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Long Run Employment and Income Growth: A by Sector Analysis

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by

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Given today's economic conditions it is becoming more essential to gain a better understanding of long run economic development in the US. This paper seeks to find economic sectors that show a significant impact on employment and income growth. This was done by estimating the elasticities for individual sectors (Manufacturing, Trade, Information, Business Services and Finance, Health and Education, and Other) and using a growth accounting approach to determine the contributions of labor for each. Over the sample period years (2001-11) it was found that business services and finance had the highest contribution to labor growth with an average annual growth of 15.7% for total output and 6.5% for total employment. In contrast, the manufacturing sector had an average annual growth of 0.14% for total output and -2.77% for employment over the same period. In the most recent years, 2010-11, the contribution of labor accounted for 8.1% of output growth in manufacturing versus 17.5% in the business services and finance sector. This suggests that there are structural changes occurring in today's economy, and there is benefit to long run economic planning at the local level.

Keywords: Regional economics, long run growth, contributions of labor, employment, local economic planning

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Introduction

Given today's economic conditions it is essential to gain a better understanding of economic development and how it relates to long-term growth in the United States. Economists debate over many growth theories (Classical, Neoclassical, the Big Push, etc…), but in depth analysis has not yielded a definitive answer as to which one to follow. This paper aims to find areas of the economy that show a significant impact on employment and income growth.

This research considers the breakdown of contributions to employment and income growth by the individual sectors of the economy (Manufacturing, Trade, Information, Business Services and Finance, Health and Education, and Other) using regional data from defined metropolitan statistical areas within the United States. This study is not meant to be conclusive, but an effort to increase the understanding of how long-term employment and income growth can be stimulated in the US.

In this research it was found that, over the sample period (2001-11), business services and finance had the highest contributions to output and employment growth. This sector averaged 15.7% annual output growth and 6.5% annual employment growth and also employs nearly twice as many people as manufacturing. This was substantially higher than what was seen in the manufacturing sector. The manufacturing sector averaged 0.14% and -2.77% annual output and employment growth respectively. This could potentially be blamed on outsourcing. However, since 2009, the sector has experienced average annual output growth of 4.8% and annual employment growth of only 0.6%. The percent increase in output accounted for by the increase in employment, or the contribution of labor, for the manufacturing sector since 2009 was 8.1% versus 17.5% for the contribution of labor in the business services and finance sector. This implies that the growth in the manufacturing sector is coming through investment in automated production equipment and does not significantly contribute to employment growth. This suggests a new core industry developing within the United States economy. There are benefits to planning economic investments within an MSA (Metropolitan Statistical Area) in a way that diversifies away the industry specific risk to employment and output growth and focuses on long-run economic development.

Certain events are viewed as random occurrences, yet for every random occurrence there is a cause. The problem lies in the inability to understand the system, and how different systems interact. To understand a system, it is essential to uncover its most basic driving forces. Technology is the most basic driving force in the labor market. The evolution of the labor market is a direct result of the development of technology. This can be observed throughout history beyond the shifts in the relatively short span of US history.

Throughout history, humans developed tools and knowledge to use them to fulfill their needs. Technology has not developed at any constant rate. Instead it appears to develop in spurts. Consider the stone hand axe, believed to be the oldest piece of human technology. How did this simple tool change the way humans would have gone about everyday activities? Throughout time, humans have developed tools to accomplish tasks more efficiently and improve the quality of life.

According to Maslow's hierarchy of needs, Physiological, Safety, Belongingness and Love, Esteem, Self-Actualization, and Self-Transcendence, physiological needs are the most basic necessities required for sustaining life. Physiologic needs motivate individuals to exert at least the minimum amount of effort required to do this or "work". The nature of everyday employment has changed from gathering food to working a "job" where one is paid with currency and allowed to use it to purchase food and other goods. The second need, "Safety," causes individuals to exert additional effort beyond mere survival. This causes people to save instead of consuming everything as soon as it is obtained. Continuing through the needs, we must fulfill and master each successive need before proceeding to the next need in the hierarchy. This constant desire to achieve more has driven the innovation of technology, improving the productivity of a society.

Review of Current Literature

To analyze long-term employment and stability without first examining the historical dynamics of the labor market would be akin to discussing classical economic theory without mentioning Adam Smith. Throughout its history, the labor market in the United States has experienced two dynamic structural shifts. The first shift occurred during the industrial revolution as unskilled operators replaced skilled artisans. As a result, the landscape of the US economy drastically changed. Prior to the industrial revolution, skilled artisans produced goods locally with little transportation of goods between regions. The second major shift began with the innovation of modern communications technology and the dynamics continue to influence the economy.

Historical Background

The industrial revolution brought about a capital deepening to US manufacturers. As machines were developed that improved labor productivity, there was a shift in the US from small, local, artisanal shops to factories to continuous processing (Goldin and Katz, 1998). This shift was toward more capital and less labor-intensive methods of manufacturing. This caused a shift in the labor market displacing many mid-skill jobs in artisanal shops for low-skill operators and laborers in factories. The use of specialized equipment and the division of labor allowed for labor productivity gains, however, these were exhausted at low levels of capital (Sokoloff, 1984, 1986).

Prior to 1850, factories were located around waterways to take advantage of hydropower. This limited the number of factories that could be built due to the limited number of locations that had a stable power source. The gains to labor productivity could be much greater if the equipment had an inanimate energy source. Additionally, the gains to productivity were increasing with firm size (Atack, Bateman, & Margo,2008). After 1850, steam became the preferred energy source as this allowed factories to locate away from rivers, thereby increasing the number of locations where factories could be built. The use of inanimate power sources brought about increased productivity and larger firm sizes. This led to an increase in management's challenges as firms distributed their products over wider geographical areas (Chandler, 1977). Katz and Margo (2013), found a positive relationship between capital deepening and firm size. Much of the capital deepening was attributed to the diffusion of inanimate power sources (Atack, Bateman, & Margo, 2004).

The third phase of development, continuous process, differed from the factory in that it was more capital intensive and used an electric energy source (Devine, 1983; Goldin & Katz, 1998). With the increasing availability of electricity, the US manufacturing sector shifted away from the use of steam. This eliminated a whole category of low-skill jobs involved in the movement of bulky raw materials and products within the plant. This shift was also accompanied by an increased demand for skills gained from formal schooling and for mid-skilled, blue-collar workers. This shift further increased the challenges faced by management as the average firm size grew. Firm size was positively correlated with the demand for skilled labor (Brissenden, 1929; Davis & Haltiwanger, 1991; Goldin & Katz, 1998; Atack, Bateman, & Margo, 2004).

The use of equipment in the manufacturing sector led to increased productivity and output. This boom was made possible by a similar revolution in the transportation sector, giving firms greater access to coal over a wider geographic area and thereby reducing the cost of using steam power (Atack, 1979; Atack, Bateman, & Weiss 1980). The transportation sector revolution replaced wind and animals with steamboats and steam-powered locomotives to stay abreast of the increasing demand. This generated a range of low, mid, and high skill jobs in the transportation sector.

The agricultural sector was also affected by the innovation of agricultural equipment and better production processes. Animal powered equipment started being replaced with mechanized equipment. In their research, Katz and Margo (2013) found the share of low-skill jobs declined overall due to the decline in the share of farm laborers in the agriculture sector. They also found the share of farm operators in the economy fell over time both in absolute magnitude and relative to the share of farm labor jobs in the agriculture sector.

Between 1850 and 1910, there was a decrease in the blue-collar/artisan share of jobs in manufacturing from 39 to 23 percent (Katz & Margo, 2013). This was accompanied by an increase in the share of operator/low-skill jobs from 58 to 65 percent, and an increase in white-collar/nonproduction jobs from 3 to 12 percent (Katz & Margo, 2013). For the overall economy there was a steady increase in the share of white-collar jobs while the share of low-skill jobs decreased. This was due to the greater decline in low-skill farm laborers relative to the increase in low-skill jobs in the manufacturing sector (Katz & Margo, 2013).

