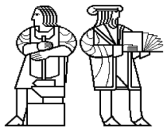

Massachusetts Institute of Technology
Engineering Systems Division

Working Paper Series

ESD-WP-2008-11

GDP-Based Productivity in Ambulatory Healthcare: A Comparison with other Industry Segments, 1998-2005

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February 2008

GDP-Based Productivity in Ambulatory Healthcare: A Comparison with other Industry Segments, 1998-2005[1]

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Keywords:
Healthcare, Productivity, Gross Domestic Product

Abstract: Few studies have focused on productivity in healthcare, let alone in ambulatory healthcare. Measurement of productivity in various healthcare segments has generally shown that productivity has either decreased (over some time period) or has increased more slowly than in other industry segments. This study shows that labor productivity has increased in ambulatory healthcare between 1998 and 2005 (by ~24%), but that capital efficiency has not changed over that time period. The study compared this result with the same measurements in the auto and information industry segments (as defined by the Bureau of Economic Analysis) and found that labor productivity gains were highest in the information industry (34%) and lowest in auto (6%), and that capital efficiency increased 8% in the information industry but decreased 7% in auto.

The study also found a strong linkage between changes in gross domestic product components for value-added and gross output and both labor and capital inputs in ambulatory healthcare. This linkage was not found in either of the other two industry segments investigated. This linkage implies that labor and capital input account for close to all of the productivity gains measured in ambulatory healthcare, but that other factors, such as labor quality, work process and structural reorganization, research and development investment and adoption of new technologies are not affecting this gain in productivity the way they may be in auto and the information industry. This result implies that addressing these factors may increase productivity in ambulatory healthcare even more than has been the case from labor and capital input increases.

1. Introduction: Healthcare costs continue to climb in a seemingly endless upward spiral. In 2006 they will have approached 20% of the Gross Domestic Product at $2.1T US. This was a 6.7% increase in spending and amounted to $7026 per person. Healthcare costs grew at 0.6% more than the GDP did in 2006[2], and they certainly didn't decrease in 2007. Some researchers predict that they will continue to increase reaching 30%-40% of GDP in the next 20 years. This is clearly

[1] I would like to acknowledge the support of the RCHN Community Health Foundation and especially of the Foundation's Executive Vice President, Feygele Jacobs
[2] **Health Affairs**. 2008.

unsustainable. At the same time, the U.S. healthcare system continues to compare poorly with those in other developed countries. A study from the London School of Hygiene and Tropical Medicine researchers shows that Americans are more likely than citizens of eighteen other industrialized countries to suffer deaths that could have been prevented by timely and effective health care. Deaths from the causes studied were reduced 16% (1997-1998, 2002-2003) but only 4% in the U.S.

There appears to be a consensus of opinion that the increasing adoption of healthcare information technology (HIT) will slow the raise in costs and help to improve quality of care primarily by increasing productivity in the healthcare segment & by changing the way healthcare is delivered[3]. The RAND Corporation has predicted about a $77B-$100B US savings in costs just from the adoption of electronic healthcare records (EHR) by medical providers over the next 15 years. They have additionally predicted a much larger savings, up to $300B a year, if the healthcare segment could improve productivity as much as other industry segments have[4]. Spending for HIT is estimated to increase by 8.6% annually over the next five years with from $6.9B US in 2007 to $10.8B US in 2012[5]. It has been generally assumed that productivity in healthcare has been lower than that of other industrial segments making investments in information technology, but is this actually the case? Bureau of Economic Analysis, Bureau of Labor Statistics and Department of Health and Human Services data can be used to evaluate whether productivity in healthcare organizations has been as flat as assumed. The result has implications for increased investment in technology in healthcare, as well as for how technology is adopted in healthcare organizations.

