# When do Firms Downsize?

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This paper examines the historical record for plant downsizing and closure in textiles. National and statewide data are used to identify the causes of downsizing. It is not possible to predict with certainty when and where downsizing will occur due to the importance of the unobserved plant management and worker efficiency that can make or break the operation. Rather, this paper identifies critical indications of potential downsizing. An analogy to medical diagnosis is apt. Physicians cannot predict with certainty which patients will have heart disease. There are "indications", however, that make the incidence of heart disease more likely. This paper presents indications for textile plant downsizing. These can be useful in anticipating such events.

Labor-force downsizing and plant closure are inevitable outcomes of the market economy. Schumpeter (1942) chronicles what he terms the "creative destruction" of economic activity, with product and production innovations leading to the expansion of some firms and the contraction and elimination of others. This creative destruction has long been a part of the industry in the United States, as Davis et al. (1996) document. It has been a characteristic of the textiles industry in North Carolina as well, as the evidence presented below will document.

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Downsizing and closure also visit substantial costs on the communities in which they occur. The businessmen and women responsible for employment and plant closure choices act responsibly, but their responsibility is primarily to their shareholders. The workers and surrounding community affected by the choices face substantial restructuring, retraining and perhaps relocation costs.

In a perfect world, perhaps, the businesses would alert their workers and communities of impending plans to downsize or close plants. In our imperfect world, however, there are two major reasons why this will not happen. First, the businesses themselves will often have little warning of a change in market conditions requiring downsizing. Business people are optimists by nature, and they have faith that something will turn up to permit continued operation. Second, any alert to workers and community of a possible closure will be the end of business as usual for that plant. Suppliers will not sell on credit; customers will not make long-term commitments; banks will not provide working capital; workers will search for new jobs on company time. Under those conditions, the possibility of downsizing becomes a certainty.

The focus of this discussion is upon the textiles industry. I define this to include five categories of economic activity: yarn and thread spinning, woven and non-woven fabric production, fabric finishing, hosiery, and specialty products (curtains, carpets, tire cord, rope and cordage). Apparel production is not included, but is treated as a downstream activity for the textiles industry.

The analysis of the paper proceeds in three parts. In the first part, I present the national trends in employment, output and apparel expenditure. There has been a negative trend in employment for half a century, but this trend has accelerated in the last decade. In the second part, I examine the causes for downsizing, and provide evidence associated with each one. In the third part I use statistical analysis of textile performance at the county level in North Carolina to identify county-specific "indications" to assist in predicting downsizing. The fourth part offers conclusions and extensions.

## I. National trends in employment, output and consumption of textiles.

There are three potential reasons for a downturn in textile employment: introduction of labor-saving technology, downturn in demand for clothing in the US, or increased competition from international trade. Table 1 reports averages of annual growth rates in these four categories for the period 1961-2000.[1]

As is evident in the table, the average growth rate in textiles consumption in the US is quite stable at around 2.7 percent per annum. Other things equal, this will tend to raise employment. Productivity growth in textiles has been substantial, with growth rates of 4.28 percent in the earlier years and 3.20 percent in the period 1996-2000. This taken alone will cause substantial reductions in textile employment. The share of consumption met through domestic production was rising by 1.46 percent per annum in the earlier

[1] The arithmetic derivation that supports this decomposition is presented in the appendix.

years. This became the slightly negative average growth rate of -0.58 percent per annum in 1990-1995, and the strongly negative average growth rate of -3.86 percent per annum in 1996-2000.

**Table 1: Average Annual Growth Rates: Textiles Industry**

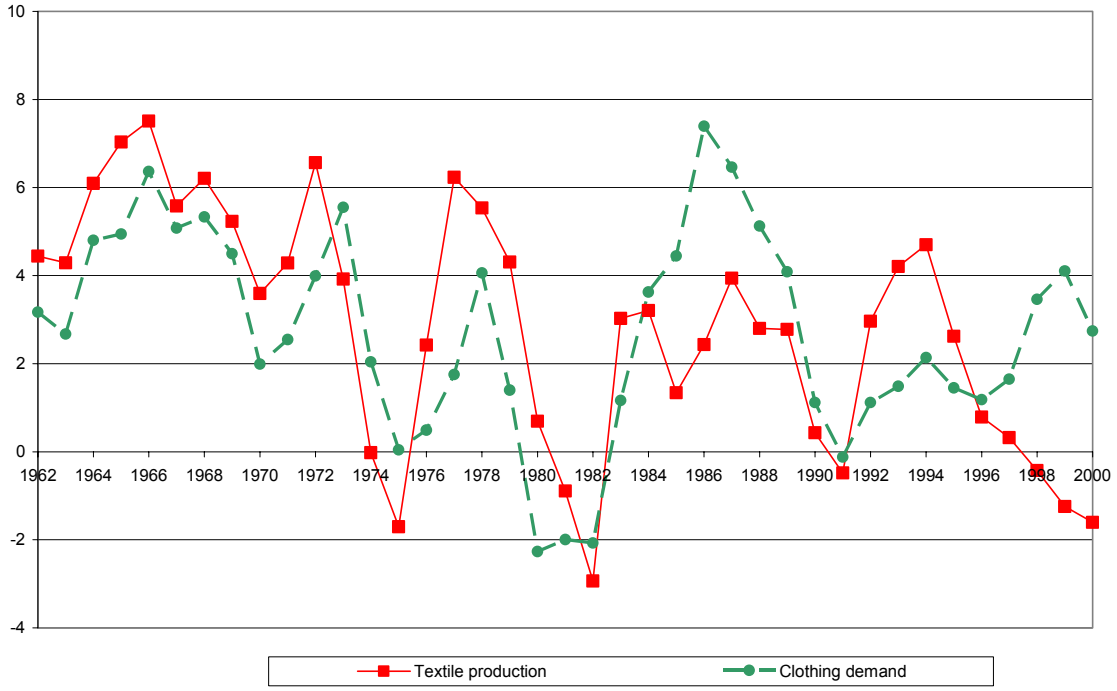
| | **Employment** | **Productivity** | **Consumption of textiles** | **Share of Consumption from Domestic Output** |
|---|---|---|---|---|
| | | | | |
| 1961-1980 | -0.36 | 4.28 | 2.68 | 1.46 |
| 1981-1995 | -1.58 | 3.47 | 2.73 | -0.58 |
| 1996-2000 | -4.42 | 3.20 | 2.83 | -3.86 |

