Pricing practices for tobacco products, 1980–94

An analysis of producer and consumer price indexes reveal that escalating prices for cigarettes cannot be attributed to higher input costs

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The Bureau of Labor Statistics producer and consumer price indexes for tobacco products accelerated throughout the 1980's. In 1991, the indexes began to slow, and in 1993, the Producer Price Index (PPI) for tobacco products dropped nearly 25 percent in just 1 month, and the corresponding Consumer Price Index for All Urban Consumers (CPI) fell nearly 6 percent. Since then, tobacco prices have been relatively stable.

An analysis of price indexes over the 1980–94 period reveals that the price increases for tobacco products did not result from higher manufacturing input costs. What factors, then, drove tobacco products and, specifically, cigarette prices up?

This article sheds light on the price movements of tobacco products by looking at the pricing strategies of the U.S. tobacco industry, because prices for tobacco products have become a major factor in the swings in the inflation rate. The analysis focuses on movements of prices for cigarettes, given that cigarettes account for 80 percent to 90 percent of both the CPI and the PPI for tobacco products, and because prices for cigarettes have been far more volatile than prices for other kinds of tobacco products.

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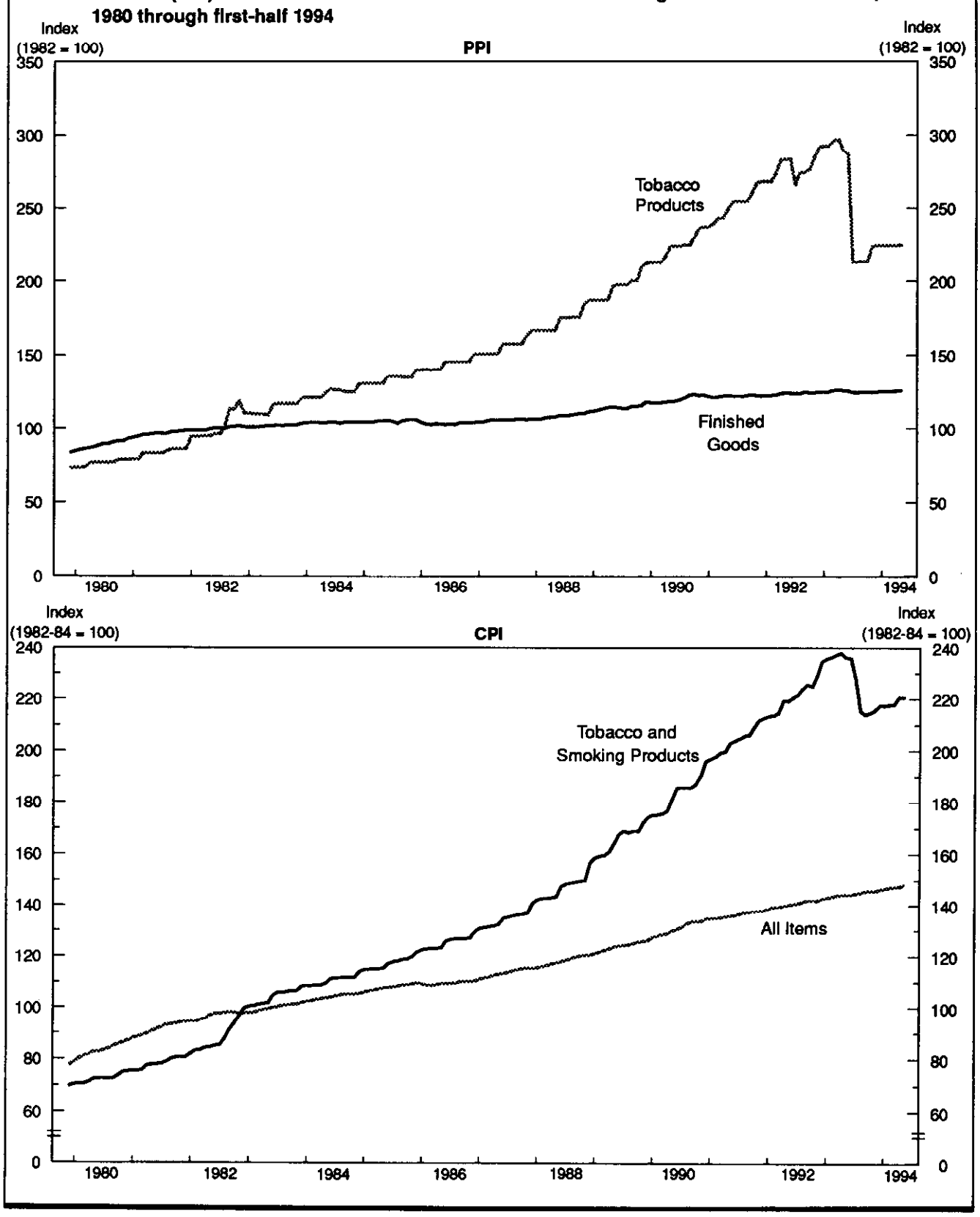
Price trends

For more than a decade, prices for tobacco products have behaved quite differently from prices in the overall economy. While prices for most items in both the CPI and the PPI have risen moderately since 1980, prices for tobacco products climbed rapidly throughout the 1980's and into the 1990's, and then fell sharply in 1993. Each year of the 1987–91 period, for example, the PPI for tobacco products advanced between 12.5 percent and 13.5 percent a year, while price movements in the broad-based PPI for Finished Goods ranged from 5.7 percent in 1990 to −0.1 percent in 1991. During the same period, increases in the CPI for tobacco and smoking products ranged from 7.9 percent in 1987 to 14.7 percent in 1989, while the broad-based CPI for All Items moved up 4.5 percent a year, on average. By December 1991, the level of the PPI for tobacco products had reached 267.2 (1982 = 100), compared with 121.9 for the PPI for Finished Goods. That same month, the CPI for tobacco and smoking products reached 211.7 (1982–84 = 100); the CPI for All Items was 137.9. (See chart 1.)

More recently, the price trend for tobacco products moderated, and then reversed. In 1992, the increase in the PPI for tobacco products slowed to 6.7 percent, barely half as much as its 1991 advance. The deceleration of the CPI for tobacco and smoking products was somewhat slower, moving from 11.1 percent in 1991 to 8.1 percent in 1992. Then, in mid-1993, reflecting a decline in the wholesale price for some cigarettes, the PPI for tobacco products dropped nearly 25 percent in just 1 month. For 1993, this index was down 22.4 percent; the corresponding CPI fell 5.9 percent. (The CPI decrease was smaller because a boost in Federal excise taxes on cigarettes at the beginning of the year offset part of the pro-

Chart 1. **Producer Price Indexes (PPI) for Tobacco Products and Finished Goods and Consumer Price Indexes (CPI) for All Urban Consumers for Tobacco and Smoking Products and All Items, 1980 through first-half 1994**



ducers' price cut, and because not all of the manufacturers' decline was passed through to the retail level.) During the first half of 1994, prices for tobacco products hardly changed in the PPI (before seasonal adjustment) and rose only modestly in the CPI. (See chart 2.)

Changing importance. Because tobacco products account for a substantial portion of both the CPI and the PPI, the sustained record of large price changes in tobacco products has had a notable impact on the measures of inflation in the American economy. In December 1980, tobacco products accounted for about 1.5 percent of the weight of the PPI for Finished Goods. By the end of the 1980's, they accounted for more than 3 percent of the weight. The impact of the dramatic mid-1993 cigarette price cut can be gauged by the drop in the relative importance of tobacco products in the PPI, from 3.08 in December 1992 to 2.37 in 1993. In the CPI, the shifts in the relative importance of tobacco and smoking products since 1980, while not as substantial as that in the PPI, are still noteworthy, rising from 1.05 in December 1980 to 1.75 in December 1992, then retreating to 1.60 by December 1993.

