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Optimal Investment Strategies

for

Enhanced Productivity

in the Textile Industry

Team:

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Goal: to identify investment strategies to achieve maximum manufacturing productivity with the ultimate goal of increasing the market share of the US textile industry.

- analyze industry, sector and firm level data
- examine the combined effects of labor, R&D, IT investment and capital expenditures on productivity
- inform capital budgeting decisions which involve significant uncertainties, especially R&D and IT investment

Adjustment costs for R&D related projects are estimated to be seven times the adjustment costs of investment in new plant and equipment. Analyzing total factor productivity, which includes the interaction between factors, will improve how the industry assesses productivity by including these costs of complexity

Caption for labor productivity graph:
While the gains in labor productivity are great, the overall level of productivity is still below the level of labor productivity of the other manufacturing sectors. This suggests tremendous potential for continued productivity growth.

Traditionally, labor productivity has been used to measure productivity growth however labor is decreasing in importance in the production of textiles. Technologically advanced manufacturing processes substitute more sophisticated machines (capital) for labor. As a result, measuring labor productivity when labor is decreasing exaggerates productivity gains.

Caption for 2 digit total productivity graph:
In the 1970's there was a slowdown in productivity growth throughout the economy that was explained by diminishing returns to science and technology. The relationship between productivity and technological growth was understood to be positive but with a diminishing horizon. This is one of the most complex yet vital issues in today's business world (Griliches, 1998).

The chart indicates that fifty years ago the textile industry was 35% as productive as it was in 1996 and that between 1996 and 1999 productivity increased by 8 percent. The data is indexed at 100 in 1996.

Caption for four digit MFP

This chart shows the productivity trends for the textile industry, broken down to the level of four digit SIC codes, where 1987, the base year, is indexed at 100. This chart highlights types of firms that have had the greatest productivity advances. Broadwoven cotton mills as well as yarn and thread mills have had declines in productivity.

Caption for exit/entry table:

This table documents the significant exit and entry in the textile industry. Historically, firms that exit an industry are generally the more inefficient firms. Those that remain and the ones that enter, on the other hand, are typically more productive and technologically advanced

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Chart 1: Comparision of MFP for SIC 22 and SIC 23

