Analyzing Environmental Policies with IGEM, an Intertemporal General Equilibrium Model of U.S. Growth and the Environment Part 2

Appendix C. Measuring industry labor input

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December 2, 2008

Revised August 29, 2009

In this Appendix, we describe the construction of labor input indexes that enter the state-space models of producer behavior presented in Chapter 3. The methodology and data sources are discussed in detail in Chapter 6 of Jorgenson, Ho and Stiroh (2005, henceforward JHS). This methodology is well-known and widely used and we give a only a brief summary in section C1. We then outline how the data have been updated from JHS (2005) in section C2 and present the results in section C3.

C.1 Methodology

The productivity of workers, as measured by their hourly wage rates, varies widely. Average wages are highest for the most highly educated male workers in the prime age group. A simple sum of hours worked that ignores differences in productivity fails to capture the impact of substitution among different types of workers. This is highly problematical in a period with large changes in the composition of the work force like those that took place during 1960-2005.

Our objective is to construct a measure of labor input that accounts for the enormous heterogeneity among workers and yet is tractable to implement. We classify workers by gender, age (seven groups), educational attainment (six groups), and employment class (two types), for each of the industries described in Table 1.1 of Part 2. In addition to the 35 IGEM industries, Households and General Government sectors are large employers. The precise definitions of the groups are given in Table C1 for the civilian workers. A slightly different data set is used for military workers in estimating the labor input of General Government.

There is a total of 2 x 7 x 6 x 2 = 168 types of workers for each industry. Table C2 gives summary data for the 35 industries. There are 168*35=5880 cells for the labor data for these 35 industries, plus 336 additional cells for Households and General Government, for a total of more than six thousand cells altogether.[1] With this framework in mind we next describe our implementation, beginning with the notation.

a) Notation

saecj subscripts for sex, age, education, class, industry

E_{saecj} Employment matrix, number of workers in cell s,a,e,c,j

h_{saecj} Average hours per week in cell s,a,e,c,j

w_{saecj} Average weeks per year in cell s,a,e,c,j

c_{saej} Average hourly compensation of employees in cell s,a,e,j

H_{saecj} hours worked by all workers in cell s,a,e,c,j

H_{lj} abbreviation for H_{saecj}: *l=1* is *s=1,a=1,e=1,c=1*;

l=2 is s=1,a=1,e=1,c=2....., l=168 is s=2,a=7,e=6,c=2

$L_{l,j}$ labor input of cell *l* in industry j

$P_{L,l,j}$ price of labor input of cell *l*

b) Methodology

The industry *volume of labor input* is expressed as a translog index of the individual components:

(C.1) $$\Delta \ln L_j = \sum_l \overline{v}_{l,j} \Delta \ln L_{l,j}$$

where $\overline{v}_{l,j} = \frac{1}{2}(v_{l,j,t} + v_{l,j,t-1})$ is the two-period average of the share of the *l*th type of labor in the value of total labor input in the *j*th industry:

$$v_{l,j,t} = \frac{P_{L,l,j} L_{l,j}}{\sum_m P_{L,m,j} L_{m,j}}, \qquad l=1,2,\ldots 168.$$

We assume that labor input for each category $\{ L_l \}$ is proportional to hours worked:

(C.2) $$L_{l,j} = Q_l H_{l,j}$$

where the proportionality constant Q_l is constant over time. For example, an hour worked by a self-employed, male worker, aged 34, with four years of college education, represents the same labor input in 1960 as in 2005.

With assumption (C.2) the labor quantity index in (C.1) can be expressed in terms of hours worked:

(C.3) $$\Delta \ln L_j = \sum_l \overline{v}_{l,j} \Delta \ln H_{l,j}$$

The corresponding *price of labor input* is the ratio of the value of labor compensation to the volume index ($P_{L,j} = VL_j / L_j$). The total value is:

[1] The number of non-zero cells is smaller since the self-employed class is zero for many sectors.

(C.4) $$P_{L,j}L_j = VL_j = \sum_l P_{L,l,j}L_{l,j}$$

Finally, the *labor quality* index measures the contribution of substitution among the components of labor input to the volume obtained from a given number of hours:

(C.5) $$Q_{L,j} = \frac{L_j}{H_j}$$

where:

(C.6) $$H_j = \sum_l H_{l,j}$$

is the *unweighted sum of hours worked*. Labor quality rises and labor input grows faster than hours worked when hours worked by employees with higher marginal products of labor grow faster than hours worked by workers with lower marginal products[2].

To construct the above indexes we require matrices of hours worked and hourly labor compensation for 168 types of labor for each year for each industry. We derive total hours worked in cell *saecj* from the number of workers in that cell, multiplied by the average hours per week and average weeks per year. The next section describes how these matrices of employment, hours/week, weeks/year and dollars/hour are constructed.

C.2 Data

A detailed description of the labor data and its sources can be found in JHS (2005, Section 6.3). That work covered the 1977-2000 period and we describe two major extensions. We incorporate the 2000 Census Public Use micro-data and link the SIC-based data to the more recent NAICS-based surveys to extend the series to 2005. The employment, hours, weeks and wage matrices are constructed from household survey data in the decennial Census and annual Current Population Surveys (CPS).