The relative importance of tobacco products is heightened when the volatile food and energy components are excluded from the PPI for Finished Goods and from the CPI for All Items. For example, the index for finished goods other than foods and energy accounted for 63.67 percent of the PPI for Finished Goods in December 1992; tobacco products accounted for 4.84 percent of the weight ((3.08/63.67) × 100 = 4.84). By December 1993, the weight of tobacco products within this so-called core or underlying rate of inflation in the PPI had declined to 3.72 percent. Similarly, the CPI for all items less food and energy accounted for 76.93 percent of the total weight for the CPI at the end of 1992, and tobacco and smoking products accounted for 2.27 percent of the core index; by December 1993, the relative importance of tobacco and smoking products was down to 2.07 percent. (See table 1.)

Price changes in tobacco products can play important if not dominant roles in the measure of inflation. This was demonstrated in 1993, when the PPI for tobacco products dropped 24.2 percent for the month of August. This single-month change accounted for nearly all of the 0.8-percent decline reported in the PPI for Finished Goods that month, and for all of the 1.1-percent decrease in the PPI for Finished Goods other than foods and energy; the core PPI would have risen slightly from July to August if not for the siz-

Chart 2. Changes in the tobacco component of the Producer Price Index (PPI) and the Consumer Price Index (CPI) for All Urban Consumers, 1980–93

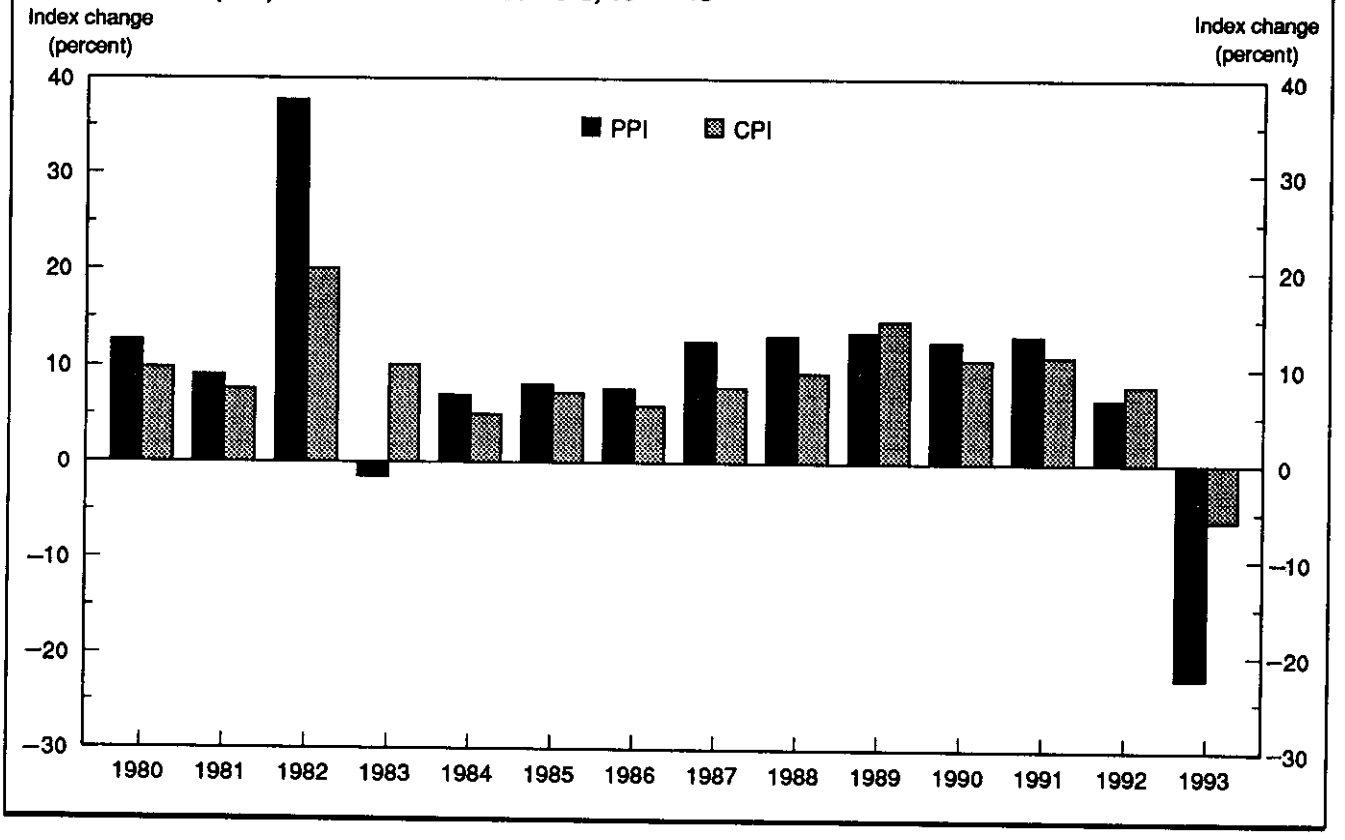


Table 1. **Relative importance of tobacco products in the Consumer Price Index for All Urban Consumers (CPI) and the Producer Price Index (PPI), 1980–93**

Year	CPI-U		PPI	
	All Items	Core	Finished Goods	Core
1980	1.05	1.47	1.50	2.31
1981	1.04	1.44	1.53	2.34
1982	1.39	2.02	2.19	3.47
1983	1.47	2.12	2.12	3.31
1984	1.49	2.13	2.04	3.19
1985	1.54	2.19	2.21	3.51
1986	1.61	2.11	2.33	3.58
1987	1.29	1.69	2.64	4.09
1988	1.35	1.76	2.86	4.38
1989	1.49	1.94	3.12	4.81
1990	1.54	2.04	2.17	5.32
1991	1.67	2.17	2.85	4.44
1992	1.75	2.27	3.08	4.84
1993	1.60	2.07	2.37	3.72

able drop in the price of tobacco products.

As shown in table 1, tobacco products are not as central within the CPI. Over the 1980–92 period, the substantial advances in the CPI for tobacco and smoking products typically accounted for 0.1 or 0.2 percent of the annual increases for the CPI, and 0.2–0.3 percent of the increases for the core CPI rate. In 1993, the increases in both the CPI and its core rate would have been 0.1 percent higher if not for the 5.9-percent drop in the tobacco and smoking products index.

Treatment of taxes

A crucial difference between the Producer Price Index and Consumer Price Index estimation methodologies involves the handling of taxes. The CPI measures changes in average retail prices for a market basket of goods and services purchased by urban consumers; therefore, CPI data reflect sales taxes (that is, taxes assessed as a percentage of the retail price) and excise taxes (actual dollar amounts per unit assessed on an item). Conversely, the PPI excludes direct taxes from its calculation because sales and excise taxes represent revenues to government rather than to the producers. This difference in methodology is critical because cigarettes are among the relatively few commodities (gasoline and alcohol are other prominent examples) to have excise taxes levied against them.

The Federal, State, and several local governments (such as in New York City) impose excise taxes on cigarettes. During the 1980–94 period under review, the Federal excise tax per pack of cigarettes doubled from 8 cents in 1980 to 16 cents in 1983, and went to 20 cents in 1991, and most recently, to 24 cents in 1993. During this period, the average State excise tax per pack of cigarettes more than doubled, from about 13 cents per pack to 29 cents. Currently, State excise taxes range from 2.5 cents per pack in Virginia to 75 cents in Michigan.[1]

The inclusion of sales and excise taxes (as well as wholesaler and retailer margins) in the CPI for tobacco and smoking products helps to explain why that index is usually not as volatile as its PPI counterpart. To illustrate:

> In 1993, the average retail price of a pack of cigarettes was about $1.70; this includes 53 cents in excise taxes (the 24-cent Federal excise tax and the 29-cent average State excise tax) and the margin of wholesalers and retailers.[2] The average producer price for cigarettes consumed domestically was 91 cents a pack, excluding all excise taxes.[3] If a manufacturer had raised its price by 5 cents, the relative of change used in the PPI for cigarettes calculation would have advanced 5.5 percent, representing the change in the unit price the manufacturer would receive from a 91-cent price per pack to a 96-cent price. Assuming the full change was passed through to the consumer without any markup, the CPI would reflect a change in the average retail price from $1.70 to $1.75, an advance of just 2.9 percent. By the same token, the CPI changes when excise taxes change, but the PPI is not affected, making the CPI more volatile in tax change situations.