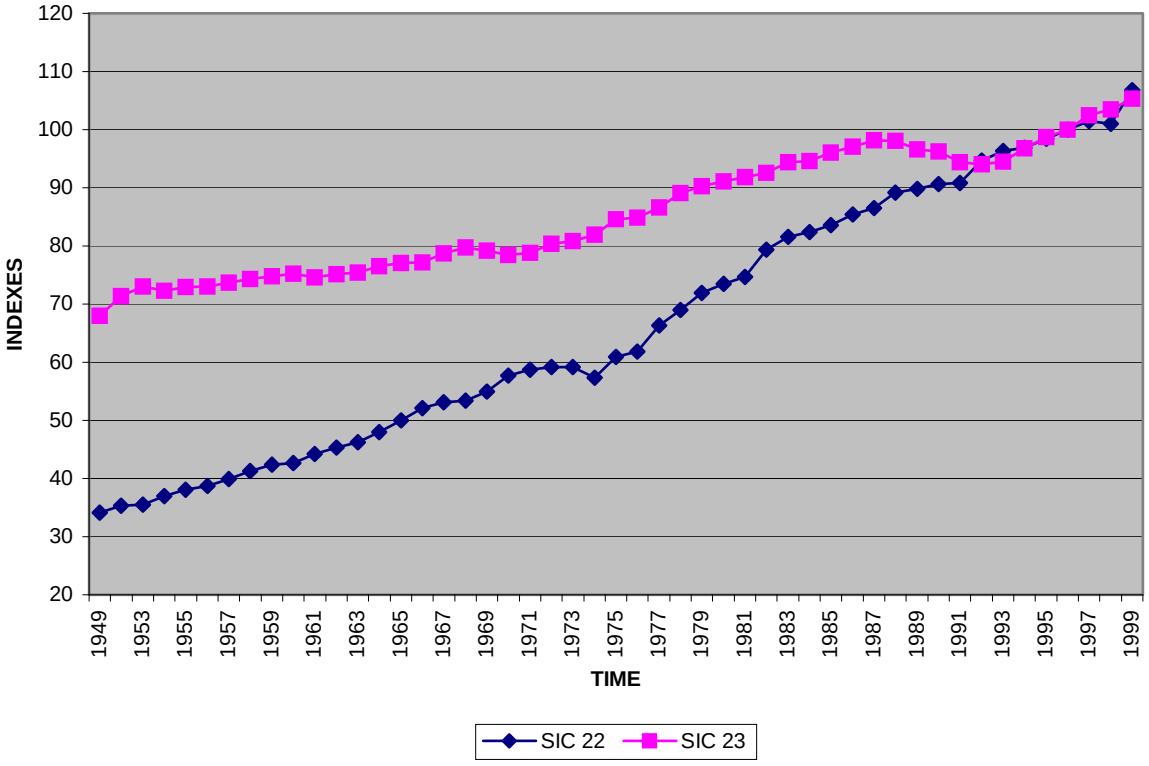


Chart 2: Comparison of MFP's of SIC-221, 222, 223, 224, 225, 226, 227, 228 and 229

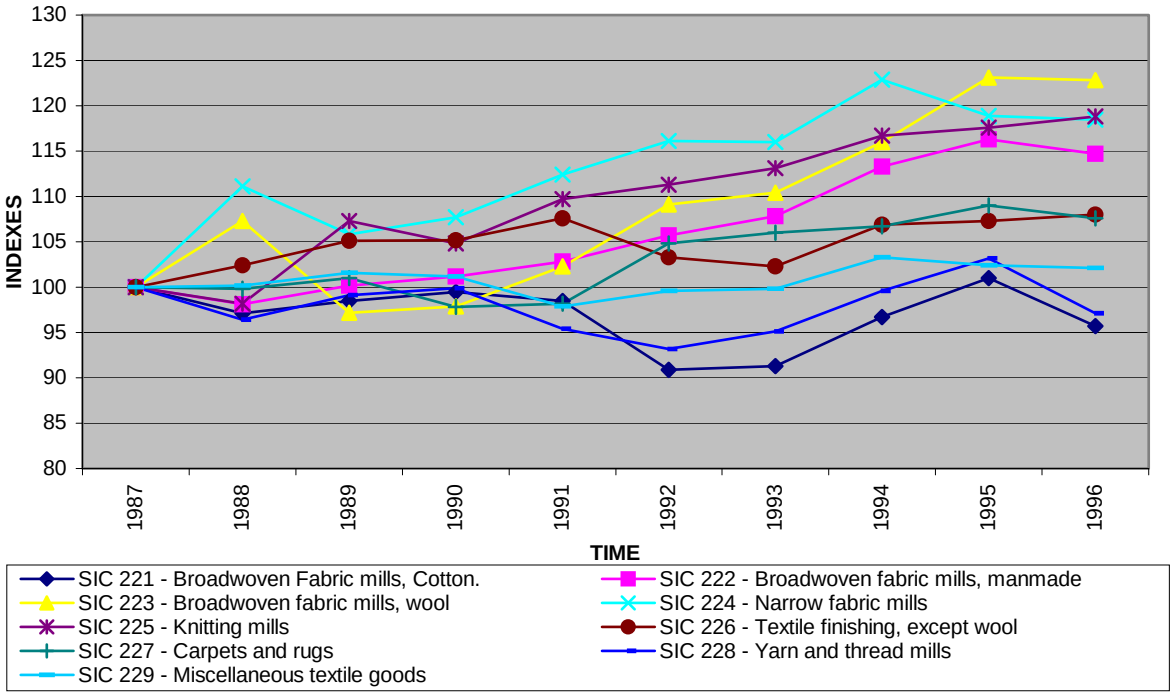
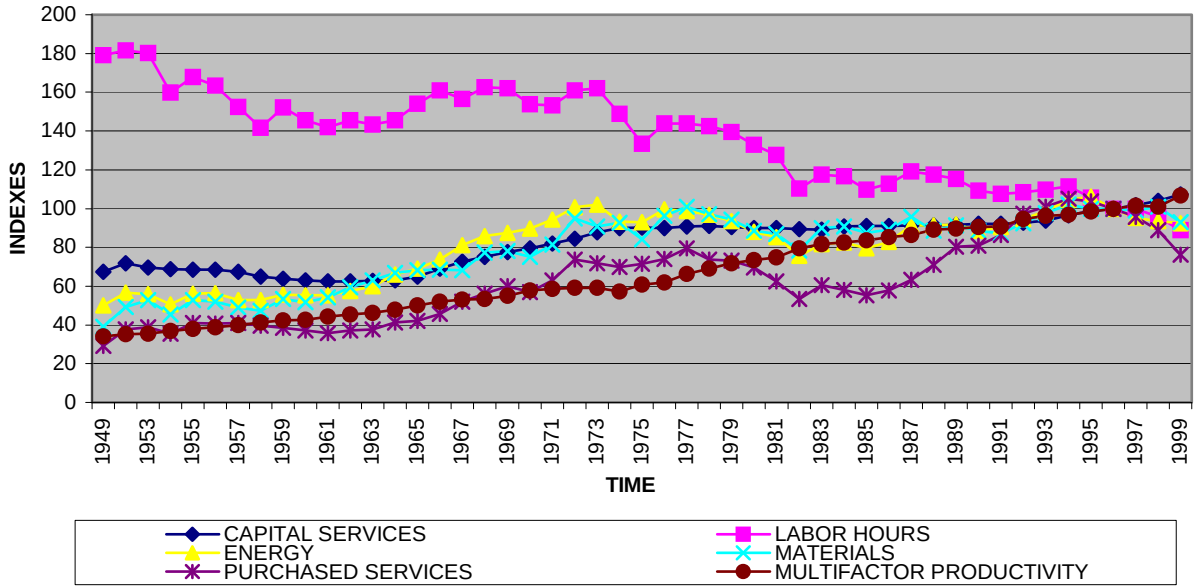


