Offshoring and the Effects on American IT Workers.

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Abstract:

This paper will use an existing model from Amiti and Wei (2009) to illustrate the potentially positive effects that offshoring will have on the productivity of American IT workers and the IT industry. The inputs that will be used to measure productivity are labor, capital, materials, service inputs, and the offshoring of materials and services and were collected from the Bureau of Economic Analysis and the Bureau of Labor Statistics. Based on a previous study from Amiti and Wei (2009), the results may suggest that there is a positive correlation from offshoring and productivity.

JEL Classification: O47, L86, F16

Key words: Productivity, Information Technology Industry, Trade and Labor Market

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1.0 INTRODUCTION

For the past 30 years offshoring has been a widely debated topic by policy makers and the public. Offshoring can be defined as the relocation of jobs or production to a foreign country (Garner, 2004). Until recently, manufacturing was the first sector in the United States to see major job loss because of import competition (Garner, 2004). This led many companies to set up global production networks of manufactured inputs that enabled firms to manufacture products overseas (Amiti and Wei 2009). While many manufacturing jobs in the United States were being threatened by offshore competition, the service sector felt job security because services were still viewed as untradeable.

With the emergence of new technologies in the 1990's and 2000's, industries found new ways to offshore service inputs. The offshoring of service jobs is a recent trend that has led many Americans to worry about job loss in high-skilled and high-waged professions like computer programming and accounting. In addition, low wage/low skilled IT jobs, for example call centers, are now being relocated to countries that offer lower production costs (Garner, 2004). Since 2004, "Just under a million Americans lost their jobs as a result of unscheduled mass layoffs and approximately 12% of these layoffs can be attributed to movement of work" (Kirkegaard, 2008). This recent trend has led many Americans to worry about how offshoring will effect employment and the standard of living. Therefore, this paper will focus on the effects that offshoring will have on the United States. More specifically, this paper will look at the effect offshoring will have on the IT industry because of the recent studies that suggest people in IT will be impacted the most by offshoring.

In order to measure the effect of offshoring on the productivity of workers in the IT industry, this paper uses an existing empirical model from Amite and Wei (2009). Three research objectives will differentiate this paper from other studies. First, this paper will focus on a specific country and the effects that offshoring will have on the productivity of workers in America. Second, the paper will be industry specific. It will focus on the offshoring of information technology (IT) jobs and the effect it may have on the industry in the United States. Last, the paper will focus on the effects of offshoring in the IT industry from 1987 to 2009. There have been many studies conducted on the offshoring of service jobs and the effects it has on American jobs. However, there are only a few studies that looked at offshoring and the effects it will have on the IT industry in America.

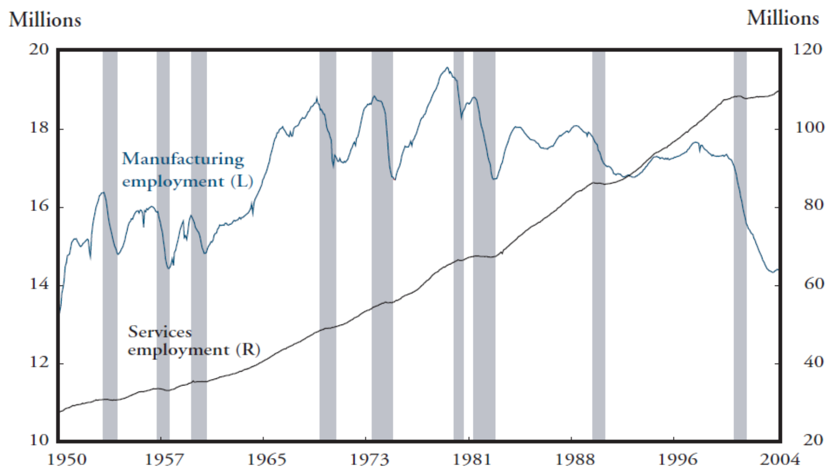
The remainder of this paper will be organized in the following manner: Section 2 has the trend and section 3 will have the literature review. Section 4 will look at the empirical model and data. In section 5, the empirical results will be presented. Section 6 is the conclusion.