The current structural shift has been caused by the growth and adoption of computer technologies. Changes in the organization of work associated with computerization raise the demand for the cognitive and interpersonal skills used by highly educated professionals and managers and reduce the demand for the routine analytical (non-manual) and mechanical (manual) skills that characterize many middle educated ordinary white collar positions and manufacturing production jobs. Computerization has less direct impact on the demand for non-routine manual skills in many low-wage in-person service jobs and in the building trades (Autor, Levy, & Murnane, 2003; Autor, Katz, & Kearney, 2006; Acemoglu & Autor, 2010; Goos, Manning, & Salomons, 2011).

Since the use of electricity in manufacturing started, there has been a continued, steady increase in demand for high-skill jobs in the economy. Goldin and Katz (2008) found that throughout most of the twentieth century, the supply of high-skilled labor has kept pace with the demand. The increasing educational attainment throughout that time narrowed the educational wage differential. However, since 1980, there has been an increase in wage differentials as the supply of high-skilled labor has slowed while the demand has continued to grow at a steady pace. There is evidence of a change in the skills demanded, polarizing the labor demand in favor of high-skill and low-skill service jobs over mid-skill jobs (Goldin & Katz 2007; Autor, Katz, & Kearney 2008; Autor 2010).

The introduction and growth of computer technology in the economy has resulted in job obsolescence. Computerization led to a decrease in demand for routine analytical and mechanical skills. It has had less impact on the demand for many low-skill, in-person service jobs, such as restaurant service workers, and in the construction and building industry, jobs characterized by less routine work (Autor, Levy, & Murnane 2003; Autor, Katz, & Kearney 2006; Acemoglu & Autor 2010; Goos, Manning, & Salomons 2011).

Evolution of Technology and Labor Market Impacts

As technology is adopted, gaps are created that stimulate demand for new areas of employment. As new technology replaces existing technology, an economy undergoes a period of structural change in employment. During this period, the economy becomes less stable as workers become displaced due to job obsolescence, and new jobs are created to fill the gaps created by the new technology. The labor market undergoes rapid evolution as new firms enter the market to take advantage of new technology and existing firms replace existing technologies with the new.

According to Komninos, Milossis, and Komninos (year), “All products and services have certain life cycles. The life cycle refers to the period from the product’s first launch into the market until its final withdrawal, and it is split up in phases.” (p. 73) The product life cycle normally consists of five phases: product development, introduction, growth, maturity, and decline. These products are based on the existing technology and change as technology changes. An exception to this type of market behavior would be in the clothing and home décor markets which tend to go through the phases according to changes in taste rather than technology.

Technology based products have a much shorter life cycle than the base technology itself. For example, compare one of the first home computers to the ones available now and it is easy to see how rapidly the technology has developed, but the base technology is still the same. Computers were originally created as electronic calculators and have since spread into multiple areas where they have proven useful and improve the quality of life, such as through the creation of improved and more efficient methods of communication.

As new technologies go through the development, introduction, and growth phases, new applications and products are created, taking advantage of its capabilities and creating demand for new jobs in the labor market. This changes the equilibrium of the job market as jobs are created and lost due to changes in skills required. A temporary increase in unemployment can occur as displaced workers are forced to reskill for alternate employment when the change in technology is large enough.

Under normal conditions, the change in the necessary skills required is small enough firms are able to retrain existing employees with little job displacement. However, when a new technology eliminates an entire job category, such as the change from steam to electric power, it creates structural unemployment as the displaced workers reskill and find jobs in other areas.

Natural Resources

Technology is not the only determinate of the labor market. Other factors to consider are geographic location and availability of resources. The recent, rapid expansion of oil and gas extraction in the US has brought more attention to the debate over the resource curse and the extraction of resources as a viable community economic growth strategy.

The viability of robust economic growth based on the extraction of natural resources has become a topic of hot debate and the growing amount of literature available suggests it is the exception rather than the rule (Ross, 1999; Sachs & Warner, 1999; Watts, 2005; Rosser, 2006). The question is whether or not the resource curse applies to the US. The theory of resource-based development was rejected by the international development literature as it causes no long-term growth in employment and the industry is entirely based on world commodity prices. This is the case where the mining and extraction sector dominates the economic structure. The US may differ as there are already well-developed, value-adding industries to make use of the resources in production.

Much of the literature discussing the resource curse has been done on the effects of resource based economic development in developing countries where there is no developed industrial structure to make use of extracted resources. These countries have relied on the export of the raw materials to the international market as the primary destination and source of income. "Much of this research concludes that very little of the economic benefits are retained in the local economy because of the ownership structure of mining firms and lax environmental or labor safety standards" (Deller & Schreiber 2012). Innis (1956), in a study of Canadian specialization around resource extraction, found the resource curse did not promote economic diversification, rather it promoted a form of dependency on an unstable industry.

In a study using state-level data, Papyrakis and Gerlagh (2007), found resource abundance tended to decrease investment and the quality of schools, while increasing overall corruption among policing authorities and stunting state-level growth. Bender (1985), compared mining-dependent counties (those where at least 20 percent of total labor and proprietary income came from mining) with other nonmetropolitan counties and found mining-dependent counties had higher birth rates, income growth, and fewer people receiving social security.

Nord and Luloff (1993) decomposed mining into three categories: coal, oil, and other, and confirmed the results from Bender (1985). However, after 1980, they found there was a deterioration of economic conditions across all three mining areas. This led to mining-dependent counties experiencing higher growth rates in poverty than rural counties.

Broken down by category, Weber, Castle, and Shriver (1988), found during the mining boom years of 1973-1985 counties with energy related mining activities saw growth in employment and earnings while those with metal related mining activities experienced a decline in employment and earnings. They also discovered that extractive industries had excessively high unemployment rates relative to other sectors.

Deller and Schreiber (2012) drew three main conclusions from their research of non-oil and gas mining activity in rural counties. Higher levels of mining employment are associated with lower population growth and higher income growth, and higher mining employment does not influence employment in other sectors. They concluded the literature on the subject is mixed and results vary by the type of mining activity and timeframe studied.

The mining and extraction industry is plagued with instability for long-term economic development, due to the unstable nature of world commodity prices. Mining is becoming a more capital-intensive industry leading to fewer, but higher paid, jobs. The mining workforce also tends to be rather transient with weak ties to the local community, migrating with mining operations.

Industrial Concentration

Drucker , in his 2011 paper, "Regional Industrial Structure Concentration in the United States: Trends and Implications," offers an explanatory analysis of regional industrial dominance for manufacturing industries. He used multiple concentration ratios to capture the size ratio between firms and compare how the concentration of a regional industry or industrial sector in a few firms affects the industry's local performance. He found during the time period studied (1963-2002), the average plant size and total employment in the US manufacturing sector dropped. Large firms also experienced a proportionately greater decrease in employment than small and medium sized firms. Some of the decline in regional concentration may have been due to outsourcing rather than vertical integration and contracts with small, local component manufacturers.

