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Keywords: Cloud computing, digital economy, national accounts, economic estimates
JEL codes: L86, E01, O30

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An Industry-Based Estimation Approach for Measuring the Cloud Economy

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The usage of cloud computing technology in business and daily life has grown rapidly in recent years. However, measurement and research on the impacts of that usage remain relatively scarce and new. The current paper examines the economic contributions of cloud technology by estimating the size of the 'cloud economy' in the United States. The author uses input from cloud industry experts and product line receipt details to identify specific commercial receipts related to the cloud industry. The author then uses an adapted input-output methodology previously employed by other groups examining the size of the technology sector to estimate the economic size of the cloud in terms of Output, Earnings, Employment, Value-Added, Direct-Effect Earnings, and Direct-Effect Employment. The estimates are simply a starting point for measuring the economic size of the cloud, but they compare favorably with other estimates from industry groups and private parties. The key advantage of the current paper is the detailing of a replicable approach to use in future research including a discussion of the identification criteria used by the consulting experts.

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1.0 Introduction

Many stakeholders acknowledge that cloud computing is an important new technology and there is a general interest to better understand the economic impacts of the technology. The current paper attempts to tackle the economic measurement issue by offering a set of estimates on the size of the cloud economy in the United States (US) using an approach previously applied by numerous researchers to the technology sector (overall) and several of its subindustries.

The interest in the role of cloud computing came to the forefront of popular and academic discussions in the early 2000s. Many researchers were interested in the shifts by firms away from in-house physical information technology (IT) infrastructure and equipment (i.e. fixed, local data storage and computing) toward remote computing services (i.e. cloud computing technology) that were occurring at that time. There was some skepticism at that time as to how extensive and impactful the shift would end up being. (Harms and Yamartino, 2010)

Approximately a decade or so into those once future changes, we are only now beginning to understand just how "the cloud" has grown specifically as a commercial enterprise. Data remain lacking. Research is still nascent. And the theoretical conceptualization of how to define and measure the cloud in socioeconomic data is still under development in many regards. Thus, it can prove exceedingly difficult to simply get a basic estimation of the cloud as an economic industry despite the prevalence and growth of the technology.

In the current paper,[1] I attempt to address that final issue of estimation by offering an approach to estimating the cloud economy in the U.S. using national accounts data from the U.S. Bureau of Economic Analysis. I follow an input-output estimation approach used by several industry trade groups to measure 'non-traditional' industries and, specifically, adapt a methodology utilized by Siwek (2015) for a previous estimation on the size of the U.S. internet sector.

The paper provides a systematic examination of the cloud's economic footprint in the U.S. through economic data with primary estimates for 2012 as well as secondary estimates for 2002 and 2007 and extrapolated estimates for 2017.[2] I estimate that cloud computing contributed approximately $149 billion (0.94 percent) in *value-added* to U.S. gross domestic product (GDP) as of 2012. I also estimate that cloud computing supported approximately 1.5 million jobs in the US, with 80 percent of that employment residing outside of the cloud industry in indirect positions. This is based on the ratio of direct-effect employment versus total employment, which are both calculated using multipliers (Table 2 helps illustrate this later). Finally, I estimate the

[1] This paper is an updated version of a previous technical report published by Internet Association. The current paper includes updated economic estimates based on a refined identification strategy following external input on the previous version. The previous report is available at https://internetassociation.org/publications/category/reports/.
[2] The most recent national accounts data necessary for the estimates are for 2012, thus the 2017 estimates are extrapolated based on previous 5-year growth rates.

cloud economy produced $252 billion in *gross output* and $252 billion in *direct-effect earnings* in 2012.[3] [4]

Section 2 reviews cloud technology, providing a brief overview for non-experts. Section 3 details the economic literature on the cloud. Section 4 presents the paper's methodology and results. Section 5 discusses and Section 6 concludes.

2.0 Understanding and defining cloud technology

One of the most important aspects of the internet as a technology has been its merging of previously disparate markets for data, phone/voice, and media. The internet created a common architecture for digital information and communication and, once employed through broadband systems, it facilitated a new type of system built on remote access, cheap storage, and inexpensive, but increasingly powerful processors. This is the cloud. (Cowhey and Kleeman, 2011)

Mell and Grance (2011: 2) at the National Institute of Standards and Technology define cloud computing as:

> *"...a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models."*[5]

More concisely, Etro (2009: 195) defined cloud computing as a "new general-purpose Internet-based technology through which information is stored in servers and provided as a service and on-demand to clients." Cowhey and Kleeman (2011: 2) added that cloud computing is a "scalable on-demand provision of remote computing and data storage."

More broadly, several key components comprise cloud infrastructure – server hardware, networking equipment, storage systems, and specialized software (SDX Central, n.d.; Bayrak, Conley, and Wilkie, 2011). Companies build remotely-accessible applications on top of that infrastructure through networking services (SDX Central, n.d.). Cloud computing is also distinguished by how it has forced new capabilities and requirements into new software options

[3] Earnings of employees and the net earnings of sole proprietors and partnerships resulting directly from cloud computing technology services rather than indirect earnings, which do not trace directly to cloud computing technology services. For example, the earnings of a cloud engineer at a cloud computing firm, but not the earnings of a security guard contracted to protect the cloud computing firm's building.

[4] For clarification, BEA (n.d) defines *gross output* as, "Total market value of industry output (sales). It equals intermediate inputs plus value-added. Gross output is not the same as gross domestic product (GDP), which only includes value-added," and *earnings* as, "Compensation of employees plus the net earnings of sole proprietors and partnerships." BEA clarifies that *direct-effect multipliers are*, "For earnings, the ratio of the total change in household earnings per dollar change in household earnings in the final-demand industry. For employment, the ratio of the total change in jobs per change in job in the final-demand industry," and that *direct impact* refers to "Change in economic activity resulting from the initial round of inputs purchased by the final-demand industry."

[5] See the link in the citation for full detail on characteristics and models.

(related to remote data access and analytical components) as they replace older software products, which are incapable of fully utilizing cloud systems and tools. In other words, older products may not be compatible with cloud systems, which forces new versions of software to build in additional capabilities and update more frequently (Alarcon and Pavlou, 2017).

3.0 Cloud in the literature

3.1 The implications of cloud in business and commerce

Some argue that the shift to the cloud has pushed *information-communication technologies* (ICT) into a fourth major epoch of development – following mainframe development, personal computer development, and the internet. The shift is not entirely novel – many see it as another wave in the back and forth between centralized and decentralized processing over the history of computing (e.g. from client-server mainframes to desktops). However, proponents argue that cloud computing technology is fundamentally transforming how ICT systems operate and how users and firms utilize ICT systems for personal and commercial endeavors. (Talukder and Zimmerman, 2010; Bayrak, Conley, and Wilkie, 2011)

The great promise of the cloud from an economic standpoint (to its proponents) is its potential to prolong and bolster ICT-driven economic growth in both developed and developing countries (Iansiti and Richards, 2012; Serha, 2015). This is contested, but there is an emerging set of literature helping to further bolster these claims. Jorgenson (2006) documented the important role of ICT in U.S. productivity gains through the 1990s into the 2000s as well as the shift away from hardware to software and digital technologies during that period. This seminal piece lays much of the foundation. Others have provided contemporary corroborative evidence. Hooton and Kaing (2018) find evidence of an increasing linkage between U.S. productivity and digital technology components like data and processing power, which enable cloud systems. Ferracane and van der Marel (2019) find evidence that digital platform restrictiveness is associated with lower ICT sector contributions to GDP and that overall productivity growth can increase with reduced digital restrictions.[6] On the other side, skeptics cast doubt on the long-term positive impact of ICT technologies on overall economic growth. Robert Gordon perhaps leads this charge. He finds evidence that the growth in the mid-1990s to early 2000s may be a one-off phenomenon (2016; 2018).[7]

Regardless of the debated long-term impacts of the ICT sector on productivity measurements, the author believes it reasonable to argue that cloud computing now plays a pivotal role in modern ICT systems (at a minimum) and, at least to some degree, in ICT's economic contributions (Riley, 2017). This does not negate the corresponding recognition of market disruption that has hit older firms and their supported jobs; rather, it reflects a broad acceptance of its prevalence and a need to better investigate previously speculated benefits. I argue there is now a need to shift from questions on *if* the cloud will be important to *how* research can better study the importance of technology's impacts (McCullagh, 2011; Riley, 2017).