What drove cigarette prices?

The steep advances in prices charged by cigarette producers since 1980 were not a reaction to escalating material costs. From December 1979 to December 1993, the Producer Price Index for leaf tobacco moved up 30.7 percent, far less than the increases for either producer or consumer prices for tobacco products. The sharp cut in cigarette prices in 1993 can hardly be explained by citing the 0.6-percent drop in the leaf tobacco index that year.

Data from the Bureau of the Census and the Federal Trade Commission provide further evidence that higher cigarette prices cannot be chiefly attributed to changing input costs. From 1980 through 1990, the value of shipments for cigarettes more than doubled, from about $10 billion to more than $25 billion. Material costs hardly budged during this span, remaining well below $5 billion each year.[4] Labor costs also showed little net change, and, in fact, were overshadowed by material costs, a reversal of the rule-of-thumb that says labor accounts for two-thirds of all costs in the manufacturing sector. Capital expenditures accounted for a smaller portion of

total production costs in 1990 than in 1980, both in absolute and relative terms. What did expand from 1980 into the 1990's were advertising costs[5] and, even more, gross markup. Gross markup is defined here as the remaining value of shipments of the industry after subtracting the industry's major costs of doing business listed above. Most of this is revenue to the industry before taxes, and a small portion is other expenses such as utility, rent, and miscellaneous expenses, not defined in the Bureau of Census or Federal Trade Commission reports. Gross markup in 1990 accounted for $15 billion of the shipment value of cigarettes, compared with $10 billion for all other costs associated with cigarettes, including advertising costs.[6] (See chart 3; all figures exclude excise tax payments.)

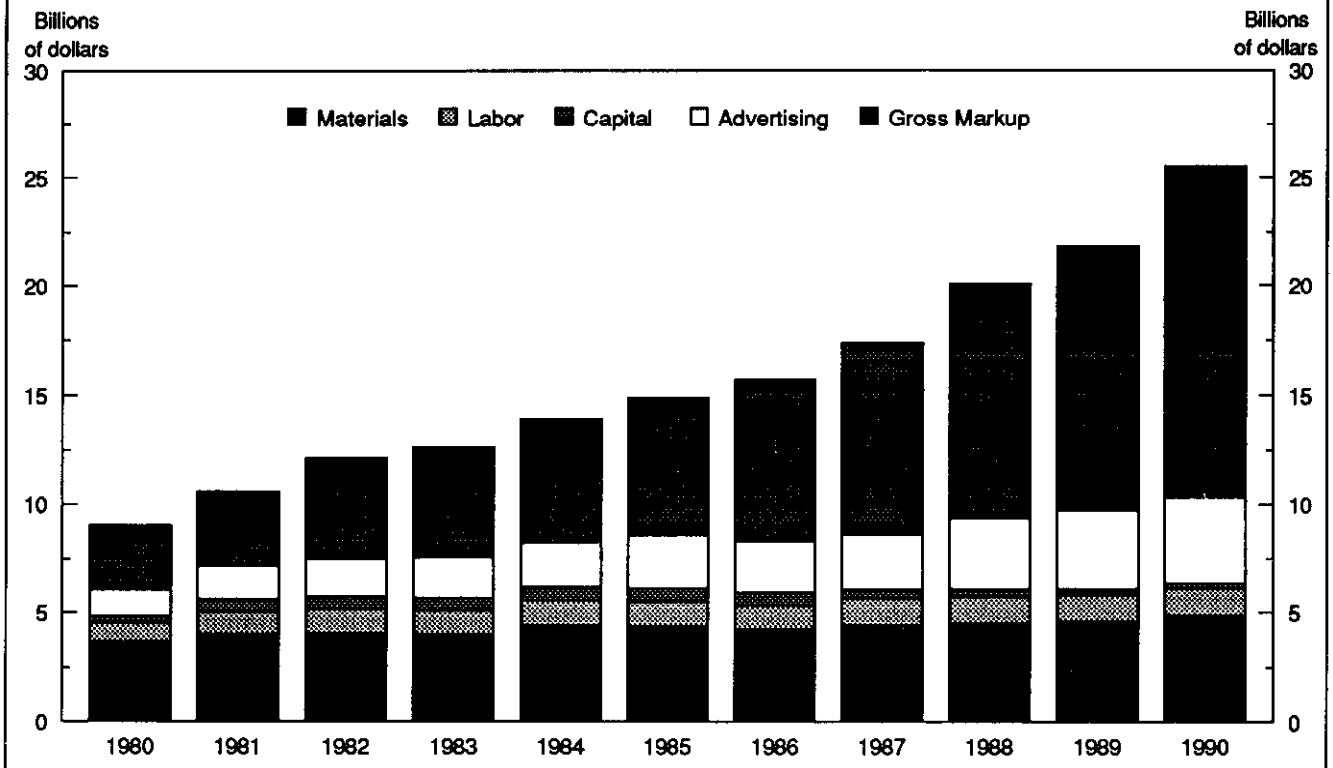
As would be expected, the increase in prices charged by the cigarette manufacturers to wholesalers is the single most important factor explaining the concurrent rise in retail cigarette prices. This disputes media accounts that often explain rising cigarette prices as resulting primarily from tax increases. While taxes on cigarettes steadily increased over the duration of this study, they actually represent a smaller proportion of the average retail price in 1993 than they did in 1980. (See chart 4.)

According to data published by the Tobacco Institute, the average retail price for a pack of cigarettes in 1980 was about 63 cents, with 21 cents, or 33 percent, being excise taxes. By 1993, the average price for a pack of cigarettes had risen to about $1.70, which included a little less than 53 cents, or 31 percent, in excise taxes. In 1992 (prior to the Federal excise tax increase and the sharp price decreases among manufacturers that occurred in 1993), excise taxes accounted for only about 25 percent of the average price for a pack of cigarettes, well below their historical high of 51 percent in 1965.[7]

Domestic cigarette production

Even as the value of shipments for cigarettes was more than doubling from 1980 into the 1990's, and as gross markup expanded several times, the total number of cigarettes produced in this country remained remarkably constant at around 700 billion per year.[8] (See chart 5.) This stability marked a balance between two offsetting market phenomena: (1) a 35-percent drop in per capita consumption of cigarettes in the United States over the 1980–93 period, and a 24-percent decline in total consumption, reflecting an intensive campaign to educate current and po-

Chart 3. **Components of value of shipments for cigarettes and changes in the components, 1980–90**



SOURCES: *Report to Congress for 1990 Pursuant to the Federal Cigarette Labeling and Advertising Act* (U.S. Federal Trade Commission, 1992); and U.S. Department of Commerce, "Preliminary Report for Tobacco Products," *Census of Manufactures, 1992.*

tential smokers about the health problems associated with cigarettes; which was offset by (2) a rise in foreign sales of American-made cigarettes. The number of cigarettes exported surged from 82 billion in 1980 to 195.5 billion in 1993, a jump of 138 percent.[9] Japan, Southeast Asia, and Western Europe provided the principal expanding markets for American-made cigarettes in the 1980's; in the 1990's, growth has focused on Latin America, Eastern Europe, most countries of the former Soviet Union, and the Middle East.[10]