> Regional concentration is linked strongly to slower growth in employment or greater declines in employment both across the manufacturing sector and within most component

> manufacturing industries. Changes in employment at the regional scale are much more powerfully associated with industrial concentration than with other structural aspects, such as diversity or specialization, demonstrating the value of concentration as a way to gauge the impacts of regional industrial structure. The degree to which industrial concentration and changes in employment are associated for particular manufacturing industries does not seem to depend on industry characteristics, such as age, technology, or capital intensity in production. Controlling for base levels of employment, I found that larger metropolitan regions tend to exhibit superior manufacturing job performance as well as lower levels of concentration, but I could not ascertain in this analysis whether the two phenomena are causally related. (Drucker 2011, p. 446)

Drucker (2011) found a negative association between the level of concentration in the regional industrial structure and employment growth. However, he could not distinguish the direction of the causality in the association. The evidence may indicate stagnation of productivity and innovation with higher concentrations in the regional industrial structure. This could cause decreased flexibility and longer reaction times to changing economic conditions. Restructuring in response to economic conditions may be slower or unsuccessful in concentrated industries. Higher levels of regional competition, as shown by lower levels of industrial structure concentration, promote innovation and employment growth in manufacturing. Lower levels of regional industrial structure concentration tend to improve the adaptability of the region's industrial structure and create firms with more flexibility and shorter reaction times when faced with changing economic conditions.

Economic Sector Diversity

Brown (2012), in an analysis of the impact of changing diversification on stability and growth, studied employment data for a 30 year period for Polk County, Florida to determine whether changes in diversification have a significant relationship with stability and employment growth. Over the 30-year period, declines in diversification were associated with increased volatility in employment growth rates. The decline in diversity and increased volatility were also associated with higher levels of employment growth. A positive association was discovered between the growth of regional employment and the share of employment in natural resource-based industries. This coincides with what Deller and Schreiber (2012) found in their study of non-oil and gas mining. The mining workforce tended to be rather transient and migrate with the mining operations (Deller & Schreiber, year). This would explain an increase in regional employment as the share of natural resource-based industry employment increased.

An increase in the diversity of a region leads to lower levels of employment volatility and growth. In more diverse regions, changes in the economic conditions affecting a single manufacturing industry have less impact on employment volatility and growth. This could be due to the absorption of workers displaced by adverse economic conditions affecting a single or small number of industries by other industries with similar skill requirements. It is more likely to take place in areas of higher diversity where the share of employment in any one industry is smaller than in areas with lower sector diversity. The absolute number of displaced workers will be less in areas of high diversity. At the same time, these areas will be better able to absorb displaced workers due to a higher number of jobs requiring similar skill sets.

This study does not take into consideration the impact of the industrial structure concentration of firms in the region on the volatility of employment growth, potentially limiting the explanatory power of the results. Drucker (2011) found higher levels of regional industrial structure concentration were strongly linked to slower employment growth and greater declines in employment. He also found regional changes in employment are more strongly associated with the level of concentration within the industrial structure than with other structural aspects such as industrial diversity in the manufacturing sector and industrial specialization. The literature points to the necessity of finding an efficient equilibrium in the regional economy to balance sector diversification and specialization as well as the regional industrial structure concentration of firms and its effects on employment growth or employment declines.

Firm Size

Big business played a major role during the industrial revolution. With the development of mass production came the expansion of markets through the creation of distribution and sales networks. This vastly increased the flow of goods through the production and distribution processes and into the hands of consumers (Chandler, 1959, 1977, 1990).

Large firms are much more capable, through their greater access to capital and large economies of scale, to support the high fixed costs of R&D and generate positive innovations such as increases in technology and productivity growth (Pagano & Schivardi, 2003). The onslaught of globalization has not minimized the importance of large firms in the business world. Large firms develop and maintain vast, global, value chains that play a crucial role in facilitating international business (Buckley, 2004).

Lee, Kim, Park, and Sanidas (2011) analyzed the impact of the number of large firms and the proportion of the sum of their sales to constant GDP. They found four main conclusions from their research. They are:

(i)big businesses significantly contribute to per capita GDP growth, (ii) big businesses

> contribute to GDP stability, (iii) big businesses exert a more definite and robust effect on economic growth than small-medium enterprises, and (iv) too much reliance on big businesses in a country might not be beneficial to overall economic growth (Lee et al., 2011, p53)

Their findings suggest big businesses exert an "independent and robust effect" (Lee et al., 2011) on an economy not accomplished by small-medium enterprises. However, too much reliance on big businesses has negative effects on GDP per capita. The best approach to economic development is one that promotes the growth in the number of both types of businesses. The effect of the location of corporate headquarters on the national economy is consistent with the inference that big businesses are important not only for their high-end goods production, but also their R&D and marketing activities in the home country.

Summary of the Literature

In the review of the literature this paper has considered many aspects of job creation and job growth. It has considered how, historically, the job market changed after the industrial revolution began in the United States in the 19^{th} century. The industrial revolution led to a temporary structural unemployment, but the jobs created generally led to higher incomes. This growth in incomes is easily discernable by comparing the average standard of living in the US now to the standard of living fifty or a hundred years ago. This paper has also discussed the impact of natural resource extraction on employment and long-term economic growth. The mining sector can positively increase employment in a region, but it is distortionary because of the transient labor force.

In the review of the effects of industrial and firm concentration on regional employment it was found that as concentration increased, employment growth benefited from the agglomeration. At the same time exposing the region to higher employment risk if there were shocks to the specific industrial sector. A more diversified regional economy, or a multi-sector regional economy, leads to less variability of employment within the region, but at the cost of lower employment growth.

The literature demonstrated the benefit of balance between the small-medium enterprises and big businesses. The benefits from large businesses stem mainly from their ability to generate steady GDP per capita growth due to wider product markets. Their ability to fund the high fixed costs of R&D also helps develop new technologies and increase the productivity of labor. Too much reliance on big businesses can have an adverse impact on GDP per capita growth suggesting there is a maximum to be found. The question that remains unanswered is: which sectors should a regional economy invest in in order to maximize the GDP per capita growth?

Theoretical Background

In order to determine the best allocation of investments in both physical and human capital (education), it is necessary to perform some analysis. The question that this paper seeks to determine is which sectors of the economy currently have a significant impact on employment growth. The analysis performed in this paper is not final and conclusive, but rather it is a beginning approach to the topic. For the analysis we follow the basic structure presented by Zelleke and Sraiheen, (2012).

In their research, Zelleke and Sraiheen used a growth accounting approach to determine the relative contributions to output of capital, labor, and technology in thirty-one Sub-Saharan African countries. The review of this paper will differ slightly, focusing on the analysis approach rather than the results of the specific analysis. They used natural log real GDP labor income in their analysis to estimate the elasticities of capital and labor with respect to output. Their estimates of the labor share of GDP coincides with earlier work by Bernanke and Gurkaynak (2002), where they estimated the average labor share for four Sub-Saharan Africa countries with similar standards of living and economic development. These studies are all based on country level data that includes real GDP and wages for all sectors combined. This is where our analysis differs in that it examines individual sectors of the economy.

The second part of the analysis by Zelleke and Sraiheen (2012) used the calculated elasticities of capital and labor with respect to output to estimate the contributions of capital and labor as well as the contributions of technology to output growth. This part of their analysis used what is known in growth literature as the Growth Accounting Equation. This equation is simply the time derivative form of the neoclassical Cobb-Douglas production function. This equation has been used in major empirical studies to decompose the sources of growth by its various sources (Denison, 1962, 1979). The form of this equation used by Zelleke and Sraiheen (2012) in their analysis of the productivity of labor was taken from the growth literature (Abel, Bernanke, & Gurkaynak, 2002).

In this research I am interested in decomposing the sources of economic growth in metropolitan areas of the United States. This is done using an individual sector approach to decompose the sources of growth. By breaking down the analysis by individual sectors, it can be determined which sectors contribute most significantly to employment and income growth. Local government officials can benefit from this research by using it to individually determine which industrial sectors should be promoted to yield long-term growth of employment and per capita income within the local economy. This is not to say local governments should seek to promote growth in only a single sector. The previously reviewed literature should also be taken into consideration when developing policies so stable growth of GDP, employment, and incomes are also achieved. Promoting only an individual sector to achieve the goals of employment and income growth through agglomeration economics alone is shortsighted. This could have severe negative repercussions in the future and cause issues similar to those seen in Detroit. I suggest the optimal growth path should include promoting growth in multiple sectors to sufficiently diversify the local economy and negate the impact of adverse shocks to any single industry.