2.0 TREND

Many people are worried about American jobs being offshored and what that could have in store for the U.S. economy. But what many people have yet to realize is that the U.S. has seen similar cases of offshoring in the past. According to Blinder (2006), the first example of offshoring was the movement of agriculture. Prior to the industrial revolution, the majority of America's population was involved with farming: "In 1810, 84 percent of the U.S. work force was engaged in agriculture, compared to the 3 percent in manufacturing" (Binder, 2004). When the industrial revolution began in the late 1700's and early 1800's, many workers migrated from the farms to the factories. As manufacturing became more prominent and more workers migrated, the economy saw its first shift with the majority of the labor force working in manufacturing. By 1960, 25% of the population worked in factories, while only 8% still worked on farms (Blinder, 2006). While working in factories, people were able to earn a steady wage, hold a steady job, and were able to provide more for the family. This provided more stability in people's lives then what was provided while working on farms. In addition to moving to more urbanized areas, people become more educated and changed the way that they did business. This provided a better life for the workers and increased the standard of living.

As people moved to the cities and as more emphasis was put on education, the skill sets of the population also changed. With more people in the 1900's achieving a high school and college education, work shifted from manufacturing to the service sector. Skilled and educated people are seeking jobs in industries like accounting, finance, medicine, technology, engineering, travel, and education. This created another shift: "In 1960, 35% of the nonagricultural workers in the United States produced goods and 65% produced services." (Blinder, 2006). By 2004, one-sixth of the nonagricultural jobs were in good producing industries and five-sixths were in services. Technology and engineering industries were able to create technology and expertise that allowed for companies to produce overseas. As companies realized the potential cost savings, many manufacturing jobs in the United States were destroyed and sent to other countries. The loss of manufacturing jobs to other countries alarmed many Americans. But at a time when manufacturing jobs were disappearing, service sector jobs were and are growing twice as fast as manufacturing jobs are disappearing, which is depicted in Figure 1 (Blinder, 2006).

Figure 1: Job Shifts Concentrated in Manufacturing

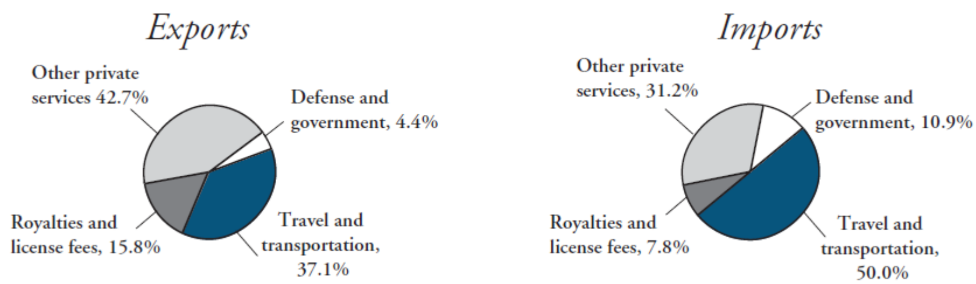


Source: U.S. Department of Labor, Bureau of Labor Statistics, Garner (2004)

Similar to when jobs shifted from agricultural to manufacturing, life styles also shifted when jobs shifted from manufacturing to services. More emphasis is being put on higher education, obtaining a high skill set, obtaining a professional job, and making a sustainable living. This increased the average wage earned by Americans, the average household income, and overall prices in the economy. The shift from manufacturing also created new innovations in technology, created new markets, and a new way of doing business.

