the uncertainty about the likely consumer response to the deviation from the “norm” of the nickel price. As Stiglitz (1999) and Rotemberg (2002) convincingly argue, a price change carries a signal to customers and the competitors. A price change, therefore, will usually involve a risk because of the price setter’s inability to predict how the signal will be interpreted by its recipients, because of the price setter’s uncertainty about the demand curve. According to Stiglitz (1999), much of the price signal is related to deviations from norms.⁸⁰ The risk from such a deviation combined with firm’s general risk aversion, will therefore reinforce the firm’s reluctance to change prices.

We find evidence that is consistent with such an interpretation of the nickel price and the perceived riskiness in increasing it. First, as discussed in section XI, Woodruff reportedly resisted doubling of Coca-Cola price from nickel to dime, for the fear that the sales volume would drop drastically, as experienced by several Louisiana bottlers that experimented with this idea (see the

⁸⁰ In Rotemberg’s (2002) model, the market participants are more concerned about the “fairness” of the price change and they respond negatively to a price increase if they consider the price increase unfair. This will lead to price rigidity. It is not clear, however, how relevant this mechanism is in the case of 6 ½oz Coca-Cola price rigidity. On one hand, any argument along this line would be weak given the fact that the Coca-Cola price remained a nickel from the first day it was introduced to public in 1886. Therefore, an argument that its price increase, in say, 1920s, isn’t fair would be difficult to defend. The argument would be even weaker during the war period when the price of sugar—one of the main ingredients of Coca-Cola—almost tripled. On the other hand, one could argue that Pepsi was offering a 12oz serving of its drink for a nickel. A price increase of Coca-Cola above 5 cents, therefore, would be perhaps difficult to defend, especially during the period in which 12oz Pepsi was selling for a nickel. We should note that Pepsi was unable to hold on the nickel price. By 1947, the 12oz bottle of Pepsi (the primary product competing with the nickel Coke) was no longer available for a nickel. Instead, in some places it sold for 6 to 10 cents, and in other places the bottles were reduced to 8oz or 10oz sizes (Martin, 1962, p. 126).

discussion above in section VI on costs of price adjustment). Consumers, Woodruff thought, may be willing to pay 10 cents for a 12oz Pepsi, but not for a 6 ½ oz bottle of Coca-Cola.

Second, consistent with this report, is Woodruff's reply to the bottlers requesting price increase: "... they [bottlers] can't be sure that pricing alone will shove them into profits during a period of inflation. These unknown factors are frightening. Maybe Mr. Woodruff's growlings get through to them, in some miraculous fashion, in the form of nightmares. 'Why talk about a dime?' Mr. Woodruff asks. 'You say you got inflation, a dime'll fix it; well, how much inflation you got? You don't know? Why ain't you talkin' about fifteen cents, or a quarter, for a drink of Coke then?' Mr. Woodruff's point is a stopper. At some stage in the industry's attempt to price itself into profits it can surely price itself out of the market, too" (*Fortune Magazine*, 1951, p. 79). Thus, the company faced a great uncertainty about the public response to the doubling of the Coke's price, which Woodruff considered to be prohibitively risky, consistent with Stiglitz's (1999) argument.

Third, the Company may indeed have been convinced that the nickel price was the "norm," the "expected price." According to a Trade Paper Insert (Coca-Cola Company Archives, 1923): "5¢—The Right Price: 5¢ is a price people pay without stopping to think they are spending money. It is the price they expect to pay for CC, because it is established by years of custom. It gives you a good profit on every sale, but it gives you most profit by giving you more sales—volume. It's the price that keeps your cash register ringing, and that's the music that builds business. 5¢ gets the crowds." Thus, by 1923 the nickel price of the Coke in the view of the Coca-Cola Company management was the "norm."

Fourth, as discussed above in section XI, our notion of cost of price adjustment included a transaction cost--in the form of less convenience--imposed on the public by a less than 100 percent price increase, because people would no longer be able to purchase a Coke using a single coin.

And fifth, as discussed in section VI, our notion of the cost of price adjustment should include the huge fixed cost of replacing the existing single-coin operated vending machines with multiple-coin operating vending machines.

Thus, if we consider the cost consequences of the explanations we can rule in (implicit contract, nominal contracting with stages of production, and two monetary transaction technology-based explanations), they all can be put under one umbrella of *broadly defined costs of price adjustment* (in the same sense as Gordon (1991) and Davis and Hamilton (2003)). That is, we can think of, say implicit contract theory as being a part of broadly defined cost of adjustment theory because a violation of the contract by changing the price, for example, will lead to cost of price adjustment in terms of the goodwill loss that result from the violation of the implicit contract.

Fixed Nature of the Costs of Price Adjustment

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 fixed cost that must be incurred 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.

In the case of Coca-Cola, however, some components of price adjustment costs we identify are of a fixed nature, in the sense that they only need to be incurred once. Below we briefly go through these costs and discuss their fixed nature. Several components of price adjustment costs we identify, however, are more of a variable nature.

(i) Monetary Transaction Cost

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 simple programming of the coin-changing mechanism at almost zero 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” (See Zbaracki, et al., 2002).

The customer inconvenience that would result from increasing the Coke price by less than 100 percent, which would be incurred due to the need to handle more coins (i.e., pennies) in a purchase of Coca-Cola, would be incurred for each unit purchased (as long as the transaction did not involve other goods/services because purchase of other items along with the Coke would likely eliminate most of the inconvenience associated with using multiple coins). Therefore, this component of the price adjustment cost would be of more variable nature.

(ii) Implicit Contract Breaching Cost

If the Coca-Cola Company increased the price of Coke above the “expected” nickel price, it would violate the implicit contract the Company has established over the years with the American public. The resulting cost, perhaps in the form of goodwill loss, however, would be a one-time cost—a fixed cost—which would eliminate this contract all together. Further price adjustment in later periods

would not be interpreted necessarily as a violation of the contract because the contract no longer exists.

(iii) Quality Adjustment Cost

The cost of adjusting quality the Coca-Cola Company incurred in 1985 when it altered the Secret formula by replacing the original Coke with the New Coke was also fixed. The cost of R&D—\$4 million—the Company spent on developing and testing the new formula, is clearly fixed, one-time cost. Similarly, the \$30 million loss the Coca-Cola bottlers incurred in the form of unsold inventories of the New Coke, was also a one-time cost. More importantly, the cost of customer upset and betrayal, discussed in detail in section VII, was also fixed, one-time cost. All the indicators suggest, that if the company did not reverse the decision to eliminate the original formula, it could actually lose most of its market share very quickly, suggesting that the fixed cost of quality adjustment was huge.