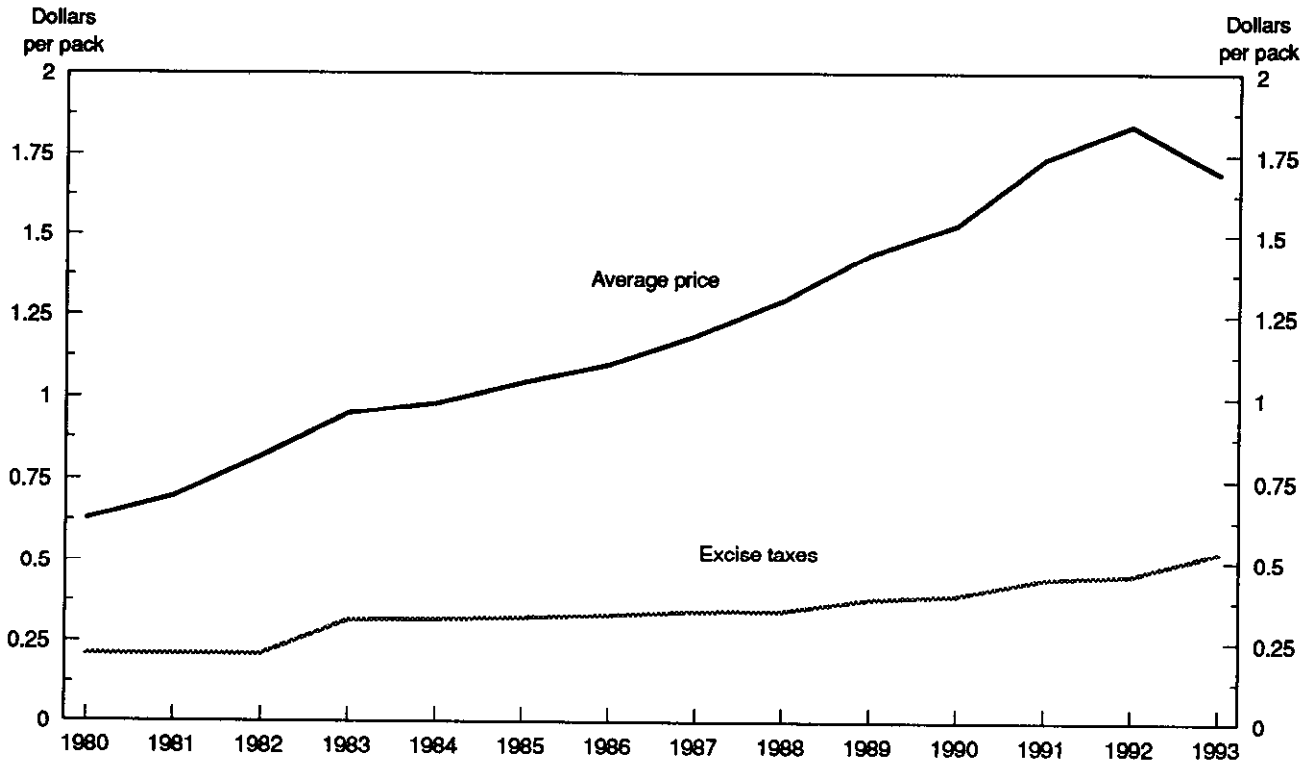
Exports were excluded from the PPI for tobacco products until December 1982. Since then, exports have been eligible for inclusion in the PPI, as this was the date for the phase-in of industry-based Standard Industrial Classification (SIC) indexes that include all domestic production. However, there were no export prices in the cigarette index through June of 1994. Three factors led to the dearth of exports in the cigarette index:

- *The relatively low volume of production for export versus production for domestic consumption when the first samples of products were collected in 1982 and 1988.* Exports were 10.6 percent of total production volume for 1982 and 17 percent for 1988. This share rose to nearly 30 percent in 1993, and tobacco exports were included in the sample of products introduced in July 1994.
- *Reluctance on the part of producers to give, and Bureau of Labor Statistics analysts to accept, intracompany prices based on cost of production for use in the index.* Some producers transfer sales for export to overseas divisions of their company at the cost of production. But, as is evident in chart 3, the pricing of cigarettes by producers since 1982 has had little to do with costs.
- *Confidentiality concerns of the producers.* Because producers consider sales for export to be more price competitive, they are often wary of releasing such information.

Demand—elastic or inelastic?

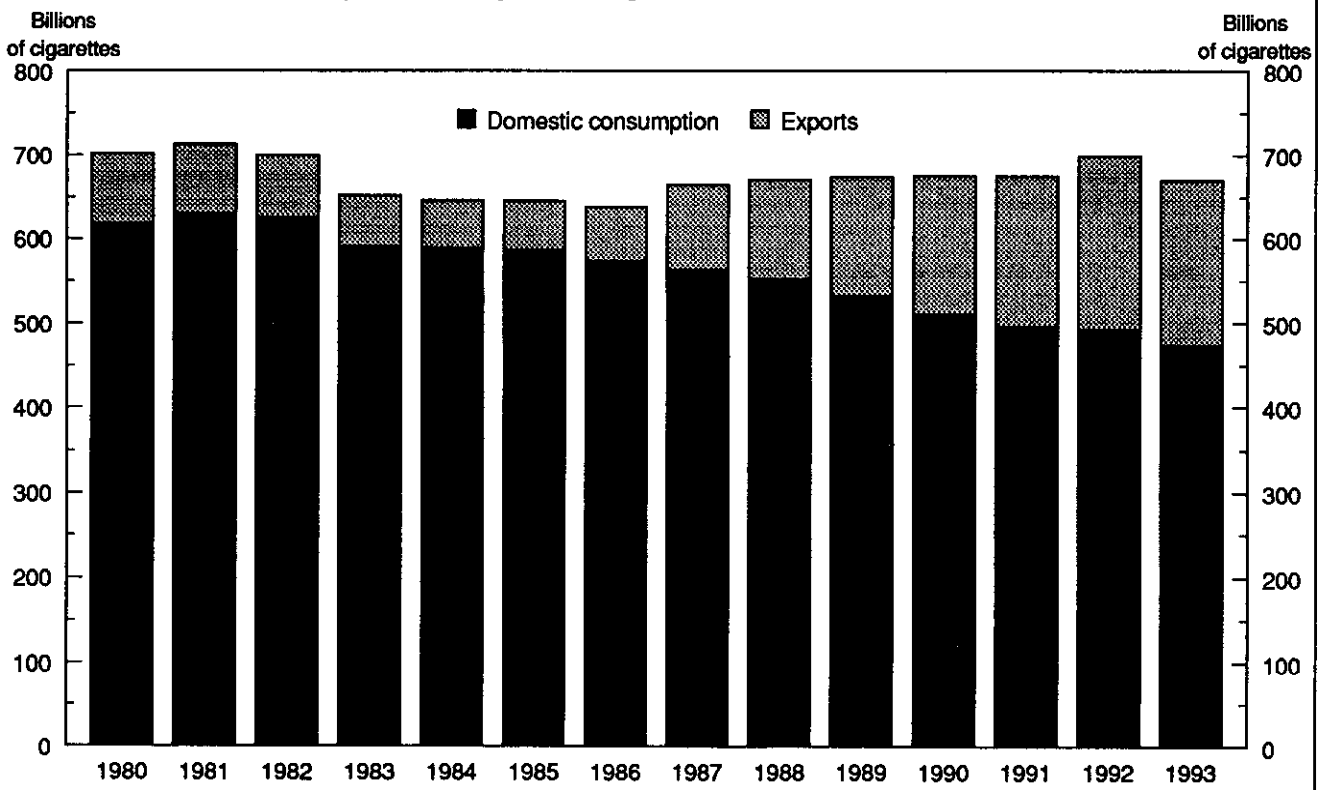
The price elasticity of demand is defined as the percentage change in quantity demanded divided by the percentage change in price. When price elasticity is equal to 1.0, the demand curve for that product is said to exhibit unitary elasticity; in this instance, the percentage change in price is equal to the percentage change in quantity sold.

Chart 4. Average price and excise taxes per pack of cigarettes, 1980–94



SOURCE: Data are from the Tobacco Institute.

Chart 5. **Domestic consumption and exports of cigarettes, 1980–93**



SOURCES: Bureau of Alcohol, Tobacco and Firearms; and Bureau of the Census.