[6] The authors look specifically at digital trade restrictiveness, but the current author argues these are indeed relevant for a discussion of cloud and digital-driven economic growth more generally.
[7] See Syverson (2017) for a comprehensive assessment of the debate on current productivity measurement issues including the ICT sector's role.

For example, readers may anecdotally appreciate the cloud has facilitated changes in how they listen to music if they use a music streaming service. How the cloud has impacted business performance and macroeconomic statistics is less obvious.

It is beyond the scope of the current paper to explore the myriad ways in which the cloud may be impacting society and the economy. However, there are two important aspects already documented and debated that are key for the current paper.

First, some research has linked cloud to the decline of ICT prices and a corresponding (and debated) misestimation of business investment, along with derived statistics such as productivity, inflation, and more (Byrne and Corrado, 2017; Coyle and Nguyen, 2018). As the costs of cloud technology decrease, ICT prices correspondingly decline. As firms shift from maintaining their own 'physical' ICT systems to utilizing cloud systems, total investment falls from an accounting standpoint as the expenditure is shifted from capital expenses to operating expenses.[8] This is a particularly important topic with far-reaching implications for everything from taxes to government statistics and more.

Second, the shift away from in-house 'hardware' systems has likely dampened activity in businesses that do not use cloud systems, while boosting efficiency in firms that more quickly integrate cloud into their production (Jin and McElheran, 2018). The researchers Jin and McElheran find evidence of greater 'learning' and prudent planning by firms using cloud, because of the flexibility it offers. Cloud systems can offer faster updates and modifications to system capabilities. Furthermore, firms that do not use cloud systems are more likely to be 'locked-in' to older, legacy systems designed and built years prior – and perhaps not at the cutting edge of functionality. In some cases, those legacy systems may work quite well, but regardless of technical performance, they commit the firm's scarce resources and lower operational flexibility. That leaves fewer resources for new investments and, potentially, IT that performs less well than cloud-based systems.

Cloud computing appears to allow more flexibility to individual firms in scaling production as demand changes. Additionally, the cloud may allow firms to (re)focus on core functions where they have primary advantages in markets as Fisher (2018) anecdotally indicates. These have proven particularly valuable to smaller and newer firms where the ability to quickly build or shed processing power and data storage is an existential issue. They have proven perhaps troublesome for older and larger companies with their own non-cloud data and computing systems.

3.2 Evidence in the literature

We are starting to see evidence of the purported advantages of cloud systems as well as a formalization of the theoretical aspects. Kepes (2011) documented four primary aspects/advantages of cloud technology from a business perspective that more formally define the utility gains espoused by the technology's cheerleaders. These are: 1) reducing the

[8] *A Dictionary of Accounting (2010)* defines *capital expenditure* as, "The expenditure by an organization of an appreciable sum for the purchase or improvement of a fixed asset ..." and it defines *operating expenses and revenues* as, "The costs and revenues incurred or generated by an organization in the normal course of business…", which excludes capital expenditures.

opportunity cost to running technology; 2) facilitating a shift from capital expenditure to operating expenditure; 3) lowering technology ownership costs; and 4) allowing businesses to refocus on core activities and increase the value of their services to clients.[9]

Around costs, Alford and Morton (2009) found evidence of significant cost savings for the U.S. government from shifting ICT systems to the cloud, finding benefit-cost-ratios of between 5.7 to 15.4 based on different scenarios. Their analysis suggests that ICT cost savings may be as much as two-thirds over a 13-year investment life cycle due to cloud technology adoption. Etro (2011) found that the payment-on-demand structure of many cloud services has allowed firms to shift some fixed costs into marginal production costs, thereby incentivizing new business creation and, thus, job creation. Deloitte (2018) found an average return for businesses of approximately $2.5 for every $1 invested in the use of public cloud services from a variety of providers.

Around firm adoption and the flexibility advantages, Jin and McElheran (2017) tracked a large sample of firms from 2006-2014 and found that cloud technology drove higher business survival and stronger growth among young firms. They also found that young firms, conditional on survival, were able to close the productivity gap between themselves and already successful incumbent firms in established markets – in some cases even surpassing the productivity of older firms. Put more plainly, startups that have grown using cloud have tended to be more productive than comparable firms that still use traditional local data storage and computing.[10] Bloom and Pierri (2018) provide evidence to support the advantages of cloud to small firms by documenting the rapid adoption of cloud computing across the United States among businesses. While still low overall, cloud computing adoption increased from less than 0.5 percent of firms in 2010 to approximately 7 percent in 2016 – an annualized increase of about 50 percent.

More directly to the issue of the cloud's overall economic impacts, most research focuses primarily on Europe or specific companies. McWilliams (2012) studied the cumulative economic benefits of the cloud for five European economies – France, Germany, Italy, Spain, and the UK – from 2010-2015. The author found that the cloud contributed a combined EUR 763 billion in value-added to the five economies' GDP and nearly 2.4 million jobs over that period. These benefits came primarily from existing business growth, new business creation, cost savings, and indirect effects. Deloitte (2017), under commission from The European Commission, found that broader cloud technology adoption across the European Union could add EUR 499 billion to the region's GDP over the next five years with related increases in employment and business creation. The authors also estimated that cloud technology contributed approximately EUR 27.9 billion or 0.2 percent of the EU's GDP in 2013.[11] In a

[9] These benefits speak directly to when organizations go from their own privately-owned cloud systems to leased (public) cloud services. The list is not exhaustive of all public cloud benefits and certainly does not capture other benefits and or disadvantages.

[10] This does not mean that all young firms are more productive than old firms, but rather that the flexibility afforded to young firms that have not already invested in in-house IT systems has fostered greater productivity for them.

[11] Note that the discrepancy between the McWilliams report and Deloitte report relates primarily to methodology and assumptions. The Deloitte report uses a variety of sensitivity analyses that incorporate the existence of barriers to cloud adoption. The report notes that if those barriers are removed their estimates on the cloud's economic contributions jump dramatically. Additionally, on a related item, the Deloitte report notes that two-thirds of employment gains in the coming years will occur in just six countries – the same five studied by McWilliams plus

separate study, Deloitte (2018) also found similar scale impacts from (only) Google's cloud services on productivity across 14 countries. These ranged from $300 million to $1.2 billion for large countries and $100 million to $600 million for medium countries. The estimates cited above are in the same order of magnitude as those of Swanson and Mandel (2017) and Mandel (2018), who estimate that the cloud will boost U.S. GDP by approximately $2 trillion over the next 10 years. Furthermore, there is additional evidence of non-pecuniary benefits (both macro and micro), such as reduced energy consumption (Hardy, 2018).

4.0 Measuring the cloud economy

4.1 Methodology

The optimism of the estimates and extrapolations above are based on limited research. The literature that exists appears confident in the future, general direction of the cloud economy, but has only a limited perspective on the cloud's historic or current economic 'footprint.' This is a vital aspect of research on the technology that will allow better tracking of how those estimates fared.

The current paper examines the role of the cloud in the U.S. economy from the period of 2002 to 2017. The paper's approach follows the precedent of previous similar studies for the identification of a subset of specialized companies or industries. For further background on the approach used and its application specifically to the technology sector, the author recommends reports from Heckler (2005), Brookings Institute (Muro et al., 2015), and the industry trade group CompTIA (2016). Hooton (2018) provides a recent critical examination of the underlying theory and practices for defining the technology sector and its subindustries in these types of studies. The BEA (Barefoot et al., 2018) has an ongoing project specifically focused on defining and measuring the digital economy, which has helped inform and refine the types of approaches seen in the previously mentioned citations.

I use five-year economic census data estimates from the U.S. Census Bureau for the years 2002, 2007, and 2012 to develop estimates for the cloud in each of those years and then extrapolate estimates for the size of the cloud economy in 2017 based on the preceding 5-year growth rates.

This process relies on the utilization of product line statistics for different industries within the North American Industrial Classification System (NAICS) to identify specific receipts associated with the cloud and then industry-specific multipliers from BEA to develop the final estimates.