2. Methodology: Labor and production productivity measures are calculated for several NAICS industry categories: Auto manufacturing (NAICS 3361), Ambulatory Healthcare (NAICS 6210) and Information Industries (BEA aggregate including NAICS 3341 Computer and Peripheral Manufacturers, 5112 Software Publishers, 5415 Computer systems design and related services) using Bureau of Economic Analysis (U.S. Department of Commerce) GDP component figures for the years 1998-2005)[6].
Measures included:

- Increase or decrease in percent GDP contribution
- Gross Output scaled by Intermediate Input – a measure of capital efficiency that indicates dollar amount of gross output, defined as sales, or receipts, and other operating income, plus commodity taxes and changes in inventories, scaled by intermediate input, defined as goods and services used in the production of other goods and services but not sold in final demand markets
- GDP value-added scaled by industry segment compensation – a measure of labor productivity in $M

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[3] The relationship of productivity, technology adoption and improvement in clinical outcome is beyond the scope of this paper, but will be the subject of an additional study. Aseparate study will be done to compare productivity in ambulatory and inpatient healthcare.
[4] **Girosi, F. R. Melli, R. Scoville**. 2005.
[5] **INPUT, Inc.** 2007.
[6] http://www.bea.gov/national/index.htm#gdp

- GDP value-added scaled by hours worked by full-time equivalent employees (BEA for GDP component data, BLS for hours worked data)
- Range of value-added over full-time equivalent employee – determines the GDP contribution of each full time employee

Calculations of productivity measurements are made using raw BEA and BLS data. Calculations were also done according to the BLS indexed formulas[7] using 2000 as the index year. This paper reports the raw data calculations as the actual figures obtained are easier to compare across industry segments than indexes. The percentages of loss or gain that the analysis is based on are the same for both raw and indexed calculations.[8]

In addition, BEA values for per cent of GDP contribution as well as chained quantity and price indices for GDP value-added, gross output and intermediate input were used to calculate per cent increase or decrease of each measure over the eight year time period.

Appendix A provides formulas for calculation of the productivity measures used in this study.

3. Results: The following tables provide labor and production productivity results by year and for overall percentages for the Auto, Ambulatory Healthcare and Information Industry NAICS categories as described above.

Year	VA/Hours Worked $M	VA/Comp $M	VA/FTE $/FTE	Gross Output/Input $M
1998	38.89	1.42	8576	**1.33**
1999	41.16	1.41	8952	**1.30**
2000	45.01	1.45	9205	**1.34**
2001	41.51	1.31	8656	**1.33**
2002	49.41	1.34	10040	**1.34**
2003	52.43	1.21	11220	**1.35**
2004	46.84	1.29	9930	**1.29**
2005	41.28	1.11	8730	**1.25**
Percent +/-	5.8	-27.3	1.8	-7.0

Table 1. Labor & Production Productivity Measures for Auto (NAICS 3361), 1998-2005

[7] http://www.bls.gov/opub/hom/homch11_b.htm#Labor%20Productivity%20Measures

[8] Results of indexed productivity calculations are available from the author.

Year	VA/Hours Worked $M	VA/Comp $M	VA/FTE $/FTE	Gross Output/Input $M
1998	43.9	1.42	7066	**3.12**
1999	45.3	1.42	7274	**3.12**
2000	47.5	1.41	7639	**3.14**
2001	50.6	1.44	8175	**3.25**
2002	52.4	1.45	8491	**3.22**
2003	54.1	1.46	8739	**3.17**
2004	55.6	1.46	9005	**3.10**
2005	57.4	1.48	9359	**3.13**
Percent +/-	23.6	3.9	24.5	<1

Table 2. Labor & Production Productivity Measures for Ambulatory Healthcare (NAICS 6210), 1998-2005

Year	VA/Hours Worked $M	VA/Comp $M	VA/FTE $/FTE	Gross Output/Input $M
1998	33.4	1.18	7363	**1.90**
1999	38.6	1.18	8393	**1.90**
2000	36.4	0.90	7449	**1.87**
2001	34.3	0.87	7158	**1.84**
2002	41.7	1.04	8777	**1.95**
2003	46.2	1.12	9892	**1.96**
2004	49.4	1.13	10478	**2.00**
2005	49.8	1.08	10536	**2.10**
Percent +/-	33.0	-9.7	30.1	7.6