The micro-data provide information on the gender, age, educational attainment, work status, industry, hours and weeks worked, and wage income for each person in the sample. Issues such at top-coding of income, multiple job holders and small sample sizes are addressed in JHS (2005, Chapter 6). The challenge for industry analysis has been the

[2] Assuming competitive factor markets, workers are paid their marginal products, thus compensation per hour equals the marginal product of labor.

change in industry classification from SIC to NAICS. In part (a) below we first discuss extensions for 1960-1990 based on the SIC. Iin part (b) we describe how we incorporated the 2000 Census, which is based on NAICS.

a) Industry Classification

In Chapter 1 we have introduced the industries identified in IGEM in Table 1.1. The list is repeated in Table C2 and includes 35 industries in the business sector as well as Households and General Government. General Government includes public schools and public hospitals which are not included in private services. In JHS (2005) 41 business industries are identified, focusing on the information technology sectors. In IGEM we use a somewhat different classification where all two-digit manufacturing industries are distinguished in order to estimate their energy use. Services is a large composite sector, unlike the more detailed classification of these industries employed in JHS (2005).

Our first step is to estimate employment, hours, weeks and compensation matrices from the decennial Census. We divide the labor force into 88 sectors. The three-digit industry data in the Census and CPS covers about 200-300 sectors, depending on the year. These data are first aggregated to the 88-industry classification and then to the 35 IGEM industries given in Table C2.

We estimate initial benchmark matrices for the 88 industries, based on the 1% sample Census Public Use sample covering about one million workers. We then estimate the corresponding matrices for the intervening years, using household data from the CPS *Annual Demographic File*, taken from the March Surveys. The CPS covers 50-100,000 workers during this period and this sample is too small to enable us to estimate such a large matrix directly. Instead, we estimate matrices of lower dimensions used as control totals to adjust the benchmarks. This interpolation for the years between the benchmarks is done using the iterative proportional fitting procedure, commonly known as the RAS procedure and described in JHS (2005, Chapter 6).

Finally, we bring the time series of matrices derived from household data in consistency with the U.S. National Income and Product Accounts (NIPAs), which are derived from establishment surveys. We scale total employment, annual hours worked,

and compensation for each industry to the data in the NIPAs, covering 65 industries[3]. We estimate a consistent set of control totals for employment, hours, and labor compensation by applying industry ratios from the household-based matrices described above. The result is a time series of labor data matrices consistent with NIPAs and suitable for applying equations (C.3) and (C.5) to the 35 IGEM sectors in Table C2, Households, and General Government.

An important difference from the NIPAs is our treatment of utilities. The NIPAs have detailed data for private utilities, federal government enterprises, and state and local government enterprises. Private utilities must be disaggregated to obtain electric utilities, gas utilities, and water. Government enterprises must be sub-divided into government electric utilities and others. The allocation of sectors not explicitly identified in the NIPAs data from the BLS Office of Employment Projections (BLS-EMP) covering 200 sectors.[4]

b) Census 2000 and NAICS

Our second major extension of JHS (2005) is the incorporation of data from the 2000 Census. The estimates in JHS (2005) extrapolate the 1990 Census, using the CPS with a sample size less than one-tenth of the Census. Here we revise the estimates for 1991-2000 by incorporating very detailed micro-data from the 2000 Census. This represents a major step forward in capturing the trends of the late 1990s, the period of the Information Age economic resurgence. We are able to capture more accurately the rapidly changing distribution of workers by gender, age and educational attainment.

The major difference between the 2000 Census and earlier Census data is the change in the industrial classification system from SIC to NAICS. The NAICS classification provides a richer characterization of the now-dominant service industries. We first created matrices of employment, weekly hours, annual weeks, and labor compensation, based on the 275 NAICS industries at the 3-digit level from the 2000 Census. Next we constructed a link that assigns each of those 275 NAICS industries to the 88 industries based on the SIC.

[3] The NIPA data by industry may be seen in *Survey of Current Business*, August 2001, Tables 6.2C, 6.3C, 6.4C, 6.7C, 6.8C, 6.9C. The complete time series is taken from www.bea.gov.
[4] See the Employment Projection Program web page, http://www.bls.gov/emp/empind2.htm.

While some of the 275 industries can be mapped directly into one of the 88 industries. For example, Crop Production is mapped directly to Farms in the SIC system, For other industries the totals must be split across several three-digit industries. For example, Travel Arrangements and Reservation Services must be needed to be mapped into Arrangement of Passenger Transportation, Other Business Services, and Membership Organizations.

We have split industries across multiple three-digit SIC industries, employing ratios from the Current Employment Statistics program of the Bureau of Labor Statistics (BLS)[5]. This allocation gives the shares of each NAICS industry going to the corresponding SIC industries. Using this map we convert the Census 2000 benchmark matrices of employment, hours worked, and labor compensation 88 industries based on the SIC data. We thus have a consistent time series for the period 1960-2000.

c) Estimating self-employment

Our employment class divides the work force between employees and self-employed and unpaid workers. The wages for employees are reported in the household surveys and total compensation is estimated in the NIPAs. The business income of the self-employed non-corporate business includes the return to the capital as well as labor compensation of self-employed workers. Procedures have to be devised to allocate part of this total to labor compensation. Our method is described in JHS (2005, p 277) and assumes that self-employed workers cost the same as employees with the same gender-age-education characteristics in each industry.

For the economy as a whole the self-employed are only about 6.9% of the work force in 2000, and thus our assumption of equal wage rates between employees and self-employed is not numerically significant. However, the fraction varies greatly, from essentially zero in some manufacturing industries to 70% in health practitioners. The other industries with high self-employment are agriculture, construction and trade.

d) Extending to 2005

The CPS data are classified on a NAICS basis after 2003 and these are treated in a similar manner to the 2000 Census. We first compile the matrices for employment, hours

[5] The ratios were downloaded February 2005 from http://www.bls.gov/ces/cesratiosemp.htm.

and compensation on the NAICS classification and then map them to the 88 industries, giving us a set of control matrices with the same definitions for 1960-2005.