The process involves several steps. First, I identify industry codes potentially related to cloud technology at a 4 to 6-digit level based on input from a set of cloud experts and by cross-referencing Standard Industrial Classification (SIC) and NAICS codes for publicly-traded cloud companies.[12] The author developed the initial set of publicly-traded cloud companies by

Poland. While a different metric, it provides some guidance for how future productivity growth compares with previous growth.

[12] NAICS codes are 2 to 6-digit identifiers for economic industries in North America. The 2-digit codes are the largest sectors of an economy and 6-digit codes are the most specific subindustries. The coding system is

referencing the annual state of the cloud report by RightScale (Weins, 2018). Next, I reviewed the companies mentioned in the report and supplemented it with a general search using search engines and news articles – the goal of the step was to expand the initial reference list of potential cloud companies. Next, I reviewed the compiled list of companies with Internet Association's cloud policy director to finalize the reference list of companies. Finally, I identified the SIC codes by referencing the reported industry codes for each company in the U.S. Securities and Exchange Commission documents.[13]

Next, I downloaded and inspected product line data for each flagged industry to identify specific gross receipt lines related to cloud activity (versus something else). This process used input from cloud technology experts, including Internet Association's cloud director (again) as well as employees that worked on cloud policy and economics from several of the companies identified in the list. I do not provide the list of cloud companies here since they formed only a small element of the overall identification methodology and because of competitive sensitivities in the market, particularly given the author's role in an industry trade association that represents several cloud companies. It is also important to emphasize that the core component of IA's methodology is the set of NAICS codes – which the report documents – and not the list of companies.

Four key criteria appeared to be important in the (cloud) product line identification process. These were:

1) Product line descriptions related to application servicing provision
2) Product line descriptions related to data and or database management
3) Product line descriptions NOT related to "custom" service or tool provisioning – i.e. services that were not custom-built.
4) Product line descriptions related to media/content provision (e.g. e-books, video streaming, etc.)

The author, however, emphasizes that the criteria given above should be seen as general guidance and not formal rules in the identification of cloud-related economic activity. Additionally, the author notes that the approach used in this paper is critically dependent on the validity of the industry multipliers from BEA and on the expertise of subjective individuals. The author previously documented articles that help establish the accepted precedent for this approach, but it is far from perfect and should be seen as an exercise to help inform future research and estimates.

Next, the author applies Regional Input-Output Modeling System (RIMS II) industry multipliers from the U.S. Bureau of Economic Analysis to the flagged product lines – those related to the cloud – to develop estimates for Output, Earnings, Employment, Value-Added, Direct-effect Earnings, and Direct-Effect Employment.

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hierarchical with 2-digit codes representing the largest sectors and all other codes (3 to 6-digit) residing under one of the 2-digit sectors. For more information, refer to the U.S. Bureau of Economic Analysis's website.

[13] Please note that the current methodology is almost certainly not exhaustive of all potential cloud companies or cloud-relevant NAICS codes. However, the approach used follows accepted practices for the identification of a subset of specialized companies or industries. Furthermore, I do not provide the list of cloud companies here since they formed only a small element of the overall identification methodology. The core component of IA's methodology is the set of NAICS codes, which the report documents.

The RIMS II is a regional economic model used to assess the economic impacts of projects (e.g. building a bridge) and which produces multipliers to use in assessing project-specific impacts in a region. Researchers commonly use the multipliers to study government policy and specific industries. The author recommends the guide from BEA (n.d.) for further information.

Finally, the paper uses the average RIMS II multiplier across all 50 states and the District of Columbia for each of the metrics above. Whenever an exact match between NAICS code and multiplier code was not possible, I used the multiplier for the next closest industry code aggregation. For example, if a six-digit NAICS code did not have a multiplier, I would have used the multiplier for the five-digit if possible, or if not five-digit, the four-digit multiplier and so forth.

The identification process does not imply that the paper counts all output from each of the firms on its list of cloud companies as activity related to the cloud. Rather, I use the list of companies only as an initial starting point to identify potential cloud industry codes, then confirmed those and other codes with input from industry experts, and then used only the relevant portion from each of those industry codes. For example, this means that the paper counts only the relevant portion of Amazon's $178 billion in 2017 revenue and 563,000 employees. I also note that it is impossible to distinguish the exact contributions of any specific company to the cloud economy's U.S. output. The paper utilizes industry codes rather than company reports and financial records, which ensures the paper captures other relevant companies not on its initial reference list while also 'anonymizing' the specific contributions of the companies on its starting reference list.[14]

Table 1 presents a list of the cloud-related NAICS codes identified by for the paper well as the multiplier used for each code and the percent of product lines flagged as relevant within that industry code. Appendix A provides full product line tables for every NAICS code with flagged product lines. Table 2 presents the paper's estimates for the U.S. cloud economy's contributions to Output, Earnings, Employment, Value-Added, Direct-effect earnings, and Direct-Effect Employment in 2012.

[14] As an illustrative example: if Amazon's industry code is 0000 and industry 0000 has a total output of $100; the paper then identified the specific product line receipts under code 0000 that were relevant for cloud and found them to equal 50% of that industry code's total contribution, or $50; note that those specific product lines represent the output contributions to cloud of all U.S. companies classified under industry code 0000 (not just those of Amazon); the paper then calculates the specific metrics, such as GDP and employment, by multiplying the $50 in output by multipliers; assume that industry 0000 had an average GDP multiplier across all states of 0.8 – this would mean that all cloud companies in industry 0000 produced $40 in value-added to U.S. GDP; if industry 0000 had an employment multiplier of 5.2, then all cloud companies in industry 0000 created 260 jobs.

Table 1: List of Flagged Industry Codes

NAICS Code	Relevant Multiplier NAICS	Percent of Product Lines Related to Cloud
443142	Industry: 44 Federal Reserve banks, credit intermediation, and related activities	0.04%
454110	Industry: 45 Securities, commodity contracts, and investments	2.33%
511210	Industry: 511200 Software publishers	7.00%
517311	Industry: 517A00 Satellite, telecommunications resellers, and all other telecommunications	No Flagged Product Lines
517312	Industry: 517A00 Satellite, telecommunications resellers, and all other telecommunications	No Flagged Product Lines
517919		No Flagged Product Lines
518210	Industry: 518200 Data processing, hosting, and related services	62.71%
519130	Industry: 519130 Internet publishing and broadcasting and Web search portals	No Flagged Product Lines
541511	Industry: 541511 Custom computer programming services	20.26%
541512	Industry: 541512 Computer systems design services	42.02%
541513	Industry: 54151A Other computer related services, including facilities management	13.26%
541519		4.72%
541910	Industry: 5419A0 Marketing research and all other miscellaneous professional, scientific, and technical services	No Flagged Product Lines
561410	Industry: 561400 Business support services	No Flagged Product Lines