Table 3. Labor & Production Productivity Measures for Information Industries (NAICS BEA aggregate), 1998-2005

Industry Segment	% GDP Contrib-ution	GO/ Input % 98-05	VA/ Comp % 98-05	VA/ Hours Worked % 98-05	VA/FTE $/FTE Range	Remarks
Auto	**-62**	**-7**	**-27***	**5.8**	**85,000-112,200 (2003)-87,000**	***FTEs decreased 16% while compensation increased 10%**
Ambulatory Healthcare	**11**	**<1**	**4***	**23.6**	**71,000-94,000**	* **FTEs increased 17% & compensation increased 35%**
Information Industry	-13	8	-10*	33	74,000-105,000	***** **FTEs decreased 20% while compensation increased 23%**

Table 4. Summary of Percent Increase or Decrease for Productivity In All Industry Segments, 1998-2005

Industry Segment	% Value Added Trend	% Price Index Trend VA	% Gross Output Trend	% Price Index Trend GO	% Inter-mediate Input Trend	% Price Index Trend II
Auto	**-14.1**	**-27.6**	**10.0**	**<1**	**15.9**	7.1
Ambulatory Healthcare	**37.5**	**14.8**	**37.4**	**14.7**	**37.1**	14.3
Information Industry	15.9	-62.6	14.2	-30.0	7.2	-5.1

Table 5. Summary of Quantity & Cost Trends for GDP Components in All Industry Segments, 1998-2005

4. Analysis & Discussion: Productivity is an indication of industry efficiency usually measured by some form of industrial output scaled by capital or labor input. Simple ratios of this form have been supplanted by more complex measures such as multifactor and total factor productivity. Multifactor productivity (MFP) is defined as "output per unit of a set of combined inputs", that is output scaled by combined multiple inputs such as "capital, labor, energy, materials, and purchased business services (KLEMS); where capital includes equipment, structures, inventories, and land". "MFP measures reflect the joint effects of many factors including research

and development (R&D), new technologies, economies of scale, managerial skill, and changes in the organization of production."[9] Total Factor Productivity (TFP) is defined as any effects in total output not caused by capital inputs or labor productivity. TFP generally represents effects related to changes in how workplaces are organized and managed, although it has also been shown that measures of TFP growth are affected by errors in the measurement of capital inputs and labor productivity.[10] These measurement and other theoretical issues resulted in the "Cambridge Controversy"[11] directed at TFP measurement and concepts in which many economists argued that it was at best moot to measure TFP and at worst meaningless. This set of opinions, as well as the difficulty of obtaining statistics to calculate TFP or MFP led to the use of raw data ratios in this study, all of which represent straightforward labor or capital productivity measures that are simple to compare across industry segments. Despite difficulties with their definition and measurement, the concepts of both MFP and TFP are useful, especially where labor productivity and capital inputs do not appear to explain trends in productivity increase or decree

The comparative patterns across industry segments in each case are interesting. Data is taken from Tables 1 through 5 in this report. In Ambulatory Healthcare there appear to be linked increases in value-added, gross output & intermediate inputs, all at about 37%, as well as their associated chained quantity and price indexes, at about 27% and 15% respectively. Neither of the other comparative segments showed this kind of linkage between output and labor or capital input. The per cent contribution to GDP increased 11% during this time. There are also increases in number of fulltime equivalent employees, compensation and hours worked throughout the eight year period. Contribution to GDP per FTE rose steadily from $71,000 to $94,000. It is worth noting that hours worked per full-time equivalent employees were low at 1630 hours per year or approximately 41 effort-weeks. These measurements were linked with substantial increases in value-added scaled by hours worked and value-added scaled by FTE (both 24%), and a smaller increase in value-added scaled by compensation (4%). The ratio of gross outputs over intermediate inputs remained flat over the period at <1%.

