

# Information Technology Intensity, Diffusion, and Job Creation

Dr. Catherine L. Mann  
Rosenberg Professor of Global Finance  
International Business School  
Brandeis University  
Visiting Scholar, Federal Reserve Bank of Boston  
[CLMann@Brandeis.edu](mailto:CLMann@Brandeis.edu)

Version dated: March 4, 2012

Using the detailed Statistics of US Business and the Annual Input-Output accounts, this paper addresses the employment dynamics of establishments of different sizes, in different sectors, and of different intensity of use of information technology hardware, software and IT-services over the time period 2001 to 2009. Findings include (1): IT-using sectors that are above-average in IT-intensity started out being three times more IT-intensive and ended up being more than four-times the IT-intensity as the below-average using sectors. Hence, *there is widening dispersion in IT-intensity across sectors in the US economy*. (2) IT producers are a small part of the economy, only about 3% of employment. However, IT-software and services establishments have tended to add jobs on net, particularly at smaller establishments (size 1-99 employees). This suggests that *IT again is the hot-bed of entrepreneurship*. (3) Small establishments that use IT intensively account for only about 5% of overall employment. However, *net job creation at these small-IT-intensive using establishments accounted for between 13% and 68% of the economy-wide net job change from 2001 to 2009*. Entrepreneurship in these IT-using services establishments appears to be promoted by the availability of IT-software and IT-services themselves. (4) *Establishments that use IT-intensively both in the manufacturing and services sectors, expand and contract employment over the business cycle relatively more than non-IT-intensive manufacturing and service establishments*. This employment management strategy is more dramatic for manufacturing than for services. (5) Three approaches to quantifying the direct and indirect gains to the US economy of lower IT prices and increased IT-intensity add up to between \$810 and \$935 billion for the five years considered 2002-2007. Including IT-services such as computer design, yields a ball-park round \$1 trillion as reasonable figure for the gain to the US economy of broad-based use of information technology hardware, software and IT-services for the mid-decade 2000s five-year time period.

Keywords: Information technology, social surplus, startups, small businesss

Supported in part by funding from the Technology CEO Council

Introduction.....	3
Findings: .....	3
Research Background .....	4
Information technology and macro-economic performance.....	4
Information technology, firm size, and jobs .....	5
Contribution of this paper .....	6
Intensity of information technology in the US economy: focus on the 2000s.....	6
IT-intensity and Employment Dynamics .....	10
The data.....	10
IT-producing sectors .....	11
IT-intensive: services vs. all economy.....	11
IT-intensive vs. not-IT-intensive: services vs. manufacturing.....	13
IT-intensity and net job creation: 2002-2009.....	13
IT intensive services: small establishments: .....	14
Summary Observations.....	15
Diffusion Gains from IT Use .....	16
Direct gains from IT production and final sales .....	16
Gains from globalization of IT—lower prices and greater variety of IT.....	16
Social surplus gains from a transformative technology .....	17
Summing up macroeconomic gains .....	19
References.....	21
Appendix Materials.....	24

### Introduction

The 1990s and early 2000s saw an avalanche of mostly positive-concluding research on how IT affects economic performance. The positive tone paused during the IT-facilitated outsourcing and offshoring of services activities of the mid-2000s. The question was raised as to whether the globalization of IT was a boom or detriment to economic performance and job creation. Indeed, researchers reevaluated whether we were even measuring IT prices and their effects on the economy properly.

This paper takes up the research thread with a focus on the 2000s and job creation at establishments of different sizes. The question is whether industries that use IT-intensively have different employment dynamics, particularly at small establishments. In this regard, the paper is related to research on startups and entrepreneurship. This new examination is made possible by public access to detailed data on employment by establishment size by industry sector that can be matched to data on information-technology inputs by sector. The specific issue of globalization of IT is put to the side, to be taken up at a later date.

Matching the data on IT, sectors, employment, and establishment size, I first evaluate how the intensity of use of IT by different sectors of the economy changed over the 2000s. I then compare employment dynamics by firm size and by IT-intensity by sectors. I then widen the perspective of analysis to consider aggregate measures of economic performance to assess the role for IT on the US economy over the 2000s.

### *Findings:*

- The intensity of use of information technology (hardware, software, IT-services), over all sectors, increased an average 150% over the 2000s. IT-using sectors that are above-average in IT-intensity started out being three times more IT-intensive and ended up being more than four-times the IT-intensity as the below-average using sectors. Hence, there is widening dispersion in IT-intensity across sectors in the US economy.
- IT producers are a small part of the economy, only about 3% of employment. However, IT-software and services establishments have tended to add jobs on net, particularly at smaller establishments (size 1-99 employees). This suggests that IT again is the hot-bed of entrepreneurship.
- IT-intensive establishments, both in the manufacturing and services sectors, expand and contract employment relatively more than non-IT-intensive manufacturing and service establishments. This ‘employment management’ strategy is more dramatic for manufacturing than for services.
- Over the 2001-2009 period, IT-intensive using services establishments of all sizes (about 20% of the economy) added about 1 million net jobs, representing a growth rate of 5%. Non-IT intensive services also added 1 million jobs, but since these sectors account for about 2/3 of employment, an additional 1 million jobs represents growth of only 1.5%. The overall economy shed jobs over this time period.

- Small IT-intensive service establishments account for only about 5% of overall employment. However, net job creation at these small-IT-intensive using establishments accounted for anywhere from 13% to 68% of the economy-wide net job change. Entrepreneurship in IT-intensive-using in the services appears to be promoted by the availability of IT-software and IT-services themselves.
- Three approaches to quantifying the direct and indirect gains to the US economy of lower IT prices and increased IT-intensity added up to between \$810 and \$935 billion for the five years considered 2002-2007. None of these methods include IT-services such as computer design, despite the increased importance of this component of the IT-package. A ball-park incorporating of IT-services points to a round \$1 trillion as a not unreasonable figure for the gain to the US economy of broad-based use of information technology hardware, software and IT-services for the mid-decade 2000s five-year time period.

## Research Background

### *Information technology and macro-economic performance*

How information technology – including hardware, software, IT-services, and telecommunications networks – influences measures of economic performance is a well-studied topic.<sup>1</sup> There are several key research threads relevant as background to this study: IT use-vs-production; globalization of IT and economic wellbeing; measurement issues.

IT-use vs. production: Early substantive work by Stiroh, Jorgenson, and others found that high-productivity IT-producers bolstered GDP growth. That observation was quickly followed by another: Some countries, such as Australia, not known as IT producers were also enjoying high productivity and GDP growth. The key finding that squared the circle, in for example Van Ark et. Al.'s 2003 study, revealed that productivity in technology-using industries increased almost 10 fold more than productivity in technology-producing industries (1979-95 vs. 1995-02).

This observation—that IT-use rather than IT-production--generates wide-spread potential for high productivity growth spawned a deeper examination of the technology-using sectors. Based on substantial research, some economies seemed to get more growth benefits from technology investment than others on account of more flexible labor and product markets, superior business environment and domestic institutions, sufficient human capital, and a threshold amount of IT capital.

Globalization of IT production and trade: A second strand of research focuses explicitly on the increased globalization and fragmentation of the production process of IT.

---

<sup>1</sup> This section draws from “Information Technology, Globalization, and Growth: Role for Scale Economies, Terms of Trade, and Variety,” Chapter 3 in Ascent After Decline: Re-Growing Economic Growth After the Great Recession, Danny Leipziger and Otaviano Canuto, eds., The World Bank, 2012 and the citations there-in.

Research finds that countries with a greater variety of products in international trade gain more, measured as total factor productivity or as an augmentation to GDP, from using IT than countries that have a more concentrated pattern of international trade in IT that is more associated with being part of a supply-chain rather than being a significant user of IT.

Measurement Through the research, there is often a question of proper measurement of IT, particularly related to quality adjustment, network externalities, and how new products are integrated into price indexes. Quality adjustment of IT hardware is now well accepted, but how to quality adjust or even how to best price software and IT-services is more challenging. This is particularly true as the production process of these IT activities are also globally fragmented. (Mann 2009a and b) Measuring gains to using IT that comes through network externalities has been investigated and estimated by Wilson (2007) as the difference between price and rate of return on IT capital investment.

How new products, introduced through trade, are incorporated into import and export price indexes is a third issue. On the one hand, 'new supplier bias' causes measured import prices to be 'too high', which would result in overstatement of measured GDP and productivity growth. On the other hand, the lower true import prices means that it is cheaper to buy IT, which adds to diffusion gains. So, the overall impact of globalization of IT has multiple facets (Houseman et. al. 2011).

#### *Information technology, firm size, and jobs*

Studies that examine the relationship between jobs and information technology are more sparse, and even more so research on the nexus of IT, firm size, and jobs. In part this is a consequence of limited data availability and the difficulties of matching data across source and concepts. In addition, there are cross-currents in the roles that IT can play in a firm's operations. But, there are pieces of the puzzle.

Small firms and technology intensity. Are small firms more or less technology-intensive than large firms? Some research finds that small firms in the U.S. appear to have higher technology intensity as measured by characteristics of employees. (Baumol, 2005) On the other hand, other research finds that so-called high-impact firms are neither young, small, nor IT-related. (Acs, et al 2008). Eckhardt and Shane (2006) find positive correlation between small size and innovative activity. Research using firm-level data finds that small firms that use websites and e-mail have higher sales and have more workers (Stangler, 2010).

IT-intensity and jobs. The relationship between workers and technology-intensity is fraught with mixed results. Of course this is because IT can be either a complement or a substitute for workers. Some research, such as by Bernard and Jensen, finds that the more technology-intensive multinational firms pay workers more, and employment grows faster. Research using firm-level data from around the world finds that firms that are globally connected through websites and e-mail have higher sales and pay workers more

(Ferro, 2010). On the other hand, IT can enable tighter control over costs, including labor costs. (Bloom, Sedun, and VanReenan, 2012).

#### *Contribution of this paper*

With regard to the macroeconomic gains associated with IT, this paper uses several different approaches to measuring the macroeconomic gains to IT use, including direct inspection of the National Income and Product Accounts (NIPA), the relationship between IT-prices and investment in IT products, and finally the social surplus concept that incorporates both direct and indirect value of IT to the macro economy.

Second, to shed further light on the relationship between IT-intensity, employment, and firm size this paper constructs a sector-specific measure of IT-intensity, and then considers how this measure is related to employment dynamics at establishments of different sizes in those sectors.

#### **Intensity of information technology in the US economy: focus on the 2000s**

The examination of the relationship between IT, industry sectors, employment dynamics, and establishment size starts by evaluating the intensity of IT used in the production process of each sector. There are a number of US government data sources that include technology measures, but the annual I-O and KLEMS databases (both from BEA) have the most sectoral disaggregation (65 sectors), while also having the most current data (2010), and offering a relatively comprehensive set of technology inputs (on this, I-O and KLEMS are somewhat different, but both allow construction of hardware inputs, software inputs, and IT-services inputs, such as computer system design).

Using these databases, IT-intensity can be defined in two ways: IT hardware, software, and IT services as a share of total intermediate inputs or IT software and services as a share of purchased services inputs. The broader measure inclusive of IT hardware will be used in subsequent analysis because of the importance of hardware price deflators. However, considering just 2010 data, the correlations of the two different measures of IT-intensity considering the two different databases (a four-way comparison) finds all correlations of the nominal data at about 70%. Once these data are measured in real terms and using the hardware-software-services measure of IT intensity, the correlation between the two databases (KLEMS vs I-O) increases to above 90%. (See Appendix table.) Therefore, the broad measure of IT-intensity (hardware, software, and IT-services), evaluated in real terms, and using the I-O database will be the foundation of this analysis.<sup>2</sup>

To evaluate IT-intensity over time requires price deflators for the specific IT inputs, as well as the overall inputs. As is well documented, the prices for various IT products have been declining over time, although the different types of IT-products have seen different price declines whereas the prices of most other intermediates have increased (see Appendix Chart). Therefore, accounting for the various price movements is key to evaluating the change in IT intensity of sectors and of the economy over all.

---

<sup>2</sup> At a future date, sensitivity analysis using the KLEMS database will be done.