Table 1: ***Rates of Plant Entry and Exit***

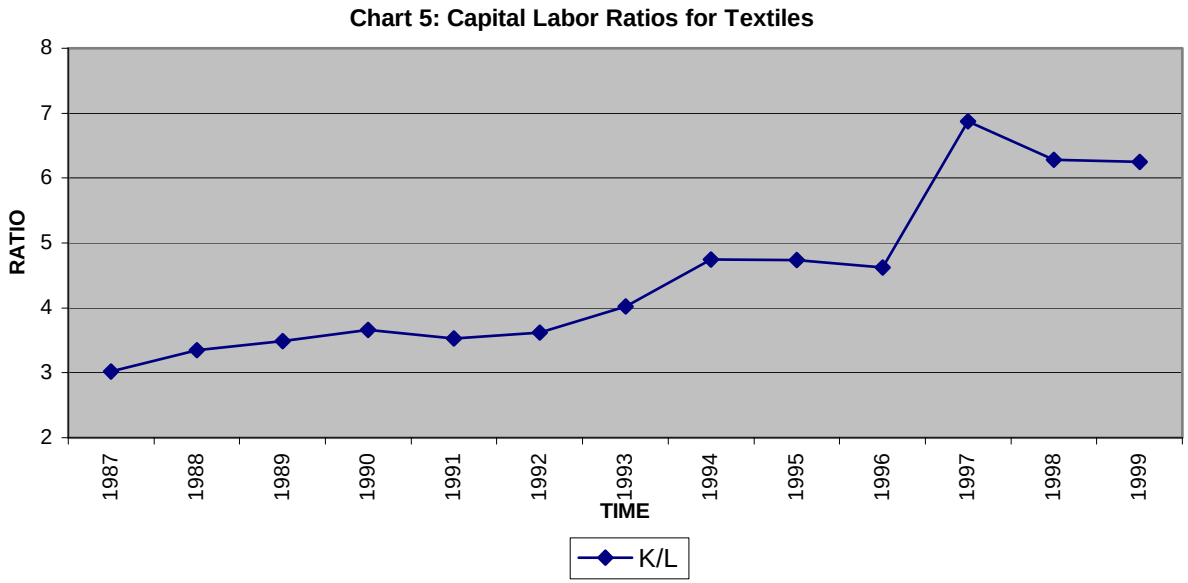
	Gross Rate of Entry	Gross Rate of Exit
Textiles		
1972-77	26%	32%
1977-82	31%	32%
1982-87	20%	38%
1987-92	28%	31%
Apparel		
1972-77	42%	44%
1977-82	48%	43%
1982-87	25%	55%
1987-92	49%	46%