Methodology

In this analysis I used the neoclassical Cobb-Douglas production function to model individual sectors of the economy. The basic Cobb-Douglas predicts output is a function of the inputs of capital and labor that are augmented by technology:

$$Y = AK^{\alpha}L^{\beta} \tag{1}$$

Where “Y" is output, “K” Capital, “L” Labor, and “A” represents the labor and capital augmenting technology (Total Factor Productivity). α and β represent the elasticity of capital and labor with respect to output. Many empirical studies consider constant returns to scale where the sum of α and β is 1. However, this assumption has been relaxed in this analysis. Most empirical studies of this nature are done on economy-wide data where the assumption may be assumed to be true.

In empirical studies α and β are estimated by transforming the Cobb-Douglas into a log linear econometric model:

$$ln(Y) = ln(A) + \alpha\, ln(K) + \beta\, ln(L) + \varepsilon \tag{2}$$

Where ln is the natural log and ε is the error term. A variation of this model to estimate α and β in other empirical studies (Zelleke & Sraiheen, 2012) has been:

$$ln(Y) = ln(A) + \alpha\, ln(1 - W_s) + \beta\, ln(W_s) + \varepsilon \tag{3}$$

Where, (W_s) represents the labor's share of output or the total compensation of labor, (1-W_s) represents the return to the owners of capital, and (Y) is real GDP. Once α and β have been estimated they can be substituted in equation (1) to solve for the Total Factor Productivity $A = Y/K^{\alpha}L^{\beta}$. The time derivative form of this model has been widely used in empirical studies (Denison 1962, 1979, 1985) and is often known as the Growth Accounting Equation. The Growth Accounting Equation is used to decompose the sources of economic growth into the portion that can be accounted for by the growth of the individual input factors, as well as the portion that is due to changes in total factor productivity. The form of this equation is:

$$\left(\frac{\Delta Y}{Y}\right) = \left(\frac{\Delta A}{A}\right) + \alpha \left(\frac{\Delta K}{K}\right) + \beta \left(\frac{\Delta L}{L}\right) \tag{4}$$

Subtracting (α+β)(ΔL/L) from both sides and substituting in (z = α + β) we get:

$$\left(\frac{\Delta Y}{Y}\right) - z \left(\frac{\Delta L}{L}\right) = \left(\frac{\Delta A}{A}\right) + \alpha \left[\left(\frac{\Delta K}{K}\right) - \left(\frac{\Delta L}{L}\right)\right] \tag{5}$$

Equation (5) is a measure of the average productivity of labor (Abel, Bernanke, & Gurkaynak, 2002). In this analysis I focus on estimating equation (3) and calculating the average productivity of labor using equation (5).

Data Sources and Selection

The sample data used in this analysis consists of 48 Metropolitan Statistical Areas (MSAs) as defined by the Bureau of Economic Analysis. The cities were selected using two methods. The first method ranked cities by income per capita growth in 2012, and the second method ranked cities by average income per capita growth from 2010 to 2012. From each of the two methods the upper, middle, and lower ten cities were selected, and duplicates were removed. MSAs with insufficient data were then removed and replaced by selecting new MSAs that were ranked closest to the ones removed for which there was sufficient data. A total of five MSAs were replaced by this method.

Data for each of the final group of MSAs in the sample were gathered from the Bureau of Economics (www.bea.gov). The dataset for each included output, total compensation of employees, and sum of full and part-time employment broken down by individual NAICS industry. Data for real GDP by sector was in millions of chained 2005 dollars. Data for total compensation of employees was in thousands of nominal dollars. This data was transformed into millions of chained 2005 dollars using the CPI as the price deflator. The CPI index was obtained from the Federal Reserve in St. Louis. The data was restricted by availability to include only the years 2001 to 2011.

For some MSAs, portions of the data broken down at the two-digit NAICS code level were restricted to avoid disclosure of confidential information. However, the sample size was large enough to avoid substantial complications due to missing observations. In some cases, the observations were estimates. These estimates were included in the analysis. The majority of missing observations were in the Healthcare and Education sector.

There was no data found for the level of capital invested by industry for the sample MSAs. This limited the expansiveness of the analysis. However, the data was sufficient to obtain results about the productivity of labor over the sample period. The data was arranged into panel form. This same analysis could have been performed using countrywide data. For the purpose of the analysis of metropolitan areas, the data gathered was used as such. I have made the assumption of relative homogeneity between MSA's using the population as a parameter. In a narrower sense, the MSAs are heterogeneous. Countrywide data is simply an aggregate of the lower level data summed across sectors. The assumption of homogeneity between MSAs is based on the assumption of homogeneity in country level data, and enables the estimation of elasticities using a shortened length of time.

Sector Breakdown

For the analysis, sectors were aggregated on common labor characteristics. The defined sectors were: Manufacturing, Trade, Information, Business Services and Finance, Health and Education, Other, and MSA Total. Manufacturing included both durable and non-durable goods manufacturing. Trade included both retail and wholesale trade. Information included publishing, motion pictures, broadcasting and telecommunications, and information and data processing. Business Services and Finance included finance and insurance, real estate and leasing, professional and scientific services, management of companies and enterprises, and administrative and support services including waste management services. Health and Education included educational, healthcare, and social services. Other is an aggregate of the remaining sectors including agriculture and mining, utilities, construction, transportation and warehousing, entertainment and recreation, accommodations and food services, and other services excluding government. MSA Total included all sectors combined including government.

The sectors included in other were deemed to be nonessential to the scope of this analysis. Agriculture and mining are rural economic activities not essentially linked to MSAs. The utilities sector was excluded because it is a saturated market with very low growth. Transportation and warehousing was excluded because it is primarily involved in trade between MSAs and not a fixed factor of production. If this study included trade between MSAs, transportation and warehousing would become essential to the model. Construction was excluded due to a lack of data.

The remaining aggregated sectors were deemed to be similar in terms of inputs and output. This was an arbitrary grouping with no basis from the literature, and should be kept in mind when evaluating the results. This analysis is limited by the relatively short time period of available data, the lack of available data on investment, and the net invested capital stock. Furthermore, no MSA specific qualifying data, except the population, was included, limiting the ability to differentiate between MSAs. This more in depth analysis is left for future research and will require the collection of more refined and MSA specific data.

Analysis and Results

Estimating the Elasticities

After preliminary testing, sample size was limited to include only MSAs with a population of less than 600,000. This resulted in the removal of 5 cities from the dataset (53 cities were in the original dataset). This was done to improve the homogeneity of the MSAs and reduced the variance of the estimated parameters. As indicated by equation (3), estimates for capital and labor were created for each sector using the same method as Zelleke and Sraiheen (2012). Table 1 lists the results of this estimation. The estimate of the constant for Other is significant at the 95% level, and the constant for MSA Total is significant at the 90% level. All other coefficients are significant at the 99% level.

The dependent variable for each sector was the log of real GDP in chained 2005 dollars. The two independent variables were the log of the estimated shares of capital and labor, as indicated in equation (3). The elasticities could not be estimated using actual employment numbers due to the error created by the equal weight in the available data of both full and part-time employment and the absence of data on capital. National level data includes employment as the full-time equivalent. Please see the Appendix for a complete list of the regression tables.