It is clear from another piece of evidence presented in section VII that the company indeed considered the fixed cost of quality adjustment to be substantial. According to that evidence, the Company prevented a quality adjustment by incurring a permanent increase in marginal cost of production. Note however that the quality adjustment cost the company avoided would be a one-time, fixed cost. The cost the Company chose to incur to avoid this fixed cost, however, is marginal cost because it was incurred for each pound of syrup produced thereafter. This implies that even though this quality adjustment cost would be incurred only once, its perceived magnitude was so high that the Company chose instead to incur higher marginal cost of production, a cost that would be incurred for each unit produced, indefinitely.

(iv) Quantity Adjustment Cost

Quantity adjustment cost consists of two components. One component, which we discussed in section VIII, is the advertising cost, which is a variable cost and thus a component of marginal cost of quantity adjustment. Perhaps a bigger cost, however, is the fixed cost of adjusting quantity, which consists of the costs of setting up syrup production lines. These include the cost of structures, as well as the cost of producer durable goods and equipment necessary for syrup production. These costs are quite substantial, as discussed above in section VIII.

XIV. Historical Prevalence of “Customary Fixed Prices”

Finally, we should comment on the generalizability of the Coca-Cola pricing practices and its strategy of pushing the quantity. We do not want to argue that the Coca-Cola pricing strategy is

necessarily a good representative of the pricing strategies pursued by many price setters. However, we have discovered that the phenomenon of the nickel price, and more generally, the phenomena of commonly used “customary fixed prices” were very widespread throughout the late 19th, and the early 20th centuries. For example, many common food items were selling for a nickel for many years. These include a cup of milk, a cup of coffee, soap, a loaf of bread, a mug of beer, Hershey’s candy-bar, a pack of Wrigley’s bubble gum, etc. (Merritt, 1948, Shapiro, 1968). When these prices were increased, they were usually set equal to a dime, where they remained for many years. Later on, these prices were increased to 15¢ or 25¢, etc. We discovered that even a less standard item, such as KC Baking Powder, was selling for a fixed price of 25¢ for over 50 years.⁸¹

More importantly, there were many chain stores in the US, called “Nickel Stores” (the predecessors of today’s “Dollar Stores”), which as the name suggests, were selling all products they carried, at a nickel price. These products included everything from sandwiches, soda (from fountain), 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.⁸² Later on, these stores turned into “Nickel and Dime Stores,” or “Dime Stores,” or even “5¢, 10¢, and 25¢ Stores.”⁸³ For example, Woolworth, which filed for bankruptcy in 1997, was the first Nickel Store in 1879.⁸⁴ Other well-known chain stores that began their operations as Nickel or Dime stores were K-mart (under the name “The Kresge Company” which was selling everything for 5¢ or 10¢), Wall-Mart (which was selling everything for 10¢), Newberry’s, G.C. Murphy, Sprouse-Reitz, Kress, TG&Y, Walker Drug Company, and Mott’s.⁸⁵

The sales figures of these chains were quite substantial. For example, The Kresge Company, which sold everything for 5 and 10 cents from its first day, had by 1912 expanded to 85 stores with annual sales of \$10,325,000.00 (over \$158.8 million in 1992\$).⁸⁶ According to the Kresge

⁸¹ Source: *Grocer’s Want Book*, a pamphlet published and distributed by the Jaques Mfg. Co., Chicago, IL, the maker of the KC Baking Powder, to the retail grocers for their use to manage and keep track of the inventories, (undated). According to this pamphlet, the KC Baking Powder has the “Same Price Today as 43 Years Ago! 25 ounces for 25¢.” A similar pamphlet, *KC Baking Powder Book*, also published and distributed by the Jaques Mfg. Co. (see item a124 from Gator Trading Co. at <http://pages.tias.com/102/PictPage/34891.html#images>), states “Same Price for Over 50 Years... 25 ounces for 25¢.”

⁸² The Five-and-Dime Stores of the turn-of-the-century slowly evolved into the variety store of the 1940s and 1950s, which in turn evolved into the discount retailing stores of the past twenty years.

⁸³ Source: http://www.lilesnet.com/paul/Memories/five_and_dime.htm.

⁸⁴ J.C. Penney, which opened his first store called the “Golden Rule” in Kemmerer, Wyoming in 1902, was selling everything for a penny (Pitrone, 2003, p. 3, and “Cheers to 100 years... 20th Century Timeline,” *Retail Traffic*, December 1, 1999, available on line at www.shoppingcenterworld.com).

⁸⁵ Smaller towns had independent Five and Dime Stores.

⁸⁶ Source: http://www.kmartcorp.com/corp/story/general/corporate_history.stm.

Company's 1913 catalog, the company at the time was still selling everything for nickel and dime.⁸⁷ According to Pitrone (2003, pp. 23–24), Woolworth, which first opened in 1879 as a Nickel Store, by 1895 was operating 28 Nickel and Dime Stores with sales over \$1 million (over \$19.2 million in 1992\$) and by 1900, the sales of the chain reached \$5 million (over \$92.5 million in 1992\$). By 1911, the company was operating 286 stores in Pennsylvania, New Jersey, Delaware, and Connecticut, and was employing 9,000 employees (Pitrone, 2003, p. 17), and by 1912 the company was operating 600 stores in the US and Europe.⁸⁸

As another example, consider the McCrory's Dime Store Chain, which was founded by John McCrory in western Pennsylvania in 1882, three years after F.W. Woolworth opened his first successful store in Lancaster, in the eastern part of the state. In 1929, McCrory was the nation's fifth-largest Dime-Store chain, with about 240 stores in the eastern and southern United States and gross sales of \$44 million (over \$385.9 million in 1992\$).⁸⁹ The chain closed its final stores in 2002. The popularity and correspondingly, the sales figures of other Nickel and Dime chains were equally impressive. Add to it the fact that by 1910, the number of Nickel and Dime chain stores operating numbered in thousands. According to one estimate, perhaps, less than 5,000.⁹⁰ According to the US Bureau of Census, in 1935 there were 127,482 chain stores operating in the US.⁹¹ It follows 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.⁹²

The phenomena of Nickel Stores, Nickel and Dime Stores, Dime Stores, etc., were not limited to the US companies. According to the Netherland's Economic History Archive and the Joods Historisch Museum of Amsterdam, a Dutch department chain store HEMA (Hollandsche Eenheidsprijzen Matschappij, which in English means "Dutch Uniform Price Company") was established in 1926 (by

⁸⁷ Source: *Kresge Katalog of 5¢ & 10¢ merchandise*, S.S. Kresge Company, Detroit Michigan, 1913 (NY: Random House, 1975), A Facsimile Edition of the Original 1913 Parcel Post 5¢ and 10¢ Katalog. Only in the mid-1920s began the Kresge Company to open stores, which sold all items for \$1.00 or less, a precursor to the current discount store.