Chart 4: Real Sector Input quantities and MFP: Comparision of Capital Services, Labor Hours, Energy, Materials, Purchased Services and MFP



Changing Technology in Textiles:

Chart 4 shows how input use has changed over the last fifty years. Labor use has been cut in half while materials, purchased services and energy use have doubled.



Between 1987-1999 the number of production workers declined by nearly 17%. The decline in non-production workers on the other hand was much less significant. Chart 5, shows that capital per worker has increased from 3% to 6.5% over the period, reflecting the technological change that textiles has undergone.

Prices and Costs:

The following price indices illustrate the price pressures on the industry. Input prices have increased five-fold while output prices and productivity have only increased 2.5 times their 1950's level. A breakdown of the input prices follows, showing the volatility of the costs of capital and energy.

Chart 6: Comparison of Sector Output Price, Combined Inputs Price and MFP

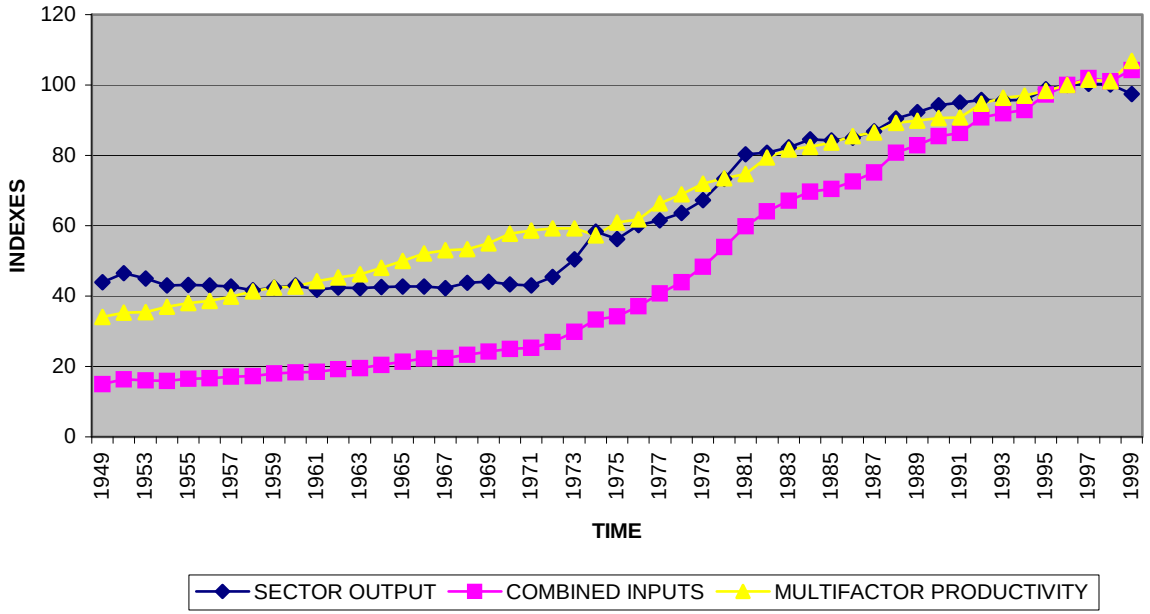


Chart 7: Input price and MFP: Comparison of Capital Services, Labor Hours, Energy, Materials, Purchased Services and MFP