Applying matched price indexes for IT-hardware, software, IT-services to overall inputs to each of the sectors in the I-O database, starting from a base year of 2002, yields the real 2010 share of IT (hardware, software, and services) in intermediate inputs for all 65 sectors.<sup>3</sup> Table below shows the ranking of sectors in terms of real IT-intensity for 2010.<sup>4</sup> (Appendix table shows the nominal ranking by the same measure.) Not surprisingly, the top sector in terms of IT-intensity is 334-computer and electronic products. Similarly, other IT sectors are IT-intensive, including 514--information and data processing systems, 5415—computer system design and related systems, and 511-publishing including software.<sup>5</sup>

An inspection of the table shows that ‘above-average’ sectors include several manufacturing sectors—transportation, electrical equipment, machinery, printing, and medical devices (in 339). But there is a preponderance of services sectors too: management, legal, professional, administrative services, education, and financial securities activities. It is also interesting that some government activities are quite IT-intensive (at the federal level, this is likely due to the IT-intensity of national defense, see Appendix table).

---

<sup>3</sup> From the BLS: IT hardware price index is PCU3341113341111, software price index is NIPA pre-pack software see Table 11 in detailed accounts. The IT-services price index is the output price index for Computer System Design and Related Services from the KLEMS database. Finally, the price index that I use to deflate all industry inputs is the NIPA GDP deflator, since there is not a intermediates deflator that include both goods and services. See appendix chart for these and other IT prices indexes.

<sup>4</sup> Using the KLEMS database, and the same definition of IT-intensity (hardware, software, IT-services), the rankings are very similar. However, several more manufacturing sectors are ‘above-average’, specifically 337, 326, 322, 331, 327. These are ‘close’ to being ‘above average’ IT-intensity using the I-O database.

<sup>5</sup> It is quite unfortunate that software is not broken out separately in either the KLEMS or the I-O database.

Real IT-intensity (2010)			
Hardware+software+IT-services as a share of industry intermediates (%)			
Commodity Description	code	Commodity Description	code
Above average IT intensity		Below Average IT intensity	
126.01 Computer and electronic products	334	9.37 Fabricated metal products	332
45.59 Federal general government	GFG	9.34 Nonmetallic mineral products	327
42.62 Other transportation equipment	3364OT	9.32 Wholesale trade	42
29.10 Information and data processing services	514	8.81 Plastics and rubber products	326
25.22 Computer systems design and related services	5415	8.65 Mining, except oil and gas	212
21.85 Broadcasting and telecommunications	513	8.53 Primary metals	331
21.75 Electrical equipment, appliances, and components	335	8.00 Furniture and related products	337
21.36 Publishing industries (includes software)	511	7.94 Paper products	322
20.27 Motor vehicles, bodies and trailers, and parts	3361MV	7.71 State and local general government	GSLG
19.94 Management of companies and enterprises	55	6.81 Retail trade	44RT
14.01 Machinery	333	6.62 Motion picture and sound recording industries	512
13.98 Legal services	5411	5.86 Oil and gas extraction	211
13.25 Miscellaneous professional, scientific, and technical ser	5412OP	5.81 State and local government enterprises	GSLG
13.23 Other services, except government	81	5.52 Ambulatory health care services	621
11.96 Administrative and support services	561	5.25 Federal Reserve banks, credit intermediation, and related activiti	521CI
11.86 Educational services	61	5.17 Textile mills and textile product mills	313TT
11.54 Printing and related support activities	323	5.10 Waste management and remediation services	562
11.27 Securities, commodity contracts, and investments	523	4.83 Accommodation	721
10.87 Miscellaneous manufacturing	339	4.79 Social assistance	624
		4.49 Chemical products	325
10.41 private and public sector average*		4.46 Wood products	321
10.08 private sector averageg		4.33 Hospitals and nursing and residential care facilities	622HO
		4.22 Rail transportation	482
17.03 average of the 'above average' private non-IT producing		4.22 Amusements, gambling, and recreation industries	713
3.97 average of the 'below-average' private sector		3.58 Rental and leasing services and lessors of intangible assets	532RL
		3.39 Construction	23
		3.14 Federal government enterprises	GFE
		3.12 Warehousing and storage	493
		2.46 Food services and drinking places	722
		2.35 Apparel and leather and allied products	315AL
		2.17 Funds, trusts, and other financial vehicles	525
		1.89 Food and beverage and tobacco products	311FT
		1.87 Truck transportation	484
		1.78 Pipeline transportation	486
		1.65 Utilities	22
		1.53 Performing arts, spectator sports, museums, and related activitie	711AS
		1.35 Support activities for mining	213
		1.19 Insurance carriers and related activities	524
		1.11 Real estate	531
		0.86 Transit and ground passenger transportation	485
		0.86 Forestry, fishing, and related activities	113FF
		0.71 Other transportation and support activities	487OS
		0.35 Air transportation	481
		0.24 Farms	111CA
		0.24 Petroleum and coal products	324
		0.16 Water transportation	483

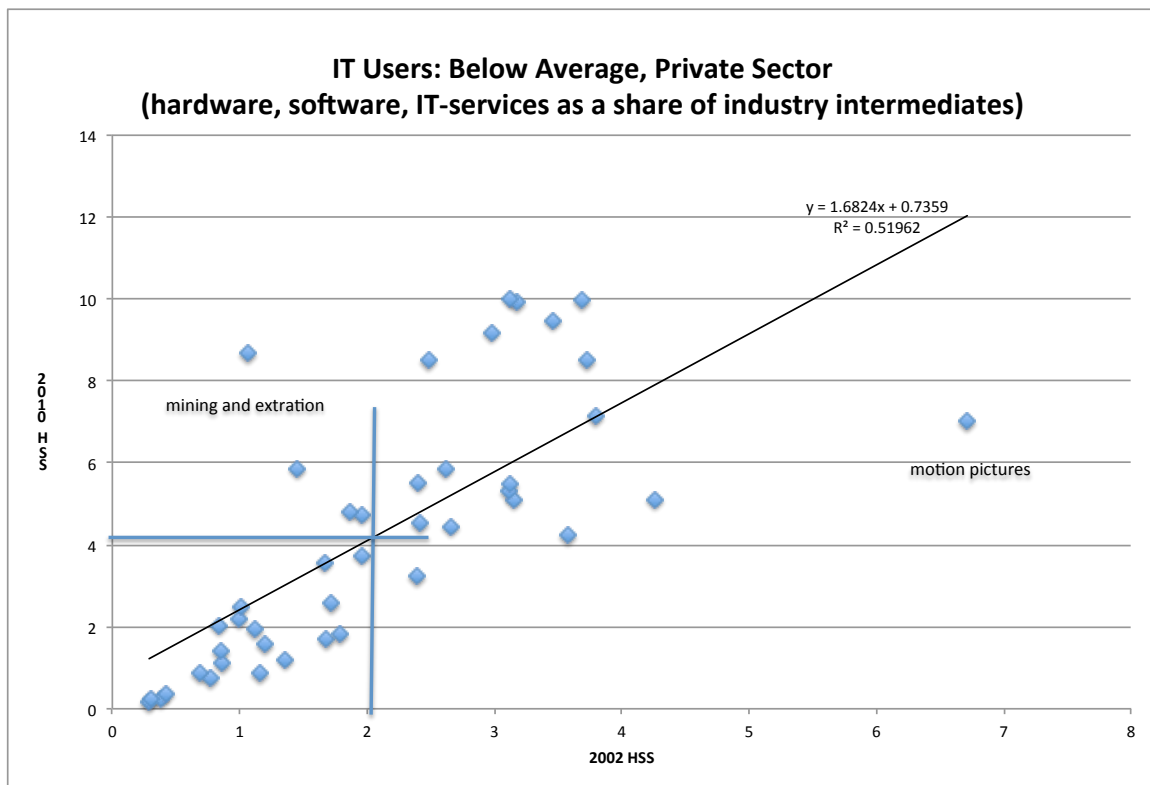
\* average of the private and government sectors, but not including any of the 'F0xx' categories, exports, imports, or commodity intermediates

How did IT-intensity in the economy evolve over the 2000s? There are several ways to present this. First, consider the change in average intensity over time. Table (below) shows that the private sector increased IT-intensity some 150%. But there is significant variation when breaking up the private sector. IT-producers dramatically increased their IT-intensity, by nearly three fold, and starting from an IT-intensity nearly 5 times above the average for the private sector as a whole (which includes them). The above-average users increased IT-intensity well more than 2.5 fold. Even the below-average users doubled their IT intensity over the 2002 to 2010 period. There is a striking difference between the above-average users and the below-average users in terms of IT-intensity. The above-average users started being three times more IT-intensive and ended up being more than four-times the IT-intensity as the below-average users.

IT intensity 2002-2010			
	2010.0	2002.0	increase %
private sector	10.7	4.3	146
IT producers	54.0	19.1	183
above average users	18.1	7.1	157
below average users	4.3	2.1	103

So, while all sectors did increase IT-intensity, there is some indication that below-average users are stratifying into those sectors that are quite lagging in IT-intensity, and others, while still below-average, are catching up. This stratification is more easily seen in a scatter plot of the data for below-average private-sector users. (Other scatter plots are in the Appendix.) The vertical and horizontal lines indicate the averages for the below-average users for the 2002 and 2010 period. The sloped line is the regression line indicating the line-of-best-fit to explain the data (each point is a sector).

The below-average of the below average mostly lie below the regression line (the lower left quadrant), whereas the rest of the sectors are scattered around the regression line (the right-hand quadrants). So, the laggards are falling further behind. These include, for example, various utility-type sectors (pipelines, water, air, ground transport), construction, warehousing, and certain manufacturing sectors (food and beverage, apparel and leather). But, there are outliers that have bucked the trend of their group. Two sectors increased IT-intensity dramatically—mining and oil and gas extraction. One sector modestly reduced IT-intensity—motion pictures.



While certainly more can be said about the changing IT-intensity of the US economy (and a macroeconomic assessment of the impact of increasing IT-intensity will follow) we turn now to examining the employment characteristics and dynamics of IT-producers vs. IT users, considering above and below average IT-intensity, manufacturing vs. services, and size of establishment.

## IT-intensity and Employment Dynamics

Did job creation differ by sector as defined by intensity of IT-use in the 2000s? Are there differences across establishments of different sizes? Does the availability of IT promote entrepreneurship? Analysis of these questions requires data on employment by establishment size by an industry classification scheme that can be matched to the IT-intensity data just reviewed. The Statistics of U.S. Business (SUSB) program available from Census allows this analysis albeit with some data cross-walking from the I-O codes, which are used to evaluate IT-intensity, and the NAICS codes used in SUSB for data on establishment characteristics.<sup>6</sup>

### *The data*

SUSB contains a wealth of data on an annual basis including several individual years, and then a time-series over the 2000s to the latest observation of 2009. For the establishment sizes (1-4, 5-9, 10-19, 20-99, 100-499, and 500+), SUSB data include initial number of employees, initial number of establishments, net change in both over the year. In addition establishments and number of employees at ‘new’ establishments (births), number of employees at expanding establishments, and similarly for contracting establishment and ‘deaths’.

The mapping between establishment and firm varies. Single establishments are single firms. So, a 2003 startup with a new EIN and, say 5 employees, would appear in the 2003-2004 SUSB in the 5-9 size category as an establishment birth. If it adds 10 employees in 2004, it would be in the 5-9 category, as an expanding establishment, adding 10 employees. But not all establishments are equivalent to firms. For example, a single firm could have multiple establishments, each with its own EIN, which could be classified in any size category. A large establishment that downsized employees in a year, could reappear the next year in the smaller size category. A large establishment that spun-off into two smaller divisions would appear as a death, and then as a birth in new smaller categories. Despite these possibilities, the size classification that I focus on (size 1-99) and large (above 100) probably does distinguish between start-up and young firms vs. older firms.

Data on employment at these establishment sizes are available at various NAICS disaggregation (4 and 6), and by various geography (whole US, state, MSA). In the early years (prior to 2007), the more granular the data, the more disclosure problems, which limits the ability to do time-series analysis. However, since 2007, statistical noise has been added to the data series.<sup>7</sup> For my work reported here, there are some disclosure problems in the pre-2007 data for the small establishments.