[9] All MFP quotes: Bureau of Labor Statistics, http://www.bls.gov/mfp/peoplebox.htm#Q01
[10] **Baily, M.N**. 2004.
[11] **Burmeister, Edwin**, 2000. & **J.E. Stiglitz**, 1974.

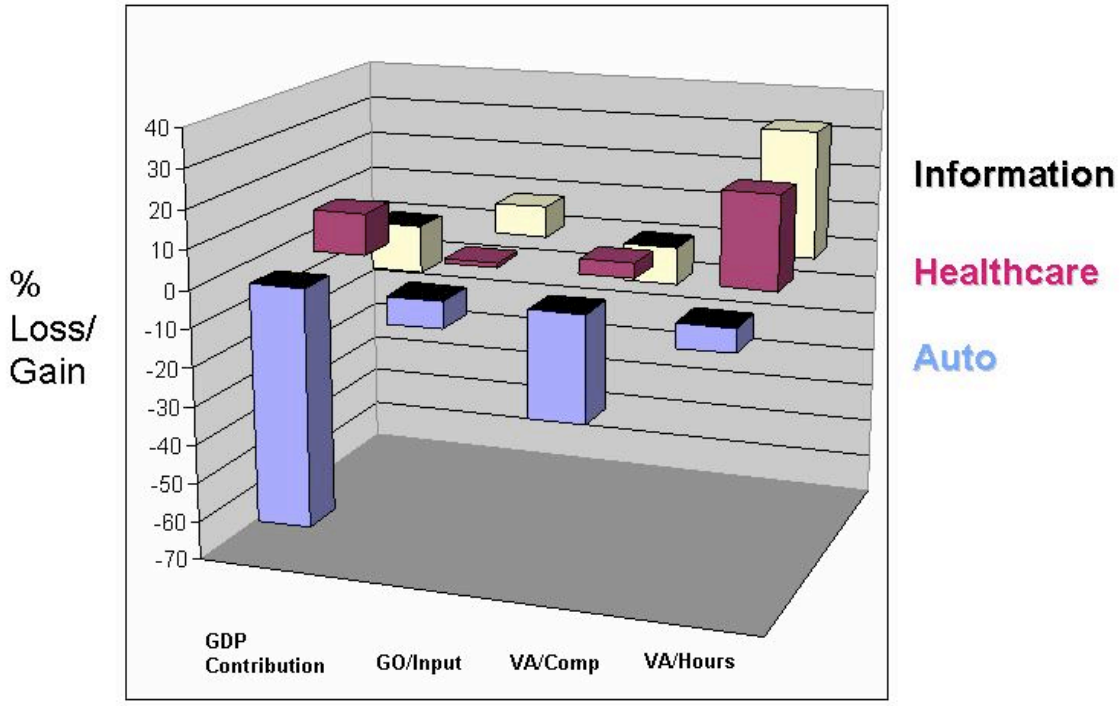

Figure 1. Productivity Patterns Across Industry Segments, 1998-2005

In the Auto segment, a 14% decrease in value-added corresponded to a 10% increase in gross output and a 16% increase in the cost of intermediate inputs. Value-added reached a peak in 2003 and then declined. Chained quantity & price indexes reflected this pattern. The per cent of GDP contribution decreased 62% during this time. FTEs and hours worked decreased 16% during this period while compensation increased 10%. Hours worked by FTEs averaged 2115 or 53 effort-weeks. The dollar contribution to GDP per full-time equivalent employee rose from $85,000 in 1998 to $112,200 in 2003 and then decreased to $87,000 in 2005. This pattern of decrease in value-added with increase in both cost of production and compensation adversely affected the productivity measurements. Value-added over hours worked increased 6% and value-added per FTE increased 2%, but value-added over compensation decreased 27% while gross outputs over intermediate inputs decreased by 7%.