Table 2: Summary of Cloud's Economic Footprint – 2012

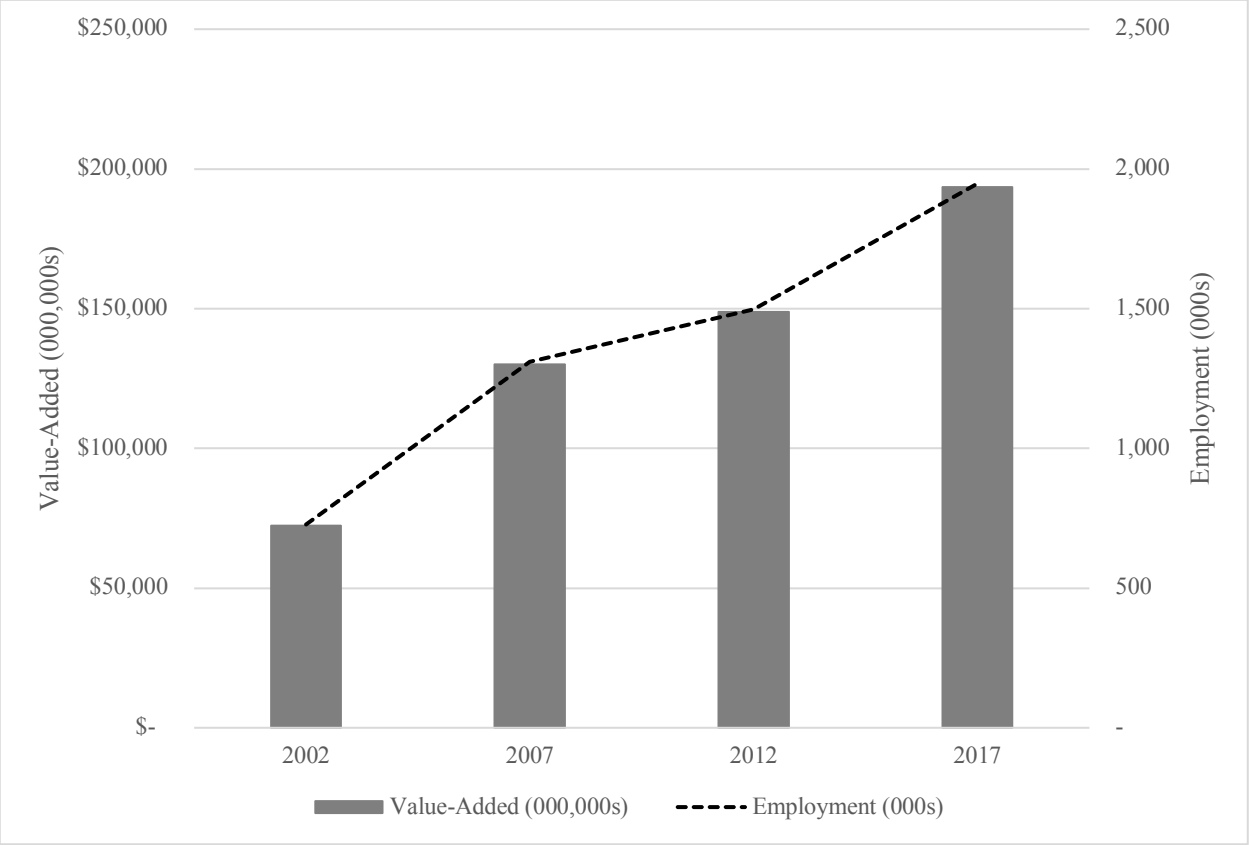
	Total Flagged Receipts ($1000)	Output ($1000)	Earnings ($1000)	Employment	Value-Added ($1000)	Direct-effect earnings ($1000)	Direct-effect employment
443142	$38,210	$54,464	$14,062	254,292	$30,852	$58,141	68,110
45411	$7,531,910	$11,539,211	$3,780,310	108,824,314	$5,285,363	$11,076,323	10,410,207
511210	$11,967,686	$15,235,169	$4,166,538	57,730,897	$10,166,667	$15,874,877	19,510,449
51731	$-	$-	$-	$-	$-	$-	$-
517312	$-	$-	$-	$-	$-	$-	$-
517919	$-	$-	$-	$-	$-	$-	$-
518210	$67,718,938	$99,822,628	$25,666,407	475,836,811	$52,368,648	$108,978,892	132,204,629
519130	$-	$-	$-	$-	$-	$-	$-
541511	$24,555,992	$31,595,810	$16,023,989	235,081,638	$21,700,804	$29,287,787	34,513,928
541512	$64,165,462	$86,738,997	$38,521,798	565,638,300	$54,269,764	$79,751,378	93,975,729
541513	$4,539,956	$5,807,832	$2,607,021	41,500,076	$3,919,442	$5,396,299	6,087,485
541519	$842,746	$1,620,736	$645,287	12,219,424	$1,045,212	$1,330,531	1,795,041
541910	$-	$-	$-	$-	$-	$-	$-
561410	$-	$-	$-	$-	$-	$-	$-
Total	$181,360,900	$252,414,847	$91,425,412	1,497,086	$148,786,751	$251,754,228	298,566

Source: Author's elaboration

According to the paper's analysis, cloud technology contributed approximately $150 billion in value-added to U.S. GDP and employment of approximately 1.5 million in 2012. For that year, these equate to approximately 0.94 percent and 1.1 percent of the respective national totals. The cloud contributed $252 billion in final-demand gross output and $91.4 billion in final-demand earnings. The cloud also contributed $252 billion in direct-effect earnings and 299,000 direct-effect employment.

Applying the same exercise to the years 2002 and 2007, the cloud economy added approximately $72.3 billion and $130.1 billion of value-added to U.S. GDP respectively. The growth trends for the cloud from 2002 to 2017 imply that the cloud contributed approximately $194 billion in value-added and 2.0 million jobs to the U.S. economy in 2017. Figure 1 shows this estimated growth over time including the 2017 extrapolations.

Figure 1: Estimated Cloud Growth 2002-2017



Source: Author's elaboration

4.2 Issues in the Analysis and Alternatives

The author previously noted two primary concerns in its methodology related to 1) the use of expert opinions to identify cloud-related industries and product lines and 2) the use of RIMS II industry multipliers to estimate the cloud's economic footprint. I expand on those here.

The reliance on expert panels to identify the technology sector and subsectors follows the practice of several groups (again, see CompTIA, 2016 as one example), but it is intrinsically subjective. Hooton (2018) dives further into the issue by examining alternative approaches, such as the use of defined, threshold-based measurements to distinguish between one industry and another. For example, several researchers have proposed measuring the aggregate research and development (R&D) expenditures of industries to identify high-tech subindustries from others. The alternative approaches, however, also rely on subjective threshold levels (e.g. 10% of gross revenue dedicated to R&D versus 8%) as well as a subjective selection of 'relevant' metrics (e.g. the use of R&D versus the concentration of employees with science, technology, engineering, and mathematics training). The feasibility of application is the key motivation for the use of the current expert-based approach for the paper (and potentially for others). Expert groups are in many ways easier to convene and consult than identifying and measuring a specific metric. Indeed, the author is unaware of what would be appropriate to measure as a distinguishing feature of cloud-related product receipts in industries. This does not excuse the subjectivity of the paper's methodology, but – working on the assumption that 'experts' do indeed have expertise on the cloud industry and that alternative approaches have their own subjectivity issues – the author argues the paper's method is appropriate and the results valuable as a next step in researching the cloud economy.

Previous research has also used RIMS II multipliers to develop specific industry economic footprint estimates.[15] However, the use of RIMS II multipliers in previous works and the current paper should not imply that there are no issues in this type of approach. The multipliers rely on their own set of assumptions, which require repeated testing and confirmation when they are constructed and revised. The current paper must rely on the assumption that the estimates derived from RIMS II multipliers are indeed accurate. I must also recognize that standard input-output tables do not divide the value-added components of an industry by product lines – i.e. the paper's approach is not possible without RIMS II multipliers. As Siwek (2015) notes the multipliers measure the impact of a change in demand, earnings, or employment in a regional economy and users typically seek to estimate increases in output, employment, and earnings from a specific change in demand in a region. However, Siwek (2015) also notes they can also be used to conduct 'contribution' analysis to determine an industry's total economic contribution. The BEA RIMS II guide provides more guidance on the model's development, assumptions, and applications for interested parties. The author repeats the argument that the

[15] The RIMS II multipliers come in two types that researchers may purchase from BEA – "Final Demand" multipliers for output, earnings, and employment, and "Direct Effect" multipliers for earnings and employment.

current paper's approach is indeed appropriate based on existing methodologies and techniques and the precedent of previous research (already cited). The results, however, should be seen as estimates to inform other research.

5.0 Discussion

The figures above rely on a subjective interpretation of which product lines and industries comprise cloud computing in the U.S. economy; however, the use of an expert-based approach is standard among researchers examining high-technology industries and activity (Hooton, 2018). Further refinement and input on the suitability of the flagged product lines and industries would be valuable as future extensions on this research. Additionally, I recommend that the 2017 estimates be updated upon the release of the 2017 economic census data to verify and improve them.

The aggregate output and value-added figures in the paper are encouraging when compared with other estimates produced by other research. Several financial and technology/cloud industry analysts have estimated annual revenues in the $100-$200 billion range (see McCullagh, 2011 for one such example), which would again put these estimates in the same 'ballpark' as these others. Indeed, the most recent estimates found by the paper, which were conducted by the Synergy Research Group (2018), place total revenue for the cloud economy at approximately $180 billion for 2017. Given their focus on only six key segments of the cloud market, rather than the more detailed product line to product line approach of the current paper, the slightly smaller, but rather close estimate provides encouragement and reinforcement of the findings as well as that of Synergy Research Group. It is important to remember these are all estimates rather than formal measurements; however, the author believes they are encouraging for future research. The previous and current estimates and their similarity could spark legitimate conversations about future revisions to the NAICS coding system (and other industry coding systems) to accommodate new industries, such as the cloud. The selection criteria used here to identify specific subindustries related to the cloud need refinement and scrutiny, but they or similar criteria in the future, bolstered by research on their validity, could assist in helping industrial classification systems accurately identify and formally measure these types of new industries. This line of research would prove valuable in the future.