When demand for a product is highly responsive to price change (that is, when the percentage change in quantity demanded exceeds the percentage change in its price), the price elasticity of demand for that product exceeds 1.0, and the demand curve is termed elastic at that point. Conversely, if the price elasticity of demand for another product is less than 1.0, demand for that product is considered inelastic (price changes do not induce a proportionate change in quantity demanded).[11]

Producers confronted by an inelastic demand for their products have an incentive to raise prices until they reach a point where demand drops so much that price hikes result in less net revenue; at this point, demand becomes elastic. Even though domestic demand for cigarettes has fallen somewhat since 1980, the 24-percent drop in total cigarette consumption has been more than matched by the 223-percent jump in retail prices, and the 207-percent rise in producer prices. Clearly, this indicates that demand for cigarettes has been inelastic.

One of the dangers to producers in such a market, short of reaching that point of consumer resistance, is that the high profits generated by the excess of unit revenue over unit cost might attract added competition. New producers might undercut established producers by offering products at a lower price that is still sufficient to secure profitability. This has not occurred in the cigarette industry because effective barriers to entry do exist. The barriers consist primarily of the massive advertising expenditures necessary to achieve some level of brand recognition and the huge capital expenditures necessary to achieve the production efficiency scale enjoyed by the six major domestic cigarette manufacturers.

Several attempts have been made to estimate the price elasticity of demand for cigarettes in the United States; the results of some of the more recent studies are shown in the following tabulation:[12]

Author and date	*Price elasticity estimates*
Baltagi and Lexin (1986)	0.215
Porter (1986)	0.051 to 0.290
Baltagi and Goel (1987)	0.114 to 0.917
Kao and Tremblay(1988)	0.495 to 1.019
Russo (1989)	0.573
Chaloupka (1991)	0.27
Wasserman, Manning, Newhouse, and Winkler (1991)	0.283
Becker, Grossman, and Murphy (1994)	0.4 (short-run) 0.75 (long-run)

Nearly all of these estimates are well below 1.0; in fact, most are below 0.5, pointing to unusually inelastic demand. In the most recent study, Becker, Grossman, and Murphy estimate the short-run elasticity of demand for cigarettes at about 0.4, consistent with most other analyses.[13] They, unlike most of their colleagues, derived an estimate for the long-run elasticity of demand, which they put at 0.75. In other words, if cigarette prices rise 10 percent, cigarette consumption can be expected to drop 4 percent initially, and eventually fall 7.5 percent.

The generally low responsiveness of consumer demand for cigarettes to price changes, at least in the short run, largely explains why cigarette manufacturers were able to keep raising their prices so sharply for so long. While no single answer fully explains why the demand for cigarettes is so price inelastic, two are offered: First, because no real comparable substitute product exists for cigarettes, consumers cannot switch to another relatively less expensive product, and still achieve the same level of utility derived from consuming cigarettes; second, although the issue of whether the amount of nicotine delivered by currently marketed cigarettes leads to addiction has not been definitively settled in scientific terms, the data on smoking cessation rates may provide useful anecdotal information. The Centers for Disease Control report that in 1990 (the most recent year for which data are available), about 46 million Americans smoked. About 15 million of them tried to quit in 1990; 1.15 million, or 7 percent, were successful.[14]

Pricing practices for cigarettes

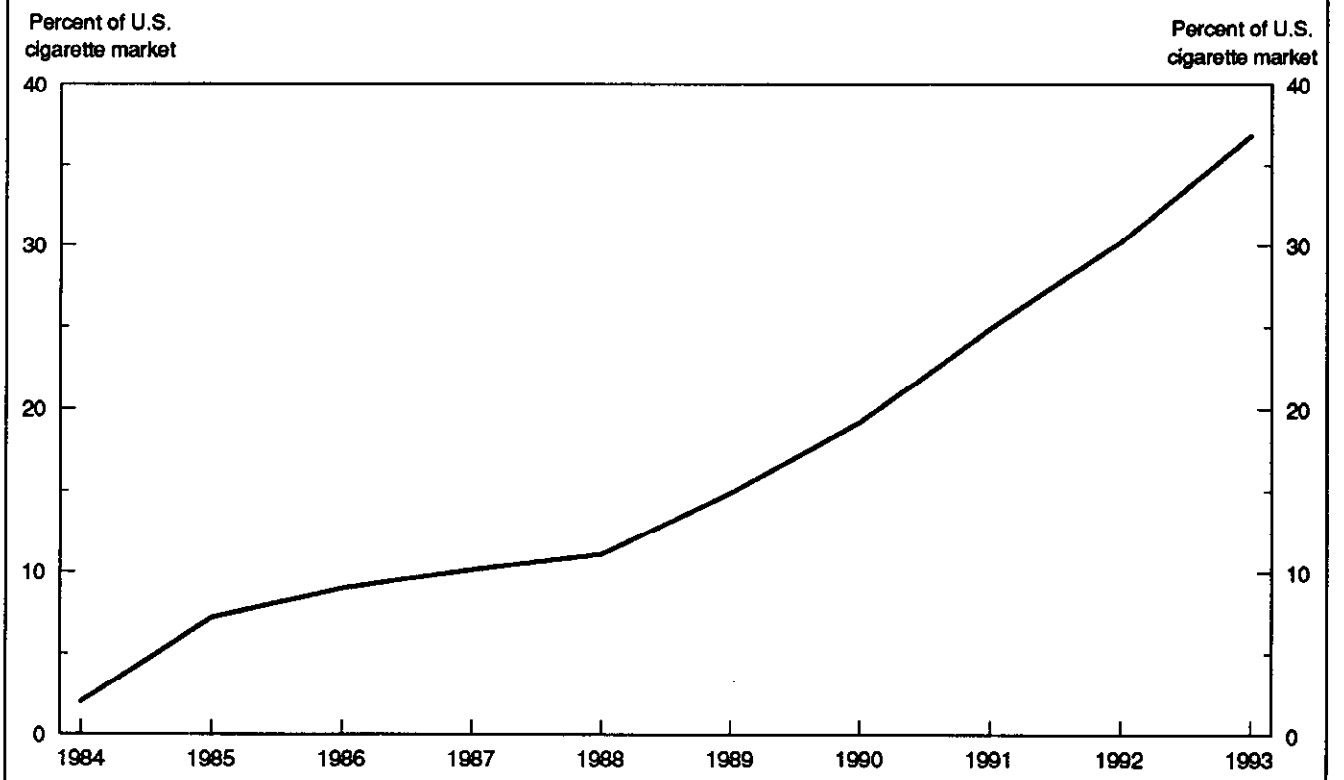
Until 1980, virtually all cigarette brands in the market were termed "premium" or "full margin" brands. The prices for cigarettes from producers were fairly uniform across all brands. There was some price variation for length, filter versus nonfilter, and menthol versus regular, but these differences were relatively small and generally reflected the differences in input and manufacturing costs. For these premium brands, top quality tobaccos were used, and these brands were promoted by the producer through all normal channels of marketing (billboards, newspapers, magazines, direct mailings, and so forth). In this environment, producers vied for market share solely through advertising and marketing campaigns. Brand image, not price, differentiated the products, and thus defined the consumer's choice.

Competition on this basis favored the largest companies with the most money and resources to devote towards advertising campaigns; as a result, smaller producers steadily lost market share. In 1980, the smallest of the six major U.S. cigarette manufacturers, Liggett Group Inc., introduced the first plain label, or "generic" cigarettes. These cigarettes were sold in simple black-and-white packages with names such as "Flavor Lights" and sold for approximately 25 percent to 40 percent less than premium brands. Consumers now had a new way to choose cigarette products—price. With this move, Liggett established a second, lower priced "discount" segment in the cigarette market, and thus began the ongoing cigarette price war.

