Productivity Growth, Capital Intensity, and Skill Levels, in the U. S. Insurance Industry, 1948-86

by Edward N. Wolff*

1. Introduction

This paper presents new estimates of labor productivity and total factor productivity (TFP) growth for the U. S. insurance industry, as well as those for the whole economy and selected subsectors, over the 1948-86 period. In addition, industry comparisons are provided for capital intensity, computerization, and skill levels.

The results indicate that labor productivity growth in the insurance industry has been positive over the 1948-86 period, averaging about 0.7 percent per year. In contrast, the growth in TFP, defined as the ratio of output to a weighted average of labor and capital inputs, has actually been negative over this period. Moreover, the insurance industry has fallen behind other sectors of the economy in terms of productivity growth. From 1948 to 1986, labor productivity growth in the insurance sector has averaged one percentage point per year less than that of the total economy. Growth in TFP has averaged one to two percentage points less, depending on the measure used.

The differential has varied over time. Before 1966, the differential in labor productivity growth ranged from 1.7 to 2.1 percentage points per year, depending on the index employed. After 1966, the differential was much less, ranging between 0.2 and 0.4 percentage points. The differential in TFP growth, on the other hand, was smallest between 1966 and 1979 (in fact, by most measures, TFP growth was greater in the insurance industry than in the total economy in the 1966-73 period). During the 1948-66 period, TFP growth in the insurance industry averaged 1.4 to 1.7 percentage points less than that of the business economy, and during the 1979-86 period, the differential increased to a range of 2.4 to 6.9 percentage points.

In sum, productivity performance has been quite poor in the insurance industry during the postwar period. This is true despite the rapid growth of capital-intensity in the insurance industry, its high absolute and relative level of computerization, and the high skill level of its work force, as will be documented below.

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2. The measurement of productivity

Labor productivity, $LPROD$, is defined as the ratio of an industry's total output (Y) to its employment (L):

$$(1) \quad LPROD = Y/L.$$

Labor productivity growth, π , is the time derivative of (1). Output is measured as Gross Domestic Product (GDP) originating by sector in constant (1982) dollars. There are two different measures of employment available. The first is "full-time equivalents" (FTE), in which part-time workers are considered on a commensurate basis with full-time employees. The second is "persons engaged in production" (PEIP), in which self-employed workers and unpaid labor (as in a family farm or business) are included in the measure of the labor input. Details on sources can be found in Table 1.

Table 1
Data Sources and Methods

1. GNP by Industry in Current Dollars: Bureau of Economic Analysis, *National Income and Product Accounts*, Table 6.1, various years.
 2. GNP by Industry in Constant (1982) Dollars: Bureau of Economic Analysis, *National Income and Product Accounts*, Table 6.2, various years.
 3. Compensation of Employees by Industry: Bureau of Economic Analysis, *National Income and Product Accounts*, Table 6.4b, various years.
 4. Full Time Equivalent Employees by Industry: Bureau of Economic Analysis, *National Income and Product Accounts*, Table 6.7b, various years.
 5. Persons Engaged in Production by Industry: Bureau of Economic Analysis, *National Income and Product Accounts*, Table 6.10b, various years.
 6. Constant-Dollar Gross Stock of Fixed Private Capital, Nonresidential and Residential, by Industry: *Survey of Current Business*, Vol. 66, No. 1, January, 1986, Table 3, pp. 56-57; *Survey of Current Business*, Vol. 67, No. 8, August, 1987, p. 101.
 7. Constant-Dollar Net Stock of Fixed Private Capital, Nonresidential and Residential, by Industry: *Survey of Current Business*, Vol. 66, No. 1, January, 1986, Table 4, pp. 58-59; *Survey of Current Business*, Vol. 67, No. 8, August, 1987, p. 103.
 8. Computerization indices: Howell and Wolff (1990).
 9. Industry by occupation employment matrices: Wolff and Howell (1989).
 10. Knowledge and data workers: Wolff and Baumol (1989).
 11. Labor force skill indices: Howell and Wolff (forthcoming).
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The "crude" TFP level is measured as the ratio of an industry's total output (Y) to a weighted average of labor input (L) and capital input (K)

$$(2) \quad TFP = Y/[aL + (1-a)K]$$

where a is the wage share. Two measures of total factor productivity growth are used. The first, which I call "crude" TFP growth, is the time derivative of equation (2). The second is the so-called Divisia measure of TFP growth, ρ , defined as:

$$(3) \quad \rho = \dot{Y}/Y - [a\dot{L}/L + (1-a)\dot{K}/K]$$

where a superscript dot ($\dot{\cdot}$) indicates the time derivative. Because of data limitations, the measure of TFP is actually a two-factor measure, consisting of labor input, as measured by employment, and capital stock, as measured by non-residential fixed plant and equipment.

Two different measures of the capital stock are used. The first is gross plant and equipment, and the second is net plant and equipment. Both series are available in constant (1982) dollars. In the gross capital stock estimates, it is assumed that the efficiency and hence value of the plant and equipment, once in place, remains unchanged, until the capital is retired or scrapped. In the net capital stock series, it is assumed that the efficiency and hence value of the capital is constantly depreciated over time as the capital is used and thus worn down. The wage share is measured by the ratio of employee compensation, defined as the sum of wages and salaries and fringe benefits, to GDP. The TFP index has been scaled so that TFP in each sector and for the full economy is set at unity in 1948.¹ Moreover, the Tornqvist approximation based on average period shares is employed to estimate TFP growth over discrete periods.