The findings here do not erase broader issues around the potential misestimation of the cloud (and mobile) platforms in productivity figures. As discussed by Byrne and Corrado (2017) and Byrne, Corrado and Sichel (2018), U.S. productivity growth has been slow since 2004 and the decline of U.S. labor productivity growth since then may be due, in some part, to the shift to cloud technology. As this shift has occurred, the investment in traditional ICT equipment and software has fallen and, thus, the boost in productivity (based on accounting methods) gained from ICT equipment and software in the 1990s through the early 2000s has also declined.[16] This specifically relates to how the cloud is handled from an accounting perspective and has two parts – the declines in prices for cloud computing technology and the treatment of cloud expenditures

[16] The falling prices and shift in accounting treatment are potentially skewing factors for productivity measurements. The issue is actively being debated and requires more nuance than can be communicated here. See the paper's citations for more background information.

in company accounting as operating expenditure rather than capital expenditure. I argue that this trend is at least somewhat misleading and that the current treatment of cloud and other digital application expenditures in accounting should be updated to potentially include cloud services as an investment as opposed to purely operating expense. This would potentially correct some of any misestimation that may be occurring and raise total estimates on the cloud's contribution to the economy. However, further research is needed on the topic to determine how much, if any, misestimation may be occurring from these factors.

Finally, I also recognize there are other aspects to the cloud economy's impacts. In particular, its large disruption of legacy software systems and the lag in transition for many organizations are major issues (Mircea, Ghilic-Micu, and Stoica, 2011; Alarcon and Pavlou, 2017). The disruption has two aspects. First, by incentivizing companies to leave their old data centers, server systems, and other capital equipment for cloud-based services and, second, by causing providers of those older systems to lose business. This disruption has undoubtedly had negative impacts on some firms and organizations as they have transitioned, forcing important questions to individuals and organizations about the benefits and costs of adopting new cloud technologies while increasing competition overall (Tak, Urgaonkar, and Sivasubramaniam, 2011; Alarcon and Pavlou, 2017). But the lag time also speaks to the cloud market still not being fully mature and future growth potential. Thus, I expect continued growth and disruption well into the coming years as cloud technology continues to become adopted even more widely, but also further distribution of its benefits.

A better understanding of how the impacts of the cloud materialize for old and new businesses is a worthy endeavor for additional research, particularly regarding the net impacts of the cloud. If we consider the cloud to offer efficiency benefits (which are documented in the literature), then I speculate that robust quantitative analysis would show overall positive benefits for businesses and industries despite disruption. Unfortunately, a full examination of this issue is beyond the scope of the current report, but a 'back of the envelope' calculation does suggest that cloud systems may provide net gains in terms of employment and GDP contributions compared to older systems, though more investigation is certainly needed. This is clear when comparing the weighted average multipliers for employment and GDP for all of the cloud-relevant industries identified in the current paper with those of the individual industries.[17] The weighted average multipliers for the cloud are 14.0603 for employment and 1.4164 for value-added (i.e. GDP). The aggregate (weighted average) multiplier for employment is higher than all of the individual industry multipliers (e.g. the employment multiplier of just NAICS 541413) except two industries, NAICS 45411 and NAICS 541519. The aggregate (weighted average) multiplier for GDP is higher than every one of the individual NAICS industry multipliers. This is hardly conclusive evidence, but it provides a small step forward over anecdotal evidence only.

6.0 Conclusion

How big is the cloud? It is a question that has been approached from an engineering standpoint and in a limited amount of research from an economics perspective. Somewhat surprisingly, however, it has not previously been directly addressed for the U.S. economy.

[17] i.e. Taking the respective multipliers of each specific industry line and weighting them according to the percentage of that industry code flagged as relevant to the cloud.

The current paper presents an NAICS-based approach to estimating the size of the U.S. cloud economy. I build on an accepted methodology for the estimation of nascent industries and sub-industries to provide a foundation for future research on the economic contributions of the cloud. The details of that methodology, which are presented in the paper, can guide future estimates, but should also be refined as our understanding of cloud technology continues to grow.

The paper's findings fall in line with other tangential estimates on the cloud's economic and business contributions but move the literature forward by providing a detailed methodology and robust estimates on the technology's GDP, earnings, and employment contributions. Perhaps the most important lesson from the report is that cloud computing has already become a force in the economy. Cloud computing is no longer a technology of the future over which to speculate; it is a very real and present boon to the internet and economic systems today. Its expected future growth will only bolster its importance.

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Appendix A – Product Line Receipt Detail For Industries with Flagged Receipts

NAICS 443142 Electronics stores

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	86,428,845	0
Women's, juniors', & misses' wear, incl accessories	2012	185	0
Major household appliances	2012	2,395,121	0
Kitchen appliances, parts, & accessories	2012	1,348,792	0
Laundry appliances, parts, accessories, incl clothes washers & dryers	2012	652,145	0
Outdoor gas grills, parts, accessories	2012	7,138	0
Other major household appliances, parts & accessories	2012	387,046	0
Small household appliances & personal care appliances	2012	54,990	0
TVs, DVD/Blu-ray players & recorders, camcorders, portable video players, e-book readers,DVDs, Blu-ray Discs, etc.	2012	12,427,935	0
Televisions & related parts & accessories	2012	7,305,651	0
Video content downloads	2012	38,210	1
DVD/Blu-ray Disc players, recorders, camcorders, portable video players, e-book readers, & related parts & accessories	2012	2,624,290	0
Electronic game/DVD combination devices	2012	1,342,351	0
DVDs & Blu-ray Discs, prerecorded	2012	1,104,682	0
DVDs & Blu-ray Discs, recordable	2012	12,751	0
Audio equipment, musical instruments (new & used), radios, audio electronic components, CDs, records, tapes, audio books, sheet music, accessories	2012	6,958,355	0
Audio equipment, components, parts & accessories	2012	6,035,137	0
Audio books	2012	1,175	0
Pre-recorded compact discs, audio tapes, & records	2012	767,927	0
New & used musical instruments, sheet music, & related items	2012	116,247	0
Audio content downloads	2012	11,750	0
Recordable compact discs & audio tapes	2012	26,119	0
Furniture, sleep equipment & outdoor/patio furniture	2012	195,788	0
New & used computer hardware, software, & supplies, incl computer game software & tablet computers	2012	33,488,697	0
Computer & peripheral equipment	2012	25,619,788	0
Prepackaged (off-the-shelf) computer software, incl computer software downloads	2012	7,868,909	0
Kitchenware & home furnishings	2012	9,109	0
Jewelry, incl watches, watch attachments, novelty jewelry, estate/antique jewelry, etc.	2012	6,691	0
Books, incl e-books	2012	152,668	0
Photographic equipment & supplies	2012	3,924,375	0
Toys, hobby goods, & games	2012	494,370	0
Optical goods, incl eyeglasses, contact lenses, sunglasses, etc.	2012	574	0
Sporting goods & recreational equipment	2012	57,472	0
Hardware, tools, & plumbing & electrical supplies	2012	7,748	0
Automotive tires, tubes, batteries, audio equipment, parts, access	2012	306,533	0
Used books, clothing, furniture, & other used items not elsewhere classified	2012	178,093	0
Used home entertainment, recreation, & culture products	2012	174,873	0
Used office furniture & exercise/fitness equipment	2012	907	0
Used hardware, tools, plumbing & electrical supplies, & building materials	2012	1,533	0
Used household & personal goods, not elsewhere classified	2012	703	0
All other merchandise	2012	17,503,582	0
Office, school, & packaging supplies	2012	464,115	0
Office equipment	2012	220,299	0
Magazines & newspapers	2012	37,122	0
Telephones, cellular phones, phone batteries, answering machines, pagers, & navigation (GPS) equipment	2012	16,287,885	0
Nonautomotive batteries	2012	477,043	0
Typewriters	2012	2,407	0
All other merchandise	2012	14,711	0
All other merchandise, excl lottery ticket sales/commissions	2012	407,900	0
All nonmerchandise receipts	2012	7,856,462	0
Labor charges for work performed by this establishment	2012	520,398	0
Labor charges for work contracted out to other establishments	2012	52,487	0
Parts, paint & materials installed in repair	2012	443,656	0
Rental of DVDs, Blu-ray Discs, DVD/Blu-ray Disc players & recorders, electronic games & devices	2012	86,404	0
Receipts from photofinishing performed by this estab	2012	51,810	0