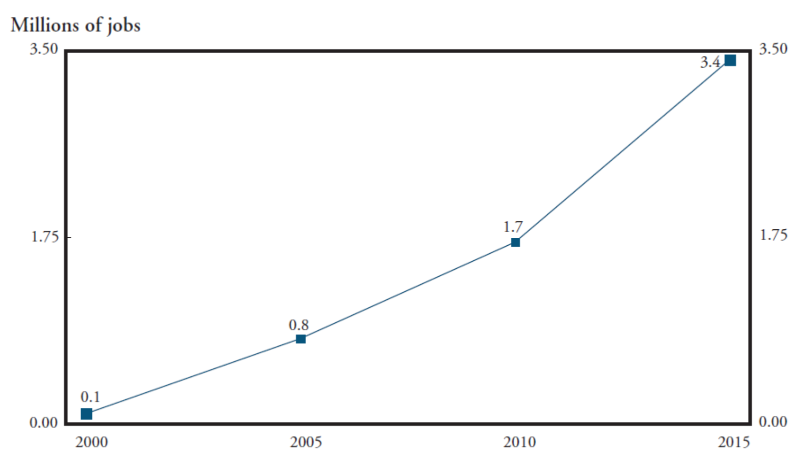
The shift is starting to happen again. Technological improvements have made it easier to send and receive information rather quickly over various internet networks. Services that were once deemed as “untradeable” have become “tradeable” (Blinder, 2006). The cheap and relatively easy flow of information has allowed many companies to offshore departments to other countries to save on lower labor costs and keep the departments that are the company’s core competencies. The realization of cost savings has increased the rate at which jobs are offshored. The amount of jobs being offshored has increased from 200,000 to 300,000 jobs a year (Garner, 2004). In 2003, international trade in services expanded to cover many different types industries. Some industries that have been impacted include travel, defense and government, transportation, education, insurance, financial services, and information technology, which is shown in Figure 2 (Garner, 2004). According to Garner (2004), 6 million jobs are expected to be offshored within the next decade, which was also based on a Goldman Sachs study. Figure 3 depicts the estimated number of jobs to be outsourced by 2015.

Figure 2: Concentration of Service Exports and Imports, 2003



Source: U.S. Department of Commerce and Garner (2004)

Figure 3: Total Number of U.S. Jobs Moving Offshore 2000 to 2015



Source: McCarthy (2002), McCarthy (2004), Garner (2004)

Previous studies infer that offshoring has not reached its peak yet. More service sector jobs are expected to be offshored within the next decade and it is hard to say how each industry will be impacted. Similar to the shifts from agriculture to manufacturing and manufacturing to services, another shift will take place. Business will be done on a more global level and the desired education and skill set will shift once again.

3.0 LITERATURE REVIEW

Measuring offshoring and the effects that it has on industries and job growth can be extremely difficult. Previously conducted studies have taken many different approaches or have adapted models from previous studies to measure offshoring and its effects. However, one thing remains consistent among the different studies: the majority of studies conducted have found that offshoring has had a positive effect on productivity and job growth. Amiti and Wei (2009) conducted the first study that found positive correlation between offshoring and productivity growth. Using an empirical model, they have concluded that service offshoring has a positive effect on productivity in the manufacturing sector by 10% (Amiti and Wei, 2009). Offshoring also allows companies to focus on their expertise, which allow the companies to grow their business and become more productive and profitable (Demiroglu, 2008). The study conducted by Amiti and Wei (2209) has also concluded that material offshoring has a positive effect on overall productivity.

Kohler and Wrona (2010) infer that the trade of tasks overseas involves a twin margin of adjustment. The extensive margin of adjustment is when jobs are lost due to firms increasing the amount of tasks that are done offshore because of low cost. The intensive margin is when jobs are created because the overall savings from offshoring prompts companies to expand employment for all of the tasks. Using theoretical models, Kohler and Wrona (2010) concluded that in most industries net job creation will be met depending on the level of the industries offshoring technology. In addition, net job creation will be met at later stages in offshoring where technological development influences the offshoring of personal tasks (Kohler and Wrona 2010).

Offshoring will have the biggest effect on industries that are more information technology based because they account for the most technological improvements that allow for the offshoring of personal tasks and they are able work over a vast area of networs (Garner, 2004).

Kirkegaard (2008) used empirical analysis from the main OECD countries to distinguish the extent of offshoring in their labor markets. The research of Kirkegaard (2008) established that 10% to 20% of jobs will be affected in the service sectors than in the manufacturing sector in most OEDC countries. In addition, data suggests that low-wage and low-skilled jobs are rapidly disappearing, while high-wage and high-skilled jobs are continuing to be created. Kirkegaard (2008) also established a three-tier data hierarchy to identify the impacts of offshoring on the OECD. The model established by Kirkegaard (2008) has been adapted and used by many other studies about the effects of offshoring.

The research conducted by Mann (2003) has found that the globalization of IT services has led to lower prices of software and services. Many companies have offshored the production of IT products because the cost to produce in certain countries is significantly lower than the cost to produce in the United States (Garner, 2004). In addition, globalization of IT services has led to IT jobs being performed overseas. Between 1994 and 2004 it estimated that 50,000 jobs has been offshored (Demiroglu, 2008). As prices and production costs continue to decrease, we can except this to lead to another wave of productivity growth, which will lead to more job growth in the United States (Mann, 2003).