⁸⁸ "Cheers to 100 years... 20th Century Timeline," *Retail Traffic*, December 1, 1999, available on line at www.shoppingcenterworld.com.

⁸⁹ Source: Alan Raucher, a Professor of History at Wayne State University, Michigan, quoted in "Last of five-and-dimes is shutting its doors," *The Oak Ridger Online*, March 21, 2002 (www.oakridger.com).

⁹⁰ Source: "Cheers to 100 years... 20th Century Timeline," *Retail Traffic*, December 1, 1999, available on line at www.shoppingcenterworld.com. In addition to the chains mentioned above, these also included Sears-Roebuck (which began as a watch store), May Department Stores, Marshall Field & Co., Hudson's, Nordstrom, Macy, Neiman Marcus, Spiegel Co., Carson Pirie Scott & Co., Siegel-Cooper's stores, Simpson-Crawford stores in NY, and Schlesinger and Mayer stores in Chicago.

⁹¹ Source: "Cheers to 100 years... 20th Century Timeline," *Retail Traffic*, December 1, 1999, available on line at www.shoppingcenterworld.com.

⁹² Although the nickel and dime prices have eventually disappeared, people kept calling the stores Nickel and Dime Stores. Few such stores still remain in many small towns across the US.

the board of Bijenkorf, another Dutch department store, which began in 1870 as a textile shop) after the success of the English and the American “uniform price stores” such as Woolworth was recognized. At HEMA stores, everything was priced either at Dfl 0.25 or Dfl 0.50. HEMA became a commercial success, especially during the depression period, where Dutch consumers could get a great variety of products (similar to the American Nickel and Dime stores) at a fixed price.

Moreover, we find that the strategies pursued by the Coca-Cola Company, were also pursued by the manufacturer of at least one fixed-price product, Jaques Mfg. Co. of Chicago, IL, the manufacturer of the 25¢ KC Baking Powder. Specifically, we discovered that, like the Coca-Cola Company, Jaques Mfg. Co. was also including the 25¢ price in its promotional material, advertisements, pamphlets, on sales booth signs, and *even on the product packaging itself*. This, to ensure that no retailer charged its customers a price higher than 25¢.

For example, in the *Grocer’s Want List* pamphlet, which the manufacturer was distributing to retailers, Jaques Mfg. Co. emphasizes the optimality of the 25¢ price: “Who Establishes the Price? We, the manufacturers of KC Baking Powder, have established the price—25 ounces for 25 cents—by showing it on the label and in all our advertising for over 43 years. This *protects your profits*. It is not necessary for you to sell KC for less and take a loss. Where the price is *not* shown on the package or in the advertising, the consumer does not know the right price and *you* have difficulty in establishing the price for which you want to sell it.” “The price is on the package. That protects your profits. Your customers never question the price of KC.” “Help make the dollar go the farthest. KC Baking Powder is profitable alike to yourself and customers. 25 ounces for 25 cents.” “KC Baking Powder is profitable alike to yourself and customers—a reason for them to “trade at home.” 25 ounces for 25 cents—same price today as it was 43 years ago.”

The company was emphasizing the fairness of the 25¢ price: “KC Baking Powder. Use it—to show your customers that you charge only fair prices. 25 ounces for 25 cents.” “You cannot be called a profiteer if you sell KC Baking Powder—25 ounces for 25 cents—same price today as 43 years ago.” “When you offer your customers KC at 25 ounces for 25 cents you show them that you believe in fair prices.” “You are interested in showing your customers a saving. Recommend KC Baking Powder, 25 ounces for 25 cents.” “Make a permanent display of KC Baking Powder. It proves your prices are fair.” “KC represents the best value you have to offer your trade.”

Like the Coca-Cola Company, Jaques Mfg. Co. was also emphasizing the quality of its product: “Our Government used millions of pounds. Your customers should know the good qualities of KC Baking Powder.” “KC is used in millions of homes where quality is considered first.” “Your customers

save in buying KC at 25 ounces for 25 cents. In using KC they do not sacrifice quality.” “KC Baking Powder-25 ounces for 25 cents. Fair price for highest quality. Why ask your customers to pay more?”

Finally, we have discovered that Jaques Mfg. Co. was also following the strategy of adjusting quantity by pushing the idea of increasing sales. For example, in the *Grocer's Want List* pamphlet, the manufacturer explicitly encourages the retail store managers to try and push sales if they want to maximize their profit: “For the sake of you profits it will pay you to push KC Baking Powder. Your customers never question the price.” “The quality and fair price of KC wins friends. The demand for KC Baking Powder is increasing steadily.” As in the case of Coca-Cola, Jaques Mfg. Co. was also using advertisement as a means of achieving higher sales: “KC is popular. It is extensively advertised which helps you get repeat business.” “More newspapers are used in advertising KC Baking Powder than any other brand.”⁹³

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. But perhaps more importantly, the methods of advertising the price as part of the product, pushing sales, etc., which we documented for Coca-Cola, seems to have been prevalent in other markets as well.

XV. Conclusion

We study the rigidity of Coca-Cola prices during the 1886–1959 period. The price of a 6 ½ oz Coke was 5 cents starting on May 29, 1886 until about 1959. Thus we are documenting a nominal price rigidity that lasted more than 70 years! This is a remarkable case of nominal price rigidity and, to our knowledge, no study has documented such a persistent price rigidity. The case of Coca-Cola is particularly interesting because 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, which led to substantial changes in the demand and supply conditions as well as to numerous regulatory interventions. Examples include fluctuations in the prices of sugar, caffeine, and other ingredients, fluctuations in costs of transportation, demographic changes, sugar rationing during the two wars, federal and state syrup taxes, and a long government lawsuit brought by the Department of Agriculture against Coca-

⁹³ We find that Woolworth, one of the first Nickel Store, was pursuing a quantity adjustment strategy, similar to the Coca-Cola Company strategy. According to Pitrone (2003, p. 12), “... the secret of success, he [F.W. Woolworth] felt was in selling large numbers of each article to make a tidy total profit.” Given the fixed Nickel price, the optimality of quantity adjustment (push) was obvious.

Cola for allegedly violating the Pure Food and Drugs Act. Yet the actual price to customers did not reflect these changes in market conditions, as traditional economic theory would predict: Robert W. Woodruff insisted that the price of a Coke be held at 5¢.

To explain this unusual puzzle, we use data provided by the Coca-Cola Company Archives, which include historical information on prices, costs, company revenues, production, sales and marketing strategy for the 1886–1959 period. In addition, we have uncovered important documents in the Robert W. Woodruff Collection at Emory University’s Library. These documents include papers and correspondence that provide information on price change strategies and on the internal discussions and debates within The Coca-Cola Company over this period. We combine this information with data collected from beverage industry trade publications and “The Coca-Cola Bottler,” along with national data on caffeine, sugar, beverage, and transportation cost trends from the Historical Statistics of the U.S.