The relation between labor productivity growth and Divisia TFP growth can be derived directly from (1) and (3):

$$(4) \quad \pi = \rho + (1-\alpha) \dot{k}/k]$$

where $k \equiv K/L$, the capital-labor ratio. Thus the growth in labor productivity is equal to the rate of TFP growth plus the rate of growth of the capital-labor ratio weighted by the capital share in income. It will also be of interest to determine the sources of labor productivity growth in the insurance sector.

3. Labor productivity growth

Table 2 shows average annual rates of labor productivity growth for the two different employment series. I have shown results for the full 1948-86 period, the longest period for which all the necessary data are available, and for selected sub-periods as well. Productivity growth rates are computed for the full economy; the private, business economy; and, for comparison, the manufacturing sector, the communications sector, wholesale and retail trade, finance and real estate, and services.

On the basis of the FTE measure, labor productivity growth for the private, business economy averaged 1.6 percent per year over the full 1948-86 period. It was much stronger between 1948 and 1966, when it averaged 2.4 percent per year; fell by over a full percentage point to 1.2 percent per year for the 1966-73 period, and then declined to almost zero during the 1973-79 period. Productivity growth then recovered to 1.0 percent per year during the 1980s. For the insurance sector, the pattern was quite different. Labor productivity growth averaged 0.7 percent per year over the whole 1948-86 period, almost a full percentage point lower than the business economy. Moreover, productivity growth was actually higher in the 1966-73 period than the 1948-66 period, 1.2 percent per year compared to 0.7 percent per year. It then fell precipitously during the 1973-79 period to -0.9 percent per year, but recovered strongly during the 1979-86 period, to 1.2 percent per year. During the 1948-66

¹ This was done by setting both U.S. labor productivity (Y/L) and capital productivity (K/L) in 1948 at unity. Since the choice of scale is arbitrary, I also tested the sensitivity of the results to the choice of base year. The results show that relative TFP levels are quite insensitive to the choice of base.

period, insurance sector productivity growth was much lower than that of the business economy, while during 1966-73 and 1979-86, it was slightly higher. Results are similar for the PEIP measure of labor productivity.

Table 2
Average Annual Rates of Labor Productivity Growth, 1948-86

	Period				
	1948-86	1948-66	1966-73	1973-79	1979-86
A. GDP per FTE					
Insurance Industry ^a	0.66%	0.74%	1.22%	-0.93%	1.23%
Full Economy ^b	1.38	2.06	1.03	0.15	1.02
Private, Business Economy ^b	1.56	2.42	1.17	0.03	1.05
Manufacturing Sector	2.77	3.01	2.60	1.09	3.74
Communications Sector	4.96	5.52	4.69	4.56	4.15
Wholesale & Retail Trade	1.31	2.03	1.21	-0.54	1.14
Finance & Real Estate ^c	0.70	2.15	-0.59	0.06	-1.20
Services ^d	0.62	1.19	0.53	-0.20	-0.04
Difference between Insurance Industry and Business Economy	-0.90%	-1.67%	0.05%	-0.96%	0.18%
B. GDP per PEIP					
Insurance Industry ^a	0.69%	0.87%	1.13%	-0.81%	1.07%
Full Economy ^b	1.64%	2.55%	1.21%	0.14%	0.99%
Private, Business Economy ^b	1.84%	2.93%	1.39%	0.04%	1.04%
Manufacturing Sector	2.79%	3.09%	2.61%	1.04%	3.69%
Communications Sector	4.94%	5.53%	4.69%	4.53%	4.04%
Wholesale & Retail Trade	1.71%	2.55%	1.67%	-0.39%	1.38%
Finance & Real Estate ^c	0.85%	2.49%	-0.44%	-0.32%	-1.08%
Services ^d	0.81%	1.36%	0.96%	-0.05%	-0.01%
Difference between Insurance Industry and Business Economy	-1.15%	-2.06%	-0.26%	-0.86%	0.04%

NOTES

^a Defined as insurance carriers (58) and insurance agents, brokers, and services (59).

^b Non-residential economy only.

^c Defined as banking (55); credit agencies (56); security, commodity brokers, and services (57); real estate (60); and holding and other investment companies (61).

^d Defined as hotels and other lodging places (63); personal services (64); business services (65); auto repair, services, and garages (66); miscellaneous repair services (67); motion pictures (68); amusement and recreation services (69); and health, legal, educational, and other services (71-74).

There are also some interesting contrasts with other sectors. On the basis of the FTE measure of employment, manufacturing showed the same pattern of productivity growth slowdown between the 1948-66, 1966-73, and 1973-79 periods, and then a strong recovery in the most recent period. Labor productivity growth in the communications sector was three times that of the business economy over the whole 1948-86 period, and it remained relatively constant throughout the postwar period. Productivity growth in the wholesale and retail trade sector over the 1948-86 period was slightly lower than that of the business economy but double that of the insurance industry. It showed the same pattern of slowdown between 1948 and 1979 and a strong recovery during the 1980s.