Sources: US Bureau of Census for employment, output, productivity. The measure of domestic consumption used, real expenditure on clothing and shoes, is taken from the Economic Report of the President 2004, and is only a proxy for true domestic consumption of textiles. As a result, the growth rates reported do not sum exactly.

The strong downturn in employment in textiles since 1995 can largely be explained by shifts in the ratio of domestic output to consumption. Figure 1 illustrates the close link between clothing demand and textiles production in the pre-1995 period. The averages of Table 1 smooth out the evident cyclic movements of demand and production that are evident in the figure. The decoupling of demand and production is apparent after 1995, as clothing demand rebounded while textile production continued its sharp decline.

Why is employment declining in textiles? This evidence from the national level provides two explanations. First, productivity growth has exceeded the growth in domestic demand for textiles. This leads to a negative growth trend in employment, as fewer workers are needed to produce the textiles demanded in the market. Second, the inroads of foreign goods have led to a sharply decreasing share of domestic production in the domestic market since 1995. In that situation, even with robust growth in demand for textiles there will be reduced domestic employment.

**Figure 1: The link between clothing demand and textile production**



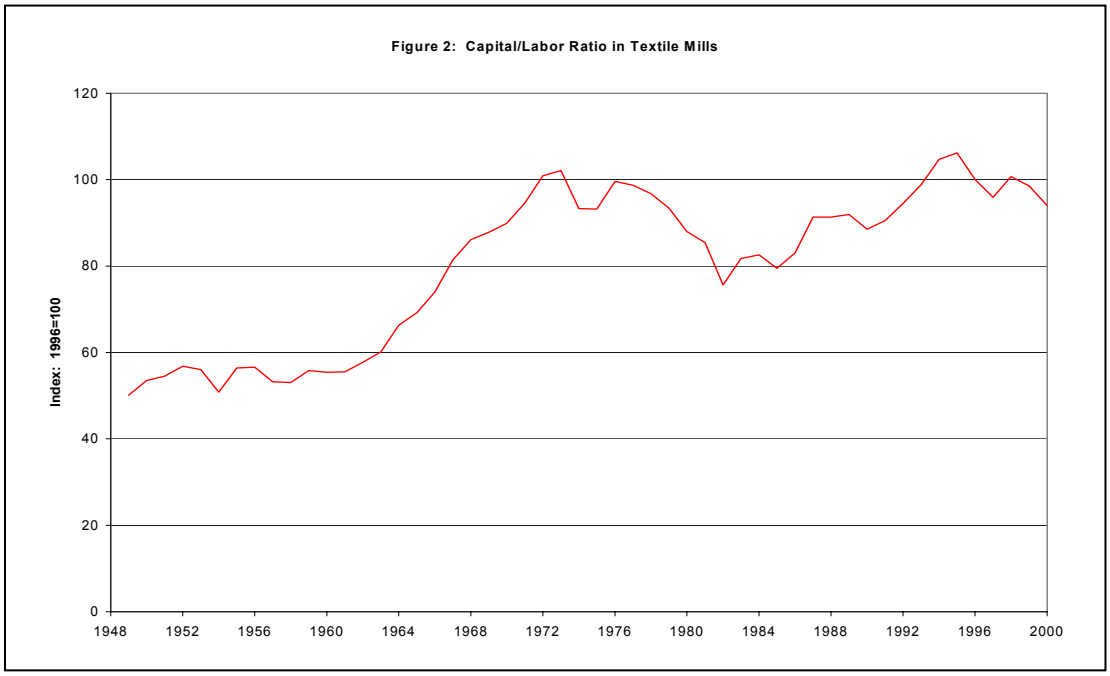

## II. What factors are driving the downsizing?

The evidence of the previous summary meshes well with the evidence from interviews with textile businesspeople.[2] There are six features of the textiles business that stand out from those interviews. First, and most fundamental, there has been technology-based growth that has led to downsizing in employment even in periods of continually increasing output growth. Second, there has more recently been a reduction in innovation in the industry. With less innovation, producers in foreign countries are adopting very similar technology to that in US plants, thus reducing any technological advantage the US firms once had. Third, apparel production has moved offshore. The traditional "supply chain" in textiles relied upon domestic factoring companies to buy up the textile product and forward it to apparel producers. As apparel production moved offshore, foreign intermediaries sprang up and forged new links between the foreign