C.3 Results

a) Employment and hours worked

First, in terms of size, there are only 1.50 million workers in the five energy-related industries in 2005, or 0.99% of total domestic employment. This includes both employees and the self employed. Table C2 shows that within the energy group, the largest industry is Electric Utilities, private and government, with 822 thousand workers, followed by Petroleum and Gas Mining with 369 thousand.

Table C3 gives the employment in the five energy industries for all years. Overall, the proportion of workers in the energy group has decreased since 1970, when it employed 1.93% of all workers. Since then services have grown much faster than primary and manufacturing sectors. Of the energy group the biggest reductions are in Gas Utilities from 277 thousand workers in 1970 to 111 in 2005, followed by Coal Mining which fell from 148 to 80 thousand. The number of workers in Electric Utilities rose from 500 to 822 thousand over this period.

We measure labor input in terms of total hours worked, not just the number of workers. Figure C1 gives the growth rate of hours worked over the period 1960-2005, ranking from the fastest to the slowest. The energy industries are indicated by yellow bars. The most rapidly growing industry was Services (3.4% per year), followed by Finance, Insurance & Real Estate (2.4%) and Construction (2.2%).

The period of 1960-2005 saw considerable electrification. Electric Utilities has the fifth highest growth rate of hours at 1.4% per year. Petroleum and Gas Mining grew at a 0.5% rate. Three of the five energy industries shrank over this period; hours worked in Gas Utilities fell at 2.0% per year, Petroleum Refining at 1.3%, and Coal Mining at 0.6%. These rates should to be compared to the national average growth rate of 1.3% per year.

Providing a more detailed picture of the energy group, Figure C2 charts the growth rate of the five industries and the economy average by sub-periods – 1960-73,

1973-95, and 1995-05. The industries are ranked by the growth rate of the most recent sub-period. We see that during 1995-2005 when the hours growth for the whole economy was 0.84% per year, only Petroleum and Gas Mining exceeded that at 1.4%; the others shrank at rates exceeding 1% per year.

During the 1973-95 period, which included the oil shocks of the 1970s, Electric Utilities hours grew at 2.6% per year, far exceeding the economy average of 1.4%. Petroleum and Gas Mining grew at 1.1% but Coal Mining, Refining and Gas Utilities shed hours at a rate exceeding 1.2% per year. In the earliest period, 1960-73, Gas Utilities expanded hours at 1.8% per year, followed by Electric Utilities at 1.2% and Coal Mining at 0.2%. Both Petroleum Mining and Refining shrank.

b) Labor cost

In Section C2 above we have observed that there are no direct observations on labor compensation for the self employed. The last column in Table C2 gives the hourly compensation of workers in year 2005. Household workers earn the lowest rates, less than $10/hour. Among the business industries Agriculture has the lowest compensation ($19/hour) while Petroleum Refining has the highest at $58/hour. Of course this does not cover the full range of variation in labor compensation. If we had disaggregated the FIRE and Services industries we would find costs exceeding $60/hour. All five of the energy-related industries have labor costs exceeding the economy average of $30.3/hour.

In Table C4 we show how the labor compensation rates have changed over time by reporting the hourly costs for 1970, 1995 and 2005. The relative ranking of the labor costs have not changed a lot during this 35-year span. Petroleum Refining has labor costs among the top three industries in each of these years. Electric Utilities and Gas Utilities also have high labor costs, ranked about five or six during these years. Coal Mining had relatively high hourly compensation in the earlier years but is now closer to the national average. On the other hand, Petroleum Refining had labor compensation rates close to the average in 1970 but the seventh highest rate in 2005.

c) Labor input and labor quality

The growth of industry labor input over 1960-2005 is charted in Figure C3, with industries ranked from the fastest to slowest. Labor input for the whole economy grew at 2.04% per year during this period. The rankings are not identical to those in Figure C1 for the growth of hours work. The two industries in the energy group with the fastest growth in labor input are also Electric Utilities (1.6% per year) and Petroleum and Gas Mining (1.1% per year). The other three energy-related industries have negative labor input growth, Coal Mining (-0.7%), Petroleum Refining (-1.0%), and Gas Utilities (-1.8%).

The key feature of our methodology is that it allows us to distinguish between total hours worked and labor input adjusted for changes in the composition of the work force. The quality of labor input in each industry is defined in (C5) as the ratio of labor input to hours worked. A rise in labor quality reflects a shift in hours worked toward more highly paid workers with higher marginal products, for example, a shift from workers with Bachelors degrees to those with Masters or higher degrees.

For the whole economy the labor quality index grew at 0.48% per year during 1960-2005. The gap in growth rates between hours and labor input in Petroleum and Gas Mining means that labor quality was rising at a rapid 0.58% per year during this period. The growth in labor quality for all industries is plotted in Figure C4 with the energy group indicated by yellow bars.

Tobacco Products has the highest growth in labor quality at 0.85% per year, as the sector shrank with the biggest reduction occurring in groups of workers with the lowest wages. Next is Agriculture, another industry with falling employment and with labor quality rising at 0.66% per year. The three industries with the next most rapid growth of labor quality are Miscellaneous Manufacturing, Leather Products and Petroleum and Gas Mining. The industries with the slowest growth of labor quality are Government Enterprises (0.06%), Services ((0.15%), and Construction (0.21%).

The energy industries that had gains in labor quality below the economy average, are Coal Mining (0.44% per year), followed by Petroleum Refining (0.31%), Electric Utilities (0.26%) and Gas Utilities (0.24%). Over the period 1960-2005 all industries had

a positive growth in labor quality. However, as noted in JHS (2005) the changes show a more varied pattern in the more recent period.