Using these data, we are able to provide some direct and indirect evidence on the actual quantitative magnitude of price, quality, and quantity adjustment costs for the Coca-Cola Company. In addition, we demonstrate that the incredibly long period of the Coca-Cola price rigidity was accompanied by equally long-lasting Coca-Cola quality rigidity. These rigidities, we argue, can be best explained by the presence of long-term relationship and implicit contract of a rather explicit form between the Coca-Cola Company and the American public. Moreover, we demonstrate that the company systematically chose the option of quantity adjustment over price or quality adjustment. This despite the fact, that the cost of quantity adjustment was substantial. The implication is that, the perceived price and quality adjustment costs in this particular setting were far bigger than the quantity adjustment cost.

Placing a unique twist on the story, we suggest three new explanations that likely played an important role in the Coca-Cola price rigidity. Finally, we provide a detailed assessment of the existing theories of price rigidity by examining their empirical relevance for the case of Coca-Cola. We find that of the twelve theories we study, nine of them can be ruled out in a straightforward way as being inconsistent with the over 70-year long price rigidity. A broadly defined cost of price adjustment notion is used to highlight the common feature of the remaining theories (the theories that we are able to rule in).

We demonstrate that the nickel coke was not really an exception in terms of the nature of its price rigidity, although it probably breaks any modern time record in terms of the longevity of the rigidity. We provide detailed historical evidence on the prevalence of widely used “customary, fixed prices” in

the US as well as in Europe, and find that a non-trivial proportion of the retail trade was conducted at 5 and 10 cents for perhaps as long as 40 years.

Finally, this study can be viewed not only as a study of unusual price rigidity, but also as a study of a *non-price market-clearing mechanism*. In this particular case, we find that the adjustment was taking place through quantity. The fact that the Coca-Cola price was a nickel for over 70 years does not necessarily imply that the Coca-Cola Company's pricing was inefficient. To the contrary, a simple examination of the Company's performance, for example in terms of its stock price, indicates that the Company did quite well in terms of any historical standard, even during the period of the big recession.

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Table 1. Gallons of Coca-Cola Syrup Sold 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).

Table 2. Advertising Material Distributed by the Coca-Cola Company in 1913

200,000	4-head cutouts for window display
5,000,000	Lithograph metal signs from 6" X 10" to 5' X 8'
10,000	Enamel metal signs 12" X 36", 18" X 45"
60,000	Fountain festoons
250,000	Special signs for bottlers 12" X 36"
50,000	Cardboard cutouts for window display
60,000	4-head festoons for soda fountains
10,000	Lithograph metal display signs
20,000	Lithograph metal display containing reproduction of bottles
50,000	Metal signs for tacking under windows
200,000	Fiber signs for tacking on walls of refreshment stands
2,000,000	Trays for soda fountains
50,000	Window trims
250,000	5-head window displays and mirror decorations
1,000,000	Japanese fans
50,000	Christmas wreaths and bell decorations for fountains
50,000	The Coca-Cola Company song
1,000,000	Calendars
50,000	Thermometers
10,000,000	Match books
50,000,000	Doilies (paper)
	24-sheet posters for billboards 10' X 20'
	Oil-cloth signs for storefronts
10,000	Large calendars for business offices
144,000	Pencils
	Transparent signs for windows and transoms
20,000	Blotters
10,000	Framed metal signs for well displays
5,000	Transparent globes, mosaic art glasswork
	Art glass signs
25,000	Baseball score cards
	Celluloid display cards
\$300,000	Newspaper advertising
	Magazine, farm paper, trade paper, religious paper ads
	Other forms of advertising

Source: Tedlow (1990, Exhibit 2-1, p. 53)

Table 3. Cost of Setting Up Coca-Cola Bottling Plants

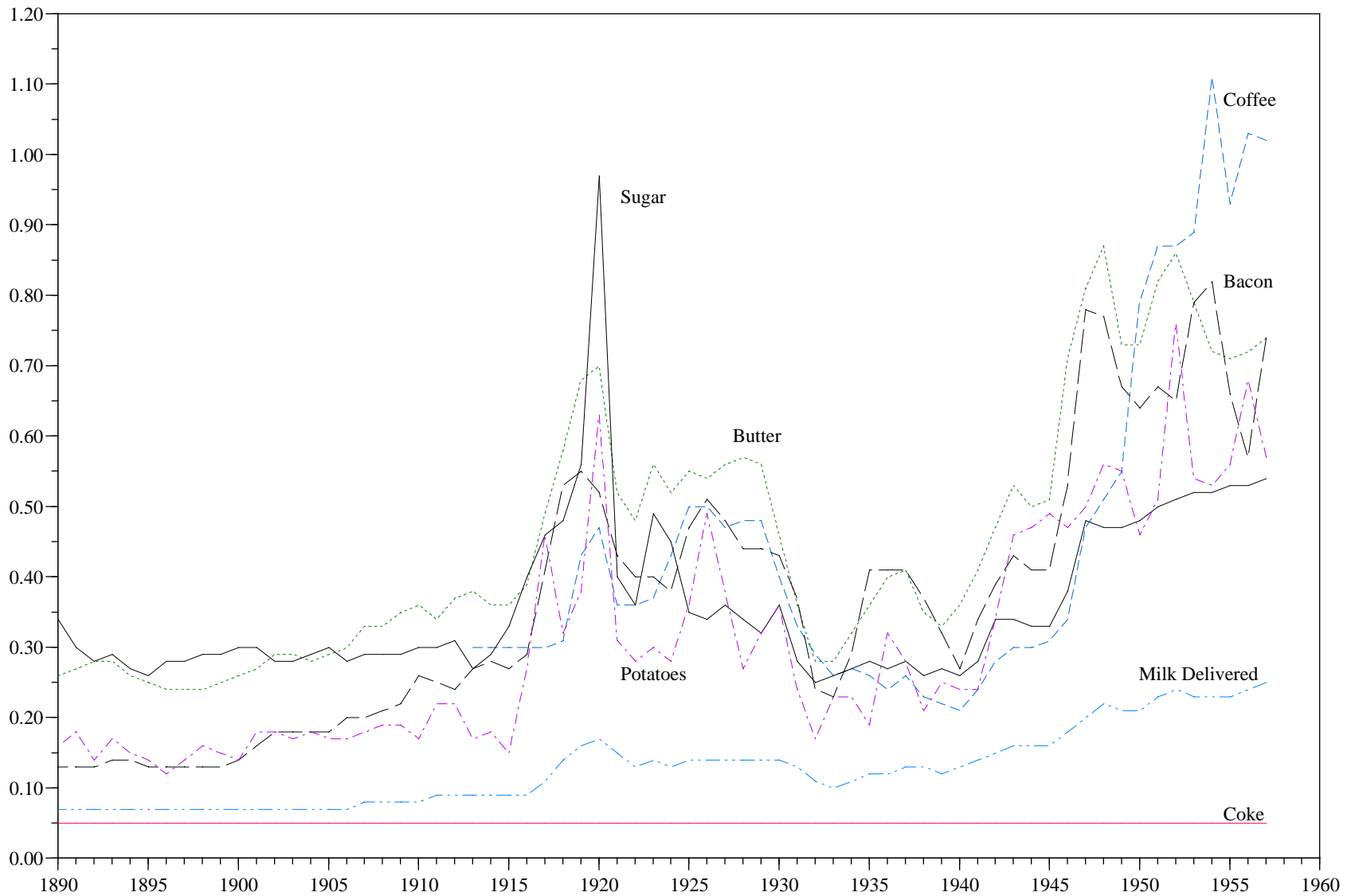
Year	Total No. of Bottling Plants ^a	No. of New Bottling Plants	Cost of Setting Up One Plant ^b
1886	1	1	
1887	1	0	
1888	1	0	
1889	1	0	
1890	1	0	
1891	1	0	
1892	1	0	
1893	1	0	
1894	1	0	
1895	1	0	
1896	1	0	
1897	1	0	
1898	1	0	
1899	1	0	
1900	4	3	132,222.00
1901	13	9	147,480.00
1902	45	32	162,738.00
1903	77	32	177,996.00
1904	123	46	193,254.00
1905	241	118	208,512.00
1906	201	-40	223,770.00
1907	268	67	239,028.00
1908	290	22	254,286.00
1909	374	84	269,544.00
1910	493	119	284,802.00
1911	611	118	300,060.00
1912	691	80	315,318.00
1913	504	13	330,576.00
1914	562	58	345,834.00
1915	636	74	361,092.00
1916	948	312	376,350.00
1917	1,020	72	391,608.00
1918	948	-72	406,866.00
1919	1,069	121	422,124.00
1920	1,095	26	437,382.00
1921	1,115	20	452,640.00
1922	1,123	8	467,898.00
1923	1,142	19	483,156.00
1924	1,186	44	498,414.00
1925	1,203	17	513,672.00