From all of these data, I extract and compile a profile of establishments of size 1-99, as well as of all establishment sizes. For the analysis, I consider initial employment and net

---

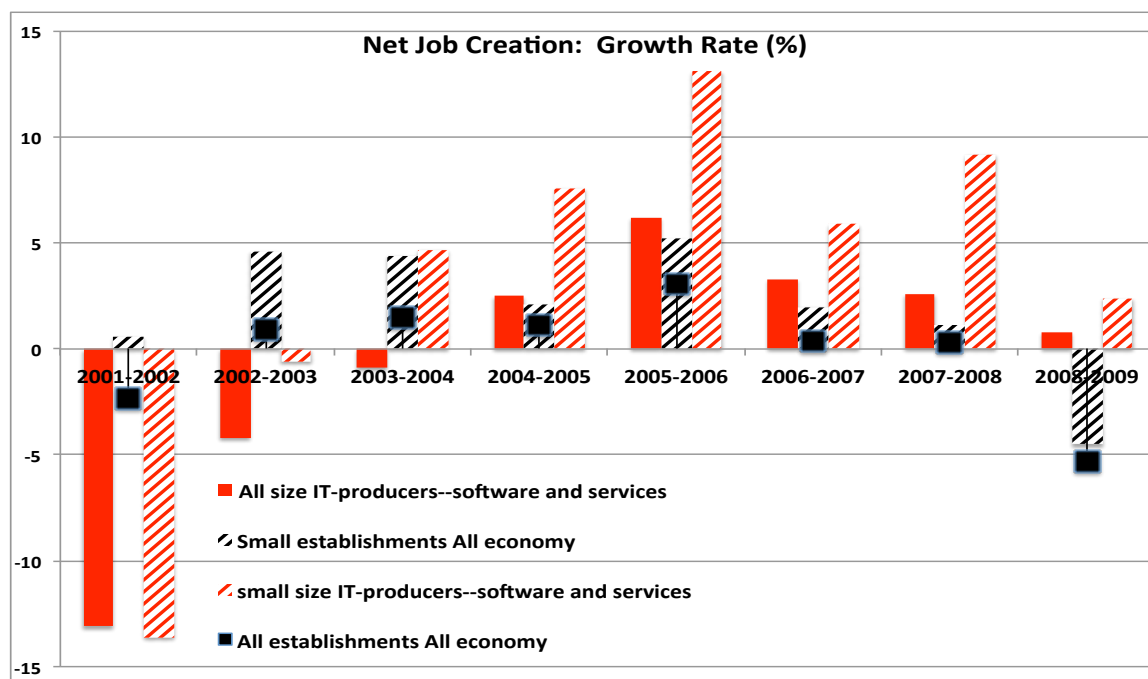
<sup>6</sup> For more on the SUSB program, see <http://www.census.gov/econ/susb/methodology.html>. The specific data used in the paper can be found at: <http://www2.census.gov/econ/susb/data/dynamic/>. Although the size classification in SUSB includes size 1-4, 5-9, 10-19, 20-99, 100-499, 500+

<sup>7</sup> For more on statistical noise, see the SUSB methodology, op cit.

change in employment.<sup>8</sup> Using the Input-Output /NAICS cross-walk, I construct the following sectoral aggregates: IT-producers (hardware, and software and IT-services), IT-intensive-users (services and manufacturing) not-IT-intensive-users (services and manufacturing) and compare these to the overall economy. The Appendix tables contain the NAICS classification in each category, and the distilled data. From these distilled data, there are the following observations:

#### *IT-producing sectors*

- IT producers are a small part of the economy. Employment averages some 3% of employment in any year, about 3 million jobs, about 1/3 in hardware and 2/3 in software and IT-services.
- The two years after the dot-com bust (2001) were not good for job creation. However, starting in 2004, IT-producers added jobs, on net, principally in the IT-software and services sector.
- The availability of new platforms, such as mobile devices to support IT-software and services startups appears to figure into the data. The growth rate of net job creation at this segment of establishments outstrips all other segments in the latter half of the 2000s. Even during the 2008-2009 recession, both the small and overall IT-producing establishments added jobs on net.

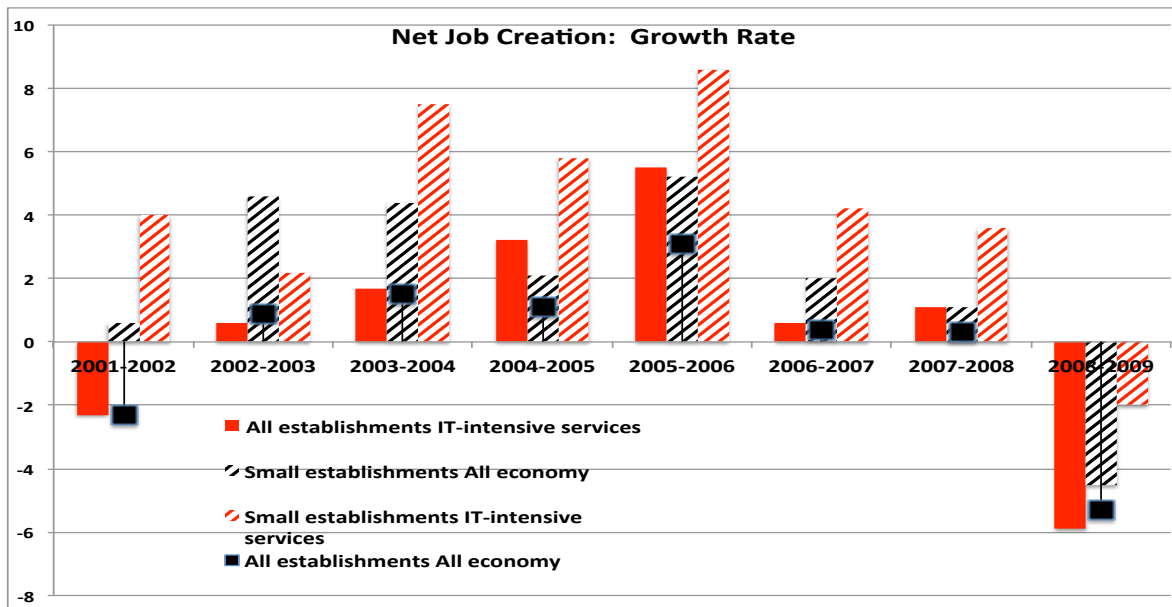
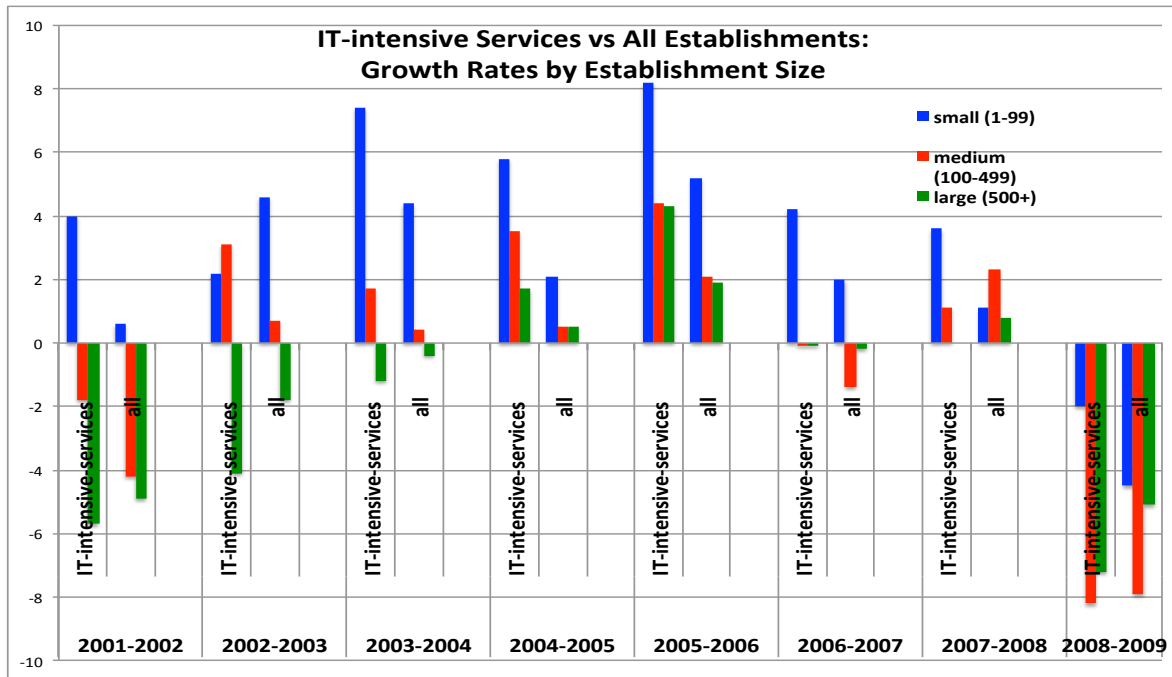


#### *IT-intensive: services vs. all economy*

- IT-intensive services represent about 20% of employment in any given year.
- IT-intensive services out-paced job growth in the overall economy in all three size classes of establishments (small, medium, and large) in almost every year.

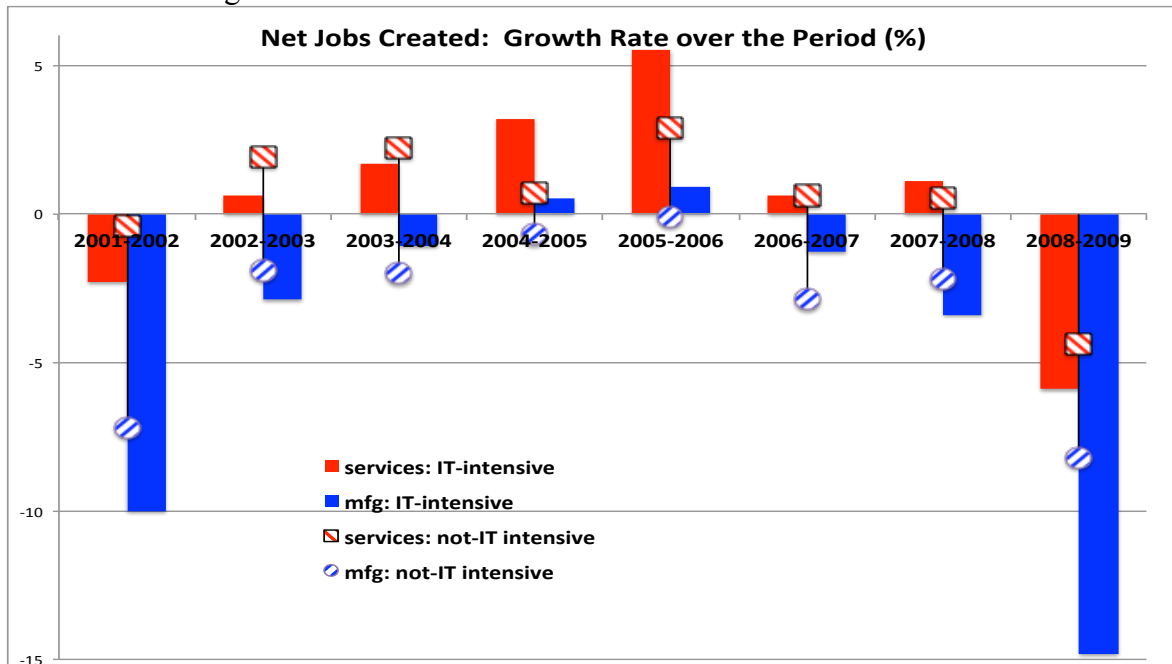
<sup>8</sup> The next version will include an analysis employment at births and at expanding establishments

- Large size establishments adjust employment significantly more in downturns, both among IT-intensive services and the overall economy. So, IT-intensity may enable establishments to manage employment to their output needs on a more rapid basis—good for employment in upturns, but shedding employment more rapidly in slowdowns.



*IT-intensive vs. not-IT-intensive: services vs. manufacturing*

- IT-intensive manufacturing establishments expand and contract relatively more than not-IT-intensive manufacturing establishments. Thus, the observation from the IT-intensive services using aggregate holds: IT-intensity may be correlated with the ability of establishments to manage employment more tightly.
- The employment management is more dramatic for manufacturing than for services. And, on balance, IT-intensive using services expand jobs on net, whereas overall manufacturing jobs are declining on net, and relatively more so for IT-intensive manufacturing sectors.