apparel makers and foreign textile makers. Fourth, the US producer has been under pressure from the "price scissors" of falling final-good price and rising wages. Fifth, the consolidation of production in the 1990s into a smaller number of larger firms through leveraged buy-out left the resulting firms less able to cope with market downturns. Sixth, expectations of even fiercer competition in the future triggered early closures and downsizing by US producers.

[2] A summary of this process can be found in Conway et al. (2003).

**Technology-based growth**.

Figure 2 illustrates the evolution of the capital-labor ratio for textile mills in the US.




While the overall evolution is one of strong increases in the use of capital relative to labor in textile mills, there are important sub-periods to recognize as well. Rapid growth in capital began around 1960, and this first modernization wave continued until 1973. At that time, a partial reversal began and continued to 1982. A second modernization wave is evident from 1983 through 1995, with a reversal of the labor-saving trend beginning in that year and continuing through 2000. This overall trend toward capital use led to ever-increasing output through 1995 but with reduction in employment.

**Price scissors**.

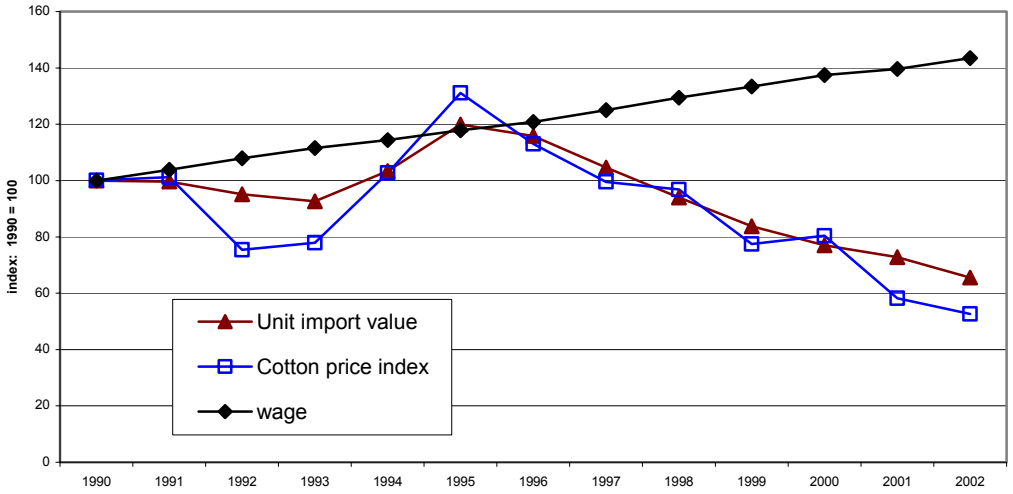
In the last decade, another source of pressure upon business has come from the "scissors" formed by declining final-good prices and rising wages. Figure 3 illustrates these pressures for firms in the cotton yarn spinning industry.

Cotton yarn producers faced price pressure from two sources. First, the unit value of cotton yarn imported into the US was declining in nominal terms throughout the period after 1995. This downward price pressure on the final product forced domestic producers to reduce their prices as well. Second, the average wage paid to textile workers rose steadily throughout this period.[3] These two blades of the "scissors" would have been

[3] The rise in the consumer price index in the US was nearly identical over this period to the rise in wages. Put differently, the real wage measured in worker purchasing power remained constant over the period. The real price of cotton yarn, then, declined by substantially more than is indicated by the nominal decline pictured in the diagram.

unbearable for producers if not for a mitigating factor: the price of the cotton used as a raw material in the yarn was also declining in line with the unit value of imports.