1926	1,221	18	528,930.00
1927	1,228	7	544,188.00
1928	1,263	35	559,446.00
1929	1,235	-28	574,704.00
1930	1,225	-10	689,962.00
1931	1,191	-34	605,220.00
1932	1,176	-15	620,478.00
1933	1,161	-15	635,736.00
1934	1,134	-27	650,994.00
1935	1,101	-33	666,252.00
1936	1,087	-14	681,510.00
1937	1,071	-16	696,768.00
1938	1,064	-7	712,026.00
1939	1,058	-6	727,284.00
1940	1,056	-2	742,574.00
1941	1,051	-5	765,532.00
1942	1,062	11	788,490.00
1943	1,050	-12	811,448.00
1944	1,052	2	834,406.00
1945			857,364.00
1946			880,322.00
1947			903,280.00
1948			926,238.00
1949			949,196.00
1950			972,154.00
1951			995,112.00
1952			1,018,070.00
1953			1,041,028.00
1954			1,063,986.00
1955			1,086,956.00
1956			
1957			
1958			
1959			

Notes:

- a. Source: "The Coca-Cola Company Bottling Plants, 1886–1940," internal Coca-Cola Company Document, Coca-Cola Company Archives, Atlanta, GA.
- b. Source: For the years 1900, 1940, and 1955, the source is Riley (1958, Table 3). For the years in between, the data are constructed by piecewise linear interpolation.

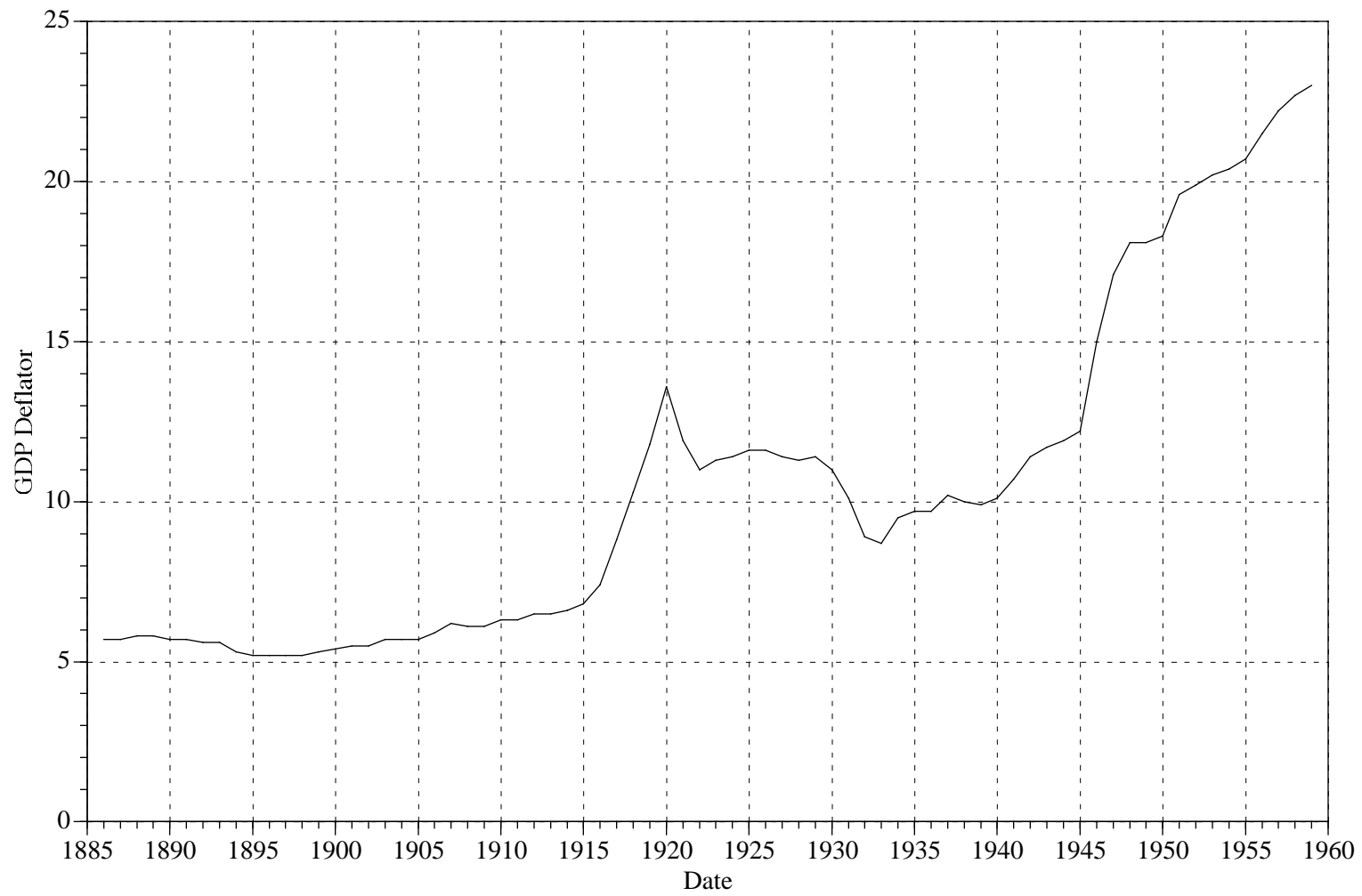
Figure 1. Retail Price of 6 1/2 oz Coke vs Retail Prices of Other Foodstuff, 1890–1957