*IT-intensity and net job creation: 2002-2009*

- Over the whole period, overall employment fell 0.5%, primarily on account of net jobs loss at IT-intensive using manufacturers and IT-hardware producers.
- Employment at IT-intensive services rose by some 1 million jobs, or about 5%. IT-intensive services account for about 20 percent of overall employment.
- Non-IT intensive using services also saw net job expansion of about 1 million jobs, but from a much larger base. Non-IT intensive services account for about 2/3 of employment. So, an additional 1 million jobs represents growth of only 1.5%

**US Employment beginning 2001 to end 2009**

Employment Category	All Establishments		All establishments		All Establishments		
	beginning 2001	Share of Employment	end 2009	Share of Employment	beg. 2001-end 2009 Growth (Decline)	share of growth	Growth Rate (for the period)
<b>Total Employment</b>	115,035,655	<b>100%</b>	114,509,689	100%	<b>(525,966)</b>	100%	<b>-0.5%</b>
IT Producers - Hardware	1,593,414	1%	961,608	1%	(631,806)	120%	-39.7%
IT Producers - Software & Services	2,188,298	2%	2,259,338	2%	71,040	-14%	3.2%
<b>Total IT Producers</b>	<b>3,781,712</b>	<b>3%</b>	<b>3,220,946</b>	<b>3%</b>	<b>(560,766)</b>	<b>107%</b>	<b>-14.8%</b>
<b>Non-IT Producers</b>	<b>111,253,943</b>	<b>97%</b>	<b>111,288,743</b>	<b>97%</b>	<b>34,800</b>	<b>-7%</b>	<b>0.0%</b>
IT-Intensive Users - Manufacturing	6,897,034	6%	4,530,652	4%	(2,366,382)	450%	-34.3%
IT-Intensive Users - Services	21,386,341	19%	22,487,600	20%	1,101,259	-209%	5.1%
<b>Total IT-Intensive Users</b>	<b>28,283,375</b>	<b>25%</b>	<b>27,018,252</b>	<b>24%</b>	<b>(1,265,123)</b>	<b>241%</b>	<b>-4.5%</b>
<b>Non-IT-Intensive User: Manufacturing</b>	<b>7,460,245</b>	<b>6%</b>	<b>6,209,861</b>	<b>5%</b>	<b>(1,250,384)</b>	<b>238%</b>	<b>-16.8%</b>
<b>Non-IT-Intensive Users: Services</b>	<b>74,185,884</b>	<b>64%</b>	<b>75,273,908</b>	<b>66%</b>	<b>1,088,024</b>	<b>-207%</b>	<b>1.5%</b>
farm, mining, utilities	1,324,439		1,435,630		111,191		

#value! ==non- disclosure

original data source: <http://www2.census.gov/econ/susb/data/>

classification based on author analysis

*IT intensive services: small establishments:*

- Small IT-intensive service establishments represent only about 5% of the economy. However, in terms of net job creation, these establishments account for a dramatically higher share of the overall net job creation in the economy.
- In recession years (2001-2002, 2008-2009), these small establishments bucked the trend of the overall economy, adding jobs on net in 2001-2002, and shedding jobs at a much slower rate in 2008-2009.
- During the boom years, when overall net job change ranged from a decline of 2.7 million (2001-02) and 6.4 million (2008-2009), to a high of 3.6 million net jobs added in 2005-2006, net job creation at the small-IT-intensive using establishments accounted for anywhere from 13% to 68% of the economy-wide net job change. In addition, the share of the economy-wide net job creation accounted for by small IT-intensive services establishments increased until the 2008-2009 Great Recession, perhaps consistent with the wider availability of new internet and cloud-based IT-software and services as inputs to the production process of IT-using activities.
- These small IT-intensive services establishments are, to some degree at least, startup firms enabled by information technology. Thus, entrepreneurship in IT-intensive services using activities appears to be promoted by the availability of IT-software and IT-services themselves.

		All Establishments		Small Establishments 1-99		Big Establishments 99+		All establishments All economy	All establishments -- IT-intensive services using		Small Establishments--IT-intensive services using		
	Employment Category	start of year	employment	start of year	employment	start of year	employment	over the year Growth (decline)	over the year Growth (decline)	Growth Rate	over the year Growth (decline)	Share of Growth (decline) of total economy	Growth Rate relative to own base at beginning of year
2001-2002	IT-Intensive Users - Services	21,386,341	19%	6,147,085	5%	15,239,256	13%	-2,660,558	(499,847)	-2.3%	244,370	-9.2%	4.0%
2002-2003	IT-Intensive Users - Services	20,827,462	19%	6,010,349	5%	14,817,113	13%	995,659	125,169	0.6%	130,131	13.1%	2.2%
2003-2004	IT-Intensive Users - Services	21,271,032	19%	6,175,726	5%	15,095,306	13%	1,675,885	369,235	1.7%	463,134	27.6%	7.5%
2004-2005	IT-Intensive Users - Services	21,670,891	19%	6,325,433	5%	15,345,458	13%	1,241,428	686,289	3.2%	366,918	29.6%	5.8%
2005-2006	IT-Intensive Users - Services	22,352,356	19%	6,353,991	5%	15,998,365	14%	3,598,320	1,233,933	5.5%	543,939	15.1%	8.6%
2006-2007	IT-Intensive Users - Services	23,594,068	20%	6,570,101	5%	17,023,967	14%	537,202	148,009	0.6%	276,987	51.6%	4.2%
2007-2008	IT-Intensive Users - Services	23,877,402	20%	6,668,592	6%	17,208,810	14%	350,401	269,663	1.1%	238,593	68.1%	3.6%
2008-2009	IT-Intensive Users - Services	23,897,094	20%	6,662,604	6%	17,234,490	14%	-6,371,738	(1,409,494)	-5.9%	(130,449)	2.0%	-2.0%

### Summary Observations

- IT producers are a small part of the economy. However, IT-software and services establishments have tended to add jobs on net, particularly at smaller establishments. This suggests that IT again is the hot-bed of entrepreneurship.
- IT-intensive establishments, both in the manufacturing and services sectors, expand and contract employment relatively more than non-IT-intensive manufacturing and service establishments. This ‘employment management’ strategy is more dramatic for manufacturing than for services. And, on balance, IT-intensive using services expand jobs on net, whereas overall manufacturing jobs are declining on net, and relatively more so for IT-intensive manufacturing sectors. Nevertheless, IT-intensity may be correlated with the ability of establishments to manage employment more tightly to demand conditions.
- Small IT-intensive service establishments account for only about 5% of overall employment. However, net job creation at the small-IT-intensive using establishments accounted for anywhere from 13% to 68% of the economy-wide net job change, perhaps consistent with the wider availability of new internet and cloud-based IT-software and services as inputs to the production process of IT-using activities. These small IT-intensive services establishments are, to some degree at least, startup firms enabled by information technology. Thus, entrepreneurship in IT-intensive services using activities appears to be promoted by the availability of IT-software and IT-services themselves.
- IT-intensive using services establishments of all sizes account for about 20% of the economy. These establishments added some 1 million jobs over the 2001-2009 period, a growth rate of 5% off the initial base employment in 2001, even as the overall economy was shedding jobs. Although non-IT-intensive services establishments also added about 1 million jobs, this was off a much larger initial base of employment. Non-IT intensive services account for about 2/3 of employment. So, an additional 1 million jobs represents growth of only 1.5%

## Diffusion Gains from IT Use

The previous analysis suggests an increasing embedding of IT-use, particularly of software and services, throughout the economy, with real differences in terms of net job creation across the IT-intensive vs. not-IT intensive sectors and small vs. larger establishments. Job creation is not the only way to measure the impact of IT use in an economy. There are several complementary approaches to quantifying the gains to the U.S. economy from IT production and use. These include: the direct gains from production, the gains to investment that come from lower prices and greater variety through international trade in IT, and finally, the broad concept known as social surplus. Each of these will be examined.

### *Direct gains from IT production and final sales*

A narrow approach to considering the macroeconomic gains to IT is to consider just how much IT is purchased and whether it is produced domestically or not. Table 2A. Contributions to Real GDP for Final Sales of Computers, Software, and Communications from the NIPAs allows an examination of this issue. The sum of gains to real GDP from production and final sales of software over the 2000-2010 period is \$2.3 trillion. However, when IT hardware is included, the gains to GDP over this period falls to \$305 billion. This is because of the significant net imports of IT-hardware. Based on NIPA accounting, imports reduce domestic production. Thus, imports of IT hardware reduce the gains to GDP from IT overall. Although from an accounting perspective this is accurate, it ignores the indirect gains to the economy that come from the increased use of IT that comes with that lower price associated with global production.

### *Gains from globalization of IT—lower prices and greater variety of IT*

Information technology is a globalized industry. In 2003 I estimated that prices of IT hardware were some 10-30% lower on account of global sourcing (Mann, 2003). That additional decline in price, multiplied by the price elasticity of investment demand for IT, yielded some \$230 billion more to GDP over the period 1995-2002.

A more recent estimate of how globalization has affected trade prices is offered in Feenstra et. al.(2009) The team considers both declines in price associated with the signing of the Information Technology Agreement in 1996 (and as it came into near full global coverage by 2007).<sup>9</sup> In addition, they consider the role that additional variety in trade plays in price declines. Variety acts to reduce prices through the channels of product competition and consumer benefits of choice.<sup>10</sup>

Using their estimates of the declines in trade prices for IT goods associated with the ITA and with variety, adjusting for the rate-of-return on IT exceeding prices (from Wilson), and multiplying by the investment elasticity of demand (from Bayoumi and Haacker) yields a back-of-the-envelope cumulative increase in investment in IT hardware of some \$185 billion over the 2002-2007 period. This increase in investment, in a NIPA accounting framework, would increase GDP by the same amount. In a growth

---

<sup>9</sup> For more on the Information Technology Agreement, see Mann and Liu (2009).

<sup>10</sup> See Broda and Weinstein for a discussion of why increased variety can be parameterized by lower prices.

accounting framework, the increase in investment augments the capital stock, and augments GDP by the share of the capital stock in GDP, which is about 30%. Thus, depending on the framework for accounting, the continued globalization of IT augments GDP by \$60 to \$185 billion over the 2002-2007 period. These are direct gains from buying IT.

*Social surplus gains from a transformative technology*

The previous two approaches to estimating the gains to using information technology consider IT's direct use. The next strategy takes account of the direct and indirect gains to using a technology that transforms what business do. These transformations have been shown in previous research to play a fundamental role in the macroeconomic gains to IT.

Social surplus accounts for the accumulated gain to GDP that a country gets as more and more buyers take advantage of a transformative technology.<sup>11</sup> From the standpoint of a final consumer, technological innovations that reduce prices yield direct gains, measured as consumer surplus. But, other firms--when they purchase inputs with embodied-technology characterized by falling prices--add indirect gains to the economy through cheaper intermediates and changes in production processes and workplace practices. The spending power and investment decisions induced by the transformative technology are enjoyed by all parts of the economy, thus accentuating the value of the innovation for GDP. This section of the paper updates calculations for the diffusion gains to the United States of the technology price declines seen in the 2000s, incorporating in particular software and IT-services.<sup>12</sup> Other macroeconomic gains from information technology are also quantified.

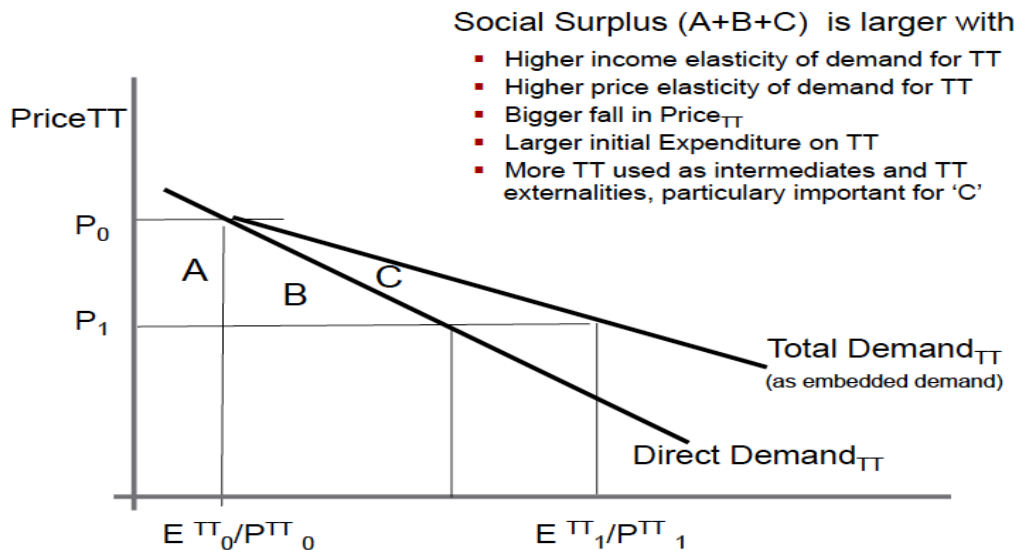
The schematic below shows the relationship between the social surplus concept and both price of the transformation technology and the direct and indirect demands for the transformation technology.

---

<sup>11</sup> See more extensive discussion of the social surplus concept and key authors (particularly Bayoumi and Haacker and Kohli) in "Information Technology, Globalization, and Growth: Role for Scale Economies, Terms of Trade, and Variety," Chapter 3 in *Ascent After Decline: Re-Growing Economic Growth*, Danny Leipziger and Otaviano Canuto, eds., The World Bank, 2012.