Average labor productivity growth in finance and real estate over the whole 1948-86 period was about equal to that of the insurance sector. However, its pattern over time was quite different. Productivity growth was very strong during the 1948-66 period, negative in the 1966-73 and 1979-86 periods, and about zero between 1973 and 1979. Finally, labor productivity growth in services also averaged about the same as that of the insurance industry over the full 1948-86 period. However, its time pattern also differed from that of the insurance industry. Labor productivity growth was strongest during the 1948-66 period, declined by half during the ensuing 1966-73 period, and became negative in the 1973-79 period. Unlike manufacturing, there was very little recovery during the 1980s.²

4. Total factor productivity growth

As noted in Section 2, labor productivity growth in an industry is a result of TFP growth and the growth in the capital-labor ratio in the industry. Table 3 shows average annual rates of crude TFP growth (as defined from equation (2)) for the two different employment series and the two capital stock series (four different measures in all). Over the full 1948-86 period, TFP growth, measured using FTE employment and gross capital stock, for the economy as a whole averaged 0.87 percent per year, and for the private business economy 0.71 percent. In the insurance industry, average TFP growth was only -0.82 percent per year. In contrast, for the manufacturing sector, TFP growth averaged 1.45 percent per year; for the communications sector, it averaged 1.69 percent per annum; for wholesale and retail trade, TFP growth averaged 0.16 percent per year; for finance and real estate, it was about zero, and for services, it was -0.35 percent per year. The differential between the TFP growth in the insurance industry and that in the business economy was -1.52 percentage points over the 1948-86 period. Moreover, of the sectors shown, TFP growth was lowest in the insurance industry.³

Results based on net capital stock show a somewhat lower rate of TFP growth for the full and business economy over the full 1948-86 period and a much lower rate, -1.48 percent per year, for the insurance industry. The resulting differential in TFP growth between the insurance industry and the business economy was -2.00 percentage points. The difference

² It is also interesting that the PEIP measure of labor input yields higher rates of productivity growth for the trade, finance and real estate sector, and services than the FTE measure, but not for the insurance industry. The reason is that the PEIP measure of employment includes self-employed workers and unpaid household labor in addition to paid employees. There was a relatively sharp reduction in the number of self-employed and unpaid workers in trade, real estate, and services during the postwar period but not in the insurance industry.

³ Results based on the PEIP index of labor input yield similar measures of TFP growth.

Table 3
Average Annual Rates of Crude TFP Growth, 1948-86^a

	Period				
	1948-86	1948-66	1966-73	1973-79	1979-86
A. FTE Employment and Gross Capital Stock					
Insurance Industry ^b	-0.82%	0.31%	0.25%	-1.14%	-4.49%
Full Economy ^c	0.87	1.65	0.34	-0.19	0.28
Private, Business Economy ^c	0.71	1.66	0.13	-0.64	-0.02
Manufacturing Sector	1.45	2.18	1.07	-0.37	1.52
Communications Sector	1.69	2.39	2.20	1.15	-0.15
Wholesale & Retail Trade	0.16	1.31	-0.37	-1.46	-0.89
Finance & Real Estate ^d	-0.06	1.17	-0.92	0.02	-2.43
Services ^e	-0.35	0.01	-1.00	-0.35	-0.66
Difference between Insurance Industry and Business Economy	-1.52%	-1.36%	0.12%	-0.50%	-4.47%
B. FTE Employment and Net Capital Stock					
Insurance Industry ^b	-1.48%	-0.39%	-0.07%	-0.53%	-6.52%
Full Economy ^c	0.77	1.34	0.22	-0.01	0.52
Private, Business Economy ^c	0.52	1.20	-0.12	-0.48	0.25
Manufacturing Sector	1.53	2.10	1.04	-0.20	2.02
Communications Sector	1.73	2.11	2.36	1.36	0.46
Wholesale & Retail Trade	-0.29	0.51	-0.63	-1.32	-1.14
Finance & Real Estate ^d	-0.65	-0.41	-1.20	1.01	-2.14
Services ^e	-0.72	-0.91	-1.23	0.45	-0.70
Difference between Insurance Industry and Business Economy	-2.00%	-1.60%	0.05%	-0.05%	-6.76%
C. PEIP Employment and Gross Capital Stock					
Insurance Industry ^b	-0.80%	0.39%	0.18%	-1.08%	-4.62%
Full Economy ^c	0.99	1.91	0.40	-0.21	0.23
Private, Business Economy ^c	0.81	1.90	0.18	-0.66	-0.08
Manufacturing Sector	1.46	2.23	1.06	-0.41	1.48
Communications Sector	1.69	2.39	2.20	1.14	-0.16
Wholesale & Retail Trade	0.30	1.56	-0.24	-1.45	-0.91
Finance & Real Estate ^d	-0.04	1.21	-0.91	-0.02	-2.42
Services ^e	-0.27	0.01	-0.84	-0.28	-0.67
Difference between Insurance Industry and Business Economy	-1.62%	-1.51%	-0.00%	-0.41%	-4.54%

Table 3 (continued)

	Period				
	1948-86	1948-66	1966-73	1973-79	1979-86
D. PEIP Employment and Net Capital Stock					
Insurance Industry ^b	-1.47%	-0.32%	-0.13%	-0.46%	-6.64%
Full Economy ^c	0.89	1.59	0.27	-0.02	0.48
Private, Business Economy ^c	0.62	1.42	-0.08	-0.50	0.21
Manufacturing Sector	1.54	2.15	1.03	-0.23	1.99
Communications Sector	1.73	2.12	2.36	1.35	0.45
Wholesale & Retail Trade	-0.18	0.73	-0.54	-1.31	-1.18
Finance & Real Estate ^d	-0.64	-0.38	-1.19	0.98	-2.14
Services ^c	-0.65	-0.84	-1.10	0.52	-0.71
Difference between Insurance Industry and Business Economy	-2.09%	-1.74%	-0.04%	0.03%	-6.85%

NOTES:

^a The TFP index is standardized such that crude TFP equals unity in 1948.

^b Defined as insurance carriers (58) and insurance agents, brokers, and services (59).