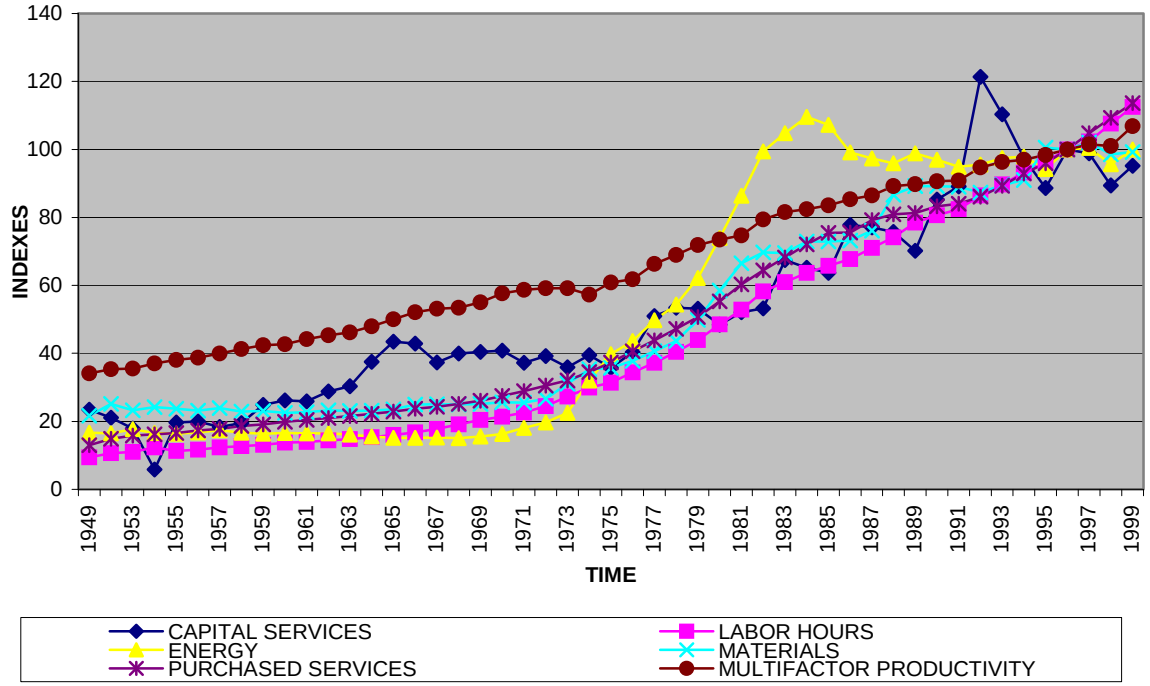


Chart 7 shows the value of production increasing up until the NAFTA period. While the costs of materials and labor shadow this trend, it is notable that, despite the large decreases in labor use, the labor bill still rises significantly.

Import Competition:

With the increase in globalization, competition from imports is a major factor the U.S. textile industry must contend with. Increased openness in trade has come with intensified competition especially from the newly industrializing countries (NICs) and has also increased outsourcing possibilities for U.S. firms. Chart 8, presents the trends in textile exports and imports. From 1972-82 U.S. exports and imports of textiles remained at par with each other. Beginning around 1983 imports began a steady increase outstripping exports by a sizeable margin. Imports rose five folds between 1982-2000. Imports in textiles came from both developing and developed countries, although the share of the former is on the increase. Exports on the other hand declined for a while between 1982-85, but increased thereafter. However, exports continued to fall short of imports.