4.0 DATA AND EMPIRICAL MODEL

4.1 DATA

The data used for this study was collected for the IT industry in the United States from 1987 to 2009. Finding data to measure the amount of IT services being offshore was extremely difficult at first because it is information that is not commonly released by private firms. After reviewing many different data sources, data was found and collected from the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS). In order to accurately reflect how offshoring effects worker productivity by accounting for industry effects and technology advancements, the log of the variables output, labor, capital, materials, and services had to be calculated (Amiti and Wei, 2009). The summery statistics for the data is provided in Table 1.

Table 1 Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Y	23	182.41	79.02	56.18	317.44
L	23	20338.43	12402.76	3210.31	36809.00
K	23	652.67	297.54	323.14	1131.91
S	23	5.15	70.62	69.50	268.90
M	23	96.64	30.59	47.59	163.56
OSS	23	205.42	97.92	90.79	403.41
OSM	23	148.90	73.96	0.00	236.93
Ln(Y)	23	5.10	0.51	4.03	5.76
Ln(L)	23	9.66	0.82	8.07	10.51
Ln(K)	23	6.38	0.46	5.78	7.03
Ln(S)	23	5.15	0.45	4.24	5.59
Ln(M)	23	4.52	97.92	3.86	5.10

4.2 EMPIRICAL MODEL

The empirical model that was used for this study was adapted from Amiti and Wei (2009). The production function for the IT industry can be written as:

$$Y_i = A_i(oss_i, osm_i)F(L_i, K_i, S_i)$$

The estimation equation for the IT industry can be written as:

$$\begin{aligned}\Delta \ln Y_{it} &= \propto_0 + \propto_1 \Delta oss_{it} + \propto_2 \Delta osm_{it} \\ &+ \beta_3 \Delta \ln L_{it} + \beta_4 \Delta \ln M_{it} + \beta_4 \Delta \ln S_{it} \\ &+ \delta_t D_t + \delta_i D_i + \varepsilon_{it}\end{aligned}$$

The subscripts I and T denote the country and the industry that the model will be using. In both the production function and the estimation equation, the meanings of the variables are consistent. However, to account for differences in technology and various industry effects from 1987 to 2009, the natural log has to be taken for output, materials, labor, and service inputs.

The dependent variable used in the empirical model and in this study is output, which is represented as Y. Y is measured as the total output that was produced by the computer and information industry in the United States between 1987 and 2009, which will be used to measure productivity. The data that was collected for Y was collected from the BLS. According to Amiti and Wei (2009), there are several different channels that can affect the productivity of workers when jobs within their industry are outsourced. One of the channels is static efficiency gains (Amiti and Wei, 2009). Static efficiency gains increases productivity because as different companies relocate the less efficient software and computer related jobs overseas, it allows the firms to focus on their more efficient software and computer producers and how those activities are performed. In addition to allowing the different IT firms to be able to focus on their core competences within the IT department, offshoring will help increase productivity by helping the firms core IT positions engage and create new technology. This new technology could be created by restructuring the departments to engage in developing new technology or by importing other less efficient services (Amiti and Wei, 2009).

The six independent variables include materials, labor, capital, service inputs, offshoring of services, and offshoring of materials. Cost of materials is represented as M and the data was obtained from the BLS. M is measured as the total cost of materials from the computer and information industry in billions of dollars. The second independent variable is the cost of labor, which is represented as L. L is measured as the total labor compensation for software producers in millions of dollars. Capital is represented as K and is the real capital input for computer design and data processing. K is measured as inputs against an index equal to 100. The fourth independent variable is service inputs, which is shown as S. S is the total amount of employed software publishers in thousands. Offshoring of services is depicted as OSS and is measured as U.S. direct foreign investment abroad in the IT industry in billions of dollars. The last independent variable, offshoring of materials, is represented as OSM. OSM is measured as the total yearly imports of computer and software related goods in millions of dollars. The data for M, K, L, and S was found in data tables from the BLS. The data for OSS and OSM was retrieved from the BEA. This is also shown in Appendix A.

5.0 EMPIRICAL RESULTS

In this study, three different regressions were performed to see how different trends in offshoring (offshoring of materials and offshoring of services) affect the productivity of workers in the United States. The results from the regressions reinforce the conclusions of previous studies that offshoring has a positive effect on productivity. For each regression, the natural log was taken for Y, L, K, S, and M. The results for the three regressions are found in Table 2.