During the early to mid-1980's, sales of generic cigarettes grew at a rather slow pace. Then in 1984, the second shot of the cigarette price war was fired. RJ Reynolds, the second largest cigarette producer, introduced another category of cigarettes into the discount segment. These so-called branded discount cigarettes cost less than premium cigarettes, but more than generic cigarettes. For the most part, branded discount cigarettes were repositioned as premium brands, so they had more "traditional" packaging and advertising budgets. The larger producers understood that sales of discount brands were cannibalizing sales of their more profitable premium brands. Therefore, the larger manufacturers sought to position branded discount cigarettes to compete directly against generics and not against premium brands. The branded discount cigarettes were an attempt by the larger cigarette manufacturers to capitalize on the growing number of price-conscious consumers while offering them some semblance of image or brand recognition. It was also true that branded discount cigarettes provided a greater profit margin than generic cigarettes and that, because some advertising was done for these brands, competition was not limited to price, thereby again giving the larger producers a competitive advantage over their smaller rivals. The volume of discount cigarette sales—branded discount and generic cigarettes—gradually increased until it reached 15 percent of all cigarette sales in 1989.[15]

Then, in 1989, Liggett, the industry's smallest producer, again countered the larger manufacturers by introducing an additional brand category into the discount segment. Their "Pyramid" brand established the new bottom rung on the cigarette price ladder, creating the "deep discount" category. Brands in this category sold for even less than generic cigarettes. The once monolithic cigarette market had been broken into two segments based on price: premium and discount. Within the discount segment, three price categories of brands existed; in descending order of price they were: branded discount, generic, and deep discount. From 1989 forward, the volume sales of the discount segment grew sharply: its market share increased to 19.2 percent in 1990, to 25 percent in 1991, to 30.2 percent in 1992,

Chart 6. **The "discount" segment share of cigarette sales by volume, 1984–93**



SOURCE: John C. Maxwell, *The Maxwell Consumer Report*, Aug. 9, 1994.

and to 36.8 percent in 1993. Chart 6 shows the sales growth of the discount segment since 1984.[16]

By mid-1992, the percentage difference between prices for brands in the discount segment and the premium segment had narrowed. (The manufacturers raised cigarette prices six times in 1990 and 1991; prices for premium brands rose about 25 percent while prices for discount brands jumped nearly 40 percent.[17]) In response, some manufacturers cut their prices on several discount brands in mid-1992. That adjustment caused a large drop in the August 1992 PPI for cigarettes and slowed the increase in this index to 7.0 percent for the entire year. The price cut also muted the 1992 increase in the CPI for tobacco and smoking products. Up to this point, wide-scale cigarette price reductions of this sort were unprecedented. But, as events in 1993 unfolded, the 1992 price decrease for discount brands was a foreshadowing of additional major changes in the cigarette market.

By the second quarter of 1993, the discount segment's market share by volume soared past 40 percent, forcing the major producers to do something to save their more profitable premium brands from extinction. They responded by lowering prices on their premium brands. Coupon discount and rebate programs were first announced in April 1993 for selected major premium brands. Producers eventually decided that they could not retain their premium brand market shares unless they dropped prices of all premium products. The price decrease to wholesalers for premium cigarettes was announced and implemented in late July 1993, causing the large drop reflected in the August 1993 PPI for tobacco products. Thus far, the strategy seems to be achieving its goal—by the second quarter of 1994, the discount segment's share of the market had fallen to 32 percent.

Seasonal patterns of price change

Prior to 1983, changes in the Producer Price Index and the Consumer Price Index for tobacco products occurred at relatively random intervals and at different times of the year, with little consistency from year to year. Beginning with July 1983 data, however, a distinct seasonal pattern emerged as the indexes regularly made substantial advances in January and July of each year. The PPI policy is to use the prices of the Tuesday of the week that contains the 12th of the month. Some of the price increases in this period occurred late in June and December, so the PPI did not reflect them until the following month.

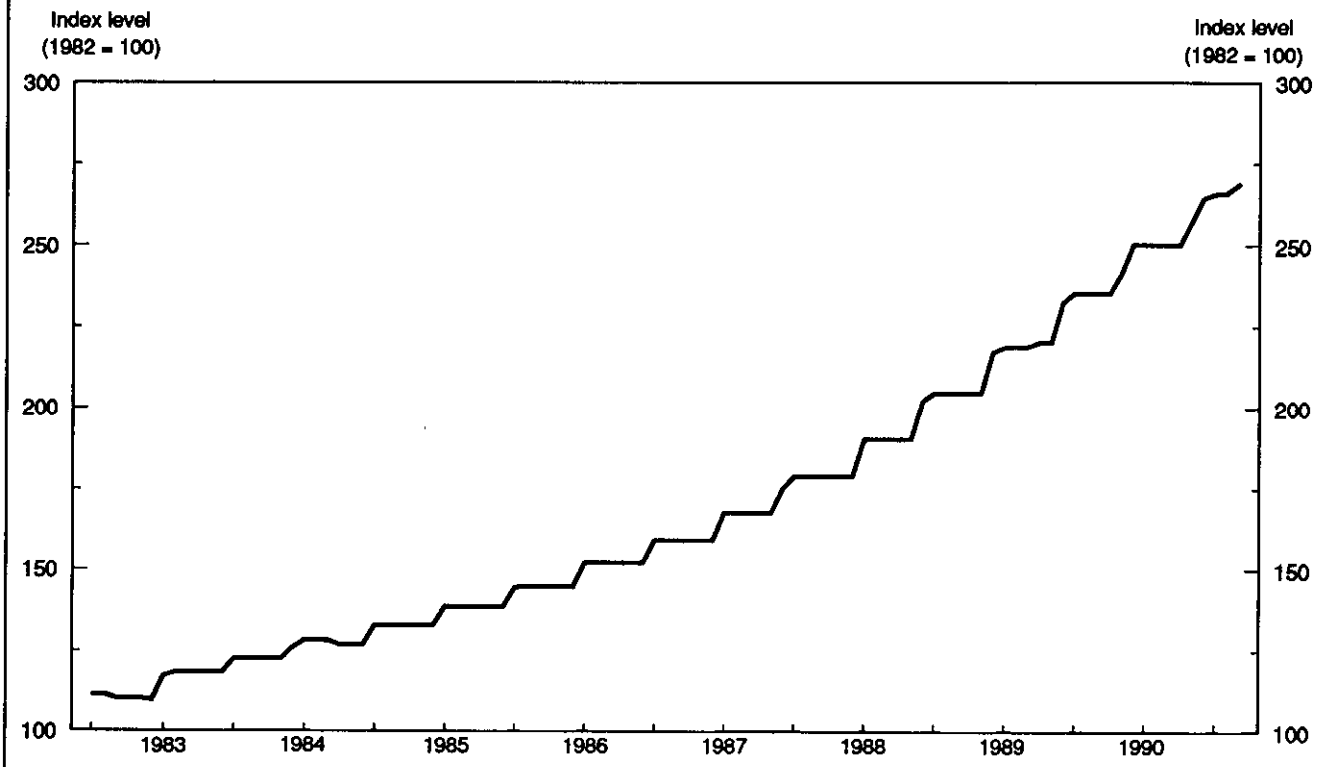
This type of change, in which producers adjust their prices in the same month and at regular intervals is often termed a "step pattern." A chart of the PPI index for cigarettes showing sizable increases at regular intervals with little or no changes for the months in between resembles the steps on a staircase. (See chart 7.) Also, the CPI for tobacco and smoking products in chart 2 reveals a subtle step pattern. This is because the PPI reflects the full impact of a manufacturer's price increase in a single month, while the CPI captures such increases over a span of 2 to 3 months, as they work their way through the producer-wholesaler-retailer-consumer pipeline. The pattern in the CPI is also less distinct, because not all retailers pass the price increases to consumers and because manufacturers' price increases will always have a smaller effect on the CPI because the CPI collects prices that include excise and sales taxes.

The January and July step pattern continued through July 1987. The next major price hike was implemented, not in January as previous experience would have projected, but in December 1987.The price hike that followed occurred in July 1988 in accordance with the older pattern. Subsequent price increases over the next 2 years shifted to a December and June pattern instead of the previous January and July standard.

During 1991, the seasonal pattern of price change shifted again, in two respects: (1) producers raised cigarettes prices three times that year, not twice; and (2) producers spread each of those three price boosts over a 2-month period. During the 1983–87 period, when one of the price leaders for cigarettes announced a boost, all other producers would normally follow within a week. But in 1991, there were 6 months in which the PPI for tobacco products jumped 1 percent or more: a spring increase in March and April, a midyear increase in June and July, and a late autumn advance over November and December. Producers would, at times, announce and implement price increases immediately; at other times, they would defer increases for up to 2 months, using special rebate or "buy-in" programs.