**Figure 3: Price Scissors in Cotton Yarn**




**Offshore shift in apparel production**.

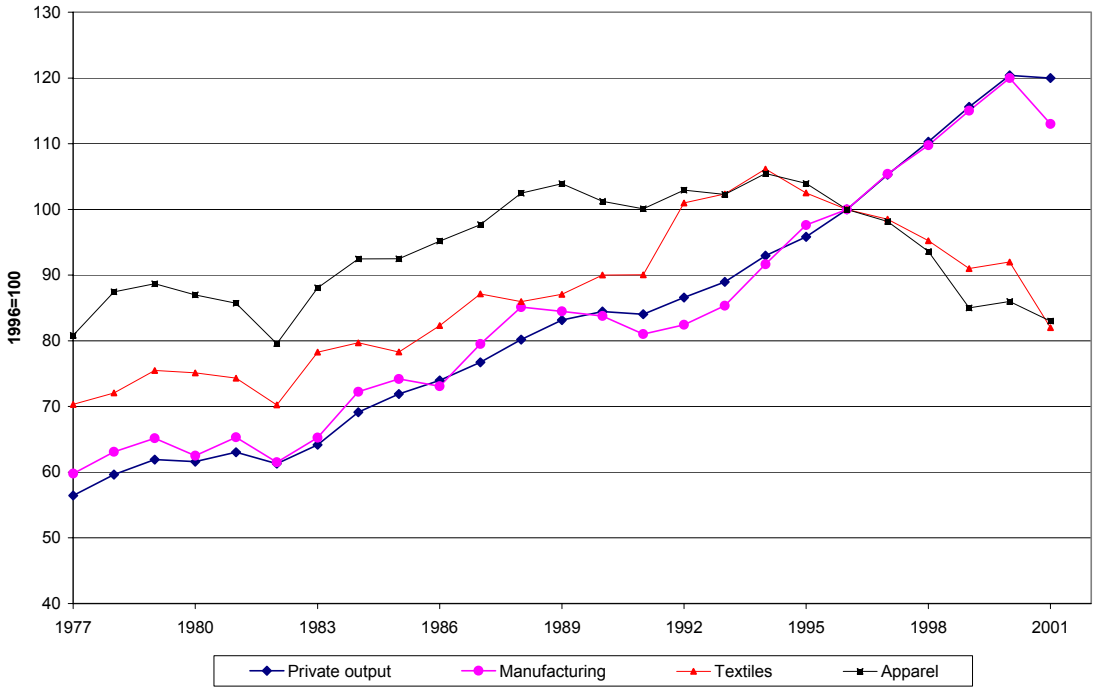
Textiles production is only a link in the supply chain for apparel to the consumer. In the US, the supply chain has traditionally been entirely within the borders: cotton grown here, yarn spun here, cloth woven here, clothes sewn here. The service of factoring grew up to intermediate between the producers at the various links of the chain.

When apparel production began to move offshore, the factors were unable to intermediate as efficiently. Domestic textiles producers found it difficult to identify foreign apparel producers, or to supply those producers in a low-cost, on-schedule way. Textiles manufacturers overseas were discovered, and foreign factors emerged to intermediate among them. Thus, as domestic apparel production fell so also did domestic textiles production. Figure 4 illustrates the close link between the quantities produced of the two sectors in recent years.

**Over-expansion and over-leveraging.**

While most of the firms in the textile sector remain one-plant operations, the large firms grew predominantly through acquisition. These acquisitions were at a price, and the price represented a bet on the future evolution of the textiles market. In some cases these acquisitions were financed through a "leveraged buy-out" of the previous owner, with the resulting larger firm obligated to service the debt incurred in the acquisition. This increases the operating costs of the firm, as it generates revenues through sales to pay not only for materials inputs, labor and machinery, but also for the interest due on the debt.

**Figure 4: Quantity Indices for US Production**

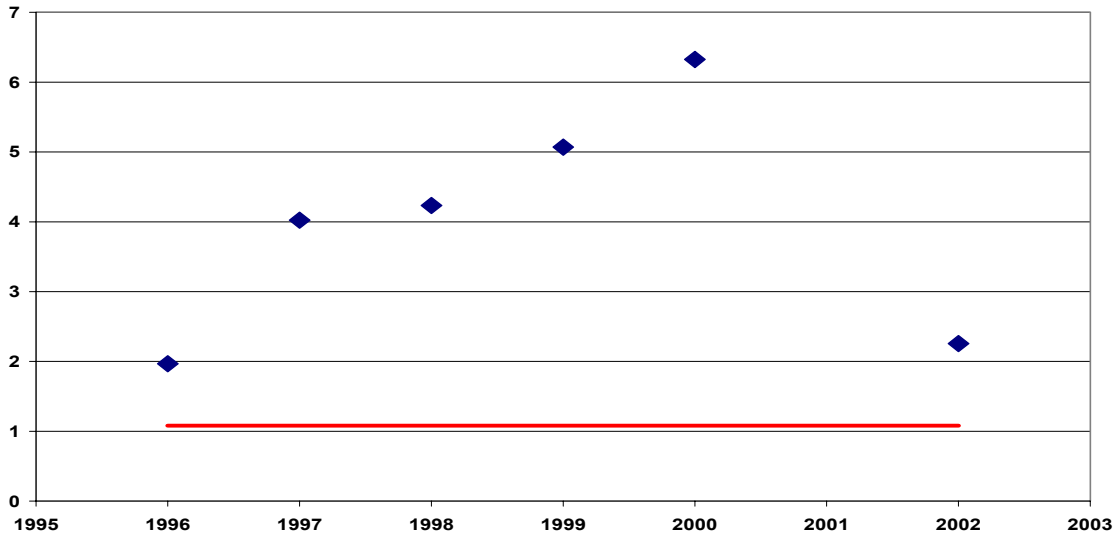



The Pillowtex Corporation provides a pertinent illustration of this concept.[4] The debt-equity ratio of all firms in this industrial classification in 1999 was 1.08, and this figure is used for comparison. Figure 5 reports this average ratio as a line, and the ratios observed for Pillowtex as diamonds, over the years 1996 – 2002.[5]

Pillowtex acquired the blanket portion of Fieldcrest-Cannon in 1996, and then acquired the remainder of Fieldcrest-Cannon in 1997. These acquisitions were largely financed through debt secured by Pillowtex assets, and thus raised the ratio of debt to equity from the industry average to 2.0 in 1996 and to 4.0 in 1997. The firm agreed to acquire Leshner Corporation as well in 1998, and financed that purchase through debt issuance. By 2000 the debt-equity ratio was over 6, and the downturn in the US economy ended any hope the firm had of continuing to finance its debt. The management declared bankruptcy in December 2000 and began downsizing.