The first regression had an R^2 value of .9776. The R^2 value is a way of measuring how well the independent variables explain the dependent variable and is between 0 and 1. The closer the

R^2 value is to 1, the better fit the independent variables are to the dependent variable. In the first regression, the overall fit of the model is significant. The independent variables that are statistically significant in the productivity of IT workers in the U.S. are L, K, S, and OSS. The statistically significant variables can be interpreted as: for every 1% increase in the cost of labor, the productivity of workers will fall by .77%. As capital inputs increases by 1%, the productivity of workers will fall by .50%. When the number of IT workers increases by 1%, the productivity of workers will increase by 2.23%. Lastly, if offshoring of services increases by 1 unit, then worker productivity will increase by .003%. The variables that are not statistically significant are OSM and M. In the first regression the signs of coefficients came out as expected, which can be seen in Appendix B. It was expected that as the cost of labor, capital, and materials increased, workers would be less productive because of the potential job loss that would result in increased costs.

In the second regression, OSM was taken out to see if OSS has a greater impact on Y without accounting for OSM because OSM is a recent trend. The R^2 value in the second regression had fallen to .9769. However, this shows that the independent variables are still strongly correlated to Y. The independent variables that are statistically significant to Y in this regression are L, K, M, and OSS. Unlike the first regression, M became significant and S became insignificant in relation to Y. The significant variables can be explained as: for every 1% increase in the cost of labor, worker productivity will fall by .81%. As capital inputs increases by 1%, worker productivity will fall by .58%. When the cost of materials for the IT industry increases by 1%, then the productivity of workers will fall by .03%. Lastly, as offshoring of services increases by 1 unit, then worker productivity will fall by .003%. Similar to the first model, the signs for the coefficients came out as expected. It is expected that as the cost of labor, capital, and materials increases then worker productivity will decrease. The signs for S and OSS are positive, as expected, because it is expected that as more service inputs and offshoring takes place in the IT industry, that productivity will increase.

The third regression included L, K, S, M, and OSM. OSS was taken out of the regression to see how the recent trend in offshoring of materials has affected the IT industry from 1989 to 2009. Like the first two regressions, the R^2 value for the third regression showed that the independent variables were a good fit to the dependent variable. However, this regression has different statistically significant independent variables. Unlike the two other regressions, this regression has L, S, M, and OSM being statistically significant to worker productivity. It also has K as being statistically insignificant to worker productivity. The significant variables can be described as: when the cost of labor increases by 1%, worker productivity decreases by .50%. Similarly, when the number of employees increases by 1%, worker productivity will increase by 1.60%. When the cost of materials increases by 1%, worker productivity will decrease by .39%. Lastly, when offshoring of materials increases by 1 unit, worker productivity will decrease by .003%. Like the other two regressions, the signs for the coefficients can be as expected.

Based on previous completed studies, it is expected that increases in S, OSS, and OSM will increase worker productivity, which is shown by the sign of the coefficients. As the amount of workers in the IT industry increases, the workers will be able to produce more output. This increase in input can also be seen as increasing productivity. The three regressions also show that as OSS increases, Y increases. Y is increasing because firms are able to outsource their none core IT competencies in order to better focus on the more efficient IT services that the company provides. Focusing on core IT competences also leads to creating new technology that could be used to help workers and offshore materials.

It is hard to discover the policy implications of the effects of offshoring on the IT industry in the United States in the long run. Many of the previous studies that have been conducted seem to see offshoring as having a positive effect on the IT industry and the United States. Mann (2003) suggests that the continuation of offshoring of IT jobs will lead to lower production costs for companies, which will result in lower prices of computer related goods. It is also suggested that lower production costs will lead companies to want to spark more technological innovation. Innovation that would lead to the development of new products, GDP growth, and job growth. Technological innovation will also allow the U.S. to produce computer related goods and other products more efficiently (Mann, 2003). Both Kirkegaard (2008) and Kohler and Wrona (2010), suggests that the lower costs of production and new technology will result in overall job creation in different types of IT positions in the United States. As certain positions are being offshored, higher skilled jobs will be created in America to monitor, train, and work with the people that are located overseas. Jobs will also be created in the core IT functions of a firm to develop new products and develop new markets that are being created when jobs are being offshored to other countries. According to Demiroglu (2008), the United States has not seen the last of offshoring. He is expecting the amount of offshoring to continue to increase within the next fear years and is expecting that certain industries will be hit harder than other industries (Demiroglu, 2008).