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

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

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



Source: Gordon (2000), Appendix A.

Figure 3. Coca-Cola Timeline

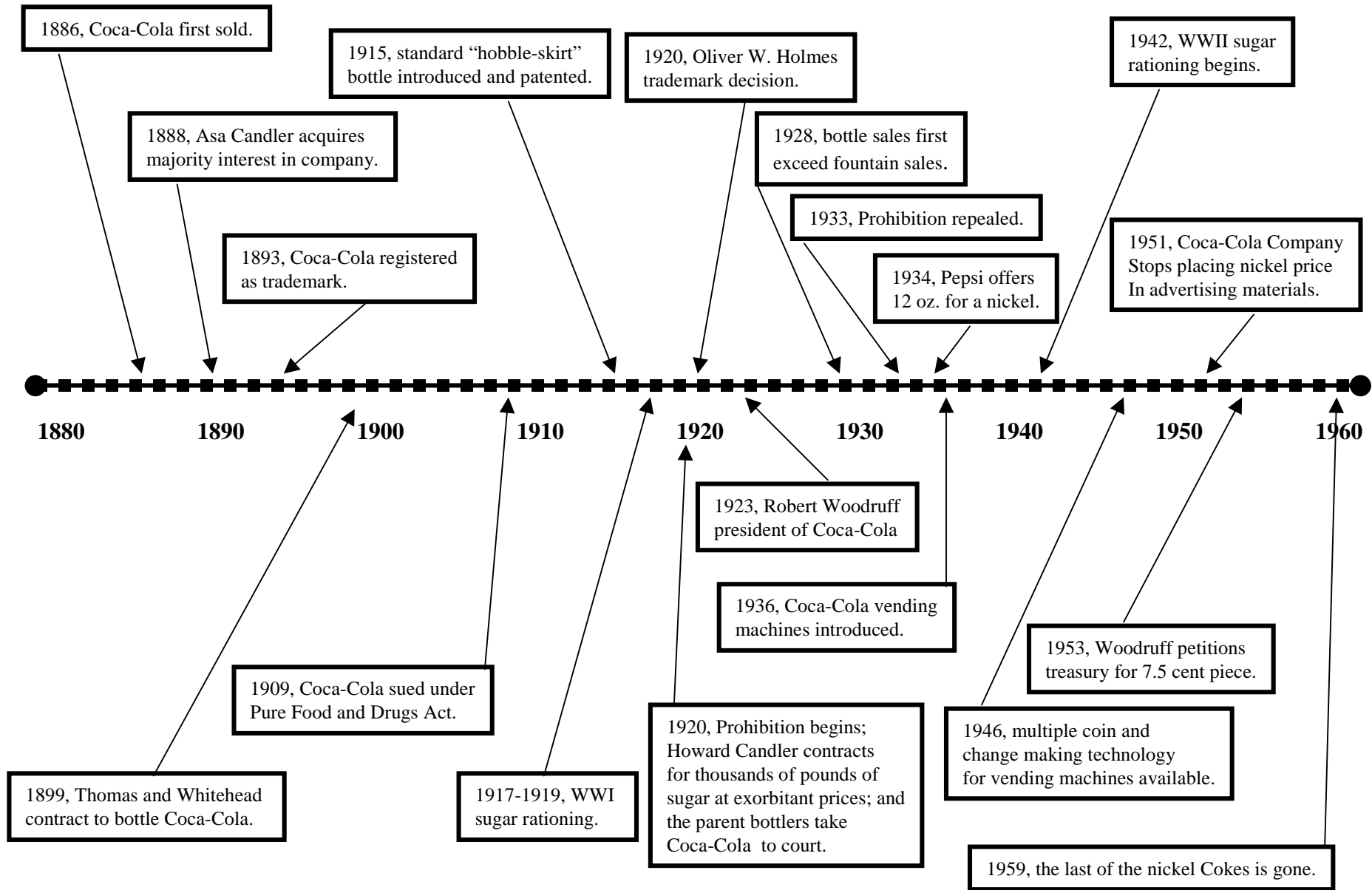


Figure 4. Adjustment of Quantity vs Adjustment of Price

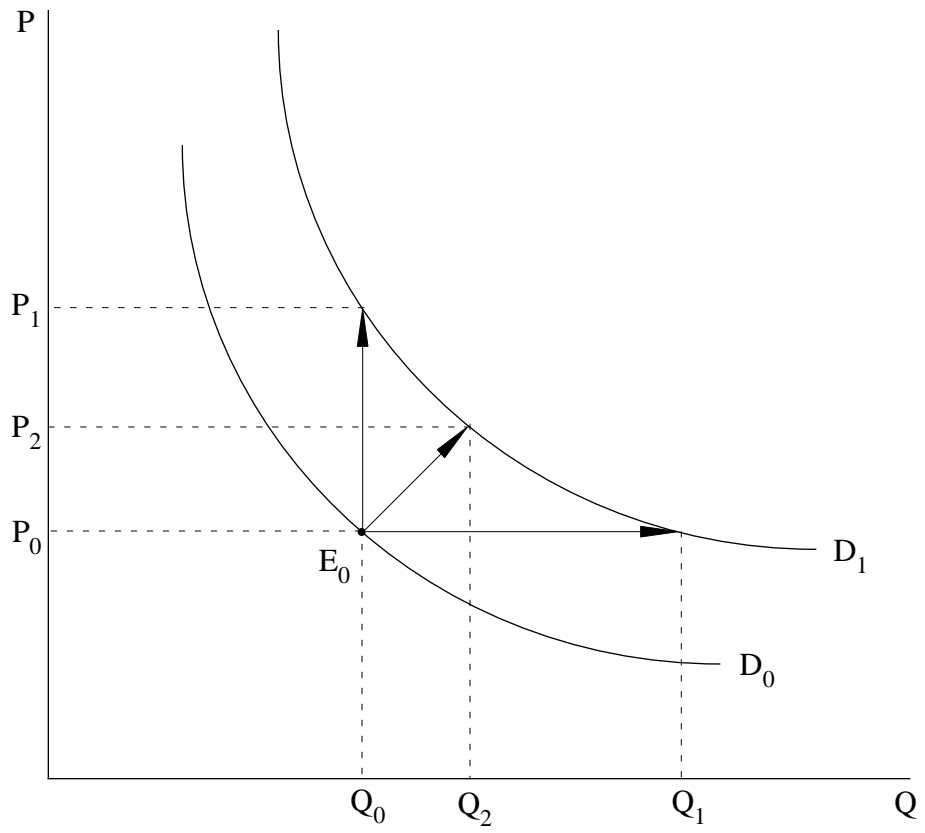
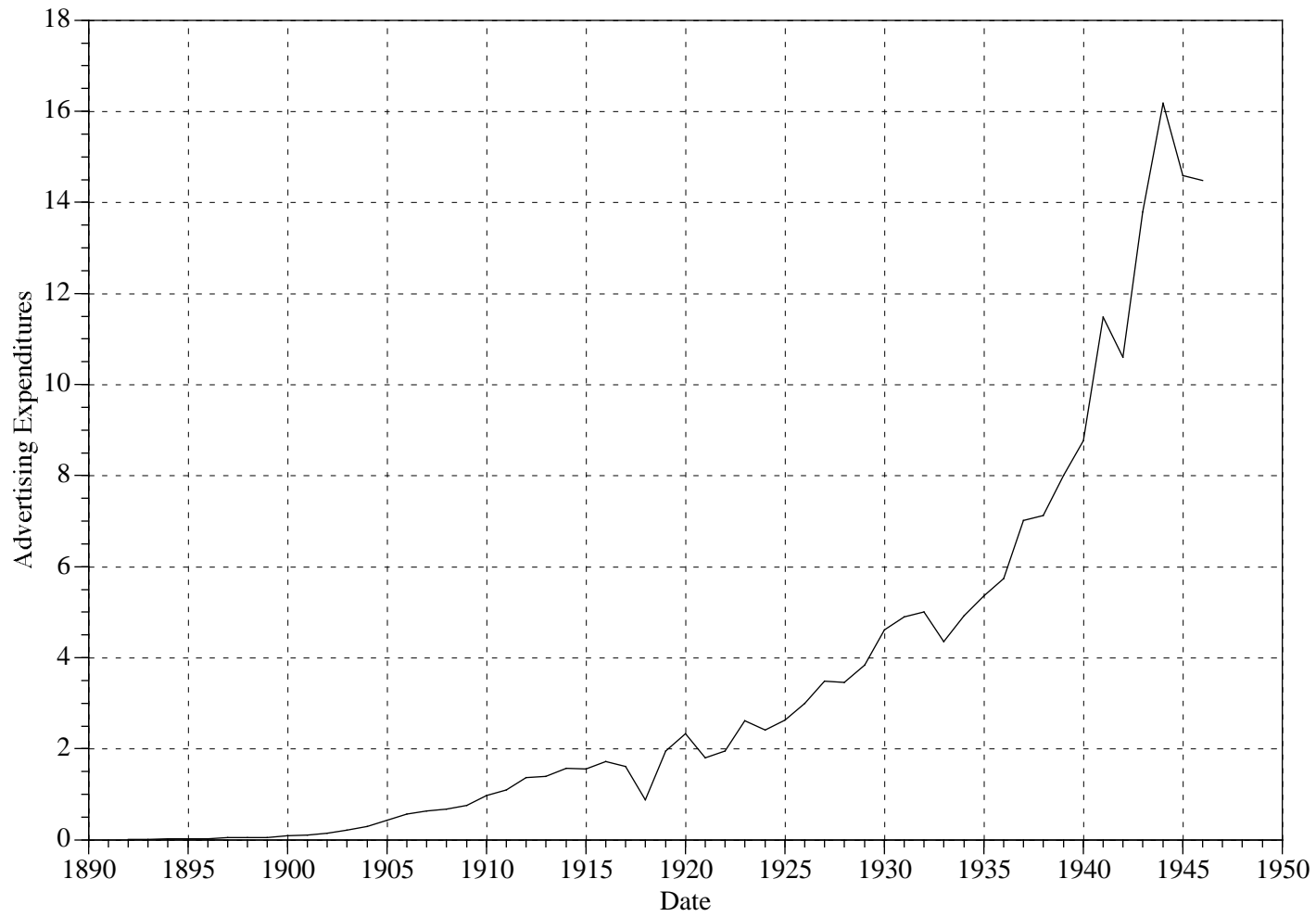
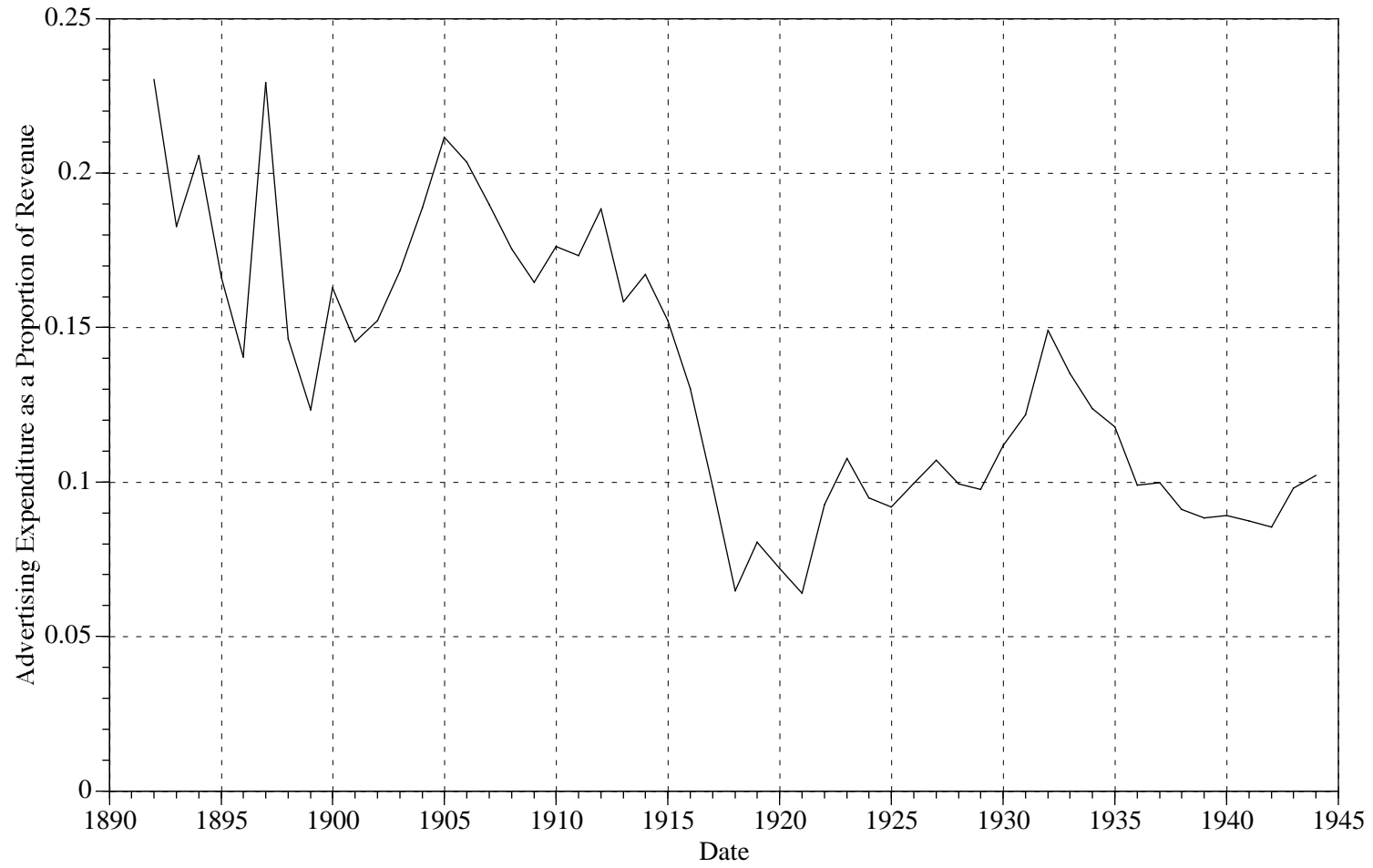