In 1992, cigarette producers again raised their prices in the spring, spread out over 2 months, but starting a month later than in the previous year (April and May in 1992, versus March and April in 1991). For the first time since 1981, there were no price increases in June or July. Then, in August, there was a large price decrease for the first time since early 1983, as producers made significant cuts in prices for their discount cigarettes. Following this, a price increase was split between November and December.

Chart 7. **The Producer Price Index for cigarettes, January and July of 1983–91**



NOTE: The January-July pattern of price increases changed to December-June beginning in 1989. Data are not seasonally adjusted.

In 1993, producers implemented a price increase in April, but several producers announced substantial discounting programs for their leading premium brands that same month. Despite this much-publicized announcement, producers did not report actual price decreases to BLS for several months, and those they reported were fairly small in magnitude. In late July (too late to be reflected in July PPI data), producers slashed their prices to wholesalers for all brands except their deep discount brands. The result was a large drop in the August PPI for Finished Goods that was curiously unanticipated by many analysts, even though the news of the steep cigarette price cut had been widely reported both in the general media and in the trade press. A modest price increase at the close of 1993 occurred entirely in the December data and thus was not spread over 2 months.

In the first 6 months of 1994, the PPI for tobacco products inched up in January and then remained unchanged through June. For the same period, the CPI for tobacco and smoking products rose modestly (2.4 percent). Many tobacco analysts believe that cigarette producers are holding the line on prices as they evaluate the long-term effect of the large price decrease for premium brands implemented in 1993. Also, the uncertainty of congressional action on increasing the Federal excise tax on cigarettes is contributing to the wait-and-see posture.

Interpreting seasonal adjustments

The PPI and CPI indexes are seasonally adjusted based on their historic pattern of price change. In January, the PPI and the CPI calculate seasonal factors for each month of the upcoming calendar year that are used to calculate the seasonally adjusted index. The unadjusted index is divided by the seasonal factor previously calculated for that month to derive the seasonally adjusted index. For tobacco products, the seasonal pattern traditionally had been much stronger in the PPI than in the CPI, because the price changes in the PPI were of a higher magnitude and occurred in 1 or 2 months, while changes in the CPI were of a smaller magnitude and were spread over more months. The shift in the step pattern that began to occur in 1987 had a more profound effect on the PPI, so the following discussion is primarily on this index.

The traditional method of seasonally adjusting the PPI adapts slowly to sudden shifts in pricing patterns, so instead of smoothing the seasonal pattern, the first shift in the step pattern caused the seasonally adjusted index to spike upward for the months it shifted to, and fall for the months it shifted from. For example, in 1989, tobacco products increased 5.0 percent in June and 0.6 percent in July before seasonal adjustment. The seasonally adjusted figures published initially for these months were 5.4 percent and –2.5 percent. Due to the relative importance of tobacco products, such large changes had an effect on higher level indexes as well. Once this new pattern began to establish itself, the PPI began to explore the use of Intervention Analysis Seasonal Adjustment modeling to cope with the problem of slow adjustment to the new pattern.[18] Seasonal factors based on Intervention Analysis Seasonal Adjustment modeling were introduced in January 1991. In that year, and in each year that followed, the pattern of price change for producers continued to shift. (See the appendix for a detailed explanation of Intervention Analysis Seasonal Adjustment modeling used for the tobacco products index in the PPI.)

Properly interpreting recent monthly changes in seasonally adjusted data for the PPI for tobacco products requires an appreciation of how shifts in pricing patterns have affected the seasonal adjustment process. An example can be found in May and June 1994 data:

> There was no change in the PPI for tobacco products before seasonal adjustment in either May or June. However, on a seasonally adjusted basis, the tobacco products index climbed 1.9 percent in May. This advance, in turn, was one of the principal factors behind the 0.4-percent rise in the closely followed PPI for finished goods other than foods and energy, which had risen only 0.1 percent in each of the 3 immediately preceding months.

Because of the role of tobacco products, BLS analysts downplayed the significance of this seeming uptick in the underlying rate of inflation. Seasonal adjustment factors for tobacco products currently decline considerably from April to May, but then more than recover from May to June. This pattern is the result of the sizable midyear price increases that had occurred in earlier years.

If the seasonal factor declines from one month to the next, and if the index before seasonal adjustment is unchanged, then the seasonally adjusted index would increase in roughly inverse proportion to the drop in the seasonal factors. A month-to-month increase in the seasonal factor has the opposite effect. If the unadjusted index for June had increased according to its normal midyear seasonal pattern, the higher seasonal factor used for June would have produced a seasonally adjusted change that is less than the unadjusted change. But change due to the "nonseasonal" components of the index would remain.

When raw data for tobacco products showed no change in May, the seasonal adjustment factors translated this into a substantial advance. Conversely, when raw data for June also showed no change, the seasonally adjusted tobacco products index slumped 2.7 percent because the normal midyear seasonal pattern failed to materialize. Largely as a result of this considerable drop, the index for finished goods other than foods and energy edged down 0.1 percent in June, vindicating the perspective that the May uptick was a statistical fluke. Thus, still reflecting the steep drop in the August 1993 tobacco products index, the PPI for finished goods other than foods and energy in June 1994 was merely 0.6 percent higher than its level of a year before. This over-the-year change, which remained below 1 percent for a full 12 months, automatically jumped in August 1994, once the drop from July to August 1993 no longer affected this calculation.

THE RESURGENCE of competitive forces that led to the unprecedented rollback in cigarette prices in 1993 and that ended the pattern of periodic large price advances is all the more remarkable in that it occurred without the emergence of new competitors. Instead, the pricing revolution was accomplished by the same six companies that have dominated the domestic cigarette industry for many years. The collapse of pricing practices of the cigarette industry has reduced, for the time being at least, what had been a significant source of inflationary pressure in the consumer and producer price indexes. The shifts in cigarette pricing practices that have occurred for each of the last 5 years (the drop in prices in 1993 being the most dramatic, of course) also invite discussion on whether even flexible seasonal adjustment methods such as Intervention Analysis Seasonal Adjustment can continue to be used to seasonally adjust indexes for tobacco products.

Footnotes

[1] *Tobacco Tax Guide* [as of October 1,1994] (New Jersey, Tobacco Merchants Association of the United States, 1994).

[2] *The Tax Burden on Tobacco* (Washington, DC, The Tobaccco Institute, Vol. 28, 1993), table 13-B, p. 118.

[3] John C. Maxwell, *The Maxwell Consumer Report*, July 6, 1994 and Aug. 9, 1994.

[4] U.S. Department of Commerce, "Preliminary Report for Tobacco Products," *Census of Manufactures, 1992*, table 1, p. 3.

[5] *Report to Congress for 1990 Pursuant to the Federal Cigarette Labeling and Advertising Act* (U.S. Federal Trade Commission, 1992), tables 3A–3D, pp. 22–25.

[6] "Preliminary Report for Tobacco Products."

[7] *The Tax Burden on Tobacco*, tables 13,13-B, pp. 86–118.

[8] *U.S. Tobacco Statistics, 1935–1992* (U.S. Department of Agriculture, 1992), table 1, p. 13; and *Tobacco Situation and Outlook Report* (U.S. Department of Agriculture, June 1994), table 1, p. 4.

[9] *U.S. Tobacco Statistics, 1935–1992.*

[10] U.S. International Trade Commission, compiled from official statistics of the U.S. Department of Commerce.

[11] Edgar K. Browning and Jacquelene M. Browning, *Micoreconomic Theory and Applications* (Little, Brown & Company Limited, 1983), pp. 86–89.

[12] Authors listed in the tabulation are cited in Gerard G. Russo, "An Optimal Cigarette Tax" (Ph.D. diss., Northwestern University, 1989), table 14; for the last two citations, see Gary S. Becker, Michael Grossman, and Kevin M. Murphy, "An Empirical Analysis of Cigarette Addiction," *American Economic Review*, June 1994, pp. 396–418; and Jeffrey Wasserman, Willard G. Manning, Joseph P. Newhouse, and John D. Winkler, "The Effects of Excise Taxes and Regulations on Cigarette Smoking," *Journal of Health Economics*, May 1991, pp. 43–64.