<sup>12</sup> See Bayoumi and Haacker for early valuation of social surplus in the 1990s. See "Information Technology, Globalization, and Growth: Role for Scale Economies, Terms of Trade, and Variety," for an update of social surplus calculations for the US and a set of other countries, for the 2000s considering only IT-hardware. This paper includes calculations for the gains to the US from software as well.

## Transformative Technology (TT) and Social Surplus



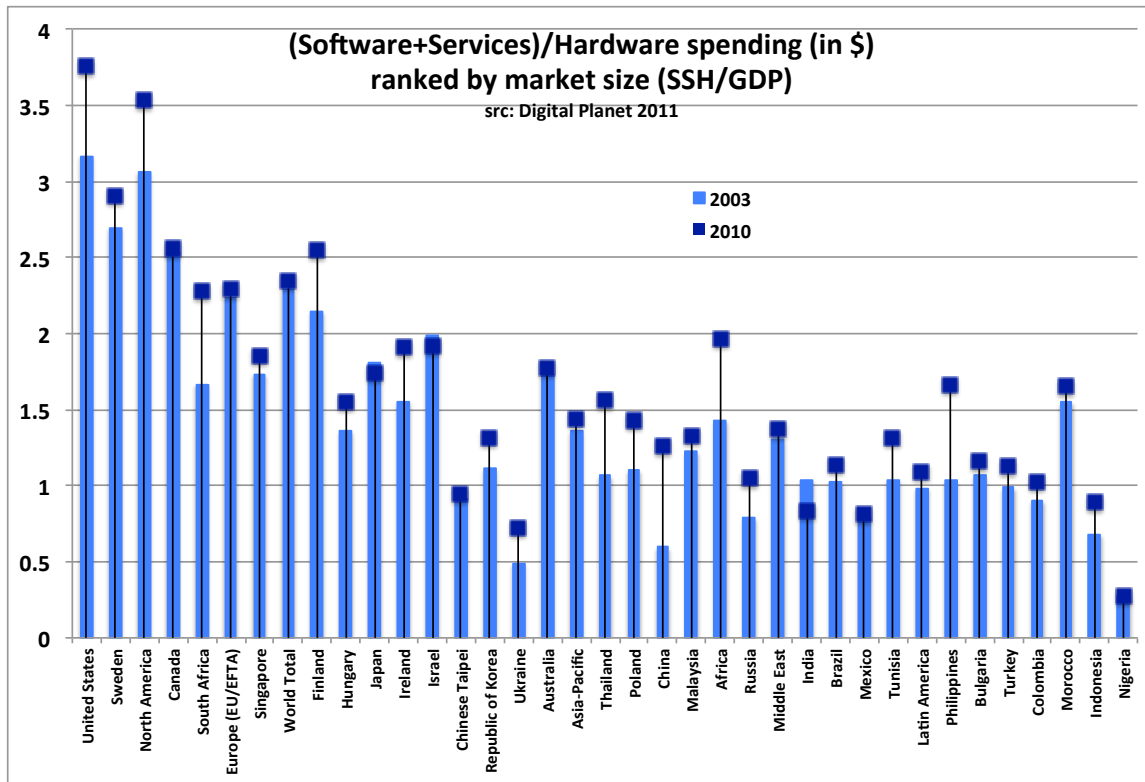
The 'transformative technology' here is information technology hardware, software, and services. Therefore, key ingredients to the calculation of social surplus include: the change in prices of IT products, the price and income elasticity of demand for those products, the indirect usage of IT-embodied products and the initial expenditure on the IT-products. This investigation considers the change in social surplus associated with the change in IT prices, and other factors, between 2000 and 2007.

The calculations use elasticities of price and income for IT hardware and software as estimated by Bayoumi and Haacker. Expenditures on IT hardware and software come from WITSA's [Digital Planet 2011](#). Prices of IT hardware and software are those used in the calculation of IT-intensity, already cited. Finally, to take account of the embodied value of IT coming through, for example, network externalities the estimates of rate-of-return exceeding price from Wilson are used to incorporate the additional value accruing to the buyers of IT products.

Using these parameters, the social surplus for the United States associated with the declining prices of IT hardware and software is about 4% of real GDP over 2000-2007. Thus real GDP is higher by some 4% or about \$500 billion, given the average real GDP over this period of \$12 trillion. These increases to GDP come from the declining prices of IT and the subsequent enabling of new businesses to startup, as well as promoting the changes in business processes and workplace practices at existing firms. These new products, processes, and practices are the hallmark of the higher total factor productivity, which is another way to describe what the social surplus concept is all about.

Since IT hardware prices continue to exhibit relatively faster price declines, the bulk of the gain comes from this source. However, although software price declines are more modest, the rate-of-return to using software is greater than that for hardware (as estimated

by Wilson). The increasingly important role for software and services is observed worldwide, as expenditure on software and services exceeds that on hardware. Indeed, nearly all countries now expend more on software and services as compared to hardware, and that ratio has increased for nearly all countries over the last decade.



#### *Summing up macroeconomic gains*

There are several different approaches to estimating the macroeconomic gains to using information technology:

- The production and final sales measure from the NIPAs, which adds up to some \$250 billion over the 2002-2007 period, but which does not include IT-services.
- The impact of a lower price and greater variety impact on investment, and through that channel on GDP and growth, which accumulates to some \$60 to \$185 billion over the same time period, but which only considers IT hardware;
- The social surplus measure, which considers both direct and indirect gains, and includes both IT hardware and software, but not IT-services, and adds some \$500 billion to GDP.
- Adding up the direct and indirect gains from IT yields a gain of between \$810 and \$935 billion for the five years considered 2002-2007.

However, these estimates likely understate the value of IT. The first two methods are direct measures, and do not account for the transformative role of IT, and one does not include software. All estimates are limited by not including IT-services. Yet, research has made clear that it is the transformative nature of information technology – the changes in business products, processes, and workplace practices – that generate the

greatest macroeconomic benefit. And the data for the US show the growing importance of software and IT-services. Thus, a round \$1 trillion is not an unreasonable figure for the gain to the US economy of broad-based use of information technology hardware, software and IT-services for the mid-decade 2000s five-year time period.

## References

- Acs, Zoltan, William Parsons and Spencer Tracy (2008). "High-Impact Firms: Gazelles Revisited" Corporate Research Board, LLC, SBA contract SBAHQ-06-Q-0014, June 2008.
- Baumol, William (2005). "Small Firms: Why Market-Driven Innovation Can't Get Along Without Them. *The Small Business Economy*, chapter 8, 2005.
- Bayoumi, T. and M. Haacker, (2002). It's Not What You Make, It's How You use IT: Measuring the Welfare Benefits of the IT Revolution Across Countries. IMF Working Paper 02/117. Washington: International Monetary Fund.
- Bloom, Nichola, Raffaella Sadun, and John Van Reenen (2012) "Americans Do IT Better: US Multinationals and the Productivity Miracle" *American Economic Review* 2012
- Broda, Christian and David E. Weinstein (2006) . "Globalization And The Gains From Variety," *Quarterly Journal of Economics*, vo121(2,May), 541-585.
- Crafts, Nicholas F.R. (2004) "Social Savings as a Measure of the Contribution of a New Technology to Economic Growth', Working Paper in Large-Scale Technological Change no. 06/04, London School of Economic (July).
- Eckhardt, Jonathan T. and Scott Shane. (2006) "Innovation and Small Business Performance: Examining the relationship between Technological Innovation and the Within-Industry Distribution of Fast-Growth Firms", Peregrine Analytics, under contract SBAHQ-04-M-0534, March 2006.
- Feenstra, Robert C., Benjamin R. Mandel, Marshall B. Reinsdorf, Matthew J. Slaughter (2009), Effects of Terms of Trade Gains and Tariff Changes on the Measurement of U.S. Productivity Growth. NBER WP15592, National Bureau of Economic Research, December 2009.
- Gust, Christopher and Jaime Marquez (2000) "Productivity Development Abroad" *Federal Reserve Bulletin* (October).
- Houseman, Susan N., Christopher J. Kurz, Paul Lengermann, Benjamin R. Mandel (2010) "Offshoring Bias in U.S. Manufacturing: Implications for Productivity and Value Added", International Finance Discussion Papers Number 1007, Board of Governors of the Federal Reserve System, September 2010.
- Kohli, Ulrich (2004) "Real GDP, real domestic income, and terms-of-trade changes," *Journal of International Economics*, vol 62, pp 83-106.

Mann, Catherine L. (2012) "Information Technology, Globalization, and Growth: Role for Scale Economies, Terms of Trade, and Variety," Chapter 3 in Ascent After Decline: Re-Growing Economic Growth After the Great Recession, Danny Leipziger and Otaviano Canuto, eds., The World Bank, 2012

\_\_\_\_\_. (2009a) "Prices for International Services Transactions: Issues and a Framework for Development," in Price and Productivity Measurement, ed., W. Erwin Diewert, Bert Balk, Dennis Fixler, Kevin Fox, and Alice Nakamura. Trafford Press: Victoria, B.C., 2009a

\_\_\_\_\_. (2009b) "Globalization and Prices of IT Software and Services: Measurement and Implications", *Conference on Measurement Issues Arising from the Growth of Globalization*, sponsored by W.E. Upjohn Institute and the National Academy of Public Administration (NAPA), 2009b.

\_\_\_\_\_. (2006) Accelerating the Globalization of America: The Role for Information Technology Peterson Institute for International Economics: Washington DC.

\_\_\_\_\_. (2003). "Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth," *International Economics Policy Brief*, Washington:Peterson Institute for International Economics, December 2003.

\_\_\_\_\_ and Xiupeng Liu, (2009) "The Information Technology Agreement: Sui Generis or Model Stepping Stone?" (with Xiupeng Liu) in Multilateralizing Regionalism edited by Richard Baldwin and Patrick Low, Cambridge University Press: Cambridge, 2009.

Mun, Sung-Bae and M. Ishaq Nadiri (2002) "Information Technology Externalities: Empirical Evidence from 42 U.S. Industries" NBER working paper 9272 Cambridge, MA.

Stangler, Dane (2010). High-Growth Firms and the Future of the American Economy, Kauffman Foundation, March 2010.

Van Ark, Bart (2005) "Does the European Union Need to Revive Productivity Growth?" Gronigen Growth and Development Centre Research Memorandum GD-75 Gronigan, The Netherlands: University Of Gronigen.

Van Ark, Bart, R. Inklaar, and Robert McGuckin (2003) "Changing Gear Productivity, ICT, and Service Industries: Europe and the United States" in The Industrial Dyanmics of the New Digital Economy ed. Jens Froslev Christensen and Peter Maskell. Cheltenham UK: Edward Elgar.

Wilson, Daniel J. (2007) "IT and Beyond: The Contribution of Heterogeneous

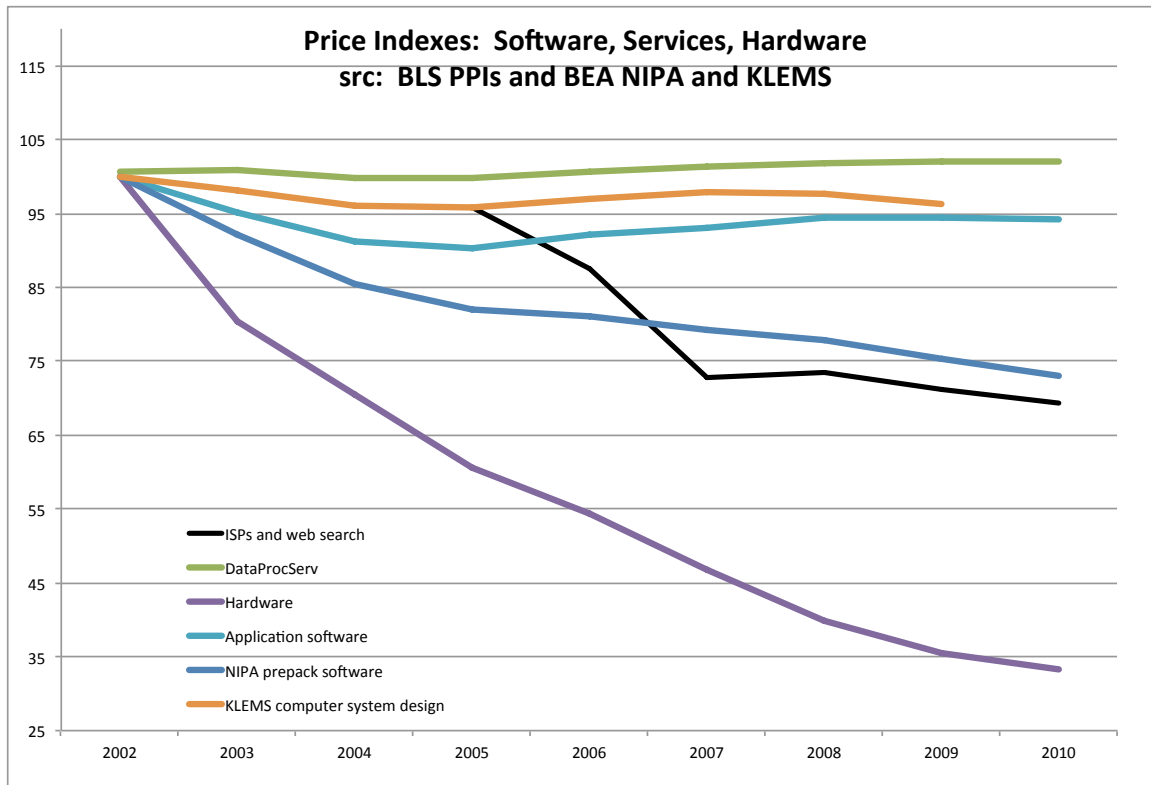
Capital to Productivity”, Working Paper 2004-13, Federal Reserve Bank of San Francisco, May 2007.