The pattern in the Information Industry aggregate was quite different from either of the other segments. A 16% gain in the amount of value-added, corresponded to a 13% decrease in GDP contribution. There was a 14% increase in gross output and a 7% increase in intermediate inputs. In all cases, the associated price indexes for these variables decreased at -62%, -30% and -6% for value-added, gross output and intermediate inputs respectively. FTEs and hours worked both decreased about 20%, but compensation rose by 23%. The dollar contribution to GDP per FTE rose from $74,000 to $105,000. Total hours worked were similar to Auto at 2115 hours per year per FTE or 53 effort-weeks. Value-added per hours worked and per FTE both increase about 30%, while value-added per compensation decreased 10%. This is understandable given the large decrease in FTEs in the segment (-20%) but

the correspondingly large increase in compensation (23%). Gross output over intermediate inputs increased by 8%.

Few studies have focused on productivity, measured in any way, in ambulatory healthcare. Some studies have looked at the potential or measured change in productivity associated with the adoption of a specific technology, EHR for example[12]. Others have focused on non-ambulatory health providers such as hospitals[13]. Still others have looked at productivity in larger segments of healthcare as part of much more comprehensive studies[14]. In general, these studies found that productivity was lower in health care compared to other industry segments or had declined over some time period. Jorgenson, *et al.* found that total factor productivity declined 1.5% between 1977 and 2000 in 'private health services', while Triplett and Bosworth reported a labor productivity decrease of 2.8% and a multifactor productivity decrease of 2.3% for the years 1992-1997.

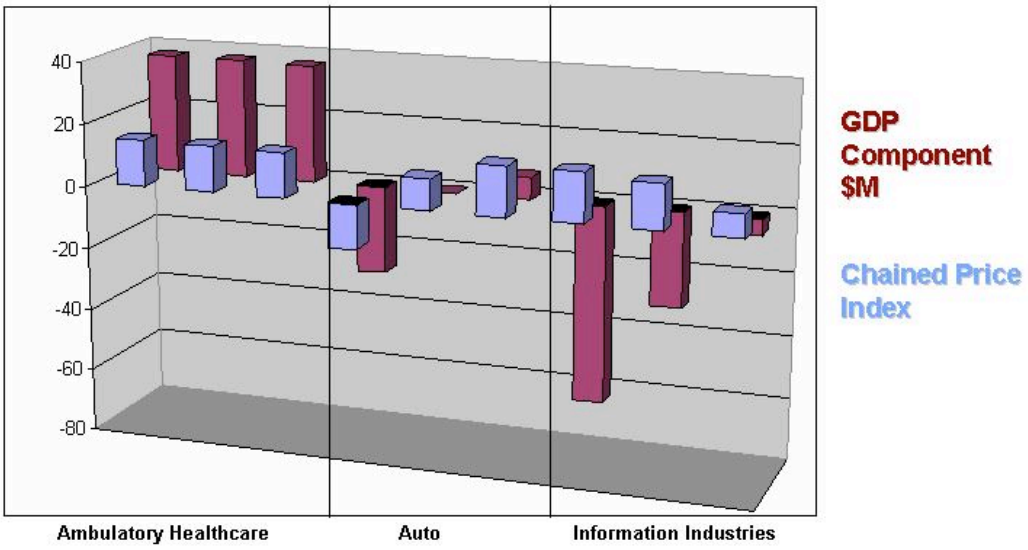

Figure 2. GDP Component Patterns, 1998-2005

The situation is different in both auto and the information industries. Labor productivity and capital efficiency is not highly coupled to the GDP components. For instance, in auto value-added increased while gross output and intermediate input decreased. In information all three components increased, but the quantity and

[12] c.f. **R. Hillestad et al.** 2005.
[13] c.f. **Cromwell, J**. 1987.
[14] c.f. **Jorgenson, D.W., M.S. Ho and K.J. Stiroh**. 2005. & **Triplett, J. and B.P. Bosworth.** 2000.

price indexes were not at all matched. Although value-added increased 15%, its chained quantity index increased 52% while its chained price index decreased 63%. This indicates that other factors were influencing the productivity measurements of these segments.