[4] These data are drawn from the 10-K reports filed by Pillowtex Corporation.
[5] There was no observation reported in 2001 because the firm reported negative equity.

**Figure 5: Debt-Equity Ratios of Pillowtex and Comparators**




**Expectations of greatly increased foreign competition in the future**.

The firms of the textile sector have been protected from excessive foreign competition for the last 30 years by the Multi-Fiber Agreement and its successor, the Agreement on Clothing and Textiles. These agreements represent a system of quotas on imports from foreign countries that limit the quantity of goods imported into the domestic market. The Agreement on Clothing and Textiles was initiated in 1995, and introduced a phased removal of these quotas. The final quotas will be removed (if the agreement is implemented as signed) on 31 December 2004.

This removal of protection was the last straw for some producers. As one industry executive put it, "…we could see 2005 on the horizon: it was a big stop sign. I believe that 2005 will be the last nail in the coffin of US textiles. Only firms with very small niches will be able to compete with foreign producers at that point. It won't matter how 'lean and mean' you are, you just can't win." This executive shut down his mill and let his workers go: even though he could continue to operate, he saw no point in doing so with the removal of quotas in the near future.[6]

**Firm characteristics in the textile industry.**

While the aggregate growth rates provide a useful look at the loss of employment in textiles, it is important as well to examine the behavior of individual plants. In Table 2, I summarize plants reporting economic information in the Census of Manufactures conducted by the US Bureau of the Census.[7] I divide the responding plants in each year

[6] I'm checking with the executive quoted for permission to credit him publicly with this statement.

[7] This portion of the research was conducted at the Triangle Census Research Data Center. The results and conclusions are those of the author and do not necessarily indicate concurrence by the Bureau of the Census. The data included have been screened to insure that no confidential data are revealed. This paper has not undergone the review that Census gives its official publications.

into three categories: entering, exiting and continuing. Entering plants are those not observed in the previous census: for example, an entering plant in 1977 will be one not reporting in 1972. Exiting plants are those observed in the current census but not reporting in the next census: for example, an exiting plant in 1977 will be one reporting in 1977 but not reporting in 1982. Continuing plants are those observed in the current census and the following census: for example, a continuing plant in 1977 will be one reporting both in 1977 and in 1982.

The statistics of Table 2 illustrate three important features of textiles production in the United States.

- **There is substantial turnover among textiles production plants**. While the total number of plants is varying somewhat from census to census, this net change is masking substantial creation and destruction of plants. In 1982, for example, there were 3033 textile plants continuing operations from 1977. There were also 2038 plants in operation that had opened since 1977. Of this total of 5072 plants, nearly half (2427) closed by the time the next census was taken in 1987. There is clearly much creative destruction at play here.

- **Continuing plants are much larger on average than plants that are exiting or entering.** Once again considering 1982: those 3033 plants continuing from 1977 had average total employment of 205 workers. The 2038 entering plants had average total employment of 39 workers, while the 2427 exiting plants had average total employment of 60 workers. This pattern is evident in every census year.

- **Those plants that continue from one census year to the next have on average larger total value of shipments in the continuation year, but smaller employment**. This is evident by comparing the characteristics of "continuing plants" for 1987 in the top half of the table with "continuing plants" for 1992 in the bottom half of the table. These are the same 2520 plants. Their total value of shipments rose on average from $20,345 to $23,116. At the same time, average employment fell from 210 to 199. This pattern of falling average employment is evident in all but one census year.

These data suggest a three-part explanation for the reduction in textiles employment. First, the number of plants in total has declined in recent years. Second, continuing plants are employing fewer workers on average, even though the value of shipments continues to rise for those plants. (Note, however, that the sample does not go deeply into the post-1995 period.) Third, the plants that exit in one census year employ more workers on average than those plants that enter in the following census year. This leads to a tendency toward downsizing that reinforces the movement in continuing plants.