Receipts from photofinishing contracted out to other estabs	2012	6,580	0
Rental or lease of appliances, stereos, TVs, photo equip, etc.	2012	50,504	0
Value of service contracts	2012	5,486,299	0
All other nonmerchandise receipts	2012	1,158,324	0

Flagged Receipts ($1000)	**$**	**38,210**	**0.04%**
Total Receipts ($1000)	**$**	**86,428,845**	

NAICS 454110 Electronic shopping and mail-order houses

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	322,958,117	0
Groceries & other food items for human consumption off the premises	2012	5,723,776	0
Produce, incl fresh & prepackaged fruits & vegetables	2012	397,716	0
Frozen foods, incl packaged foods sold in a frozen state	2012	1,156,919	0
Dairy products & related foods, incl milk, cheese, butter, yogurt, eggs, etc.	2012	208,218	0
Bakery products baked on premises	2012	29,195	0
Bakery products not baked on the premises, excl frozen	2012	165,033	0
Delicatessen items, incl deli meats & other service deli items	2012	75,766	0
Ice cream & other frozen dairy products	2012	14,104	0
Meat & poultry, incl prepackaged meats	2012	251,484	0
Fish & seafood, incl refrigerated prepackaged fish & seafood	2012	69,765	0
Candy, prepackaged cookies, & snack foods	2012	629,776	0
Bottled, canned, or packaged soft drinks & other nonalcoholic beverages	2012	176,831	0
All other groceries & food items	2012	2,547,272	0
Packaged liquor, wine, & beer	2012	910,745	0
Cigars, cigarettes, tobacco, & smokers' accessories, excl sales from vending machines operated by others	2012	474,164	0
Drugs, health aids, beauty aids, incl cosmetics	2012	99,382,762	0
Prescriptions	2012	79,923,621	0
Nonprescription medicines	2012	736,581	0
Vitamins, minerals, & other dietary supplements	2012	6,170,652	0
Cosmetics, incl face cream, make-up, perfumes & colognes, etc.	2012	5,645,531	0
Hearing aids & supplies	2012	42,219	0
Personal hygiene supplies	2012	2,990,031	0
Health aids & home healthcare equipment	2012	3,874,127	0
Household soaps, detergents, cleaners, & cleaning supplies	2012	270,014	0
Household cleaning supplies	2012	63,853	0
Household soaps, detergents, & cleaners	2012	206,161	0
Paper & related products, including paper towels, toilet tissue, wraps, bags, foils, etc.	2012	611,973	0
Paper & plastic tableware	2012	121,608	0
Gift wrap, gift bags, & tissue paper	2012	48,386	0
Paper towels, napkins, toilet & facial tissue, & food wraps, bags, foils & oth related products	2012	441,979	0
Men's wear, incl accessories	2012	8,063,254	0
Women's, juniors', & misses' wear, incl accessories	2012	19,014,200	0
Children's wear, incl boys', girls', & infants' & toddlers' clothing & accessories	2012	2,929,965	0
Costumes & unisex clothing	2012	863,053	0
Footwear, incl accessories	2012	7,506,985	0
Sewing, knitting, needlework goods, incl fabrics, patterns, sewing supplies, notions, yarns, laces, trimmings, needlework kits, etc.	2012	591,404	0
Curtains, draperies, blinds, slipcovers, bed & table coverings	2012	4,174,354	0
Major household appliances	2012	3,045,259	0
Small household appliances & personal care appliances	2012	3,265,241	0
TVs, DVD/Blu-ray players & recorders, camcorders, portable video players, e-book readers,DVDs, Blu-ray Discs, etc.	2012	8,093,506	0
Televisions & related parts & accessories	2012	3,232,380	0
Video content downloads	2012	522,161	1
DVD/Blu-ray Disc players, recorders, camcorders, portable video players, e-book readers, & relat ed parts & accessories	2012	3,179,135	0
Electronic game/DVD combination devices	2012	169,101	0
DVDs & Blu-ray Discs, prerecorded	2012	690,881	0
DVDs & Blu-ray Discs, recordable	2012	299,848	0
Audio equipment, musical instruments (new & used), radios, audio electronic components, CDs, records, tapes, audio books, sheet music, accessories	2012	8,014,975	0
Audio equipment, components, parts & accessories	2012	3,946,658	0
Audio books	2012	940,203	1
Pre-recorded compact discs, audio tapes, & records	2012	1,206,490	0
New & used musical instruments, sheet music, & related items	2012	1,147,354	0
Audio content downloads	2012	657,785	1
Recordable compact discs & audio tapes	2012	116,485	0
Furniture, sleep equipment & outdoor/patio furniture	2012	12,229,287	0
Upholstered furniture	2012	1,343,160	0

Sleep sofas, daybeds, futons, & other dual-purpose pieces	2012	490,736	0
Mattresses, box springs & air mattresses	2012	1,548,633	0
Office furniture, incl computer-related furniture	2012	1,815,051	0
Outdoor/patio furniture	2012	2,043,445	0
Other living room, dining room, kitchen & bedroom furniture	2012	4,498,641	0
Infants' furniture	2012	489,621	0
Flooring & floor coverings	2012	949,444	0
New & used computer hardware, software, & supplies, incl computer game software & tablet computers	2012	37,249,573	0
Computer & peripheral equipment	2012	30,875,253	0
Prepackaged (off-the-shelf) computer software, incl computer software downloads	2012	6,374,320	0
Kitchenware & home furnishings	2012	9,332,236	0
Outdoor charcoal grills, parts, accessories	2012	41,689	0
Decorative accessories & home furnishings	2012	5,998,145	0
Kitchenware	2012	3,292,402	0
Jewelry, incl watches, watch attachments, novelty jewelry, estate/antique jewelry, etc.	2012	7,110,705	0
Books, incl e-books	2012	5,411,761	1
Photographic equipment & supplies	2012	1,820,142	0
Toys, hobby goods, & games	2012	5,260,057	0
Toys, incl wheel goods	2012	2,555,947	0
Games, incl video & electronic games	2012	1,544,835	0
Hobby goods	2012	1,159,275	0
Optical goods, incl eyeglasses, contact lenses, sunglasses, etc.	2012	841,888	0
Sporting goods & recreational equipment	2012	9,702,770	0
Boats & other sport vehicles, parts & accessories	2012	1,115,763	0
New boats, canoes, kayaks, motors, parts & accessories	2012	510,351	0
Used boats, canoes, kayaks, motors, parts & accessories	2012	59,656	0
All-terrain vehicles (ATVs) & personal watercraft	2012	426,317	0
All other sports vehicles, parts & accessories	2012	119,439	0
Hardware, tools, & plumbing & electrical supplies	2012	3,954,696	0
Lawn, garden, & farm equipment & supplies	2012	4,665,276	0
Cut flowers	2012	1,757,140	0
Indoor potted plants & floral items	2012	347,531	0
Outdoor nursery stock	2012	474,707	0
Fertilizer, lime, chemicals, & other soil treatments	2012	18,367	0
Lawn & garden tools	2012	345,331	0
Lawn & garden machinery, equipment, & parts	2012	728,611	0
Farm machinery, equipment, & parts	2012	22,499	0
All other farm supplies, incl grain & animal feed	2012	32,422	0
All other lawn & garden supplies	2012	938,640	0
Dimensional lumber & other building/structural materials & supplies	2012	552,958	0
Paint & sundries	2012	3,450	0
Cars, trucks, motorcycles, & other powered transportation vehicles	2012	547,529	0
Automotive tires, tubes, batteries, audio equipment, parts, access	2012	8,222,683	0
Pets, pet foods, & pet supplies	2012	3,398,513	0
Baby goods not elsewhere classified, incl bottles, monitors, carriers, swings, etc.	2012	346,111	0
Used books, clothing, furniture, & other used items not elsewhere classified	2012	743,663	0
Used clothing, footwear, personal access, jewelry, & related products	2012	121,687	0
Used home furniture, household appliances, kitchenware, home furnishings, & home lawn & garden goods	2012	59,214	0
Used home entertainment, recreation, & culture products	2012	439,766	0
Used office furniture & exercise/fitness equipment	2012	7,765	0
Used hardware, tools, plumbing & electrical supplies, & building materials	2012	54,000	0
Used household & personal goods, not elsewhere classified	2012	61,231	0
All other merchandise	2012	30,160,741	0
Stationery products	2012	1,721,055	0
Office paper, incl computer printer, copier, fax, & typewriter cut sheet paper	2012	2,270,800	0
Office, school, & packaging supplies	2012	6,334,605	0
Office equipment	2012	3,919,219	0
Greeting cards, calendars, maps, road atlases	2012	319,091	0
Magazines & newspapers	2012	238,319	0
Luggage & leather goods	2012	636,991	0
Antiques, items over 100 years old	2012	633,496	0
Collectibles, incl items which are old, but less than 100 years old	2012	2,946,041	0
Art goods, incl original pictures & sculptures	2012	224,859	0