^c Non-residential economy only.

^d Defined as banking (55); credit agencies (56); security, commodity brokers, and services (57); real estate (60); and holding and other investment companies (61).

^e Defined as hotels and other lodging places (63); personal services (64); business services (65); auto repair, services, and garages (66); miscellaneous repair services (67); motion pictures (68); amusement and recreation services (69); and health, legal, educational, and other services (71-74).

reflects the fact that, as we shall see in the next section, the growth in the net capital stock was substantially higher than that of the gross capital stock in the insurance industry. The growth of net capital stock was also higher than that of gross capital stock in the trade, finance and real estate, and service sectors, and TFP growth based on net capital stock consequently lower than that based on gross capital.

For the business economy, TFP growth was considerably higher in the first half of this period, 1948-66, than in the latter half. Like labor productivity growth, TFP growth slowed down over the 1948-79 years, with the annual rate of TFP growth declining from 1.7 percent in the 1948-66 period to 0.1 percent in 1966-73, and then to -0.64 percent over 1973-79 on the basis of gross capital stock and FTE employment. However, there was no recovery in TFP growth during the 1979-86 period, with TFP growth averaging zero percent per year. In the insurance industry, TFP growth fell continuously over the full period, from 0.31 percent per year in 1948-66, to 0.25 percent in 1966-73, -1.14 percent in 1973-79, and then sharply down to -4.49 percent in 1979-86. On the basis of the net capital stock data, annual TFP growth was negative throughout the full 1948-86 period, varying from -0.39 percent per year in 1948-66, to -0.07 percent in 1966-73, -0.53 percent in 1973-79, and -6.52 percent in 1979-86.

Table 4
Average Annual Rates of Divisia TFP Growth, 1948-86

	Period				
	1948-86	1948-66	1966-73	1973-79	1979-86
A. FTE Employment and Gross Capital Stock					
Insurance Industry ^a	-0.33%	0.34%	0.44%	-1.09%	-2.19%
Full Economy ^b	0.92	1.67	0.42	-0.14	0.41
Private, Business Economy ^b	0.82	1.71	0.29	-0.51	0.21
Manufacturing Sector	1.85	2.29	1.51	0.16	2.48
Communications Sector	2.61	2.95	2.99	2.36	1.54
Wholesale & Retail Trade	0.38	1.36	-0.08	-1.24	-0.31
Finance & Real Estate ^c	-0.04	1.18	-0.91	0.03	-2.39
Services ^d	-0.15	0.18	-0.56	-0.30	-0.45
Difference between Insurance Industry and Business Economy	-1.16%	-1.37%	0.15%	-0.58%	-2.41%
B. FTE Employment and Net Capital Stock					
Insurance Industry ^a	-0.64%	-0.20%	0.37%	-0.67%	-2.78%
Full Economy ^b	0.85	1.40	0.36	0.02	0.63
Private, Business Economy ^b	0.68	1.32	0.15	-0.36	0.46
Manufacturing Sector	1.89	2.23	1.51	0.28	2.76
Communications Sector	2.63	2.76	3.12	2.52	1.91
Wholesale & Retail Trade	0.08	0.72	-0.13	-1.08	-0.35
Finance & Real Estate ^c	-0.60	-0.32	-1.16	0.95	-2.08
Services ^d	-0.37	-0.46	-0.56	0.19	-0.44
Difference between Insurance Industry and Business Economy	-1.33%	-1.52%	0.22%	-0.31%	-3.23%
C. PEIP Employment and Gross Capital Stock					
Insurance Industry ^a	-0.31%	0.43%	0.38%	-1.01%	-2.31%
Full Economy ^b	1.07	1.96	0.52	-0.15	0.40
Private, Business Economy ^b	0.98	1.99	0.41	-0.50	0.20
Manufacturing Sector	1.86	2.34	1.51	0.13	2.45
Communications Sector	2.60	2.96	2.99	2.35	1.49
Wholesale & Retail Trade	0.60	1.66	0.18	-1.16	-0.18
Finance & Real Estate ^c	-0.02	1.23	-0.89	-0.03	-2.37
Services ^d	-0.03	0.29	-0.29	-0.20	-0.43
Difference between Insurance Industry and Business Economy	-1.29%	-1.56%	-0.03%	-0.51%	-2.51%

Table 4 (continued)

	Period				
	1948-86	1948-66	1966-73	1973-79	1979-86
D. PEIP Employment and Net Capital Stock					
Insurance Industry ^a	-0.62%	-0.11%	0.31%	-0.59%	-2.89%
Full Economy ^b	1.00	1.69	0.47	0.02	0.61
Private, Business Economy ^b	0.83	1.60	0.27	-0.35	0.45
Manufacturing Sector	1.90	2.29	1.52	0.25	2.72
Communications Sector	2.62	2.76	3.13	2.50	1.86
Wholesale & Retail Trade	0.31	1.01	0.13	-0.99	-0.21
Finance & Real Estate ^c	-0.58	-0.27	-1.14	0.89	-2.07
Services ^d	-0.25	-0.35	-0.29	0.29	-0.42
Difference between Insurance Industry and Business Economy	-1.46%	-1.71%	0.04%	-0.24%	-3.34%

NOTES:

^a Defined as insurance carriers (58) and insurance agents, brokers, and services (59).

^b Non-residential economy only.

^c Defined as banking (55); credit agencies (56); security, commodity brokers, and services (57); real estate (60); and holding and other investment companies (61):

^d Defined as hotels and other lodging places (63); personal services (64); business services (65); auto repair, services, and garages (66); miscellaneous repair services (67); motion pictures (68); amusement and recreation services (69); and health, legal, educational, and other services (71-74).