To better understand the changes in labor quality growth, we estimate growth by sub-periods, as shown in Figure C5. These are ranked by the growth rates in the 1995-2005 period. We see that labor quality in the energy group as a whole grew slower than the total economy rate of 0.45% per year during 1995-2005. Among the energy group Petroleum Refining had the fastest growth of labor quality in the most recent decade, while Petroleum and Gas Mining has the slowest at 0.09% per year.

The rankings of industries by growth of labor quality during the 1973-1995 period were quite different, The two energy mining industries had quality growth exceeding 0.7% per year compared to the national average rate of 0.47%. The other industries in the energy group also had substantial quality growth in this period of oil shocks. In the earliest sub-period, 1960-73, when the national average was growing at 0.53% per year, Electric Utilities, Coal Mining and Petroleum Refining had labor quality growth less than 0.15% per year. Overall, we conclude that more highly-educated workers have been moving towards the high-technology industries identified in JHS (2005) and fewer to the declining energy industries. It must be emphasized that all the energy industries showed positive growth in quality in all sub-periods.

d) Changes in the work force composition

Changes in labor quality reflect the changing composition of hours worked by gender, class, age, and education. As described in JHS (2005, Chapter 6), the rise in educational attainment for the economy as a whole contributes most to the growth in labor quality, followed by the aging of the labor force. Wages are highest in the prime age group of 45-54 years old and this group expanded relative to the younger groups with the maturing of the baby boomers during this period. The rapid entry of women into the labor force in the 1970s led to a fall in the quality index, since they had lower average wages.

To analyze the change in labor quality for the energy group, we tabulate the share of workers with educational attainment of a BA degree or better in each of the energy industries for 1960, 1970, 1980, 1990 and 2005 in Table C5. The highest quality growth

during 1960-2005 was in Petroleum Gas Mining, one of the two energy industries that expanded its work force. Educational attainment in Petroleum and Gas Mining rose with the rest of the economy, from only 13.4% with a BA degree or more in 1960 to 28.6% in 2005.

Coal mining is one of the declining industries in the U.S. economy and has the second largest increase in labor quality among the energy group. Its share of workers with a BA degree or more rose from 1.1% to 9.7%. Most of the industries in the energy group have lower average educational attainment than the overall economy in 2005. Only Petroleum Refining has a share of workers with more than a BA that is higher than the national average of 30.0%. Although the industries in the energy group have lower shares of highly educated workers, their wages are higher than the national average as shown in Table C2. The relative wages in the energy-mining industries are likely due in part to the high degree of health and injury risks.

The second important contributor to the change in labor quality is the change in the age structure. In any given period labor compensation rises from the youngest workers up to the age group 45-54 and then declines with age. Thus a work force that is increasingly young will see falling labor quality, while falling birth rates will generate rising quality. In Table C6 we give the share of the work force that is in the prime age group, for each of the energy-related industries.

For the entire labor force the share of workers in the prime age group fell from 20.9% in 1960 to 15.9% in 1980 and then rose rapidly to 22.9% in 2005. The age structure for the energy group follows this national trend; however, all five industries have a share of prime-aged workers that is much higher than the national average. In year 2005, the industries with the largest share of prime-aged workers were Coal Mining (42%) and Petroleum Refining (37%). Even the lowest share in Petroleum and Gas Mining (30.1%) is much higher than the national average of 22.9%.

Finally, Table C7 presents data on the share of female workers in the energy group over this period. For the work force as a whole the share rose from dramatically in the earlier part of the period, from 30% in 1960 to 41% in 1980 and then rose more slowly to 46.3% in 2005. The energy industries have a far lower share of female workers than the national average: 6% in Coal Mining in 2005, 17% in Petroleum and Gas

Mining, and 18% in Petroleum Refining. The change in the female share over time, however, exceeds the national average in some cases; Petroleum and Gas Mining doubled the female share from 8% in 1960 to 17% in 2005.

To summarize: The workers in the energy group are older, more male, less educated than the national average, but enjoy wages that are higher than the average. The change in labor quality spans the range seen in the rest of the economy with the slowest change in Electric and Gas Utilities. Differences in growth rates of labor input reflect the large changes in the composition of the energy sector over the period 1960-2005 with the spread of electrification and the rise in domestic mining of petroleum and natural gas. .

Table C1. Classification of civilian labor force for each industry

	No.	Categories
Gender	2	Male; Female
Class	2	Employees; Self-employed and unpaid
Age	7	16-17; 18-24; 25-34; 35-44; 45-54; 55-64; 65+
Education		
1960-92	6	0-8 years grade school
		1-3 years High School
		4 years High School
		1-3 years College
		4 years College
		5+ years College
1992+	6	0-8 years grade school
		grade 9-12 no diploma
		High School graduate
		some College no Bachelors degree
		Bachelors degree
		more than BA degree