WITSA World Information Technology and Services Alliance, (various years) Digital Planet.

## Appendix Materials

Appendix table: correlations

correlations (calculated using 2010 data)	
real HSS vs nominal HSS	
KLEMS data	0.92041
IO data	0.95994
KLEMS vs IO data	
Real HSS	0.96030
nominal HSS	0.65347
nominal ss	0.72850
correlations (calculated using 2010 data)	
nominal HSS vs nomina ISS	
KLEMS data	0.7354
IO data	0.6984
KLEMS vs IO data	
nominal HSS	0.6535
nominal ss	0.7285
HSS - hardware, software, IT services as a share of intermediate inputs	
SS --software and IT services as a share of intermediates inputs (I-O)	
SS-- software and IT services as a share of purchased services inputs (KLEMS)	



Real IT-intensity (2010)

Hardware+software+IT-services as a share of industry intermediates (%)

Commodity Description	code	Commodity Description	code
Above average IT intensity		Below Average IT intensity	
126.01 Computer and electronic products	334	9.37 Fabricated metal products	332
123.40 National defense: Gross investment	F06I*	9.34 Nonmetallic mineral products	327
116.12 Nondefense: Gross investment	F07I*	9.32 Wholesale trade	42
48.31 Private fixed investment	F020*	8.81 Plastics and rubber products	326
45.59 Federal general government	GFG	8.65 Mining, except oil and gas	212
44.85 Imports of goods and services	F050*	8.53 Primary metals	331
42.62 Other transportation equipment	3364OT	8.00 Furniture and related products	337
40.61 State and local government gross investment, education	F08I*	7.94 Paper products	322
34.22 Change in private inventories	F030*	7.71 State and local general government	GSLG
29.10 State and local government gross investment, other	F09I*	6.81 Retail trade	44RT
29.10 Information and data processing services	514	6.62 Motion picture and sound recording industries	512
25.22 Computer systems design and related services	5415	5.86 Oil and gas extraction	211
24.15 Exports of goods and services	F040*	5.81 State and local government enterprises	GSLE
21.85 Broadcasting and telecommunications	513	5.52 Ambulatory health care services	621
21.75 Electrical equipment, appliances, and components	335	5.25 Federal Reserve banks, credit intermediation, and related activities	521CI
21.36 Publishing industries (includes software)	511	5.17 Textile mills and textile product mills	313TT
20.27 Motor vehicles, bodies and trailers, and parts	3361MV	5.10 Waste management and remediation services	562
19.94 Management of companies and enterprises	55	4.83 Accommodation	721
14.01 Machinery	333	4.79 Social assistance	624
13.98 Legal services	5411	4.49 Chemical products	325
13.25 Miscellaneous professional, scientific, and technical services	5412OP	4.46 Wood products	321
13.23 Other services, except government	81	4.33 Hospitals and nursing and residential care facilities	622HO
11.96 Administrative and support services	561	4.22 Rail transportation	482
11.86 Educational services	61	4.22 Amusements, gambling, and recreation industries	713
11.54 Printing and related support activities	323	3.76 Personal consumption expenditures	F010*
11.27 Securities, commodity contracts, and investments	523	3.58 Rental and leasing services and lessors of intangible assets	532RL
10.87 Miscellaneous manufacturing	339	3.39 Construction	23
10.64 Commodity Intermediates	*	3.14 Federal government enterprises	GFE
10.41 avg of private and public sectors*		3.12 Warehousing and storage	493
10.08 private sector avg		2.46 Food services and drinking places	722
		2.35 Apparel and leather and allied products	315AL
		2.17 Funds, trusts, and other financial vehicles	525
		1.89 Food and beverage and tobacco products	311FT
		1.87 Truck transportation	484
		1.78 Pipeline transportation	486
		1.65 Utilities	22
		1.53 Performing arts, spectator sports, museums, and related activities	711AS
		1.35 Support activities for mining	213
		1.19 Insurance carriers and related activities	524
		1.11 Real estate	531
		0.86 Transit and ground passenger transportation	485
		0.86 Forestry, fishing, and related activities	113FF
		0.71 Other transportation and support activities	487OS
		0.35 Air transportation	481
		0.24 Farms	111CA
		0.24 Petroleum and coal products	324
		0.16 Water transportation	483

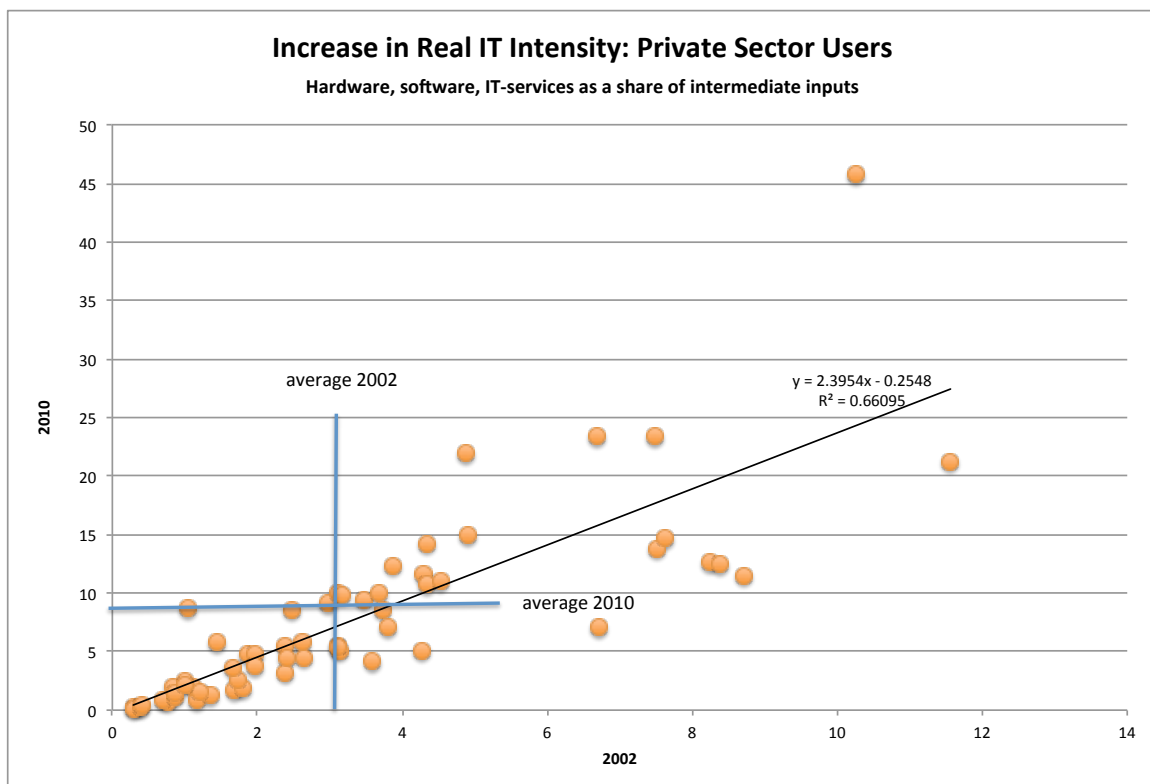
\* average of the private and government sectors, but not including any of the "F0xx" categories, exports, imports, or commodity intermediates

Appendix Table -- Industry Ranking based on 2010 I-O data

'HW+soft+serv/industry intermediates\*100

These sectors are 'below-average' IT intensity			These sectors are "above-average" IT-intensity		
Commodity / Industry	i_O Code		Commodity / Industry	I-O Code	
0.091220599 Petroleum and coal products	324		5.01424092 Machinery		333
0.122855928 Water transportation	483		5.23885769 State and local general governme	GSLG	
0.183520467 Farms	111CA		5.26860276 Other services, except governer		81
0.257977878 Air transportation	481		6.21979173 Motor vehicles, bodies and trailers	3361MV	
0.462178944 Other transportation and support activities	487OS		6.75846969 Electrical equipment, appliances, i		335
0.618142482 Transit and ground passenger transportatio	485		6.76249592 Mining, except oil and gas		212
0.672511108 Forestry, fishing, and related activities	113FF		7.37936719 Educational services		61
0.728944012 Real estate	531		7.67584694 Miscellaneous professional, scien	5412OP	
0.749960793 Food and beverage and tobacco products	311FT		7.6816963 Administrative and support service		561
0.811810481 Support activities for mining	213		7.74657173 Legal services		5411
0.940616708 Insurance carriers and related activities	524		8.07379434 Broadcasting and telecommunicat		513
0.94331271 Utilities	22		8.35294705 Securities, commodity contracts, e		523
1.039314157 Truck transportation	484		8.61536468 Management of companies and ei		55
1.114666116 Pipeline transportation	486		11.4196034 Computer systems design and rel		5415
1.124060929 Performing arts, spectator sports, museums	711AS		12.2006535 Publishing industries (includes sof		511
1.139558976 Apparel and leather and allied products	315AL		14.3524146 Other transportation equipment	3364OT	
1.516133606 Food services and drinking places	722		15.2531131 Information and data processing s		514
1.537723198 Construction	23		24.4754543 Federal general government	GFG	
1.539471065 Chemical products	325		41.1474817 Computer and electronic products		334
1.59519177 Funds, trusts, and other financial vehicles	525				
1.860139228 Wood products	321				
1.874855558 Textile mills and textile product mills	313TT				
1.91318036 Warehousing and storage	493				
2.245640197 Hospitals and nursing and residential care f	622HO		average of the 'below average'		2.168563653
2.396822816 Amusements, gambling, and recreation indi	713		average of the 'abvoe average'		11.03351408
2.47742993 Rental and leasing services and lessors of i	532RL				
2.511961722 Federal government enterprises	GFE		average of the 'below average' private sector		2.03913053
2.531168409 Ambulatory health care services	621		average of the 'above average' private sector		10.58367386
2.566123233 Accommodation	721		average of the 'above average' private sector - IT users		20.00521294
2.713319934 Primary metals	331				
2.713785926 Paper products	322				
2.750477447 State and local government enterprises	GSLE				
2.763496144 Motion picture and sound recording industri	512				
2.864443766 Federal Reserve banks, credit intermediatic	521CI				
3.043060787 Waste management and remediation servic	562				
3.05160727 Plastics and rubber products	326				
3.167313057 Furniture and related products	337				
3.246351835 Social assistance	624				
3.276977135 Rail transportation	482				
3.299658405 Nonmetallic mineral products	327				
3.712594015 Fabricated metal products	332				
3.771157501 Retail trade	44RT				
3.846853152 Wholesale trade	42				
3.922244021 Miscellaneous manufacturing	339				
4.420396704 private sector average					
4.614300205 Printing and related support activities	323				
4.660048523 Oil and gas extraction	211				
4.686476155 average					

Classification Aggregates (using NAICS codes)
IT-producers hardware
334
IT-producers software and services
5112+518+519 +5415
514=~518,519
IT-intensive users: mfg
323+333+335+3391+33640T+3364mv
33640T=3364,65,66,69
3364mv=3361,62,63
IT-intensive users: services
4541 e -shop
523+5411+5412OP
5412OP=5412,13,14,16,17.18,19
55,561,61
not include 513 broadcast TV radio
not include 81 other services nec