**Table 2: Textile plants in the US**

| | **1972** | **1977** | **1982** | **1987** | **1992** | **1997** |
|---|---|---|---|---|---|---|
| **Continuing plants (units)** | 3221 | 3033 | 2644 | 2520 | 2537 | |
| Total Employment (workers) | 239 | 233 | 210 | 210 | 196 | |
| Total Value of Shipments ($ thousands) | 7163 | 10996 | 14561 | 20345 | 23764 | |
| Percent of firms with (invest/TVS) >.05 | 24 | 18 | 19 | 20 | 21 | |
| **Exiting plants (units)** | 2390 | 1797 | 2427 | 1330 | 1422 | |
| Total Employment (workers) | 69 | 78 | 60 | 96 | 75 | |
| Total Value of Shipments ($ thousands) | 1969 | 3466 | 3562 | 7813 | 6775 | |
| Percent of firms with (invest/TVS) >.05 | 25 | 14 | 8 | 10 | 22 | |
| **Continuing plants (units)** | | 3221 | 3033 | 2644 | 2520 | 2537 |
| Total Employment (workers) | | 232 | 205 | 216 | 199 | 186 |
| Total Value of Shipments ($ thousands) | | 10776 | 13815 | 20486 | 23116 | 28165 |
| Percent of firms with (invest/TVS) >.05 | | 16 | 15 | 18 | 20 | 25 |
| **Entering plants (units)** | | 1609 | 2038 | 12-6 | 1439 | 1437 |
| Total Employment (workers) | | 61 | 39 | 71 | 72 | 52 |
| Total Value of Shipments ($ thousands) | | 3026 | 2572 | 6215 | 8110 | 6710 |
| Percent of firms with (invest/TVS) >.05 | | 18 | 10 | 14 | 24 | 27 |

Source: Census of Manufactures, various years, US Bureau of the Census

## III. When do plants close in North Carolina?

These national statistics speak volumes about the behavior of North Carolina firms, if only because North Carolina makes up such a large portion of the US production. However, we can zero in more closely on North Carolina through use of information from the Davison's Textile Blue Book from various years over the last three decades.[8]

As Table 3 indicates, the number of plants in operation in North Carolina dropped by 18 percent (from 1271 to 1042) over that quarter-century.[9] Those totals fail to illustrate, however, the tremendous turnover in business establishments. Between 1975 and 1980, for example, 371 operations went out of business while 199 operations opened.[10] In each five-year period, the percent of operations closing down or under new management was between 20 and 30 percent. The percent of new operations was much more volatile, running from 16 to 40 percent of existing operations. Much of this "churning" was due to firms selling off low-performing plants to competing firms: the turnover then is visible only in examining the ownership at the plant level. However, net exit must involve the shuttering of plants, while net entry represents the bringing online of capacity unused in the previous period. Only 29 percent of the 1975 operations are still active under the same management in 2000.

**Table 3: Firm Entry and Exit: North Carolina Textile Sector**

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Textile Operations | 1271 | 1100 | 1027 | 1221 | 1157 | 1042 |
| | | | | | | |
| Operations exiting | 371 | 268 | 224 | 329 | 416 | |
| Operations entering | 199 | 195 | 418 | 265 | 301 | |
| Net entry | -172 | -73 | +194 | -64 | -115 | |
| | | | | | | |
| Percent exiting | | 29 | 24 | 22 | 27 | 36 |
| Percent entering | | 16 | 18 | 40 | 22 | 26 |

Source: Davison's Textile Blue Books for 1975, 1980, 1985, 1990, 1995, 2000.

[8] Davison's Textile Blue Book has been published since 1866 by Davison Publishing Company of Concord, NC. It provides a listing of textile mills, dyers and finishers by state in the United States, Canada and Mexico, including information on employment, equipment, and type of product manufactured. We have collected the data for North Carolina firms from the 1975, 1980, 1985, 1990, 1995 and 2000 editions of this Blue Book.

[9] The Blue Book was primarily an advertising book, and thus the reporting in the book was voluntary. To check coverage, I compared the number of plants reported in this book with the number of plants reported by the North Carolina Employment Security Commission for the same years. The aggregate number is greater than 90 percent of the official statistics in all periods. The correlation of number of reported plants by county over these years for Davison's and official statistics was 0.93. I conclude that the Davison's reports provide a reasonable picture of the North Carolina textile industry.

[10] The term "operation" refers to the same corporation operating a facility in the same physical location in both years. The number of new firms will be less than the number of new operations, since existing corporations can buy the facilities of failing competitors and re-open those facilities. If a corporation "reincorporates" under a new name, or moves its operations to a different address, it is treated as a new corporation in these figures.

This information provides a useful resource for determining the risk factors that are associated with plant closure. Firm exit is an indicator of downsizing and plant closure. Firm entry is the antidote to job loss. In this section I report results from two sets of investigations. The first examines the incidence of entry and exit at the county level; this identifies county-level risk factors associated with downsizing and with job creation. The second looks at the firm level to identify firm-level characteristics that are risk factors for firm exit and indications of firm entry in North Carolina.

**County-level risk factors**.

The number of firms entering the textiles industry (Enter), or exiting the textiles industry (Exit), can be computed by county from the Davison's Textile Blue Book data. So also can the number of plants observed per county in any year (PlantNo).

If entry and exit are not random, then there will be county-specific or firm-specific variables that influence significantly the observed number entering or exiting.[11] The county "risk factors" I consider include.[12]

- The percentage of population having completed high school five years (Lhpct).
- The percent of population living in rural areas (Lruralpct).
- The population of the county (Lpop).
- The percent of the population living below the poverty line (Lperpov).
- The average per capita income of the population (Lpcy).
- The number of highway miles divided by the population (Lhwypop).

Year-specific dummy variables are denoted Dxxxx, with "xxxx" the digits of the year in question.