Corresponding results based on the Divisia index (see Equation (3)) are shown in Table 4. Results on TFP growth for the full economy based on the Divisia index are very similar to those based on the crude TFP measure for the full 1948-86 period and each of the sub-periods. However, estimates of TFP growth for the insurance industry are somewhat higher for the full period and each of the sub-periods. The Divisia measure of TFP growth, based on FTE employment and gross capital stock, for the insurance industry over the full 1948-86 period was -0.33 percent per year, about 0.5 percentage points greater than the corresponding crude TFP measure. The differential between the full economy and the insurance industry was 1.16 percentage points, about 0.4 percentage points less than that based on the crude TFP measure. However, for the 1948-66, 1966-73, and 1973-79 periods, the differential was about the same as that based on the crude TFP measure, whereas for the 1979-86 period, the differential was considerably smaller than the corresponding crude TFP figure.

As noted above, TFP growth fell off for the insurance industry beginning in the early 1970s and continuing through the 1980s. However, the drop in TFP growth in the insurance industry was less precipitous in the 1979-86 period based on the Divisia index than on the crude TFP index. Divisia TFP growth, based on FTE employment and gross capital stock, in the insurance industry averaged -2.2 percent per year over the 1979-86 period, compared to -4.5 percent on the basis of the crude TFP index.

In summary, by all measures, TFP performance in the insurance industry was considerably below average during the postwar period. Indeed, among the six sectors considered in the tables, it was by far the weakest. TFP performance was particularly disastrous during the 1980s, when some recovery for the full economy, and strong recovery for manufacturing, was evident.

5. Capital formation

The first two columns of Table 5 show the capital intensity (capital-labor ratio) in the various sectors relative to the private, business economy. We can see that the insurance industry has a very low capital intensity (high labor intensity) of production. In 1948, its capital-labor ratio, based on gross capital stock and FTE employment, was only 18 percent of the overall average, though by 1986 it had climbed to 36 percent. In 1986, the communications industry had the highest capital-intensity of the six sectors, 5.3 times the average.

Table 5
Capital-Labor Ratios and Annual Growth Rates, 1948-86

	<i>Capital-Labor Ratios^a</i>		<i>Average Annual Growth Rates</i>				
	<i>1948</i>	<i>1986</i>	<i>1948-86</i>	<i>1948-66</i>	<i>1966-73</i>	<i>1973-79</i>	<i>1979-86</i>
A. FTE Employment and Gross Capital Stock							
Insurance Industry ^b	0.18	0.36	3.29%	1.33%	2.59%	0.53%	11.41%
Full Economy ^c	1.51	1.26	1.09	0.93	1.47	0.70	1.46
Business Economy ^c	1.00	1.00	1.57	1.50	1.88	1.16	1.80
Manufacturing	0.54	0.92	2.98	2.33	3.53	3.00	4.07
Communications	1.62	5.26	4.66	5.09	3.35	4.34	5.15
Wholesale & Retail	0.30	0.38	2.15	1.54	2.98	1.62	3.33
Finance & Real Estate ^d	3.91	3.00	0.87	1.14	0.38	0.04	1.39
Services ^e	0.26	0.31	2.11	2.76	2.99	0.28	1.12
Difference between Insurance Industry and Business Economy			1.72%	-0.17%	0.72%	-0.62%	9.61%
B. FTE Employment and Net Capital Stock							
Insurance Industry ^b	0.17	0.44	4.33%	3.12%	2.83%	-0.85%	13.35%
Full Economy ^c	1.61	1.28	1.27	1.58	1.61	0.31	0.95
Business Economy ^c	1.00	1.00	1.88	2.34	2.18	0.83	1.28
Manufacturing	0.61	0.88	2.84	2.52	3.52	2.62	3.17
Communications	1.96	5.53	4.61	5.47	3.09	4.03	4.41
Wholesale & Retail	0.29	0.41	2.83	3.02	3.09	1.24	3.42
Finance & Real Estate ^d	3.72	3.26	1.53	2.90	0.68	-1.04	1.04
Services ^e	0.24	0.33	2.72	4.52	2.99	-1.06	1.09
Difference between Insurance Industry and Business Economy			2.45%	0.79%	0.65%	-1.68%	12.07%

Table 5 (continued)

	Capital-Labor Ratios ^a		Average Annual Growth Rates				
	1948	1986	1948-86	1948-66	1966-73	1973-79	1979-86
C. PEIP Employment and Gross Capital Stock							
Insurance Industry ^b	0.21	0.37	3.32%	1.45%	2.51%	0.65%	11.24%
Full Economy ^c	1.56	1.29	1.35	1.42	1.65	0.70	1.44
Business Economy ^c	1.00	1.00	1.86	2.02	2.10	1.17	1.78
Manufacturing	0.65	1.01	3.00	2.41	3.54	2.95	4.02
Communications	2.02	5.82	4.64	5.10	3.36	4.31	5.04
Wholesale & Retail	0.30	0.39	2.55	2.06	3.44	1.77	3.57
Finance & Real Estate ^d	4.21	3.06	1.02	1.47	0.53	-0.34	1.51
Services ^e	0.26	0.30	2.30	2.94	3.42	0.43	1.15
Difference between Insurance Industry and Business Economy			1.47%	-0.56%	0.40%	-0.53%	9.46%
D. PEIP Employment and Net Capital Stock							
Insurance Industry ^b	0.20	0.46	4.36%	3.25%	2.74%	-0.73%	13.18%
Full Economy ^c	1.66	1.31	1.53	2.07	1.79	0.30	0.92
Business Economy ^c	1.00	1.00	2.16	2.85	2.41	0.85	1.26
Manufacturing	0.74	0.97	2.86	2.60	3.53	2.56	3.12
Communications	2.43	6.12	4.59	5.48	3.10	4.01	4.31
Wholesale & Retail	0.28	0.42	2.23	3.54	3.55	1.39	3.66
Finance & Real Estate ^d	4.00	3.33	1.67	3.24	0.82	-1.42	1.15
Services ^e	0.24	0.32	2.91	4.69	3.41	-0.90	1.12
Difference between Insurance Industry and Business Economy			2.20%	0.40%	0.34%	-1.58%	11.92%