Figure 5. Coca-Cola Advertising Expenditures, 1892–1946 (in millions of U.S. dollars)



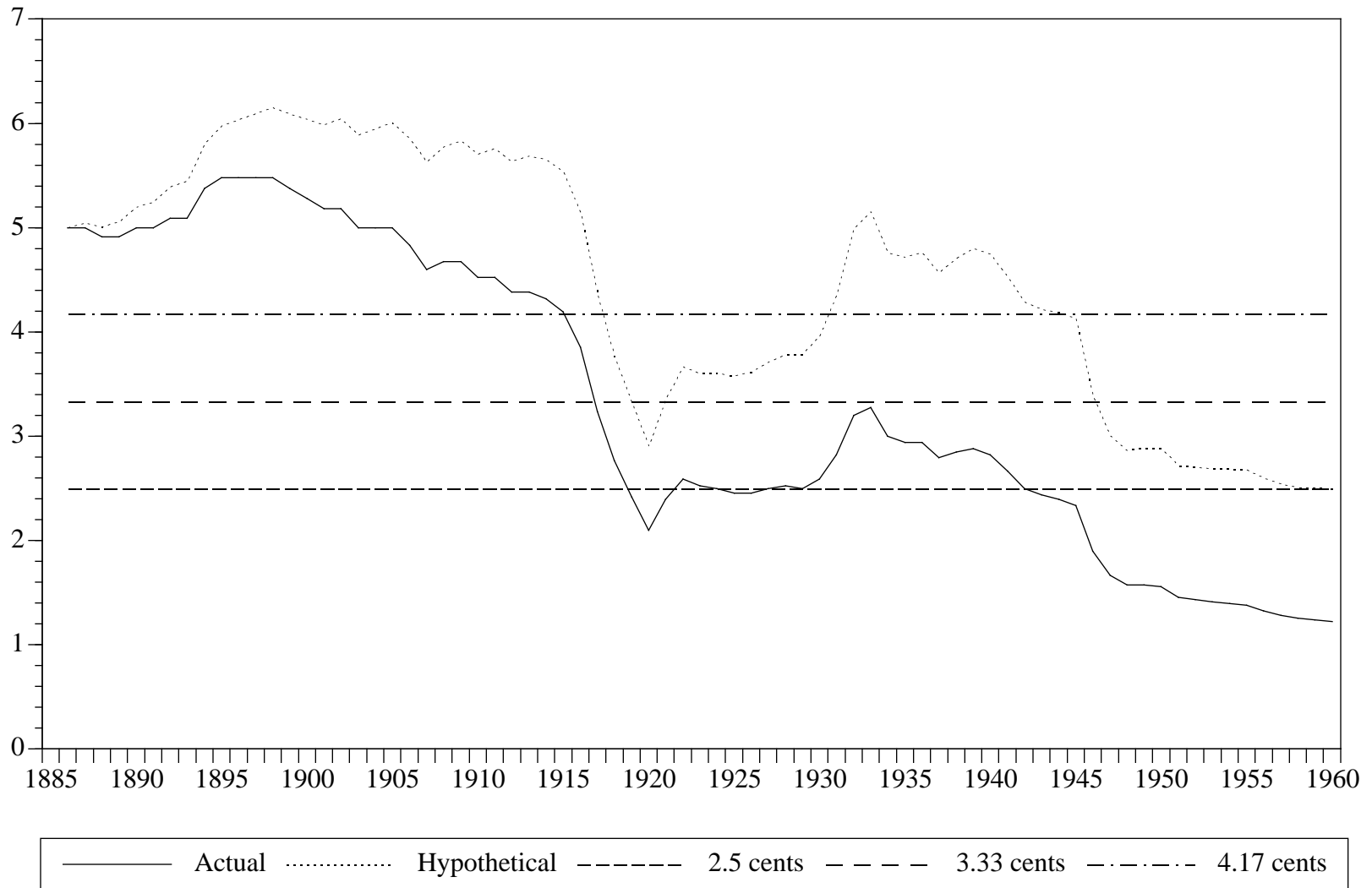
Source: Internal Company Documents, Coca-Cola Company Archive, Atlanta, GA.

Figure 6. Coca-Cola Advertising Expenditures as a Proportion of Revenue, 1892–1946



Source: Internal Company Documents, Coca-Cola Company Archive, Atlanta, GA.

Figure 7. Real Price of Coca-Cola in 1886 Cents Based on Gordon's (2000) GDP Deflator,
 Actual (Productivity Growth = 0) vs Hypothetical (Productivity Growth = 0.0097)



Source: Authors' Calculations. See text for details.

Figure 8. Optimality of Quantity Adjustment for a Monopolist with a Fixed Contract Price