[13] Becker, Grossman, and Murphy, "An Empirical Analysis of Cigarette Addiction."

[14] John Bloom, American Cancer Society, compiled from data gathered by Centers For Disease Control and Prevention, Office on Smoking and Health.

[15] *The Maxwell Consumer Report.*

[16] *The Maxwell Consumer Report.*

[17] *Tobacco Situation and Outlook Report* (U.S Department of Agriculture, September 1994), tables 5–6, pp. 6–7.

[18] See James A. Buszuwski and Stuart Scott, "On the Use of Intervention Analysis in Seasonal Adjustment," paper presented at the ASA Section on Business and Economic Statistics, 1988; and James A. Buszuwski and Stuart Scott, "Some Issues in Seasonal Adjustment when Modeling Interventions," paper presented at the ASA Section on Business and Economic Statistics, 1993.

APPENDIX: Intervention Analysis Seasonal Adjustment in the PPI

The standard method for seasonal adjustment of time series data in the Producer Price Index system, the X-11 program developed by the U.S. Bureau of the Census, is not suitable when the timing of price movements changes as abruptly from year to year as it has for tobacco products. While the conventional X-11 seasonal adjustment program does adapt to changes in seasonal patterns over time, this adaptation is slow. BLS has therefore employed Intervention Analysis Seasonal Adjustment methods to accelerate the adaptation of seasonal factors to the seasonal shifts described above.[1]

By 1987, the large January and July movements that had become the pattern for the PPI for tobacco products since 1983 were firmly entrenched in X-11 seasonal factor calculations. When the pattern of price increases switched to a December and June pattern of price increases in place of the previous January and July pat-

Table A–1. **X-11 ARIMA/80 quality control statistics**

Item	F-statistics		M_7	Q	Unusual events[1]
	Stable	Moving			
1991					
Span: January 1983–December 1990					
No prior adjustments (X-11 ARIMA/80)	12.4	1.6	0.686	0.51	
With prior adjustments (Intervention Analysis Seasonal Adjustments)	97.2	.3	.200	.24	6/84, [2]5/89, 5/90, [2]11/87, 11/90
Intervention Analysis Seasonal Adjustment model used: L010011					
1992					
Span: January 1983–December 1991					
No prior adjustments (X-11 ARIMA/80)	13.3	1.8	.686	.51	
With prior adjustments (Intervention Analysis Seasonal Adjustment)	89.5	.2	.207	.28	6/84, [2]11/87, [2]5/89, 5/90, [2]10/90, 4/91, 5/91
Intervention Analysis Seasonal Adjustment model used: L010111					
1993					
Span: January 1985–December 1992					
No prior adjustments (X-11 ARIMA/80)	5.8	1.9	1.043	.77	
With prior adjustments (Intervention Analysis Seasonal Adjustment	43.2	.8	.33	.45	[2]11/87, [2]5/89, 5/90, [2]10/90, 5/91, 5/92, 8/92
Intervention Analysis Seasonal Adjustment model used: L012011					
1994					
Span: January 1986–December 1993					
No prior adjustments (X-11 ARIMA/80)	3.1	8.1	2.250	1.16	
With prior adjustments (Intervention Analysis Seasonal Adjustment)	11.2	1.6	.725	.61	[2]11/87, [2]5/89, 5/90, [2]10/90, 5/91, 5/92, 8/92
Ramps:[3] July 1993–August 1993					
Intervention Analysis Seasonal Adjustment model used: L012011					

[1] Dates marked as unusual events are considered one-time occurrences that are not part of a recurring pattern.
[2] Seasonal shift, that is, a shift of an existing pattern from month to month.
[3] A ramp denotes a one-time "level shift" that occurs for one or several months.

tern, the change could not be adequately reflected in seasonally adjusted data through conventional X-11 methodology. As a result, the initially published seasonally adjusted indexes for December and June would show increases that were too large, followed by equally unrealistic seasonally adjusted decreases in January and July.

Intervention Analysis Seasonal Adjustment methods, based on the X-11 ARIMA/80, were first introduced in the calculation of the January 1991 PPI's for tobacco products and cigarettes. By this time, price increases had shifted from occurring solely in January to occurring primarily in December for 4 consecutive years; the shift from July to June had been in place for 2 years. Generally, a pattern shift such as this must be observed for 2 consecutive years before it can be modeled as a seasonal shift in BLS Intervention Analysis Seasonal Adjustment methodology. Using intervention analysis with indexes from January 1983 through December 1990, BLS analysts determined that seasonal shifts occurred in December 1987 and again in June 1989. Increases that were recorded in 3 months—June 1984, May 1990, and November 1990—were judged anomalous, one-time events that were not part of a re-

curring pattern and were therefore modeled as unusual events. The result of the use of intervention analysis was a substantial improvement in the quality control statistics for tobacco products and cigarettes, versus the control statistics with no prior adjustment for X-11 ARIMA/80.[2]

The evolution in 1991 to a pattern where price increases were spread over more than 1 month at a time led to a decision to add another seasonal shift, from December to November, because now there were 2 consecutive years marked by strong November price advances. Intervention analysis continued to be used in later years, but with a deterioration in the quality of all results, as the trend towards less stable seasonality and greater random patterns became more established. The previous step pattern with price increases at certain, more-or-less definite times of the year has given way to a pattern of changes set more by competition than by the calendar.

Control statistics. Table A–1 provides information and statistics regarding seasonal adjustment for the cigarettes index during the 1991–94 period. The statistics for each year list the time interval analyzed, the control statistics for the X-11 ARIMA/80 (no prior adjustments) and those related to the "with prior adjustment" model selected. This model is derived from Intervention Analysis Seasonal Adjustment methods, which uses X-11 ARIMA/80 as a starting point. Various models and time intervals are tested to see which produces the best statistical results and best matches expectations of future price change for the index. Testing and analysis generally occur soon after the December indexes are available, so that a model and factors for the next year are ready for use before the January index release for that year. The data in table A–1 are for the cigarette index, but in most cases the numbers and trends for the tobacco products index are identical or close.

The PPI has various guidelines or thresholds that the preceding tests are expected to meet before the index is seasonally adjusted when using Intervention Analysis Seasonal Adjustment. These thresholds are as follows: The F-statistic for stable seasonality should be greater than 7; the F-statistic for moving seasonality should be less than 3; and the M_7 and Q statistics should each be less than 1. These are general guidelines, and exceptions are made for statistics that are borderline (for instance, an index with an F-statistic less than 7 may be seasonally adjusted when other circumstances are weighed).

Obviously, use of Intervention Analysis Seasonal Adjustment has improved the control statistics from what they would have been using standard X-11 ARIMA/80 in each of the 4 years listed in table A–1. It is also obvious that as the magnitude and timing of price changes have shifted over the last several years, the quality of X-11 and Intervention Analysis Seasonal Adjustment has been dropping, especially for the last 2 years. If the pattern continues to shift and change in 1994, the control statistics may continue to fall near or below the thresholds discussed above. What model to use for 1995, or whether to seasonally adjust the tobacco products and cigarette indexes, will be based on the control statistics for the best model available and other factors, such as what the future seasonal pattern is expected to be relative to current and past index data.

Footnote to the appendix

[1] James A. Buszuwski and Stuart Scott, "On the Use of Intervention Analysis in Seasonal Adjustment," paper presented at the ASA Section on Business and Economic Statistics, 1988; and Buszuwski and Scott, "Some issues in Seasonal Adjustment when Modeling Interventions," paper presented at the ASA Section on Business and Economic Statistics, 1993.

[2] X-11 ARIMA/80 with no prior adjustments (no interventions) generates seasonal factors that are similar, but not identical, to those for Census X-11. A direct comparison with Census X-11 control statistics is not possible, because this index series was removed from the production system that generates seasonal factors using Census X-11 methodology.