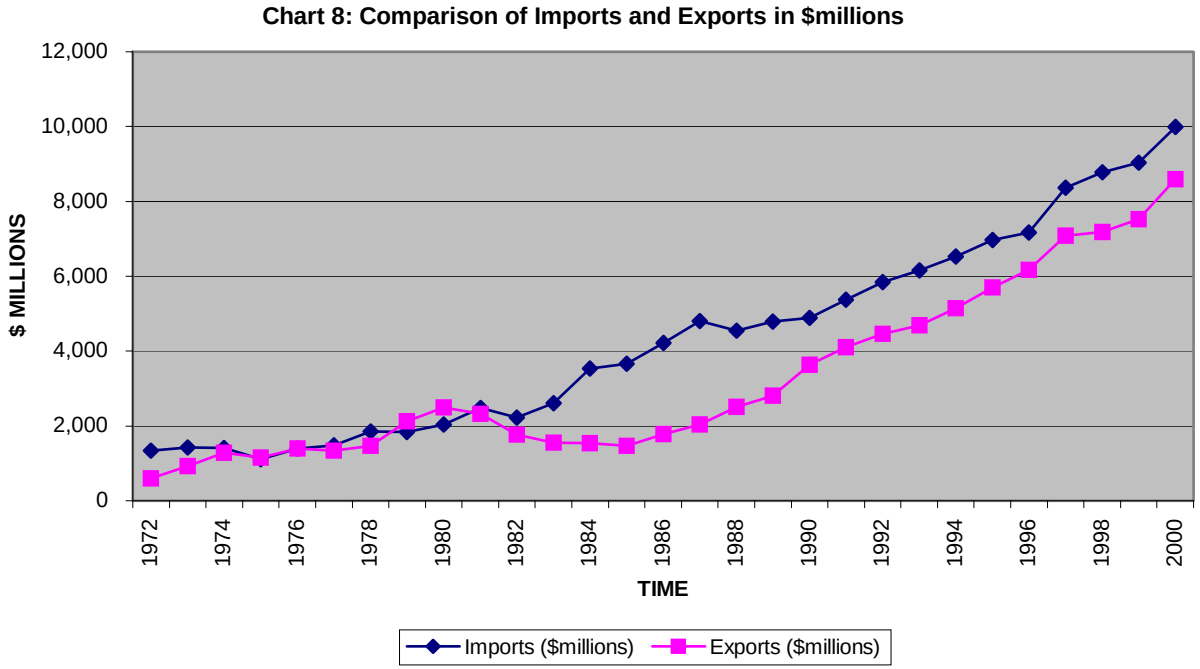
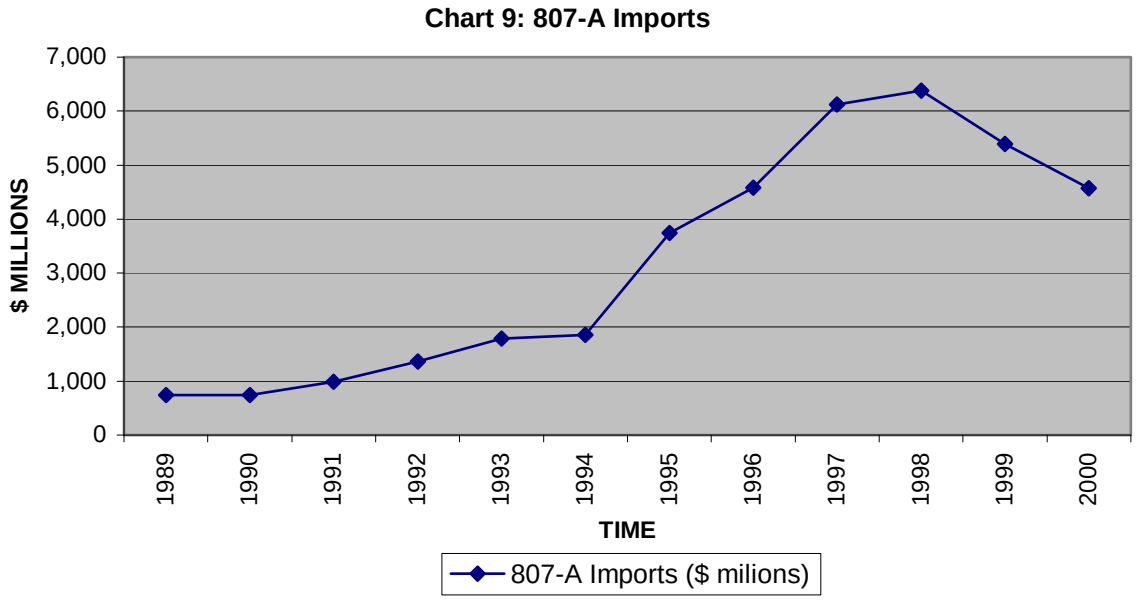