Table 1 Elasticity coefficients for Capital and Labor by sector

Sector	**Capital**	**Labor**	**Constant**
Manufacturing	*0.340*	*0.665*	*0.666*
Trade	*0.327*	*0.680*	*0.606*
Information	*0.467*	*0.535*	*0.715*
Bus. Services & Finance	*0.445*	*0.504*	*1.086*
Health & Education	*0.066*	*0.929*	*0.277*
Other	*0.178*	*0.823*	*0.581*
MSA Total	*0.071*	*0.938*	*0.272*

Dependent Variable is natural log of real sector GDP in chained 2005 dollars.
Full regression tables for each sector can be found in the Appendix.

Table 2 illustrates the breakdown of the contributions of labor to output by sector for all 48 MSAs included in the analysis. The variability of these estimates was improved by removing MSAs with populations greater than 600,000. Presented in Table 2 are the average output growth and the average employment growth in conjunction with the average contribution of labor and the average productivity of labor over the entire sample period.

By sector results

This analysis is based upon a sample of MSAs within the United States. As such, the results may be applied more broadly to the United States as a whole. However, for this analysis, the results will be interpreted as being representative of the MSAs within the United States.

Manufacturing

The analysis of the manufacturing sector indicates that while it appears to have moderate growth over the entire period, it is not making a significant contribution to employment growth. That is, prior to the financial crisis (2008-09), the manufacturing industry averaged a 3.19 % annual growth rate over the 6 year period while at the same time total employment was declining at an average annual rate of 1.91 %. In the post-crisis years, the sector has averaged a 4.79 % growth rate while employment in the sector has only increased at an average annual rate of 0.59 %. During the Financial crisis, sector output declined by 13.4 % and employment by 8.67 %.

Without data on the capital stock of the manufacturing sector to support this analysis, the contribution of labor accounts for only 8.1 % of the annual 4.79 % growth (calculated as *CL/GDP* from Table 2). This indicates a continued capital deepening of the manufacturing sector. The growth in the manufacturing sector is due mainly to an increase of the capital labor ratio as expressed in equation (5) above.

An analysis of the manufacturing sector must consider the effect of government subsidization of the sector. The higher growth rate of the manufacturing sector in the post financial crisis years is in part due to the higher subsidies given manufactures as part of the stimulus plan. According to Guenther (2012), most of the programs go to support workforce training, export assistance, business counseling, and technological development. His report also indicates there is no clear estimate as to the actual amount of federal funds being used to subsidize the manufacturing industry. It therefore becomes more difficult to determine the portion of growth that is the result of the subsidies.

Trade

The Trade sector is a composite of both retail and wholesale trade. It has seen significant growth of 2.46% over the entire sample period. The growth since the financial crisis has in fact been slightly higher, possibly due to increased activity in the manufacturing industry. This is entirely speculative though. The sector experienced average annual growth of 4.25% over the six years prior to the recession, and 4.32% over the years since. (In this paper the terms recession, the Great Recession, the financial crisis, or the Global Financial crisis are used synonymously) Prior to the recession, employment in the sector increased at an average annual rate of 1.53 %. During the years since, it has decreased at an annual rate of 0.27 %. The contribution of labor growth to total output accounts for -4.17 % of growth since the recession as opposed to 36 % prior. This indicates the capital labor ratio has increased significantly since the recession.

Table 2 Contributions to productivity

Sources of Economic Growth by Sector (Averages)				
	GDP	***CL***	***Labor Gr***	***Labor Productivity***
Manufacturing				
2002-2011	0.14%	-1.841	-2.77%	3.185
2002-2007	3.19%	-1.266	-1.91%	5.394
2008-2009	-13.40%	-5.756	-8.66%	-4.377
2010-2011	4.79%	0.391	0.59%	4.265
Trade				
2002-2011	2.46%	0.218	0.32%	2.138
2002-2007	4.25%	1.044	1.53%	2.706
2008-2009	-4.76%	-1.856	-2.73%	-2.015
2010-2011	4.32%	-0.184	-0.27%	4.590
Information				
2002-2011	1.76%	-1.699	-3.18%	4.573
2002-2007	4.44%	-0.970	-1.81%	6.163
2008-2009	-2.95%	-2.963	-5.54%	1.549
2010-2011	-1.32%	-2.640	-4.94%	2.966
Bus Services & Finance				
2002-2011	15.65%	3.272	6.49%	9.395
2002-2007	17.02%	4.338	8.60%	8.699
2008-2009	14.71%	1.142	2.26%	12.536
2010-2011	12.56%	2.204	4.37%	8.380
Health & Education				
2002-2011	6.49%	5.070	5.45%	5.624
2002-2007	5.43%	7.593	8.17%	3.320
2008-2009	15.78%	3.476	3.74%	18.153
2010-2011	0.01%	-1.063	-1.14%	-0.231
Other				
2002-2011	2.34%	0.747	0.91%	1.428
2002-2007	1.73%	1.666	2.03%	-0.296
2008-2009	3.13%	-1.443	-1.75%	4.882
2010-2011	3.36%	0.176	0.21%	3.148
MSA Total				
2002-2011	1.94%	0.910	0.97%	0.960
2002-2007	2.79%	1.666	1.78%	0.998
2008-2009	-1.09%	-1.268	-1.35%	0.276
2010-2011	2.41%	0.822	0.88%	1.529
Avg # Obs				
2002-2011	450			
2002-2007	275			
2008-2009	91			
2010-2011	85			

Calculations of the contributions of labor are based on the estimated production function by sector. CL stands for the contribution of labor = β(Labor Gr), β is given in Table 1 for each sector

This sector of the economy generally receives the majority of their subsidies through the local governments where they are located. This comes in the form of reductions in property tax liabilities, reduced sales tax rates, etc. Of this, it is hard to say what percentage came from the federal government because of the indirect path. However, the majority of this sector's growth can be attributed to consumption growth before the recession and more to export growth after the recession. Although, the data to support these statements is not displayed here, US exports have risen since the recession and average consumption growth was higher during the six years prior.

Information

The information sector, which is a composite of publishing, motion pictures, broadcasting and telecommunications, and information and data processing, has not experienced recent positive growth. This combination of subsectors (as defined by NAICS code) has seen an average increase in output of 1.76 % per year over the sample period. However, the average annual growth was 4.44 % before 2008, and after 2009 it fell to -1.32 % average growth per year. This sector has seen negative employment growth over the entire time ranging from -1.81 % annually before 2008 to -4.94 % since 2009. Rather than seeing an increase in labor productivity over this time period, the average labor productivity growth has decreased by half from 6.16 % to 2.97 %.

An analysis of the causes of the employment decline in this sector would be necessary to make any determination. Some causes might be the changes in the sector caused by the sector itself such as a decrease in publishing due to eBooks. Additionally, this sector was on the rise during the 1990's during the technology bubble. This bubble finally burst about the beginning of the sample period. The overconfidence of investors prior to the collapse of the bubble led to many large, but not profitable, businesses in this sector, especially in the area of telecommunications and data processing. Since then, the number of firms in the industry began to fall as firms were bought out or went bankrupt due to market saturation. A number of the information technology jobs in this sector may have also just been reclassified as business services; depending on the market the firm serves. The majority of the telecommunications infrastructure was put into place during the 1990's and early 2000's. While the majority of the jobs now are in maintaining the infrastructure.

Business Services and Finance

The Business Services and Finance sector is the most interesting as it has seen the highest average growth rates over the sample period. The sector has seen an overall average growth rate of 15.65 % between 2002 and 2011 including the years of the financial crisis. Between 2002 and 2007, the sector averaged an annual growth rate of 17.02 %. Since 2009 it has only averaged 12.56 % growth. During the financial crisis the sector experienced average growth of 14.71 % per year, which is a surprising result due to the inclusion of financial industries.