Table C2. Employment and Labor Compensation in 2005

		Employment (000s)	Labor Value ($ Billions)	Hourly Cost ($/hr)
1	Agriculture	3,427	150.5	19.2
2	Metal Mining	32	2.8	42.3
3	Coal Mining	80	6.5	36.2
4	Petroleum and Gas	369	38.1	44.2
5	Nonmetallic Mining	108	6.9	29.2
6	Construction	9,107	472.2	26.2
7	Food Products	1,635	83.2	26.8
8	Tobacco Products	31	3.4	57.3
9	Textile Mill Products	348	14.5	22.3
10	Apparel and Textiles	364	15.9	25.0
11	Lumber and Wood	840	35.9	22.8
12	Furniture and Fixtures	479	24.3	27.1
13	Paper Products	526	37.0	35.5
14	Printing and Publishing	1,342	77.7	32.4
15	Chemical Products	940	99.6	53.4
16	Petroleum Refining	115	13.7	58.3
17	Rubber and Plastic	858	43.4	26.2
18	Leather Products	42	2.1	29.5
19	Stone, Clay, and Glass	543	30.7	29.0
20	Primary Metals	527	35.9	34.3
21	Fabricated Metals	1,353	73.3	28.1
22	Industrial Machinery	1,561	124.7	40.3
23	Electronic & Electric Equip	1,227	98.4	41.3
24	Motor Vehicles	856	71.3	41.7
25	Other Transportation Equip	759	61.0	40.9
26	Instruments	776	64.5	42.9
27	Miscellaneous Manufacturi	402	20.9	28.5
28	Transport and Warehouse	4,870	247.6	26.7
29	Communications	1,412	112.6	44.1
30	Electric Utilities	822	73.1	49.0
31	Gas Utilities	111	10.4	50.2
32	Trade	32,634	1128.7	22.3
33	FIRE	8,873	726.9	47.7
34	Services	48,331	2293.0	28.8
35	Government Enterprises	1,789	117.7	42.3
	Households	1,313	15.5	9.5
	Government	22,585	1227.7	37.8
	Total Economy	151,388	7661.4	30.3

Table C3. Employment in the energy group (1000s)

	Coal	Oil&Gas	Refining	Electric	Gas Util
1970	148	281	189	500	277
1971	150	273	187	517	276
1972	163	274	184	471	338
1973	163	283	185	492	335
1974	182	313	190	547	289
1975	215	339	189	556	270
1976	230	355	194	542	288
1977	241	388	200	556	295
1978	236	443	202	568	321
1979	256	485	203	624	303
1980	253	576	198	668	288
1981	238	713	205	682	304
1982	244	721	192	708	287
1983	195	613	187	814	184
1984	200	625	179	848	164
1985	191	596	172	871	152
1986	177	462	164	883	143
1987	162	415	161	907	127
1988	151	419	158	884	163
1989	146	396	155	874	169
1990	147	410	156	900	162
1991	136	410	158	905	165
1992	127	369	155	879	181
1993	113	359	150	873	181
1994	113	352	147	901	145
1995	106	335	143	869	150
1996	99	335	139	853	136
1997	97	354	137	861	118
1998	93	354	135	851	127
1999	87	310	131	822	159
2000	79	321	126	856	118
2001	82	361	124	869	119
2002	81	354	121	866	118
2003	74	348	118	843	114
2004	76	353	115	836	113
2005	80	369	115	822	111

Table C4. Compensation per Hour ($/hr)

	Industry	1970	1995	2005
1	Agriculture	2.05	10.49	19.21
2	Metal Mining	5.28	28.80	42.31
3	Coal Mining	5.92	25.50	36.16
4	Petroleum and Gas	5.08	26.17	44.23
5	Nonmetallic Mining	4.86	19.78	29.18
6	Construction	5.35	18.68	26.15
7	Food Products	4.21	18.31	26.83
8	Tobacco Products	4.36	36.26	57.27
9	Textile Mill Products	3.32	14.70	22.27
10	Apparel and Textiles	3.53	12.93	24.96
11	Lumber and Wood	4.14	16.20	22.82
12	Furniture and Fixtures	4.01	16.30	27.11
13	Paper Products	4.54	22.58	35.50
14	Printing and Publishing	5.55	20.90	32.43
15	Chemical Products	5.46	30.58	53.37
16	Petroleum Refining	6.57	32.31	58.31
17	Rubber and Plastic	4.34	18.09	26.15
18	Leather Products	3.62	14.99	29.46
19	Stone, Clay, and Glass	4.85	20.56	28.98
20	Primary Metals	5.65	24.76	34.28
21	Fabricated Metals	5.05	20.61	28.11
22	Industrial Machinery	5.28	23.82	40.32
23	Electronic & Electric Equip	4.76	24.00	41.27
24	Motor Vehicles	6.61	34.62	41.68
25	Other Transportation Equip	6.13	27.06	40.88
26	Instruments	5.52	26.67	42.89
27	Miscellaneous Manufacturing	4.45	18.73	28.54
28	Transport and Warehouse	5.19	19.49	26.65
29	Communications	5.51	29.57	44.15
30	Electric Utilities	5.60	29.74	49.00
31	Gas Utilities	5.69	29.69	50.22
32	Trade	3.59	14.87	22.33
33	FIRE	4.69	27.45	47.66
34	Services	4.23	19.09	28.77
35	Government Enterprises	4.37	29.39	42.34
36	Households	1.98	7.56	9.45
38	Government	4.71	24.37	37.81
	Total economy	4.25	19.15	29.15

Table C5. Percentage of Workers with a College Degree or Above (%)

	Industry	1960	1970	1980	1990	2005
3	Coal Mining	1.1	2.9	5.4	8.5	9.7
4	Petroleum & Gas Mining	13.3	13.6	19.2	26.4	28.6
16	Petroleum Refining	11.8	15.4	21.7	26.3	31.0
30	Electric Utilities	10.5	6.4	15.0	22.6	25.4
31	Gas Utilities	8.6	8.4	16.5	22.2	26.6
	Total Economy	9.6	12.6	18.7	23.8	30.0

Table C6. Percentage of Workers aged 45-54 (%)