Telephones, cellular phones, phone batteries, answering machines, pagers, & navigation (GPS) equipment	2012	3,505,931	0
Souvenirs & novelty items	2012	2,077,402	0
Artificial/silk flowers, plants, & trees	2012	93,826	0
All other merchandise	2012	5,239,106	0
All other merchandise, excl lottery ticket sales/commissions	2012	1,015,001	0
All nonmerchandise receipts	2012	5,369,856	0
All other nonmerchandise receipts	2012	5,369,032	0

Flagged Receipts ($1000)	**$**	**7,531,910**	**2.33%**
Total Receipts ($1000)	**$**	**322,958,117**	

NAICS 511210 Software publishers

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	171,075,355	0
System software publishing	2012	37,993,209	0
Operating systems software publishing	2012	9,029,695	0
Network software publishing	2012	8,608,544	0
Database management software publishing	2012	11,275,377	1
Development tools and programming languages software publishing	2012	4,132,562	0
Other system software publishing	2012	4,947,031	0
Application software publishing	2012	74,165,779	0
General business productivity and home use applications publishing	2012	31,395,154	0
Game software publishing	2012	8,479,790	0
Cross-industry application software publishing	2012	16,348,214	0
Vertical market application software publishing	2012	7,334,799	0
Utilities software publishing	2012	3,797,935	0
Other application software publishing	2012	6,809,887	0
Information technology (IT) technical consulting services	2012	5,369,798	0
Application service provisioning, with or without integration of related services	2012	692,309	1
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	575,794	0
Licensing of rights to reproduce and distribute computer software	2012	1,922,188	0
Custom application design and development services	2012	3,364,982	0
Information technology (IT) technical support services	2012	9,153,018	0
Software related technical support services	2012	9,153,018	0
Information technology (IT) related training services	2012	5,335,903	0
Resale of merchandise	2012	17,361,560	0
Resale of merchandise - Computer hardware and software	2012	17,287,298	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	74,262	0
All other receipts	2012	15,140,815	0
All other receipts	2012	15,140,815	0

Flagged Receipts ($1000)	**$**	**11,967,686**	**7.00%**
Total Receipts ($1000)	**$**	**171,075,355**	

NAICS 518210 Data processing, hosting, and related services

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	107,994,265	0
System software publishing	2012	158,621	1
Application software publishing	2012	1,125,758	1
Information technology (IT) technical consulting services	2012	2,393,472	0
Application service provisioning, with or without integration of related services	2012	24,294,678	1
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	18,385,487	0
Business process management services - Financial	2012	6,519,566	0
Business process management services - Human resources	2012	503,813	0
Business process management services - Supply-chain management	2012	1,211,304	0
Business process management services - Customer relations management	2012	1,156,564	0
Business process management services - Vertical markets	2012	1,909,486	0
Other business process management services	2012	7,061,972	0
Website hosting services, with or without integration of related services	2012	12,081,543	1
Website hosting - With integration of related services	2012	11,064,365	0
Website hosting - Without integration of related services	2012	1,012,518	0
Collocation services	2012	1,504,498	1
Data storage services	2012	1,592,108	1
Data management services	2012	15,240,362	1
Video and audio streaming services	2012	4,151,831	1
Other data processing or IT infrastructure provisioning services	2012	2,414,950	1
Internet access services - Broadband (i.e., always-on)	2012	159,692	0
Internet access services - Narrowband (i.e., dial-up)	2012	2,482	0
Information and document transformation services	2012	1,422,336	1
Imaging and other data capture services	2012	979,520	0
Data conversion and migration services	2012	442,604	0
Custom application design and development services	2012	2,985,342	0
Network design and development services	2012	266,523	0
Computer systems design, development, and integration services	2012	445,120	1
IT infrastructure and network management services	2012	2,152,597	1
Network management services	2012	1,261,498	0
Computer systems management	2012	886,068	0
Information technology (IT) technical support services	2012	10,062,127	0
Software related technical support services	2012	4,692,241	0
Hardware related technical support services	2012	268,813	0
Combined hardware and software technical support services	2012	2,105,697	0
Auditing and assessing computer operations	2012	4,275	0
Data recovery services	2012	20,408	0
Disaster recovery services (business continuity services)	2012	1,134,536	1
Computer forensics	2012	16,562	0
Domain name registration services	2012	107,031	0
Other IT technical support services	2012	1,695,685	0
Resale of merchandise	2012	1,428,498	0
Resale of merchandise - Computer hardware and software	2012	1,067,854	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	360,644	0
All other receipts	2012	5,726,240	0
All other receipts	2012	5,726,126	0

Flagged Receipts ($1000)	**$67,718,938**	**62.71%**
Total Receipts ($1000)	**$107,994,265**	

NAICS 541511 Custom computer programming services

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	121,231,992	0
Maintenance and repair - Computer hardware and peripheral equipment	2012	87,907	0
Temporary staffing services	2012	2,595,476	0
Temporary staffing - Information technology (IT) staff	2012	2,595,476	0
System software publishing	2012	65,817	1
Application software publishing	2012	497,601	1
Information technology (IT) technical consulting services	2012	3,898,599	0
Application service provisioning, with or without integration of related services	2012	1,934,817	1
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	1,198,517	1
Website hosting services, with or without integration of related services	2012	729,425	1
Data storage services	2012	213,197	1
Video and audio streaming services	2012	109,850	1
Internet access services - Broadband (i.e., always-on)	2012	40,354	0
Internet access services - Narrowband (i.e., dial-up)	2012	2,217	0
Custom application design and development services	2012	84,402,439	0
Website design and development services	2012	17,959,035	0
Database design and development services	2012	12,235,535	1
Other custom application design and development services	2012	31,220,275	0
Customization and integration of cross-industry application software	2012	8,827,671	0
Customization and integration of vertical market application software	2012	7,812,191	0
Customization and integration of other packaged software	2012	6,224,397	0
Network design and development services	2012	1,314,442	1
Network security design and development services	2012	756,636	0
Network design and development services, other than security	2012	531,617	0
Computer systems design, development, and integration services	2012	3,547,851	1
Computer systems design services	2012	805,901	0
Computer systems design and development services	2012	1,661,646	0
Computer systems integration services, including telephony	2012	1,069,668	0
IT infrastructure and network management services	2012	2,574,533	1
Network management services	2012	834,227	0
Computer systems management	2012	1,740,306	0
Information technology (IT) technical support services	2012	13,070,599	0
Software related technical support services	2012	10,357,523	0
Hardware related technical support services	2012	191,636	0
Combined hardware and software technical support services	2012	1,472,047	0
Disaster recovery services (business continuity services)	2012	60,058	1
Computer forensics	2012	56,557	1
Domain name registration services	2012	17,792	1
Other IT technical support services	2012	914,986	0
Licensing of rights to reproduce and distribute computer software protected by copyright	2012	462,500	0
Rental and leasing of computer hardware	2012	25,282	0
Information technology (IT) related training services	2012	343,010	0
Engineering services	2012	806,536	0
Resale of merchandise	2012	1,668,678	0
Resale of merchandise - Computer hardware and software	2012	1,477,714	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	190,964	0
All other receipts	2012	1,642,345	0
All other operating receipts	2012	1,642,345	0