We know that total factor productivity is influenced by changes in how workplaces are organized and managed, and that multifactor productivity reflects not just labor and capital factors but also research and development investment and adoption of new technologies as well as the same kinds of organizational changes that affect TFP[15]. We also know that the two industry segments that appear to be affected by multiple factors have, over the last 25 years or so, made substantial investments in research and development, adopted new technologies and carried out relatively extreme structural and management reorganizations. These factors are a way of life in the information industries and currently are continuing in the auto industry, so we should expect multiple factors to continue to be relevant in affecting productivity in these industries.

The ambulatory health segment has not made many of these changes up until this time. Unlike the inpatient (hospital) care segment, investment in new technologies, whether in hardware (medical devices and computers) or software applications have not been a priority. Neither has structural or management reorganization. This segment is only just now faced with needing to make some of these changes as it focuses on the adoption of electronic healthcare records (EHR) which require investments in hardware and work reorganization. Ambulatory healthcare has made progress in labor productivity without making these changes, but not in capital efficiency. In order to consolidate and extend the labor productivity gains made from 1998 to 2005, and to begin to make gains in capital efficiency, this segment will have to address the key factors that affect these productivity changes. These include increased research and development spending, increased technology adoption and addressing economies of scale as well as making serious efforts at productive structural and work reorganization, and improving managerial skill. Advances in these areas will allow ambulatory healthcare to lower costs and improve both labor productivity and capital efficiency.

[15] **Brynjolfsson, E., L. M. Hitt & Y. Shinkyu**. 2002.

5. Appendix A: Definitions and formulas for calculating productivity measures:

Definitions:

1. ambulatory healthcare – industries that provide health care services directly or indirectly to ambulatory patients and do not usually provide inpatient services. Health practitioners in this subsector provide outpatient services, with the facilities and equipment not usually being the most significant part of the production process[16]
2. value added – the corrected (2005 revision) contribution of a NAICS industry segment to the gross domestic product. All values from Bureau of Economic Analysis figures (in millions of dollars, current)
3. hours worked – the estimated hours worked by NAICS industry segment from the Bureau of Labor Statistics figures (in hours per time period)
4. compensation – the estimated compensation (sum of wages and salaries and supplements) paid to employees in a NAICS industry segment for a specific time period (in millions of dollars, current)
5. gross output - the sales, or receipts, and other operating income, plus commodity taxes and changes in inventories of a NAICS industry segment for a specific time period (in millions of dollars, current)
6. intermediate inputs – the goods and services that are used in the production process of other goods and services for a specific NAICS industry segment and are not sold in final-demand markets (in millions of dollars, current)

Formulas:

1. **$VA/H = VA_{tx} / (H_{tx} X 1000)$**, VA in $m, H in 1000s, VA/H in $M
2. **$VA/C = VA_{tx} / C_{tx}$**, VA in $m, C in $M, VA/C in $M
3. **$VA/FTE = VA_{tx} / (FTE_{tx} x 1000)$** VA in $M, FTE in 1000s, VA/FTE in $
4. **$GO/Input = GO_{tx} / Input_{tx}$** GO in $M, Input in $M GO/Input in $M

Indexed productivity measurements were calculated to compare with the Bureau of Labor Statistics measurements as follows:

5. **$(V_a/V_0)/(L_a/L_0) = P$,** where V_a equals value output in year a, V_0 equals the value output in the index year, L_a equals labor input in year a & L_0 equals labor input in the index year

Value inputs used include BEA value-added (GDP contribution) & BEA gross output, labor inputs used include BLS hours worked, BEA compensation, BEA full-time equivalent employees & BEA intermediate input.

6. **PerCent Change = $100-(Comp_{t1} / Comp_{tx}) x 100$**

[16] North American Industry Classification System (NAICS) 1997 definition of NAICS class 621, ambulatory healthcare, Department of Commerce, http://www.census.gov/epcd/naics/NDEF621.HTM

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