NOTES:

^a The capital-labor ratio in each sector is shown as a proportion of the capital-labor ratio of the private, business economy.

^b Defined as insurance carriers (58) and insurance agents, brokers, and services (59).

^c Non-residential economy only.

^d Defined as banking (55); credit agencies (56); security, commodity brokers, and services (57); real estate (60); and holding and other investment companies (61).

^e Defined as hotels and other lodging places (63); personal services (64); business services (65); auto repair, services, and garages (66); miscellaneous repair services (67); motion pictures (68); amusement and recreation services (69); and health, legal, educational, and other services (71-74).

On the other hand, the rate of growth of the capital stock in the insurance industry was well above average over the postwar period. The growth of the gross capital/FTE ratio averaged 3.3 percent per year between 1948 and 1986, compared to 1.6 percent for the business economy, a difference of 1.7 percentage points per year. Of the six sectors, communications had the highest rate of growth in capital intensity and the insurance industry was second, followed by manufacturing. The differential between the insurance industry and the business economy in net capital stock per FTE worker was 2.5 percentage points.

As indicated above, the growth in the net capital stock was about one percentage point higher than that of the gross capital stock in the insurance sector, though only 0.3 percentage points higher for the business economy. The reason is that the composition of capital in the insurance industry is quite different from that of other sectors in the economy. In particular, the insurance industry has a much higher ratio of plant to equipment than the average for the economy as a whole. Since equipment depreciates much faster than plant, the higher the share of plant in total capital stock, then *ceteris paribus*, the greater the difference between the growth rate of net and gross capital stock.⁴ However, these differences have changed over time. In the 1960-69 period, 74 percent of the economy's investment went to equipment and 26 percent to plant; for the insurance industry, the respective proportions were almost opposite, 23 percent and 77 percent. However, in the 1980-85 period, 78 percent of investment in insurance was in the form of equipment, compared to 81 percent for the overall economy.

The growth in capital intensity (gross stocks per FTE) for the business economy was 1.5 percent per year in the 1948-66 period, increased to 1.9 percent in 1966-73, fell to 1.2 percent in 1973-79, and then recovered to 1.8 percent in the most recent period. In the insurance industry, the pattern was similar. The annual growth rate in gross stocks per FTE rose from 1.3 percent in 1948-66, slightly below average, to 2.6 percent in 1966-73, above average, fell to 0.53 percent in 1973-79, below average, and then accelerated sharply to 11.4 percent during the 1980s, considerably above average. This high rate of growth of capital intensity was due to an extremely high rate of capital formation, 13.7 percent per year, *not* a low rate of employment growth. In fact, employment in the insurance industry grew by 2.2 percent per year, almost twice the overall average. Net stocks per FTE in the insurance industry had a similar trend, except that there was a slight reduction in its rate of growth between the 1948-66 and 1966-73 periods.

Table 6 shows comparative data on the degree of computerization in selected sectors of the economy. Computer investment for year t is measured as the sum of an industry's investment in office, computer and accounting machinery (OCA) over the six years prior to and including t . These investments are in constant (1982) dollars, so that at least a portion of the change in computer quality has been taken into account (see Gordon, 1987). OCA investments were summed over seven years on the grounds that it is a period long enough both to capture most of the computer stock in use and to avoid the undue influence of

⁴ In a simple model, where it is assumed that the investment proportions between plant and equipment remain constant over time and that investment increases at a constant rate over time, the higher the proportion of plant in total investment, the greater the difference between the growth rates of net and gross capital stock. This factor also explains the discrepancies found between net and gross capital growth rates for the finance and real estate sector and the service sector.

unusually large or small annual purchases of computers, and short enough to limit the mix of different generations of computers and to avoid the need for making assumptions about depreciation.

Table 6
Computerization Intensity by Industry, 1954-85^a

	Investment in OCA per Full-Time Equivalent Employee (1982 \$ 1,000 per Employee)			
	1954-60	1964-70	1974-80	1979-85
Insurance Industry	946	731	2,308	5,849
Full Economy	262	192	849	2,631
Total Manufacturing	259	230	1,061	2,948
Petroleum Refining	1,901	701	3,658	11,659
Machinery	714	745	3,137	9,129
Wholesale Trade	228	359	1,525	6,141
Banking and Finance	1,062	886	5,576	19,485
Real Estate	1,363	2,301	2,074	5,287
	Investment in OCA per Dollar of GDP		Investment in OCA per Dollar of Capital Stock	
	1974-80	1979-85	1974-80	1979-85
Insurance Industry	0.068	0.201	0.168	0.251
Full Economy	0.022	0.063	0.011	0.032
Total Manufacturing	0.032	0.070	0.017	0.040
Petroleum Refining	0.028	0.082	0.010	0.023
Machinery	0.091	0.144	0.073	0.148
Wholesale Trade	0.036	0.126	0.046	0.140
Banking and Finance	0.204	0.612	0.081	0.220
Real Estate	0.006	0.018	0.004	0.009

^a Source: Howell and Wolff (1990).