Flagged Receipts ($1000) **$24,555,992**
Total Receipts ($1000) **$121,231,992** **20.26%**

NAICS 541512 Computer systems design services

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	152,706,095	0
Maintenance and repair - Computer hardware and peripheral equipment	2012	1,401,765	0
Temporary staffing services	2012	464,688	0
Temporary staffing - Information technology (IT) staff	2012	464,688	0
System software publishing	2012	94,200	0
Application software publishing	2012	72,774	0
Information technology (IT) technical consulting services	2012	21,393,926	0
Application service provisioning, with or without integration of related services	2012	831,464	1
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	761,139	0
Website hosting services, with or without integration of related services	2012	160,560	1
Data storage services	2012	218,209	1
Video and audio streaming services	2012	50,364	0
Internet access services - Broadband (i.e., always-on)	2012	47,454	0
Internet access services - Narrowband (i.e., dial-up)	2012	2,151	0
Custom application design and development services	2012	24,489,829	0
Website design and development services	2012	2,088,636	0
Database design and development services	2012	4,053,548	1
Other custom application design and development services	2012	5,731,024	0
Customization and integration of cross-industry application software	2012	5,788,058	0
Customization and integration of vertical market application software	2012	3,504,691	0
Customization and integration of other packaged software	2012	3,323,872	0
Network design and development services	2012	2,278,186	0
Network security design and development services	2012	1,260,110	0
Network design and development services, other than security	2012	1,018,076	0
Computer systems design, development, and integration services	2012	73,633,251	0
Computer systems design services	2012	10,154,892	0
Computer systems design and development services	2012	6,398,288	0
Computer systems integration services, including telephony	2012	56,948,219	1
IT infrastructure and network management services	2012	1,774,741	1
Network management services	2012	985,156	0
Computer systems management	2012	789,585	0
Information technology (IT) technical support services	2012	13,685,206	0
Software related technical support services	2012	3,620,510	0
Hardware related technical support services	2012	899,026	0
Combined hardware and software technical support services	2012	8,293,183	0
Disaster recovery services (business continuity services)	2012	178,721	1
Computer forensics	2012	66,287	0
Domain name registration services	2012	21,493	0
Other IT technical support services	2012	605,986	0
Licensing of rights to reproduce and distribute computer software protected by copyright	2012	146,442	0
Rental and leasing of computer hardware	2012	249,059	0
Information technology (IT) related training services	2012	979,288	0
Engineering services	2012	484,896	0
Resale of merchandise	2012	7,211,166	0
Resale of merchandise - Computer hardware and software	2012	6,880,073	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	331,093	0
All other receipts	2012	2,182,565	0
All other operating receipts	2012	2,182,565	0

Flagged Receipts ($1000)	**$64,165,462**	**42.02%**
Total Receipts ($1000)	**$152,706,095**	

NAICS 541513		Computer facilities management services	
Product Description	**Year**	**Total Receipts ($1000)**	**Flagged Product**
Industry total	2012	34,241,591	0
Maintenance and repair - Computer hardware and peripheral equipment	2012	138,934	0
Temporary staffing services	2012	80,637	0
Temporary staffing - Information technology (IT) staff	2012	80,637	0
Application software publishing	2012	3,807	0
Information technology (IT) technical consulting services	2012	409,810	0
Application service provisioning, with or without integration of related services	2012	1,143,896	0
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	3,028,982	0
Website hosting services, with or without integration of related services	2012	101,958	1
Data storage services	2012	130,849	1
Video and audio streaming services	2012	75,592	1
Internet access services - Broadband (i.e., always-on)	2012	25,729	0
Custom application design and development services	2012	4,423,225	0
Website design and development services	2012	106,156	0
Database design and development services	2012	4,163,935	1
Other custom application design and development services	2012	60,274	0
Customization and integration of cross-industry application software	2012	57,916	0
Customization and integration of vertical market application software	2012	21,399	0
Customization and integration of other packaged software	2012	13,545	0
Network design and development services	2012	502,883	0
Network security design and development services	2012	150,565	0
Network design and development services, other than security	2012	352,318	0
Computer systems design, development, and integration services	2012	5,023,457	0
Computer systems design services	2012	66,599	0
Computer systems design and development services	2012	104,718	0
Computer systems integration services, including telephony	2012	4,852,140	0
IT infrastructure and network management services	2012	12,880,648	0
Network management services	2012	1,988,049	0
Computer systems management	2012	10,892,599	0
Information technology (IT) technical support services	2012	3,654,650	0
Software related technical support services	2012	427,408	0
Hardware related technical support services	2012	1,290,290	0
Combined hardware and software technical support services	2012	1,167,268	0
Disaster recovery services (business continuity services)	2012	67,622	1
Computer forensics	2012	8,579	0
Domain name registration services	2012	6,187	0
Other IT technical support services	2012	687,296	0
Licensing of rights to reproduce and distribute computer software protected by copyright	2012	13,554	0
Rental and leasing of computer hardware	2012	10,210	0
Information technology (IT) related training services	2012	52,661	0
Engineering services	2012	85,985	0
Resale of merchandise	2012	729,662	0
Resale of merchandise - Computer hardware and software	2012	683,416	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	46,246	0
All other receipts	2012	1,724,430	0
All other operating receipts	2012	1,724,430	0

Flagged Receipts ($1000)	**$**	**4,539,956**	**13.26%**
Total Receipts ($1000)	**$**	**34,241,591**	

NAICS 541519 Other computer related services

Product Description	Year	Total Receipts ($1000)	Flagged Product
Industry total	2012	17,851,607	0
Maintenance and repair - Computer hardware and peripheral equipment	2012	78,457	0
Temporary staffing services	2012	182,303	0
Temporary staffing - Information technology (IT) staff	2012	182,303	0
System software publishing	2012	1,342	0
Application software publishing	2012	47,838	0
Information technology (IT) technical consulting services	2012	7,093,912	0
Application service provisioning, with or without integration of related services	2012	74,887	0
Business process management services, including financial, human resources, supply-chain, customer relations, and vertical markets management	2012	100,166	0
Website hosting services, with or without integration of related services	2012	336,077	1
Data storage services	2012	280,141	1
Video and audio streaming services	2012	5,508	1
Internet access services - Broadband (i.e., always-on)	2012	28,318	0
Internet access services - Narrowband (i.e., dial-up)	2012	1,661	0
Custom application design and development services	2012	867,965	0
Website design and development services	2012	319,260	0
Database design and development services	2012	104,087	1
Other custom application design and development services	2012	74,310	0
Customization and integration of cross-industry application software	2012	277,624	0
Customization and integration of vertical market application software	2012	45,566	0
Customization and integration of other packaged software	2012	47,118	0
Network design and development services	2012	203,350	0
Network security design and development services	2012	103,826	0
Network design and development services, other than security	2012	99,524	0
Computer systems design, development, and integration services	2012	230,624	0
Computer systems design services	2012	83,709	0
Computer systems design and development services	2012	58,702	0
Computer systems integration services, including telephony	2012	88,213	0
IT infrastructure and network management services	2012	410,691	0
Network management services	2012	285,199	0
Computer systems management	2012	125,492	0
Information technology (IT) technical support services	2012	6,885,045	0
Software related technical support services	2012	924,871	0
Hardware related technical support services	2012	143,090	0
Combined hardware and software technical support services	2012	2,701,186	0
Disaster recovery services (business continuity services)	2012	116,933	1
Computer forensics	2012	131,331	0
Domain name registration services	2012	1,289,791	0
Other IT technical support services	2012	1,577,843	0
Licensing of rights to reproduce and distribute computer software protected by copyright	2012	191,712	0
Rental and leasing of computer hardware	2012	2,764	0
Information technology (IT) related training services	2012	173,445	0
Engineering services	2012	66,770	0
Resale of merchandise	2012	405,274	0
Resale of merchandise - Computer hardware and software	2012	398,822	0
Resale of merchandise - Other merchandise, excluding computer hardware and software	2012	6,452	0
All other receipts	2012	183,357	0
All other operating receipts	2012	183,357	0
Flagged Receipts ($1000)		**$ 842,746**	**4.72%**
Total Receipts ($1000)		**$ 17,851,607**	