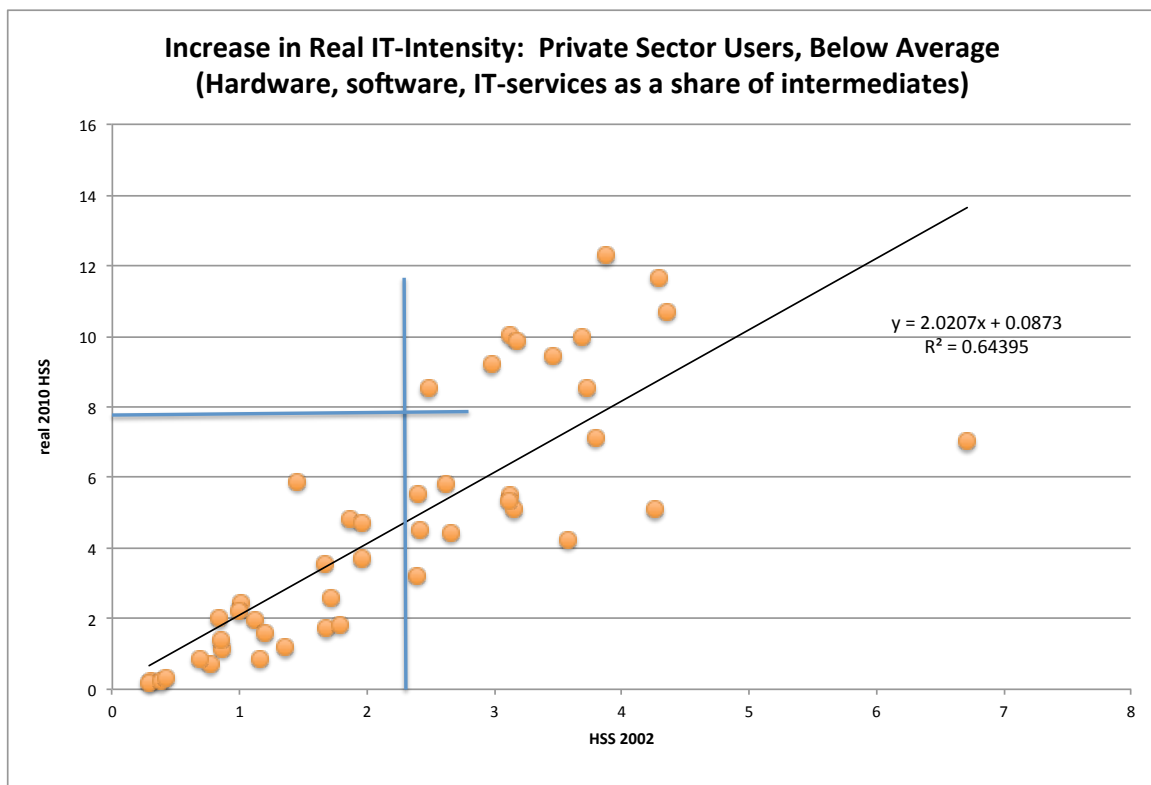
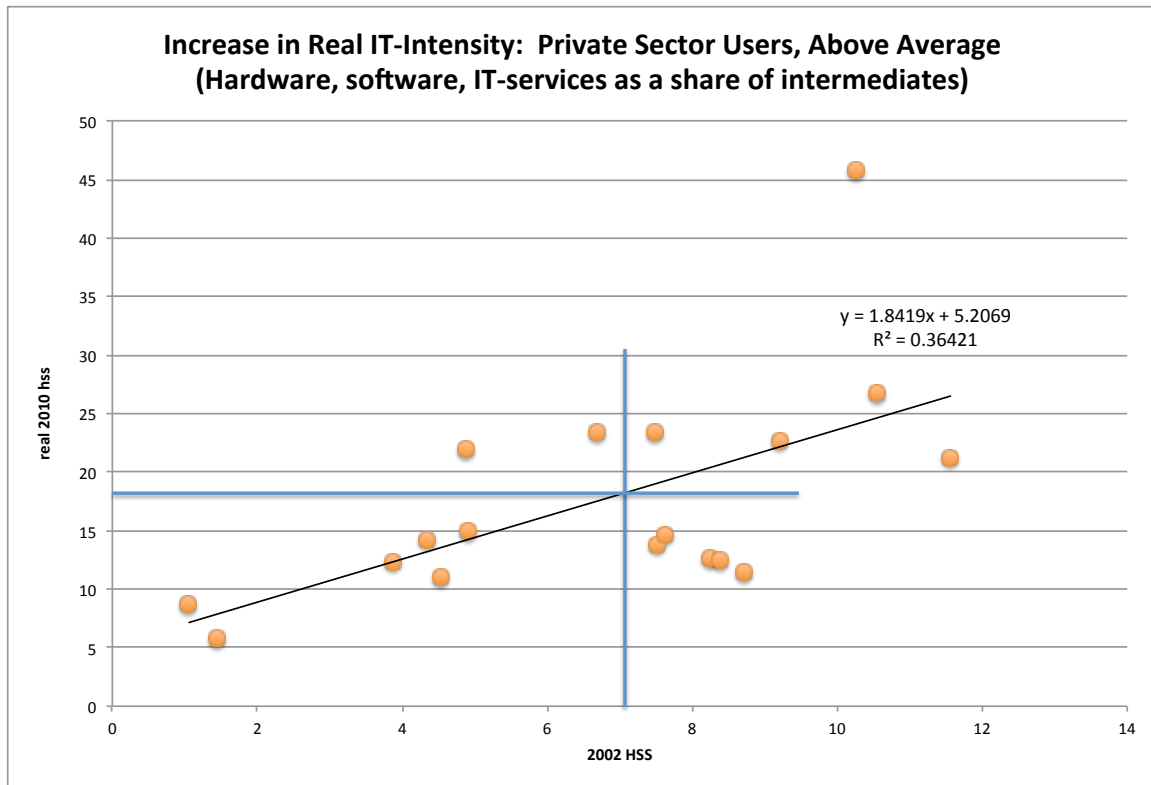


Table Explained: US Employment From Year to Year

	Employment at All Establishments		Employment at Small Establishments 1-99		Employment at Big Establishments 99+		All Establishments		Small Establishments		
Employment Category	2001	Share of Employment	2001	Share of Employment	2001	Share of Employment	2001-2002 Growth (decline)	Growth Rate	2001-2002 Growth (decline)	Share of Growth	Growth Rate
Employment Category	In the year	Share of Employment	in the year	Share of Employment	in the year	Share of Employment	number of jobs gained or lost during the year	Growth Rate (jobs gained or lost relative to beginning of the year)	number of jobs gained or lost during the year	jobs gained or lost as a share of total jobs gained or lost in the whole economy	number of jobs gained or lost at 1-99 relative to the beginning of the year
<b>Total Employment</b>	115,035,655	100%	40,948,699	36%	74,086,956	64%	(2,660,558)	-2.3%	252,832	-9.5%	0.6%
IT Producers - Hardware	1,593,414	1%	206,076	0%	1,387,338	1%	(294,468)	-18.5%	(24,086)	0.9%	-11.7%
IT Producers - Software & Services	2,188,298	2%	700,340	1%	1,487,958	1%	(286,492)	-13.1%	(95,349)	3.6%	-13.6%
<b>Total IT Producers</b>	3,781,712	3%	906,416	1%	2,875,296	2%	(580,960)	-15.4%	(119,435)	4.5%	-13.2%
<b>Non-IT Producers</b>	111,253,943	97%	40,042,283	35%	71,211,660	62%	(2,079,598)	-1.9%	372,267	-14.0%	0.9%
IT-Intensive Users - Manufacturing	6,897,034	6%	2,104,591	2%	4,792,443	4%	(683,097)	-9.9%	(173,751)	6.5%	-8.3%
IT-Intensive Users - Services	21,386,341	19%	6,147,085	5%	15,239,256	13%	(499,847)	-2.3%	244,370	-9.2%	4.0%
<b>Total IT-Intensive Users</b>	28,283,375	25%	8,251,676	7%	20,031,699	17%	(1,182,944)	-4.2%	70,619	-2.7%	0.9%
<b>Non-IT-Intensive User: Manufacturing</b>	86,752,280	75%	32,697,023	28%	54,055,257	47%	(1,477,614)	-1.7%	182,213	-6.8%	0.6%
<b>Non-IT-Intensive Users: Services</b>	93,649,314	81%	34,801,614	30%	58,847,700	51%	(2,160,711)	-2.3%	8,462	-0.3%	0.0%
Non-mfg economy (services, ag, mining, utils)											

original data source: <http://www2.census.gov/econ/susb/data/>

#value! ==non- disclosure

classification based on author analysis

In 2001, for example, the 1-99 category of IT-intensive users-services added 244,370 jobs, which offset by 9.2% the total jobs lost in the economy that year

In 2001, for example, the 1-99 category of IT-intensive users-services added 244,370 jobs, which represented a 4.0% growth in jobs in that size and sector category

### US Employment 2001-2002

	All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
Employment Category	2001	Share of Employment	2001	Share of Employment	2001	Share of Employment	2001-2002 Growth (decline)	Growth Rate	2001-2002 Growth (decline)	Share of Growth	Growth Rate
Total Employment	115,035,655	100%	40,948,699	36%	74,086,956	64%	(2,660,558)	-2.3%	252,832	-9.5%	0.6%
IT Producers - Hardware	1,593,414	1%	206,076	0%	1,387,338	1%	(294,468)	-18.5%	(24,086)	0.9%	-11.7%
IT Producers - Software & Services	2,188,298	2%	700,340	1%	1,487,958	1%	(286,492)	-13.1%	(95,349)	3.6%	-13.6%
Total IT Producers	3,781,712	3%	906,416	1%	2,875,296	2%	(580,960)	-15.4%	(119,435)	4.5%	-13.2%
Non-IT Producers	111,253,943	97%	40,042,283	35%	71,211,660	62%	(2,079,598)	-1.9%	372,267	-14.0%	0.9%
IT-Intensive Users - Manufacturing	6,897,034	6%	1,819,080	2%	5,077,954	4%	(692,012)	-10.0%	(162,700)	6.1%	-8.9%
IT-Intensive Users - Services	21,386,341	19%	6,147,085	5%	15,239,256	13%	(499,847)	-2.3%	244,370	-9.2%	4.0%
Total IT-Intensive Users	28,283,375	25%	7,966,165	7%	20,317,210	18%	(1,191,859)	-4.2%	81,670	-3.1%	1.0%
Non-IT-Intensive User: Manufacturing	7,845,200	7%	1,832,293	4%	6,012,907	8%	-565279	-7.2%	-106149	4.0%	-5.8%
Non-IT-Intensive Users: Services	74,185,884	64%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	-289182	-0.4%	398107	-15.0%	#VALUE!
Non-mfg economy (services, ag, mining, utils)	75,125,368	65%	30,243,825	74%	44,881,543	61%	-322,460	-0.4%	396,746	-14.9%	1.3%

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/susb/data/>  
classification based on author analysis

### US Employment 2002-2003

		All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
Employment Category		2002	Share of Employment	2002	Share of Employment	2002	Share of Employment	2002-2003 Growth (decline)	Growth Rate	2002-2003 Growth (decline)	Share of Growth	Growth Rate
Total Employment		112,376,756	100%	40,435,605	36%	71,941,151	64%	995,659	0.9%	1,877,624	188.6%	4.6%
IT Producers - Hardware		1,300,441	1%	190,275	0%	1,110,166	1%	(102,908)	-7.9%	(2,759)	-0.3%	-1.5%
IT Producers - Software & Services		1,940,933	2%	633,747	1%	1,307,186	1%	(82,106)	-4.2%	(4,106)	-0.4%	-0.6%
Total IT Producers		3,241,374	3%	824,022	1%	2,417,352	2%	(185,014)	-5.7%	(6,865)	-0.7%	-0.8%
Non-IT Producers		109,135,382	97%	39,611,583	35%	69,523,799	62%	1,180,673	1.1%	1,884,489	189.3%	4.8%
IT-Intensive Users - Manufacturing		6,230,757	6%	1,969,548	2%	4,261,209	4%	(179,576)	-2.9%	(5,604)	-0.6%	-0.3%
IT-Intensive Users - Services		20,827,462	19%	6,010,349	5%	14,817,113	13%	125,169	0.6%	130,131	13.1%	2.2%
Total IT-Intensive Users		27,058,219	24%	7,979,897	7%	19,078,322	17%	(54,407)	-0.2%	124,527	12.5%	1.6%
Non-IT-Intensive User: Manufacturing		7,262,706	6%	1,728,711	4%	5,533,995	8%	-138126	-1.9%	22903	2.3%	1.3%
Non-IT-Intensive Users: Services		73,920,104	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1380232	1.9%	1371072	137.7%	#VALUE!
non-IT-intensive: Non-mfg economy (services,		74,814,457	67%	29,902,975	74%	44,911,482	62%	1,373,206	1.8%	1,737,059	174.5%	5.8%