	Industry	1960	1970	1980	1990	2005
3	Coal Mining	30.5	23.2	15.0	20.2	41.6
4	Petroleum & Gas Mining	22.6	25.2	15.3	15.1	30.1
16	Petroleum Refining	25.7	29.5	17.7	19.5	36.9
30	Electric Utilities	19.9	18.9	18.4	19.5	33.8
31	Gas Utilities	18.9	26.3	24.7	18.7	35.5
	Total Economy	20.9	19.9	15.9	16.1	22.9

Table C7. Percentage of Female Workers (%)

	Industry	1960	1970	1980	1990	2005
3	Coal Mining	1.0	2.4	6.0	5.2	6.4
4	Petroleum & Gas Mining	7.9	15.1	16.1	19.5	16.7
16	Petroleum Refining	13.4	13.5	16.2	19.3	18.4
30	Electric Utilities	17.6	15.3	20.7	24.2	25.7
31	Gas Utilities	13.7	11.0	21.5	24.3	25.3
	Total Economy	30.3	35.9	41.3	45.0	46.3

Figure C1. Growth in Industry Hours Worked, 1960-2005 (% per year)

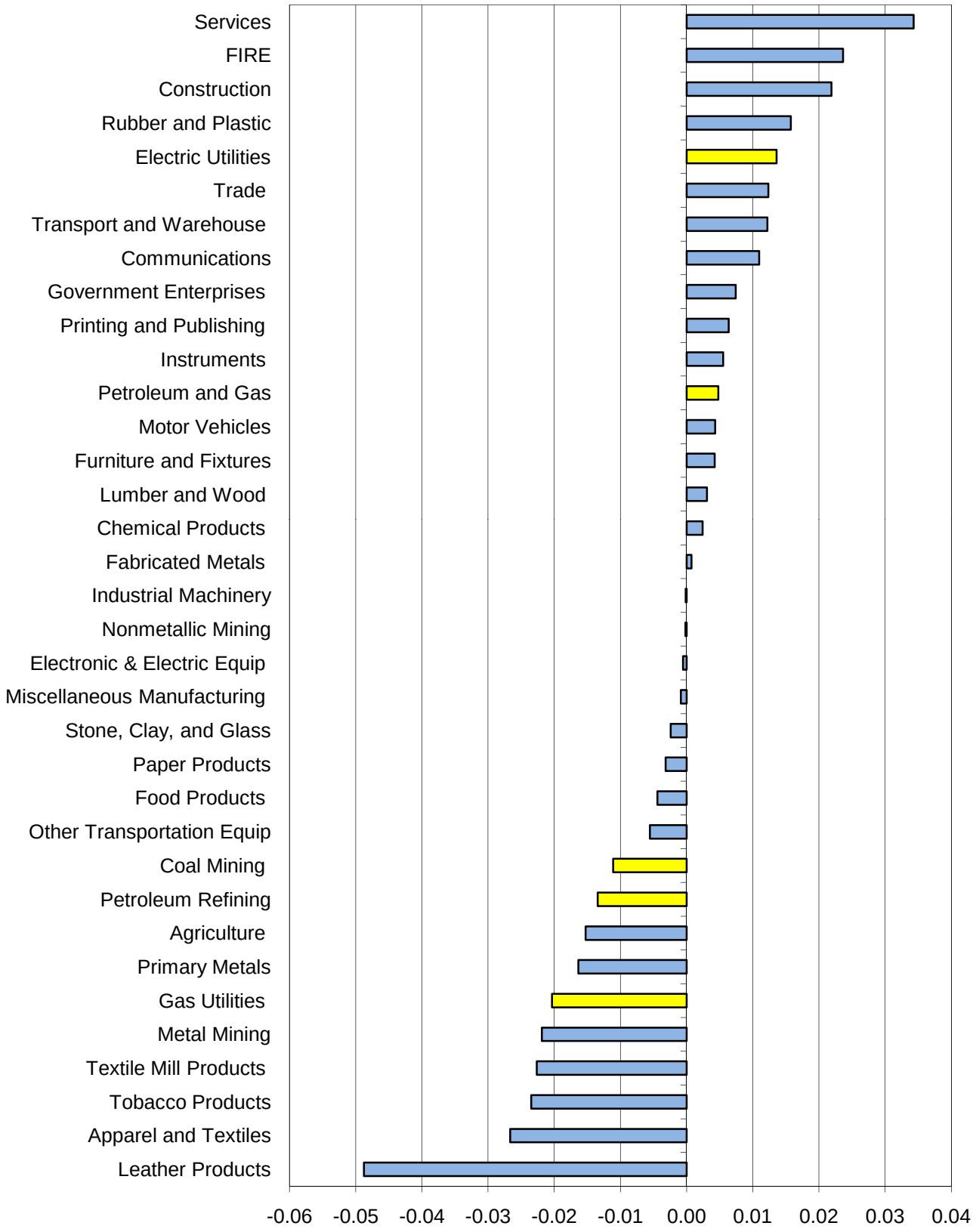
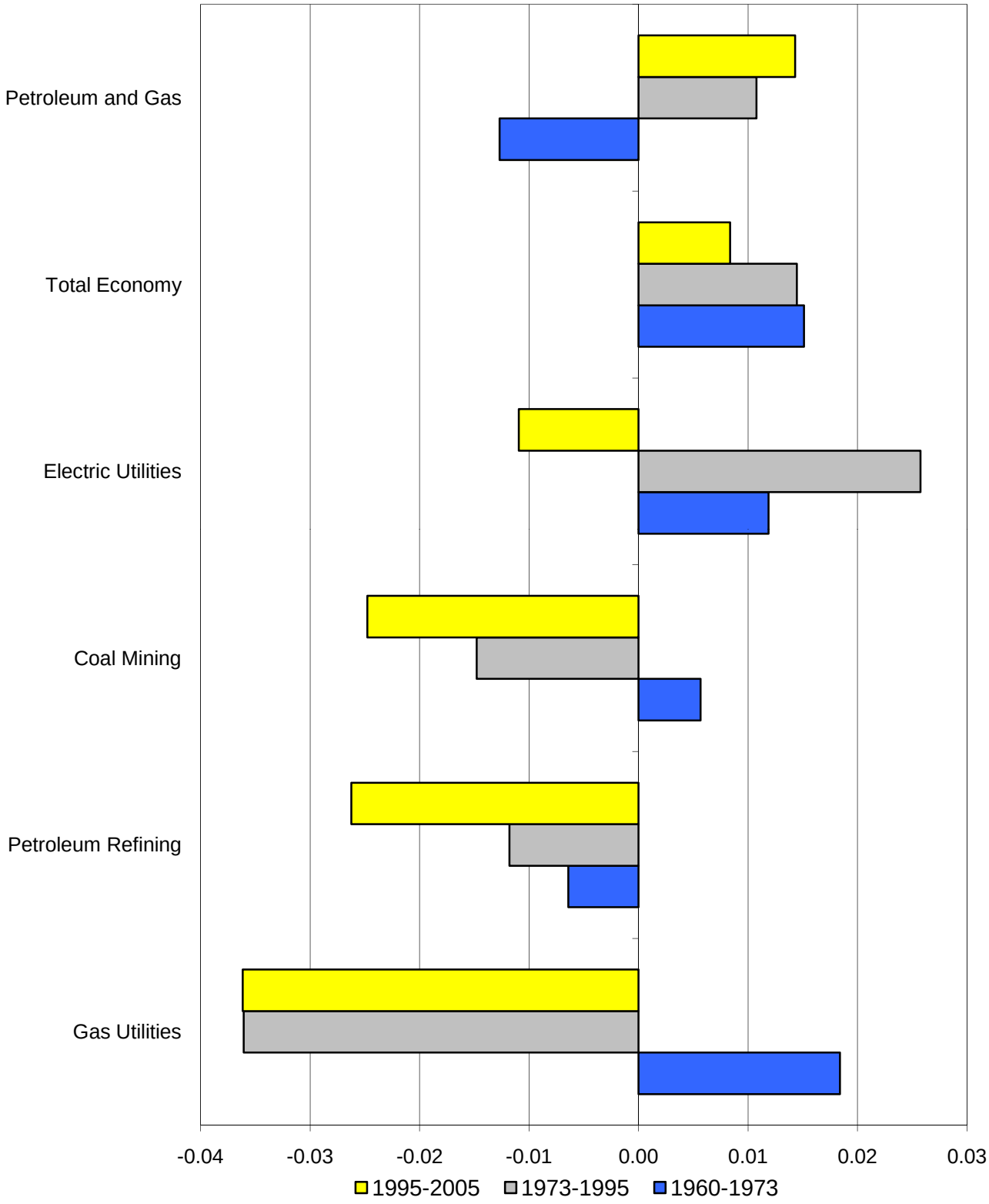