Table 2: Empirical Results for Productivity

	Y		
	I	**II**	**III**
Constant	3.824798 (.9271319)	3.513941 (.7969608)	3.763619 (1.071861)
L	-0.7728245*** (0.2643188)	-0.8093365 *** (.2548949)	-0.495566 * (.2796027)
K	-0.5035673 ** (.2258385)	-.583436 *** (.1906978)	-0.1470791 (.2073231)
S	2.232352 *** (.4950415)	2.427958 (.3989427)	1.60156 *** (.4987627)

M	-0.078806 (.1743678)	-0.0332826 *** (.1588089)	-0.3902659 *** (.1463022)
OSS	0.0031615 *** (.0012181)	0.0037416 *** (.0008654)	
OSM	0.0010712 (.0015568)		0.0038679 *** (0.0012995)
R^2	0.9776	0.9769	0.9681
F-Statistics	116.19	143.79	103.25
Observations	23	23	23

Note: *** , **, and * denotes significance at the 1%, 5%, and 10% .
Standard errors are in parentheses.

6.0 CONCLUSION

This paper used empirical analysis to show that the offshoring of IT jobs in the United States has a positive effect on worker productivity. The results show that higher cost of labor, capital, and materials leads to a decrease in productivity in the IT industry. Based on previous studies, offshoring in the IT industry is far from over. The IT industry will be one of the most impacted industries in the United States. Jobs will move overseas at an increasing rate, but we can expect to benefit from this as a country. As companies offshore their non-core IT functions, it will allow them to focus on their more functions and save in labor costs. This will create job growth in core departments and innovation from core IT functions that could lead to the development of new products and the establishment of new international markets, which will result in overall GDP growth. Offshoring and technological innovation will also result in more job creation. Jobs will be created to develop new technologies, work with existing and new technology, and to work and train employees that are overseas. This will also increase the standard of living as wages will increase for more prominent positions within the service sector.

Therefore, as jobs are being offshored at a drastic rate, one can infer that the overall impact on the country will be more beneficial then harmful. Similar to what happened to the agricultural sector and the manufacturing sector, service sector jobs will be offshored, but will not disappear completely (Blinder, 2006). Eventually, we may see another shift in our economy, education, skill sets, and standard of living.

Appendix A: Variable Description and Data Source

Acronym	Description	Data Source
Y	Productivity measured as the total output produced by the IT industry.	Bureau of Labor Statistics
L	Labor is the total compensation for software produces in millions of dollars.	Bureau of Labor Statistics
K	Capital is the real capital input for computer design and data processing, which is measured against an index of 100.	Bureau of Labor Statistics
S	Service inputs is the total amount of employed software produces in thousands.	Bureau of Labor Statistics
M	Materials is the total cost of materials from the computer and information industry in billions of dollars.	Bureau of Labor Statistics
OSS	Offshoring of services is measured as the U.S. direct foreign investment abroad by the IT industry in billions of dollars.	Bureau of Economic Analysis
OSM	Offshoring of materials is the annual imports of computer and software related goods in millions of dollars	Bureau of Economic Analysis

Note: The natural log was taken for Y, L, M, S, and K to account for industry and technology changes from 1987 to 2009.

Appendix B: Variables and Expected Signs

Acronym	Variable	Description	Expected Sign

Y	Productivity	Total output produced by the IT industry.	+
L	Cost of Labor	Total compensation for software produces in millions of dollars.	-
K	Capital	Real capital input for computer design and data processing, which is measured against an index of 100.	-
S	Service Inputs	Total amount of employed software produces in thousands.	+
M	Cost of Materials	Total cost of materials from the computer and information industry in billions of dollars.	-
OSS	Offshoring of Services	U.S. direct foreign investment abroad by the IT industry in billions of dollars.	+
OSM	Offshoring of Materials	Annual imports of computer and software related goods in millions of dollars	+

Note: The natural log was taken for Y, L, M, S, and K to account for industry and technology changes from 1987 to 2009.

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