Three different measures of computer intensity are used here. The first is the ratio of OCA investments over the six year period to full-time equivalent employment. These results are shown for four periods: 1954-60, 1964-70, 1974-80, and 1979-85. The second line of Table 6 documents the tremendous growth in computer investment for the economy as a whole since the 1960s, from \$ 192 per FTE in 1964-70 to \$ 2,631 per FTE in 1979-85. The insurance industry was considerably above average in terms of its computer investment. This was true from the 1950s, when its computer investment intensity was almost four times the average for the economy, to the 1980s, when it was over twice the average. From the mid-1950s to the mid-1980s, the insurance industry consistently ranked fourth or fifth in terms of OCA investment per FTE on the 64-industry level. The banking and finance sector generally led in this dimension, followed by petroleum refining and the machinery sector. Wholesale trade and the real estate sectors also had high levels of computerization during this period.

The second measure is investment in OCA in 1982 dollars per 1982 dollar of GDP. Results are shown for the 1974-80 and 1979-85 periods. The insurance industry ranked second according to this index of computerization, with the banking and finance sector first. The third measure is investment in OCA as a proportion of the total capital stock. Results are again shown for 1974-80 and 1979-85. By this criterion, the insurance industry had the highest rate of computerization in the economy.

Thus, by all three criteria, computerization was very strong in the insurance sector. This was true as early as the late 1950s, so that computerization is not a recent phenomenon for insurance. However, the rate of computerization accelerated substantially during the 1970s and again during the 1980s in the insurance industry, as it did in the economy generally.

6. Labor and skill composition

I next present some comparisons of the composition of the labor force in the insurance industry with those of other sectors. The first is based on the information intensity of the work force. The basic data come from the 1960, 1970, and 1980 decennial censuses in the U.S. The tables of raw occupation by industry for each year were first aggregated, in conformity with a relatively consistent classification scheme, into 267 occupations and 64 industries (see Wolff and Howell [1989] for details on the matrix construction). The occupations have been grouped further into six categories: (i) knowledge, (ii) data, (iii) services, (iv) goods, (v) a hybrid class including both knowledge and data functions, and (vi) a hybrid class including both data and service functions. We then somewhat arbitrarily split the hybrid knowledge/data category half into knowledge workers and half into data workers and, in similar fashion, split the hybrid data/service category half into data and half into service workers. The resulting groups are referred to as "total knowledge", "total data", and "total service" categories. Information workers are then defined as the sum of (total) knowledge and (total) data workers. The non-information category is composed of the residual, including (total) service and goods workers.⁵

Professional and technical workers have generally been classified as knowledge or data workers, depending on whether they are producers or users of knowledge. The line is perhaps more than a bit arbitrary at points, and some judgment calls have been made. Moreover, in some cases, professional workers have been classified as data-service workers. This was done with doctors and nurses, since they both use information and perform a personal service. Management personnel have been classified as performing a dual data and knowledge function, since their tasks involve both the production of new information for administrative decisions and the use and transmission of this information. Clerical workers are classed data workers for obvious reasons. I have classified as goods workers all labor that transforms or operates on materials or physical objects. These include craft workers, operatives (including transportation workers who move physical goods), and unskilled labor. The remaining group is the service workers, who, primarily, perform personal services.

Table 7 reports the percent of information workers in the labor force of selected major industrial groups. It is instructive, first, to consider the relative information-intensity of the

⁵ We also split these groups using other ratios. However, the major results concerning the growth of employment of knowledge and data workers and of the information sector are quite insensitive to the proportions in which we split the two hybrid groups into their constituent parts.

Table 7
Knowledge and Data Workers as a Percent of Employment
By Industry, 1960-1980
(percentages)

	1960			1970			1980		
	Knowl.	Data	Info.	Knowl.	Data	Info.	Knowl.	Data	Info.
Insurance Industry	9.1	80.9	90.0	6.6	86.9	93.5	7.6	85.7	93.3
Full Economy	6.8	35.4	42.2	7.9	40.6	48.6	9.1	43.4	52.5
Manufacturing	6.2	23.7	29.9	8.3	26.7	35.0	8.8	28.3	37.0
Communications	10.2	57.7	67.9	12.5	55.4	67.8	16.4	52.5	68.9
Wholesale & Retail	7.5	54.9	62.4	6.5	53.0	59.5	8.8	52.1	60.9
Finance & Real Estate	8.4	67.9	76.3	9.6	69.6	79.2	8.8	73.0	81.8
Services	8.4	37.9	46.2	9.4	45.7	55.1	10.2	48.7	58.9

various sectors. For the full economy, knowledge and data workers comprised 49 percent of the total work force in 1970. The insurance sector was the most information-intensive, with 94 percent of its employees being knowledge or data workers in 1970. The finance and real estate sector was next in line, with 79 percent of its employees in information occupations, followed by communications with 68 percent, trade with 60 percent, and services with 55 percent. Manufacturing was last in this group, with only 35 percent.

Between 1960 and 1970, information workers increased as a proportion of total employment in the full economy from 42 to 49 percent. They also increased in all the sectors shown except wholesale and retail trade. During the 1970s they increased relatively in all sectors except insurance, where they remained virtually constant as a proportion of industry employment. However, in 1980, insurance was still the most information-intensive industry in the economy.