Table 4 provides regression analyses of entry and exit. Three variables (Lpop, Lperpov, Lhwypop) were not significant regressors in any of the four specifications, and were thus excluded from the regressions reported in the table.

[11] If exit and entry were a totally random event, then we would observe the pattern of entry and exit following either a Poisson or negative binomial process. The Poisson process is one in which entry (or exit) occurs randomly, with the constraint that the mean of the distribution and the variance of the distribution are equal. The negative binomial distribution relaxes the latter restriction; the "dispersion" coefficient indicates the degree to which the variance exceeds the mean.

[12] These variables are downloaded from NC-LINC for the appropriate years. All of these are measured five years previously to the endogenous variable (the L stands for "lagged") to control for any simultaneity. County-specific effects are created as well and are used in estimation: their coefficients are suppressed from the output.

| **Table 4: Analysis of Entry and Exit of Textile Plants – by county** | | | | |
|---|---|---|---|---|
| | Exit | | Enter | |
| | Poisson | Negative Binomial | Poisson | Negative Binomial |
| | | | | |
| **Lpcy** | **-252.32** | **-299.78** | **145.95** | **145.97** |
| | (53.56) | (72.08) | (59.32) | (60.44) |
| **Lhspct** | **-0.16** | **-0.17** | **0.12** | **0.12** |
| | (0.02) | (0.03) | (0.02) | (0.02) |
| **Lruralpct** | **0.03** | **0.03** | **-0.02** | **-0.02** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| **PlantNo** | **0.03** | **0.04** | **0.04** | **0.05** |
| | (0.01) | (0.01) | (0.01) | **(0.01)** |
| **d1975** | **-5.09** | **-5.26** | | |
| | (0.48) | (0.65) | | |
| **d1980** | **-4.19** | **-4.40** | **2.92** | **2.96** |
| | (0.39) | (0.52) | (0.29) | (0.31) |
| **d1985** | **-2.84** | **-3.03** | **1.99** | **2.01** |
| | (0.27) | (0.37) | (0.23) | (0.24) |
| **d1990** | **-1.23** | **-1.30** | **1.43** | **1.45** |
| | (0.14) | (0.20) | (0.15) | (0.16) |
| **d1995** | | | **0.31** | **0.32** |
| | | | (0.11) | (0.11) |
| | | | | |
| Dispersion | 0 | **0.13** | 0 | 0.00 |
| | --- | (0.04) | --- | (0.01) |
| | | | | |
| County-specific effects | Y | Y | Y | Y |
| | | | | |
| Log likelihood | 1545.4 | 1563.27 | 1293.2 | 1293.3 |
| N | 600 | 600 | 600 | 600 |

Standard errors reported in parentheses. Those coefficients printed in bold are significant at the 95 percent level of confidence. Three variables were included, but proved to have insignificant contribution: the ratio of primary highway miles to square miles of area, the lagged percent of population in poverty, and the lagged population of the county were used as separate regressors but proved to have no additional explanatory power. Intercept and county-specific effects also included.

The risk factors for firm exit are given in the second column of Table 4. Not surprisingly, there is a scale effect to firm exit: the more firms you begin with, the more likely it will be that one will exit. This scale effect is the coefficient on PlantNo of 0.04. There is also a growing likelihood over time, other things equal, that firms will exit: this effect is evident in the coefficients on the time-specific dummy variables.

The risk factors that differ across counties are given by the first three coefficients in the column. Firms are less likely to exit from a county with higher per capita income (Lpcy). They are less likely to exit from a county with a higher percentage of the population with high school

completed (Lhspct). They are more likely to exit from a county with a higher percentage of population living in rural areas (Lruralpct).

The positive indications for retaining textiles firms are illustrated by the coefficients in the third column.[13] Once again, there is a scale effect: firms are more likely to enter a county that already has a larger number of existing plants. There is also a time effect – firms were significantly more likely to enter between 1975 and 1980 than they were between 1995 and 2000. Firms are more likely to enter a county with higher average per capita income. Firms are also more likely to enter a county with a higher percent of the population having completed high school, and a county with a lower percentage of rural population. These characteristics are all significant at the 95 percent level of confidence.

**Firm-level risk factors**.

In Table 5, I examine the probability of closure of North Carolina textiles plants: 2479 observations in all over the period 1975 - 2000. Two sets of failure indicators are considered: the county-level variables defined above, and firm-level variables describing the number of materials used in production (totalma), the number of activities performed at the plant (totalac) and the number of types of final goods produced (totalpr).[14] A positive parameter estimate indicates an increased probability of closure of the plant with an increase in that variable.

The time-specific dummy variables indicate a relatively lower probability of closure for the relatively earlier initial year.[15] The percent of county population to have completed high school enters significantly, and with expected sign: those counties with higher ratios had firms that survived longer on average.[16]

There were interesting indications from the firm-level characteristics. The plants that reported use of more materials in the initial year (totalma) were significantly more likely to survive, and those reporting more activities (totalac) were also significantly more likely to survive. The number of products reported (totalpr) had a negative though insignificant effect on the propensity to remain in operation. Thus, the more diversified the better for these plants.