Total employment in this sector increased at an average rate of 8.60 % per year prior to 2008. During the Financial crisis years, sector employment grew by 2.26 % on average. Since 2010, this has increased to an average rate of 4.37 %. The growth in employment accounted for 25.5 % of total output growth prior to 2008 and only 17.5 % since 2009 based on our estimates. This sector has seen the highest growth rates compared to all other sectors in both employment and output over the entire sample period.

During the crisis, the federal government supplied large amounts of cash to the financial sector in the form of bailouts to support the industry and prevent bank runs that would have further exacerbated the deflation of the liquidity markets. This may have some affect on the sectors growth. Further analysis would necessitate controlling for this exogenous influence.

Health and Education

The health and education sector has seen the second highest average growth rate over the entire sample period. The average growth rate for the entire period was 6.49 % per year. However, the average annual growth prior to the recession was 5.43 % and has only been 0.01 % since. During the recession the sector experienced 15.78 % real output growth.

Employment in the sector has increased at an average annual rate of 5.45 % over the entire sample period. Prior to the recession, employment increased at an average rate of 8.17 %. This declined to 3.74 % growth during the recession and -1.14 % on average per year since the recession. Prior to the recession, labor growth contributed to 140 % of GDP growth by the calculation (employment growth was higher than output growth), while the productivity of labor was diminishing over the same time period. Part of this error is due to the way in which the elasticities of capital and labor for this sector were calculated. The calculated elasticity of capital to output in this sector was 0.066 (Table 1), which is very low considering the level of capital investment required by these organizations.

This sector also receives a substantial amount of its funds from government in the form of grants, Medicare, and Medicaid. The majority of these institutions are either public or non-profit, which may account for the disproportionate elasticity of labor to output in this sector. Since 2009, the average productivity of labor has drastically declined from 3.32 to -0.231, indicating there is excess employment in this sector.

Other

This sector is simply an aggregation of the remaining sectors not broken out in the rest of the analysis. This includes as mentioned earlier, agriculture and mining, utilities, construction, transportation and warehousing, entertainment and recreation, accommodations and food services, and other services excluding government from the line item breakdown of the original data by NAICS code. As a whole, this sector has experienced an average of 2.34 % annual GDP growth for the entire sample period, and an average annual employment growth of 0.91 %.

MSA Total

The total GDP growth has averaged 1.94 % over the entire sample period. The growth prior to the recession averaged 2.79 %, and over the years since, GDP growth has averaged 2.41 %. Employment has had an average growth rate for the entire sample period of 0.97 %.

Conclusion

The innovation of new technologies is an important driving force behind the evolution of the labor market. Technologies follow a life cycle pattern. As a new technology moves from the development to adoption phases it begins a structural shift in the demand for skills in the labor market. Large firms are the early adopters of new technology, finding ways of implementing the new technology that increase efficiency in production and generate new comparative advantages. The costs of implementing new technology in the production process decreases as it proceeds from the early adoption to growth phase causing disequilibrium in the labor market and generating employment gaps. These “gaps” become areas of employment with a higher wage differential. Labor market participants reskill in order to take advantage of these positions causing a shift in the labor supply which closes the gap and brings the labor market back toward its equilibrium.

As the new technology continues through the growth and into the maturity phase there is a slowdown in the demand for the specific labor skills. Here, the labor market maintains a steady state where there are few distortions caused by shifts in either the labor demand or labor supply.

During the growth and into the maturity phase, the new technology continues to diffuse throughout all firms until the industry becomes saturated.

The final stage in the technology's life cycle is the decline and obsolescence. As large firms lose their comparative advantage they seek new technologies to remain competitive. When a new technology emerges, large firms begin shifting their production process again to take advantage. This leads to a decline and ultimate obsolescence of the former technology. Creating a new period of structural shifts in the labor market and generating new employment gaps. The old technology is crowded out during its decline phase as new technology replaces it.

The labor market responds to this constantly shifting environment by adjusting the skills supplied. If the suppliers of labor over-anticipate the demand for certain skills, the real wage falls due to the surplus. Firms face a finite demand for their output. As they substitute more labor in their production process, it leads to a decline in the productivity of labor. The productivity of labor may even become negative if firms over-anticipate demand.

The manufacturing sector is currently undergoing a capital deepening process which is being stimulated by government subsidies. The industry is experiencing growth through the use of automated production processes. This leads to the creation of new types of jobs in the manufacturing industry while destroying others. Since 2009, the industry has grown at an average annual rate of 4.8 %, but employment over the same period grew by only 0.6 %. This was after a decline in employment of 8.7 % annually over the previous two years. The growth of manufacturing leads to growth in other sectors, but it is beyond the scope of this research to determine the nature and magnitude of these effects, and is left for future researchers to answer.

The health and education sector has experienced the second highest growth rate between 2002 and 2011, but growth has slowed in this area since 2009. The average annual growth since

2009 has been 0.01 % and employment has declined by 1.14 % annually. This sector has had negative average labor productivity over this period supporting the theory of firms over anticipating demand.

The business services and finance sector has experienced the highest growth rates over the sample period, both in terms of output and employment. These are ancillary services for business, including scientific services. Scientific services develop new technologies for other businesses. This sector accounts for the majority of the employment growth over the study period, indicating a possible comparative advantage in this sector. There are some indications the growth in this sector is slowing over the sample period, but this is left as an area of further research. The labor demand in this sector is growing, but at a decreasing rate. The recession years have a lower employment growth rate, but these years are considered as a negative shock to the entire economy, total real output and employment growth were both negative.

The information sector accounts for less than 2 % of total employment in the sample MSAs, ranking it as the smallest sector. This sector experienced higher average growth prior to the recession, but it was not due to employment growth. Employment in the sector on average declined over the entire period. Since 2008 the sector has experienced negative growth, leading to greater declines in employment in the sector. Part of this decline may be due to classification error, as some companies may be redefined as a business service.

The trade sector contains both retail and wholesale trade. Since the recession, the sector has seen positive output growth of 4.3 % but negative employment growth of 0.3 %. The growth in manufacturing and exports may account for the majority of this growth, as consumption growth has been slower in the post-recession years. Further analysis is necessary to make a definite determination and is left for future research.

Table 3 displays summary statistics for MSAs ranked by average output and employment growth for the entire time period. Table 4 displays the same statistics, but excludes the recession years. The far right column lists the percentage of average total private sector employment for each sector. The average private sector employment for MSA Total is the sum of average employment in all sectors listed over the MSA Total employment. One hundred minus this percent is the estimated average public sector employment. This includes all Federal, State, and Local government employees. Top output and employment growth is defined as 1.5 standard deviations above the means for the entire sample. Bottom output and employment growth is defined as 1.5 standard deviations below the means.

There is little difference in the employment weights between the full sample averages and the sample averages excluding 2008-09 for the top employment growth MSAs. In comparison, the employment weights differ substantially between the full and restricted sample averages when using output growth to rank the MSAs. The main difference between MSAs ranked by output and employment growth is the percentage of private sector employment involved in manufacturing and the proportion of total employment involved in the public sector.

MSAs with the highest output growth in both the restricted and full samples are characterized by having relatively higher employment weights in manufacturing and lower weights in public sector employment compared to MSAs with highest employment growth. MSAs with the lowest employment growth have relatively higher employment weights in manufacturing. The other employment weights differences are mixed between business services and finance and public sector employment. Performance of a full analysis of these employment weights to determine the optimal structure would require gathering more MSA specific data over a longer time period in order to perform a time-series analysis. The information detailed in Tables 3 and 4 can give directional guidance towards stability and job creation.

The results indicate a tradeoff between output growth and employment growth. An emphasis on the manufacturing sector will increase output, but it does not lead to higher employment growth due to technological changes and the shift to automated production. Too high a concentration in the business services and finance appears to have a negative impact on employment and output growth. In estimating the elasticities of capital and labor with respect to output, this sector displayed decreasing returns to scale, as did the health and education sector.