Figure C2. Growth in Hours worked in Energy group, by Subperiod



Note: Figure sorted by the 1995-2005 average.

Figure C3. Growth in Industry Labor Input, 1960-2005 (% per year)

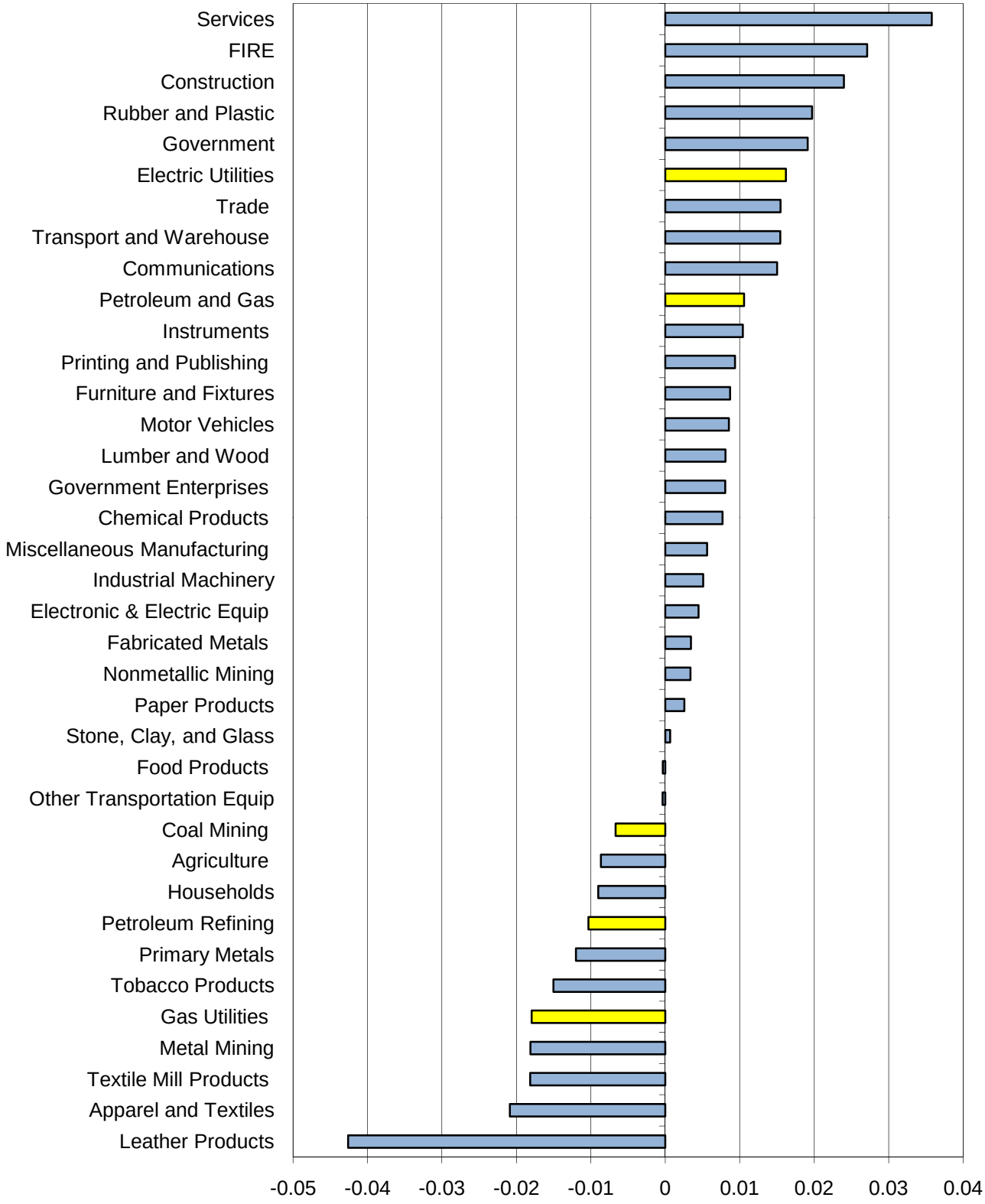


Figure C4. Growth in Industry LaborQuality, 1960-2005 (% per year)

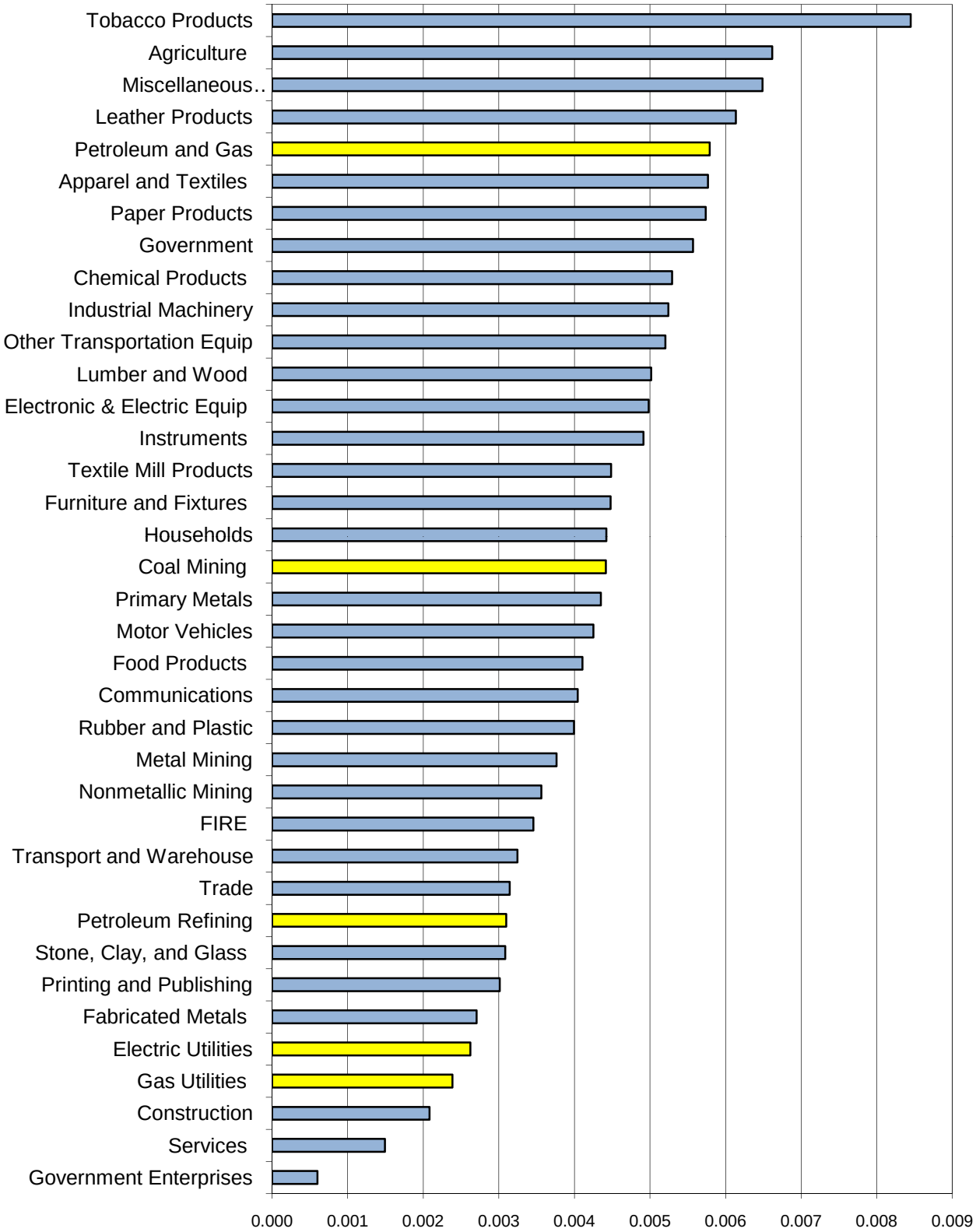


Figure C5. Growth of Labor Quality by Subperiod (% per year)