Chart 9, presents the data on section-807A imports. 807 imports are re-imported items whose components were first exported and assembled abroad, and duty is only paid on value added. These provide an approximate measure of the extent of outsourcing done by

U.S. textile firms. Although a fairly recent phenomena, section-807 imports in 1998 were 3 times their value in 1993. This includes the period when NAFTA became operative (1996). However these figures register a decline after 1998, which is surprising.



International competition has intensified in textiles, which has forced structural changes on the U.S. textile industry. International competition forces domestic firms to become more efficient and productive. In the light of the changing dynamics of the global textile market it is imperative to examine how productivity in U.S. textiles has evolved to meet these challenges.

$$Q_{\iota\tau} = A\varepsilon^{\lambda\tau} C^{\alpha}_{\iota\tau} L^{\beta}_{\iota\tau} K^{\gamma}_{\iota\tau} M^{\delta}_{\iota\tau} \varepsilon_{\iota\tau}.$$

K, representing knowledge was introduced by Griliches (1984) to the standard Cobb-Douglas production function to quantify the contribution of investment in R&D as measured by a distributed lag effect of past R&D investment.

The parameters of interest are α, β and γ. These represent the elasticities of output relative to capital, labor and R&D investment.

The elasticity of capital indicates the percentage increase in production to expect from increased investment in plant and equipment. The R&D elasticity indicates the impact on production due to investment in R&D. Comparison of these measures reveals the relative importance of various investments.

Anu's model:
TFP

Changes in TFP will reflect movements in the production frontier caused by R&D and IT investment, as separate from disembodied technical change. Initial estimates of the production function for U.S. textile industry will require adjustments for inflation, depreciation of the capital stock, and estimation of the depreciation rate of R&D. This is likely to be very different than the depreciation of plant and equipment investment. Additionally, R&D is likely to have a lagged effect on productivity. The level of spending on labor and capital must also be corrected for "double counting", 46% of R&D is spent on labor.