The richness of this analysis could be greatly increased through the in depth analysis of MSAs in the US and would benefit the economy by helping to establish optimal sector weights that would create stable income and employment growth. This is similar to the portfolio theory in finance used to establish weights that maximize the return/risk ratio. Expanding the time period and the frequency of the data would allow for future researchers to use time series analysis in determining the optimal economic structure. This will benefit policy makers in determining the optimal approach to economic development in the United States. Specifically, cities or MSAs stand to gain significantly from this type of analysis in creating policies that enhance stable long run growth in employment and incomes.

The availability of data on capital allocation within MSAs is a limitation of this research. Cooperation between local governments and researchers in gathering and analyzing city specific data on capital and labor over a longer time period would help to establish MSA specific optimal economic sector weights. Through initiating this type of research, local governments can work with businesses in allocating capital to areas that will lead to stable long run employment and income growth. Overemphasis on single sectors considered a core industry can increase the variability of employment and output growth. Diversifying the local economy's structure between various sectors can reduce the fluctuations in employment. Emphasizing the development of higher wage jobs will lead to higher average levels of education and income in the MSA. Additionally, this should also lead to higher wages in consumer service industries such as retail, restaurants, and other leisure time consumption services.

Drawing a further comparison to investment in financial portfolios, there are several methods that investors use to choose investments. These are Passive, "gut instinct," and the fundamental analysis approach. It is the fundamental approach that has been proven to yield significantly better results. This approach requires forecasting future growth and selecting assets based upon their returns while diversifying between sectors to reduce risk. Diversifying between sectors reduces the industry specific risk to the portfolio. The fundamental approach reduces the risk of paying too much for an asset which contrasts the passive investor's belief in market efficiency and the "gut instinct" investor's shot in the dark approach.

By this same approach, MSAs can benefit from cooperation with economic researchers through the development of long run economic forecasts that use fundamental quantitative analysis to establish optimal economic portfolios that balance between output and employment growth. This approach would reduce and eliminate the overinvestment in one area of the region's economy. This would moderate the industry risk to employment leading to more stable output and employment growth.

From the top and bottom employment growth in table 4 we can see the percentage of employment in each sector, manufacturing has a higher percentage of employment in the bottom employment growth group than the top. By comparing these it can be seen that the bottom employment group has higher output growth in the manufacturing sector than in the top employment growth group, but employment is actually falling. In the business services and finance sector the employment growth and output growth are higher in the bottom employment growth group, but they have a lower percentage of employment. The growth in the top employment group is slower, but still strong. The overall growth between the two groups though is higher in the top employment growth sector for both output and employment. This suggests that there is an optimal economic portfolio that would balance between output and employment growth. Through a fundamental approach to future investment, MSAs can improve their economic portfolio and realize higher than average growth of employment and output.

Table 3 Top and Bottom Output and Employment Growth

TOP_OUTPUT	***GDP***	***Contrib Labr***	***Labor***	***Prod Labr***	***pop grwth***	***Emplymnt***	***% Priv. Sectr Empl***
Manufacturing	0.0488	-0.0022	-0.0034	0.0702	0.0171	12,554	10.5%
Trade	0.0525	0.0102	0.0150	0.0374	0.0171	17,986	15.0%
Information	0.0381	-0.0110	-0.0207	0.0681	0.0171	2,192	1.8%
Bus Service & Finance	0.1937	0.0514	0.1020	0.0969	0.0171	26,620	22.3%
Health & Education	0.0100	0.0282	0.0304	-0.0203	0.0171	19,405	16.2%
Other	0.0216	0.0196	0.0239	-0.0023	0.0171	40,805	34.1%
MSA Total	0.0485	0.0259	0.0276	0.0206	0.0171	152,945	78.2%

BOT_OUTPUT	***GDP***	***Contrib Labr***	***Labor***	***Prod Labr***	***pop grwth***	***Emplymnt***	***% Priv. Sectr Empl***
Manufacturing	-0.0014	-0.0296	-0.0446	0.0434	0.0042	7,810	9.3%
Trade	-0.0027	-0.0084	-0.0123	0.0096	0.0042	14,022	16.7%
Information	0.0201	-0.0186	-0.0348	0.0549	0.0042	1,594	1.9%
Bus Service & Finance	-0.0292	0.0061	0.0120	-0.0406	0.0042	19,932	23.7%
Health & Education	0.0347	0.0214	0.0230	0.0117	0.0042	13,179	15.7%
Other	-0.0186	-0.0052	-0.0063	-0.0123	0.0042	27,559	32.8%
MSA Total	-0.0120	-0.0034	-0.0036	-0.0084	0.0042	97,082	86.6%

TOP_EMPL_GR	***GDP***	***Contrib Labr***	***Labor***	***Prod Labr***	***pop grwth***	***Emplymnt***	***% Priv. Sectr Empl***
Manufacturing	0.0246	0.0054	0.0081	0.0377	0.0173	2,797	4.4%
Trade	0.0523	0.0113	0.0165	0.0356	0.0173	11,468	18.1%
Information	0.0436	-0.0080	-0.0149	0.0694	0.0173	1,065	1.7%
Bus Service & Finance	0.2198	0.0274	0.0544	0.1682	0.0173	13,000	20.6%
Health & Education	0.0026	0.0254	0.0273	-0.0246	0.0173	5,827	9.2%
Other	0.0422	0.0307	0.0373	0.0049	0.0173	29,060	46.0%
MSA Total	0.0487	0.0305	0.0325	0.0159	0.0173	88,433	71.5%

BOT_EMPL_GR	***GDP***	***Contrib Labr***	***Labor***	***Prod Labr***	***pop grwth***	***Emplymnt***	***% Priv. Sectr Empl***
Manufacturing	0.0869	-0.0322	-0.0484	0.1356	0.0002	10,943	12.8%
Trade	-0.0033	-0.0095	-0.0140	0.0108	0.0002	14,574	17.0%
Information	-0.0147	-0.0303	-0.0567	0.0421	0.0002	1,284	1.5%
Bus Service & Finance	-0.0257	0.0012	0.0023	-0.0279	0.0002	18,247	21.3%
Health & Education	0.0215	-0.0844	-0.0908	0.1122	0.0002	10,113	11.8%
Other	-0.0023	0.0069	0.0084	-0.0107	0.0002	30,355	35.5%
MSA Total	0.0037	-0.0104	-0.0110	0.0149	0.0002	99,029	86.4%

Table 4 Restricted Top and Bottom Output and Employment Growth

TOP_OUTPUT (2008-09 excluded)	*GDP*	*Contrib Labr*	*Labor*	*Prod Labr*	*pop grwth*	*Emplymnt*	*% Priv. Sectr Empl*
Manufacturing	0.2012	0.0097	0.0145	0.1866	0.0064	25,982	31.7%
Trade	0.0481	0.0050	0.0074	0.0406	0.0064	13,422	16.4%
Information	0.0495	-0.0204	-0.0382	0.0878	0.0064	782	1.0%
Bus Service & Finance	0.0381	0.0194	0.0384	0.0017	0.0064	10,753	13.1%
Health & Education	0.0203	-0.0276	-0.0297	0.0500	0.0064	7,030	8.6%
Other	0.0236	0.0197	0.0239	-0.0003	0.0064	24,065	29.3%
MSA Total	0.0831	0.0172	0.0183	0.0647	0.0064	90,801	90.3%