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/susb/data/>  
classification based on author analysis

### US Employment 2003-2004

		All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
Employment Category		2003	Share of Employment	2003	Share of Employment	2003	Share of Employment	2003-2004 Growth (decline)	Growth Rate	2003-2004 Growth (decline)	Share of Growth	Growth Rate
Total Employment		113,373,663	100%	40,996,016	36%	72,377,647	64%	1,675,885	1.5%	1,823,909	108.8%	4.4%
IT Producers - Hardware		1,189,404	1%	186,045	0%	1,003,359	1%	(71,108)	-6.0%	205	0.0%	0.1%
IT Producers - Software & Services		1,912,619	2%	608,269	1%	1,304,350	1%	(17,987)	-0.9%	28,357	1.7%	4.7%
Total IT Producers		3,102,023	3%	794,314	1%	2,307,709	2%	(89,095)	-2.9%	28,562	1.7%	3.6%
Non-IT Producers		110,271,640	97%	40,201,702	35%	70,069,938	62%	1,764,980	1.6%	1,795,347	107.1%	4.5%
IT-Intensive Users - Manufacturing		6,125,861	5%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	(67,020)	-1.1%	17,641	1.1%	#VALUE!
IT-Intensive Users - Services		21,271,032	19%	6,175,726	5%	15,095,306	13%	369,235	1.7%	463,134	27.6%	7.5%
Total IT-Intensive Users		27,396,893	24%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	302,215	1.1%	480,775	28.7%	#VALUE!
Non-IT-Intensive User: Manufacturing		8,739,818	8%	2,442,366	6%	6,297,452	9%	-175414	-2.0%	30487	1.8%	1.2%
Non-IT-Intensive Users: Services		74,747,785	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1667007	2.2%	1284768	76.7%	#VALUE!
non-IT-intensive: Non-mfg economy (services,		74,134,929	65%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1,638,179	2.2%	1,284,085	76.6%	#VALUE!

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/susb/data/>  
classification based on author analysis

# US Employment 2004-2005

	All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
Employment Category	2004	Share of Employment	2004	Share of Employment	2004	Share of Employment	2004-2005 Growth (Decline)	Growth Rate	2004-2005 Growth (Decline)	Share of Growth	Growth Rate
Total Employment	115,050,943	100%	41,816,945	36%	73,233,998	64%	1,241,428	1.1%	895,299	72.1%	2.1%
IT Producers - Hardware	1,108,342	1%	181,873	0%	926,469	1%	(25,042)	-2.3%	5,409	0.4%	3.0%
IT Producers - Software & Services	1,897,089	2%	608,726	1%	1,288,363	1%	48,058	2.5%	46,060	3.7%	7.6%
Total IT Producers	3,005,431	3%	790,599	1%	2,214,832	2%	23,016	0.8%	51,469	4.1%	6.5%
Non-IT Producers	112,045,512	97%	41,026,346	36%	71,019,166	62%	1,218,412	1.1%	843,830	68.0%	2.1%
IT-Intensive Users - Manufacturing	6,073,980	5%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	27,885	0.5%	#VALUE!	#VALUE!	#VALUE!
IT-Intensive Users - Services	21,670,891	19%	6,325,433	5%	15,345,458	13%	686,289	3.2%	366,918	29.6%	5.8%
Total IT-Intensive Users	27,744,871	24%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	714,174	2.6%	#VALUE!	#VALUE!	#VALUE!
Non-IT-Intensive User: Manufacturing	8,577,615	7%	2,429,718	6%	6,147,897	8%	-59472	-0.7%	49583	4.0%	2.0%
Non-IT-Intensive Users: Services	76,375,206	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	572261	0.7%	#VALUE!	#VALUE!	#VALUE!
non-IT-intensive: Non-mfg economy (services,	75,723,026	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	563,710	0.7%	#VALUE!	#VALUE!	#VALUE!

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/subs/data/>  
classification based on author analysis

# US Employment 2005-2006

	All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
	Share of Employment		Share of Employment		Share of Employment		2005-2006 Growth (Decline)		2005-2006 Growth (Decline)		Growth Rate
Employment Category	2005		2005		2005			Growth Rate		Share of Growth	
Total Employment	116,294,185	100%	41,711,870	36%	74,582,315	64%	3,598,320	3.1%	2,179,685	60.6%	5.2%
IT Producers - Hardware	1,058,951	1%	179,176	0%	879,775	1%	6,157	0.6%	7,168	0.2%	4.0%
IT Producers - Software & Services	1,947,734	2%	620,767	1%	1,326,967	1%	120,990	6.2%	81,475	2.3%	13.1%
Total IT Producers	3,006,685	3%	799,943	1%	2,206,742	2%	127,147	4.2%	88,643	2.5%	11.1%
Non-IT Producers	113,287,500	97%	40,911,927	35%	72,375,573	62%	3,471,173	3.1%	2,091,042	58.1%	5.1%
IT-Intensive Users - Manufacturing	6,109,715	5%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	57,262	0.9%	#VALUE!	#VALUE!	#VALUE!
IT-Intensive Users - Services	22,352,356	19%	6,353,991	5%	15,998,365	14%	1,233,933	5.5%	543,939	15.1%	8.6%
Total IT-Intensive Users	28,462,071	24%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1,291,195	4.5%	#VALUE!	#VALUE!	#VALUE!
Non-IT-Intensive User: Manufacturing	8,469,455	7%	2,394,278	6%	6,075,177	8%	-6092	-0.1%	78709	2.2%	3.3%
Non-IT-Intensive Users: Services	77,028,928	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	2214128	2.9%	#VALUE!	#VALUE!	#VALUE!
non-IT-intensive: Non-mfg economy (services,	76,355,974	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	2,186,070	2.9%	#VALUE!	#VALUE!	#VALUE!

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/subs/data/>  
classification based on author analysis

# US Employment 2006-2007

		All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
		Share of Employment		Share of Employment		Share of Employment		2006-2007 Growth (Decline)		2006-2007 Growth (Decline)	Share of Growth	Growth Rate
Employment Category		2006		2006		2006			Growth Rate			
Total Employment		119,894,009	100%	42,667,621	36%	77,226,388	64%	537,202	0.4%	865,837	161.2%	2.0%
IT Producers - Hardware		1,057,474	1%	178,149	0%	879,325	1%	1,528	0.1%	6,948	1.3%	3.9%
IT Producers - Software & Services		2,062,186	2%	657,950	1%	1,404,236	1%	68,282	3.3%	39,060	7.3%	5.9%
Total IT Producers		3,119,660	3%	836,099	1%	2,283,561	2%	69,810	2.2%	46,008	8.6%	5.5%
Non-IT Producers		116,774,349	97%	41,831,522	35%	74,942,827	63%	467,392	0.4%	819,829	152.6%	2.0%
IT-Intensive Users - Manufacturing		6,166,038	5%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	(81,456)	-1.3%	20,110	3.7%	#VALUE!
IT-Intensive Users - Services		23,594,068	20%	6,570,101	5%	17,023,967	14%	148,009	0.6%	276,987	51.6%	4.2%
Total IT-Intensive Users		29,760,106	25%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	66,553	0.2%	297,097	55.3%	#VALUE!
Non-IT-Intensive User: Manufacturing		8,449,735	7%	2,394,358	6%	6,055,377	8%	-245435	-2.9%	6899	1.3%	0.3%
Non-IT-Intensive Users: Services		79,272,353	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	449871	0.6%	#VALUE!	#VALUE!	#VALUE!
non-IT-intensive: Non-mfg economy (services,		78,564,508	66%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	646,274	0.8%	515,833	96.0%	#VALUE!

#value! ==non- disclosure  
original data source: <http://www2.census.gov/econ/subs/data/>  
classification based on author analysis

# US Employment 2007-2008

Employment Category	All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
	2007	Share of Employment	2007	Share of Employment	2007	Share of Employment	2007-2008 Growth (Decline)	Growth Rate	2007-2008 Growth (Decline)	Share of Growth	Growth Rate
<b>Total Employment</b>	120,581,294	100%	42,672,885	35%	77,908,409	65%	350,401	0.3%	461,724	131.8%	1.1%
IT Producers - Hardware	1,043,262	1%	173,048	0%	870,214	1%	(6,623)	-0.6%	4,782	1.4%	2.8%
IT Producers - Software & Services	2,145,707	2%	668,202	1%	1,477,505	1%	56,746	2.6%	61,411	17.5%	9.2%
<b>Total IT Producers</b>	3,188,969	3%	841,250	1%	2,347,719	2%	50,123	1.6%	66,193	18.9%	7.9%
<b>Non-IT Producers</b>	117,392,325	97%	41,831,635	35%	75,560,690	63%	300,278	0.3%	395,531	112.9%	0.9%
IT-Intensive Users - Manufacturing	6,095,224	5%	1,927,599	2%	4,167,625	3%	(207,325)	-3.4%	(24,149)	-6.9%	-1.3%
IT-Intensive Users - Services	23,877,402	20%	6,668,592	6%	17,208,810	14%	269,663	1.1%	238,593	68.1%	3.6%
<b>Total IT-Intensive Users</b>	29,972,626	25%	8,596,191	7%	21,376,435	18%	62,338	0.2%	214,444	61.2%	2.5%
<b>Non-IT-Intensive User: Manufacturing</b>	8,209,701	7%	2,366,862	6%	5,842,839	7%	-177570	-2.2%	-21055	-6.0%	-0.9%
<b>Non-IT-Intensive Users: Services</b>	79,743,883	66%	31,513,190	74%	48,230,693	62%	375261	0.5%	183633	52.4%	0.6%
non-IT-intensive: Non-mfg economy (services)	79,209,998	66%	30,868,582	72%	48,341,416	62%	415,510	0.5%	202,142	57.7%	0.7%

#value! ==non- disclosure

original data source: <http://www2.census.gov/econ/susb/data/>

classification based on author analysis

# US Employment 2008-2009

Employment Category	All Establishments		Small Establishments 1-99		Big Establishments 99+		All Establishments		Small Establishments		
	2008	Share of Employment	2008	Share of Employment	2008	Share of Employment	2008-2009 Growth (Decline)	Growth Rate	2008-2009 Growth (Decline)	Share of Growth	Growth Rate
<b>Total Employment</b>	120,881,427	100%	42,126,418	35%	78,755,009	65%	(6,371,738)	-5.3%	(1,890,733)	29.7%	-4.5%
IT Producers - Hardware	1,014,417	1%	170,095	0%	844,322	1%	(52,809)	-5.2%	(11,257)	0.2%	-6.6%
IT Producers - Software & Services	2,242,444	2%	700,214	1%	1,542,230	1%	16,894	0.8%	16,554	-0.3%	2.4%
<b>Total IT Producers</b>	3,256,861	3%	870,309	1%	2,386,552	2%	(35,915)	-1.1%	5,297	-0.1%	0.6%
<b>Non-IT Producers</b>	117,624,566	97%	41,256,109	34%	76,368,457	63%	(6,335,823)	-5.4%	(1,896,030)	29.8%	-4.6%
IT-Intensive Users - Manufacturing	5,317,551	4%	1,782,903	1%	3,534,648	3%	(786,899)	-14.8%	(234,806)	3.7%	-13.2%
IT-Intensive Users - Services	23,897,094	20%	6,662,604	6%	17,234,490	14%	(1,409,494)	-5.9%	(130,449)	2.0%	-2.0%
<b>Total IT-Intensive Users</b>	29,214,645	24%	8,445,507	7%	20,769,138	17%	(2,196,393)	-7.5%	(365,255)	5.7%	-4.3%
<b>Non-IT-Intensive User: Manufacturing</b>	6,762,760	6%	1,466,983	3%	5,295,777	7%	-552899	-8.2%	-109915	1.7%	-7.5%
<b>Non-IT-Intensive Users: Services</b>	80,211,531	66%	31,007,609	74%	49,203,922	62%	-3557662	-4.4%	-1413678	22.2%	-4.6%
non-IT-intensive: Non-mfg economy (services)	81,647,161	68%	31,343,619	74%	50,303,542	64%	-3,586,531	-4.4%	-1,420,860	22.3%	-4.5%

#value! ==non- disclosure

original data source: <http://www2.census.gov/econ/susb/data/>

classification based on author analysis