When we consider knowledge and data workers separately, we do notice substantial differences. In the full economy, knowledge workers as a proportion of total employment increased from 6.8 percent in 1960 to 9.1 percent in 1980. In contrast, in the insurance industry, this proportion fell from 9.1 percent, above average in 1960, to 7.6 percent, below average in 1980. Indeed, the insurance sector declined from being the second-most knowledge intensive sector to 1960, after communications, to last place among these sectors in 1980. Communications remained in first place, and by 1980, 16 percent of its labor force was employed in knowledge occupations.⁶

Skill Levels. Other comparisons are based on skill indices developed for the work force. Three measures are used. The first is a measure called substantive complexity (SC). The SC variable is derived from a factor analytic test of a large number of cognitive and aptitude variables from the Fourth Edition of the Dictionary of Occupational Titles (see U. S. Department of Labor, 1977). It was highly correlated with Specific Vocational Preparation (training time requirements), Data (synthesizing, coordinating, analyzing), and three

⁶ See Wolff and Baumol (1989) for more discussion of trends in the U. S. information sector.

worker aptitudes – Intelligence (general learning and reasoning ability), Verbal and Numerical (see Miller et al., 1980, Appendix F, p. 339). The second measure used here is median years of schooling, and the third is average employee full-time, full-year earnings. The last two indices are based on 1970 Census of Population data.

Each occupation in the 1970 occupation by industry matrix was first assigned a skill score on the basis of each of the three indices. The industry skill score is then computed as the weighted average of the occupational scores in each industry, with occupational employment shares as weights (see Howell and Wolff, forthcoming, for more details on the skill indices).

Results are shown in Table 8. By all three measures, the insurance industry is considerably above average in terms of the skill level of its employees. The average SC level of the insurance industry is 35 % above that of the total labor force; median education is about a full grade above average; and its average earnings 18% above that of the total labor force. On the 64-sector level, it ranks sixth in SC, with only professional services (6.92), non-professional business services (5.97), radio and television broadcasting (5.66), educational services (5.49), and advertising (5.47) ahead of it. Its educational rank is seventh, behind educational services (14.80), professional services (14.47), non-professional business services (13.76), radio and television broadcasting (13.56), medical services (13.44), and advertising (13.25). In terms of full-time earnings, its rank is fourth, behind professional services (\$ 12,063), radio and television broadcasting (\$ 10,420), and advertising (\$ 9,997). Thus, by these three indices, the insurance has one of the highest skilled labor forces in the U. S. economy.

Table 8
Skill Measures by Industry, 1970

	Substantive Complexity (SC)	Median Education (years)	Full-Year Earnings (\$ 1,000)
Insurance Industry	5.46	13.14	9.16
Full Economy	4.05	12.30	7.78
Manufacturing	3.62	11.78	7.96
Communications	4.75	12.97	8.62
Wholesale & Retail	4.01	12.20	8.02
Finance & Real Estate	5.12	12.91	8.65
Services	4.86	12.77	7.86

7. Concluding remarks

We are now in a position to better understand the trends in labor productivity growth in the insurance industry. Over the full 1948-86 period, labor productivity growth was modest but positive. However, the growth in technology (TFP) was actually negative. It was thus only through the strong growth in capital intensity that the insurance industry was able to achieve its relatively modest growth in labor productivity. Labor productivity growth was strongest during the 1966-73 and 1979-86 periods. Its relatively good performance during the first of these periods is due to a small but positive growth in TFP and a relatively high growth in capital intensity; during the second of these two periods, it is due

exclusively to an extremely high rate of growth in capital intensity, despite a (very) negative growth in TFP. Labor productivity growth was lowest and negative during the 1973-79 period, due to a negative growth in TFP and a very small growth in capital intensity (negative growth in net capital stock per FTE).

The results presented above also indicate that the insurance sector is one of the most skill-intensive and information-intensive sectors of the economy. Moreover, by various dimensions, this sector has been one of the most computer-intensive since the mid-1950s, and by one criterion, investment in OCA as a proportion of capital stock, had the highest rate of computerization during the first half of the 1980s. The major puzzle to explain is that, despite these factors, productivity performance in the insurance industry was quite poor over the postwar period. A related puzzle is why its growth in technology (TFP) was consistently low and, indeed, negative for certain periods, despite its very strong growth in capital intensity. Another interesting question is why its rate of capital formation was so high during the 1980s?

There are a number of possible explanations. First, the low rates of TFP growth may be associated with high costs of adjustment from the insurance industry's extremely high rates of capital formation, particularly during the 1980s. Moreover, there may be high adjustment costs linked with an extremely rapid rate of computerization. Both factors may account for the negative TFP growth found for the industry during the 1980s. Second, there are some extremely difficult measurement problems associated with defining output for the insurance industry. In particular, net interest comprises a large proportion of insurance GDP. Changes in net interest are directly related to the performance of the financial markets, which has little connection to changes of real inputs into the insurance industry.

Third, computerization necessitates a concomitant investment in computer personnel and general employee training, which shows up in the accounts as labor costs, not (fixed) investment. Also, computerization may have led to better "quality" output which is not captured in standard measures – in particular, improved claim handling and customer information, greater insurance coverage of new customers, and better assessment of risk factors.

Are there any broader implications of this study for the "information sector" as a whole? As noted above, the insurance industry is the most information intensive sector in the economy. If the results of this study for the insurance industry are indicative of trends for the information sector in general, then they have potentially pessimistic implications for the overall productivity performance of advanced economies as they switch from being industrialized economies to becoming information economies.

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