DK’s page

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+----------------------------------------------------------------------+
| Least Squares with Group Dummy Variables                             |
| Ordinary    least squares regression    Weighting variable = none    |
| Dep. var. = TFP5     Mean=   .9167331481    , S.D.=   .1127470070    |
| Model size: Observations =     270, Parameters =  20, Deg.Fr.=    250 |
| Residuals:  Sum of squares= 1.691048055    , Std.Dev.=         .08224 |
| Fit:        R-squared=  .505469, Adjusted R-squared =         .46788 |
| Model test: F[ 19,    250] =   13.45,    Prob value =          .00000 |
| Diagnostic: Log-L =    301.7515, Restricted(b=0) Log-L =     206.6919 |
|             LogAmemiyaPrCrt.=   -4.925, Akaike Info. Crt.=     -2.087 |
| Estd. Autocorrelation of e(i,t)     .624477                          |
+----------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 DIFF     -.5798735770E-04  .33016730E-04   -1.756   .0802  102.56994
 TARIFF   -.1422150689E-01  .16321950E-02   -8.713   .0000  17.518165
```

Estimated Fixed Effects

Group	Coefficient	Standard Error	t-ratio
1	1.01827	.03039	33.50578
2	1.25143	.04019	31.14110
3	1.40199	.06085	23.03962
4	1.03925	.02826	36.77543
5	1.29829	.04936	26.30096
6	1.27702	.04933	25.88522
7	1.42597	.06285	22.68801
8	1.38771	.05449	25.46681
9	1.13874	.04179	27.25075
10	1.20645	.04182	28.85125
11	1.05979	.02781	38.10233
12	1.32725	.03890	34.11593
13	1.03239	.02869	35.98591
14	1.16968	.02688	43.51101
15	.96038	.02659	36.11427
16	1.16288	.03304	35.19974
17	1.00918	.02381	42.38138
18	.92600	.02536	36.51306

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+---------------------------------------------------------------------+
|                Test Statistics for the Classical Model              |
|                                                                     |
|        Model            Log-Likelihood    Sum of Squares    R-squared  |
| (1)  Constant term only      206.69191   .3419497763D+01     .0000000  |
| (2)  Group effects only      263.12473   .2251221259D+01     .3416515  |
| (3)  X - variables only      213.53499   .3250485033D+01     .0494262  |
| (4)  X and group effects     301.75151   .1691048055D+01     .5054689  |
|                                                                     |
|                              Hypothesis Tests                       |
|               Likelihood Ratio Test                F Tests          |
|          Chi-squared   d.f.  Prob.         F    num. denom. Prob value |
| (2) vs (1)   112.866     17     .00000     7.693   17   252     .00000 |
| (3) vs (1)    13.686      2     .00107     6.941    2   267     .00115 |
| (4) vs (1)   190.119     19     .00000    13.449   19   250     .00000 |
| (4) vs (2)    77.254      2     .00000    41.407    2   250     .00000 |
| (4) vs (3)   176.433     17     .00000    13.561   17   250     .00000 |
+---------------------------------------------------------------------+
--> MATRIX;LIST;ALPHA$

Matrix Result   has 18 rows and  1 columns.
               1
        +--------------
       1|  .1018272D+01
       2|  .1251434D+01
       3|  .1401989D+01
       4|  .1039253D+01
       5|  .1298292D+01
       6|  .1277018D+01
       7|  .1425975D+01
       8|  .1387708D+01
       9|  .1138737D+01
      10|  .1206453D+01
      11|  .1059791D+01
      12|  .1327246D+01
      13|  .1032390D+01
      14|  .1169680D+01
      15|  .9603766D+00
      16|  .1162881D+01
      17|  .1009185D+01
      18|  .9259999D+00
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Textile Mill Products

221	Broadwoven fabric mills, cotton
2211	Broadwoven fabrics mills, cotton
222	Broadwoven fabric mills, manmade fiber and silk
2221	Broadwoven fabrics mills, manmade fiber and silk
223	Broadwoven fabrics mills, wool
2231	Broadwoven fabrics mills, wool
224	Narrow fabric mills
	Narrow fabrics mills
225	Knitting Mills
2251	Women's hosiery, except socks
2252	Hosiery, n.e.c.
2253	Knit outerwear mills
2254	Knit underwear mills
2257	Weft knit fabrics mills
2258	Lace and warp knit fabrics mills
2259	Knitting mills, n.e.c.
226	Textile finishing, except wool
2261	Finishing plants, cotton
2262	Finishing plants, manmade
2269	Finishing plants, n.e.c.
227	Carpets and rugs
2273	Carpets and rugs
228	Yarn and thread mills

2281	Yarn spinning mills
2282	Throwing and winding mills
2284	Thread mills
229	Miscellaneous textile goods
2295	Coated fabrics, not rubberized
2296	Tire cord and fabrics
2297	Nonwoven fabrics
2298	Cordage and twine
2299	Textile goods, n.e.c.