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[13] The third column is used here for statistical reasons. In the "exit" equation, the Poisson distribution was rejected in favor of the Negative Binomial distribution as the underlying distribution of the data – thus, we used column 2. In the "entry" equation, the Poisson distribution does as well as the Negative Binomial distribution, and thus I use the corresponding statistics in column 3.

[14] In Davison's Textile Blue Book, the plant reports the type of material used in production (e.g., cotton, man-made fiber, wool, silk, jute), the number of activities used (e.g, weaving, spinning, dyeing, finishing), and the number of final products (e.g., hosiery, cloth, bedding, automotive). The number reported in each case is used in these variables. In some cases, the values are inferred from the short written description of the product if no material or process is reported.

[15] Time-specific variables are included to control for the random right-censoring associated with 2000 as an artificial final observation for those plants continuing through 2000. The pattern of declining negative coefficients indicates that a plant that opens later has a larger probability of survival to 2000, other things equal.

[16] The other county level variables were introduced. While they were jointly significant in explaining survival, they were individually insignificant. The regression using Lhspct alone was chosen from among them for reporting.

**Table 5: Proportional hazards analysis of all plants in operation in 1975-2000**

2479 observations

Endogenous variable: Number of years observed (5-year increments) in operation

| Likelihood Ratio Test: | Chi-Square | DF | Pr > ChiSq |
|---|---|---|---|
| | 1010.91 | 9 | <.0001 |

| Variable | DF | Parameter Estimate | Standard Error | Chi-Square | Pr > ChiSq | Hazard Ratio |
|---|---|---|---|---|---|---|
| **Lhspct** | 1 | -0.04498 | 0.02242 | 4.0233 | 0.0449 | 0.956 |
| **D75** | 1 | -4.67114 | 0.65413 | 50.9939 | <.0001 | 0.009 |
| **D80** | 1 | -4.04808 | 0.53530 | 57.1875 | <.0001 | 0.017 |
| **D85** | 1 | -3.24038 | 0.40041 | 65.4910 | <.0001 | 0.039 |
| **D90** | 1 | -2.70282 | 0.27421 | 97.1549 | <.0001 | 0.067 |
| **D95** | 1 | -1.98637 | 0.21761 | 83.3259 | <.0001 | 0.137 |
| **totalma** | 1 | -0.11416 | 0.03353 | 11.5900 | 0.0007 | 0.892 |
| **totalac** | 1 | -0.10334 | 0.02460 | 17.6463 | <.0001 | 0.902 |
| **totalpr** | 1 | 0.02022 | 0.05112 | 0.1565 | 0.6924 | 1.020 |

Excluded variable: D00

These results were derived through use of stratified analysis to correct for unobserved heterogeneity at the county level. The regressors have very similar coefficient estimates with the same pattern of significance when this stratification is excluded.

## IV. Conclusions.

When do firms downsize? Profitability (or non-profitability) is critical, and the results of this paper can be interpreted as an extended explanation for the low profitability of textiles firms in North Carolina in recent years. This analysis has also shown that other forces are at play – forces that operate at the county level, or that depend upon the management and operation strategy of the firm. Import competition is one, but not the only, factor in this explanation.

There are "policy" prescriptions to derive from this analysis at two levels.

- At the more microeconomic level, it is clear that all firm management strategies in textiles are not created equal. The problems associated with over-leverage, and the survivability from diversification of materials used and activities undertaken, are both features of management strategy that can be revisited.
- At the level of county and state government, there are "risk factors" in this work that can be used in establishing an early warning system for textiles downsizing. The features of firm management strategies belong in this early warning system. So also do systemic factors like the "price scissors" effect from international competition or the labor-saving advance of technology.

We should draw a caveat as well from this exercise. There are textiles plants in operation over the past quarter century that will fail all the risk-factor tests we come up with. Much of the firm's ability to survive and thrive is idiosyncratic. While the factors identified here are important, the effectiveness of management and workers in the firm are even more important. We must give great weight to the track record of the individual in applying such an early warning system.

**Appendix: Deriving the decomposition of employment growth into its components.**

The level of employment in an industry in period t can be decomposed as follows.

$$L_t = \tau_t C_t / \mu_t \qquad \text{(A1)}$$

$L_t$ is employment in textiles in the US in period t. $\mu_t = (Q_t/L_t)$ is a productivity measure: the average output (in square meters) per labor-hour in period t. $\tau_t = (Q_t/C_t)$ is the ratio of domestic production of textiles to domestic consumption of textiles in period t. $C_t$ is the quantity of textiles demanded in the US in period t.

If we denote the growth rate of a variable $x_t$ between periods t and t-1 by $g(x_t)$, then we can rewrite our employment definition as

$$g(L_t) = - g(\mu_t) + g(C_t) + g(\tau_t) \qquad \text{(A2)}$$

Negative growth in textile employment can be decomposed into three sources. First, productivity improvements lead to reduction in employment. Second, reductions in demand for the products in which textiles are used will reduce the derived demand for labor. Third, reductions in the share of domestic production in total consumption will reduce textile employment as well. These are the components reported in the columns of Table 1.

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