BOT_OUTPUT (2008-09 excluded)	*GDP*	*Contrib Labr*	*Labor*	*Prod Labr*	*pop grwth*	*Emplymnt*	*% Priv. Sectr Empl*
Manufacturing	0.0532	-0.0242	-0.0364	0.0897	0.0007	8,021	6.5%
Trade	0.0168	-0.0042	-0.0061	0.0230	0.0007	20,956	17.0%
Information	-0.0216	-0.0346	-0.0648	0.0433	0.0007	2,221	1.8%
Bus Service & Finance	-0.0377	0.0037	0.0073	-0.0447	0.0007	31,495	25.5%
Health & Education	0.0383	0.0234	0.0252	0.0133	0.0007	16,988	13.8%
Other	-0.0233	-0.0053	-0.0065	-0.0168	0.0007	43,608	35.4%
MSA Total	-0.0102	-0.0017	-0.0019	-0.0084	0.0007	142,251	86.7%

TOP_EMPL_GR (2008-09 excluded)	*GDP*	*Contrib Labr*	*Labor*	*Prod Labr*	*pop grwth*	*Emplymnt*	*% Priv. Sectr Empl*
Manufacturing	0.1161	0.0235	0.0353	0.0996	0.0183	3,860	5.7%
Trade	0.0726	0.0182	0.0267	0.0457	0.0183	12,108	17.9%
Information	0.0671	-0.0046	-0.0086	0.0986	0.0183	1,224	1.8%
Bus Service & Finance	0.3043	0.0305	0.0604	0.2470	0.0183	14,187	21.0%
Health & Education	-0.0023	0.0287	0.0308	-0.0330	0.0183	6,536	9.7%
Other	0.0354	0.0396	0.0481	-0.0128	0.0183	29,546	43.8%
MSA Total	0.0439	0.0352	0.0375	0.0060	0.0183	76,790	87.9%

BOT_EMPL_GR (2008-09 excluded)	*GDP*	*Contrib Labr*	*Labor*	*Prod Labr*	*pop grwth*	*Emplymnt*	*% Priv. Sectr Empl*
Manufacturing	0.1322	-0.0143	-0.0215	0.1538	-0.0006	10,160	12.7%
Trade	0.0207	-0.0022	-0.0033	0.0240	-0.0006	13,831	17.2%
Information	0.0009	-0.0920	-0.1720	0.0539	-0.0006	1,209	1.5%
Bus Service & Finance	0.5915	0.0336	0.0667	0.5319	-0.0006	14,216	17.7%
Health & Education	-0.0305	-0.0253	-0.0272	0.0015	-0.0006	10,058	12.5%
Other	-0.0195	0.0012	0.0014	-0.0209	-0.0006	30,812	38.4%
MSA Total	0.0302	-0.0011	-0.0012	0.0314	-0.0006	96,308	83.4%

BIBLIOGRAPHY

Acemoglu, Daron and David H. Autor. 2010. "Skills, Tasks, and Technologies: Implications for Employment and Earnings." O. Ashenfelter and D. Card, eds. *Handbook of Labor Economics*, Volume 4, Part B. New York: Elsevier.

Atack, Jeremy; Fred Bateman; and Robert A. Margo. 2004. "Skill Intensity and Rising Wage Dispersion in Nineteenth Century American Manufacturing" *Journal of Economic History* 64: 172-192.

Atack, Jeremy; Fred Bateman; and Robert A. Margo. 2008. "Steam Power, Establishment Size, and Labor Productivity Growth in Nineteenth Century American Manufacturing," *Explorations in Economic History* 45: 185-198.

Atack, Jeremy; Fred Bateman; and Thomas Weiss. 1980. "The Regional Diffusion and Adoption of the Steam Engine in American Manufacturing," *Journal of Economic History* 40: 281-308.

Atack, Jeremy. 1979. "Fact or Fiction? The Relative Costs of Steam and Water Power: A Simulation Approach." *Explorations in Economic History* 16: 409-437.

Autor, David H. 2010. "The Polarization of Job Opportunities in the U.S. Labor Market," Center for American Progress and The Hamilton Project, April.

Autor, David H.; Frank Levy; and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration," *Quarterly Journal of Economics* 116: 1279-1333.

Autor, David H.; Lawrence F. Katz; and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market," *American Economic Review* 96: 189-94.

Autor, David H.; Lawrence F. Katz; and Melissa S. Kearney. 2008. "Trends in U.S. Wage Inequality: Revising the Revisionists," *Review of Economics and Statistics* 90: 300-23.

Bender, Lloyd. D., Bernal L. Green, Thomas F. Hady, John A. Kuehn, Marlys K. Nelson, Leon B. Perkinson, and Peggy J. Ross. 1985. "The Diverse Social and Economic Structure of Non-Metropolitan America." Agriculture and Rural Economic Division, Economic Research Service, U.S. Department of Agriculture: Washington, DC.

Bernanke, Ben, and Refet S. Gürkaynak. 2001. "Is growth exogenous? : taking Mankiw, Romer, and Weil seriously" / Ben S. bernanke, Refet S. Gürkaynak. n.p.: Cambridge, MA. : National Bureau of Economic Research, c2001., 2001.

Brissenden, Paul F. 1929. "Earnings of Factory Workers, 1899-1927: An Analysis of Payroll Statistics." Washington DC: Government Printing Office.

Brown, Carl C. 2012. "The impact of changing diversification on stability and growth in a regional economy." *Research In Business & Economics Journal* 5, 1-10.

Buckley, Peter J., 2004. "Asian network firms: an analytical framework." *Asia Pacific Business Review* 10 (3/4), 254–271.

Chandler Jr., Alfred D. 1990. "Scale and Scope: the Dynamics of Industrial Capitalism." *Harvard University Press*, Cambridge, MA.

Chandler Jr., Alfred D., 1959. "The beginning of big business in American industry. In: Tedlow, R.S., John, R.R., Jr. (Eds.), Managing Big Business: Essays from the Business History Review." *Harvard Business School Press*, Boston, MA.

Chandler Jr., Alfred D., 1977. "The Visible Hand: Managerial Revolution in American Business." *Belknap Press of Harvard University Press*, Cambridge, UK.

Chandler, Alfred. 1977. The Visible Hand: The Managerial Revolution in American Business. *Harvard University Press*, Cambridge, MA.

Davis, Steven J. and John Haltiwanger. 1991. "Wage Dispersion Between and Within U.S. Manufacturing Plants, 1963‑1986." In Brookings Papers on Economic Activity: Microeconomics 1991, pp. 115‑180. Washington, DC: *The Brookings Institution.*

Deller, Steven, and Andrew Schreiber. 2012. "Mining and Community Economic Growth." *The Review of Regional Studies* 42, no. 2: 121-141.

Denison, Edward Fulton. (1979). "Accounting for Slower Economic Growth: The United States in the 70's." *The Brooking Institute.* Washington, DC.

Denison, Edward. 1962. "The Sources of Economic Growth in the United States and the Alternatives Before US." *The Brookings Institute*. Washington, D.C.

Devine, Warren D. 1983. "From Shafts to Wires: Historical Perspective on Electrification," *Journal of Economic History* 43: 347-372.

Drucker, Joshua. 2011. "Regional Industrial Structure Concentration in the United States: Trends and Implications." *Economic Geography* 87, no. 4: 421-452.

Goldin, Claudia and Lawrence F. Katz. 2007. "Long-Run Changes in the Wage Structure: Narrowing, Widening, Polarizing." *Brookings Papers on Economic Activity*, no. 2: 135-67.

Goldin, Claudia and Lawrence F. Katz. 2008. "The Race between Education and Technology." *The Belknap Press of Harvard University Press.* Cambridge, MA.

Goldin, Claudia, and Lawrence F. Katz. 1998. "THE ORIGINS OF TECHNOLOGY-SKILL COMPLEMENTARITY." *Quarterly Journal Of Economics* 113, no. 3: 693-732.

Goos, Maarten; Alan Manning; and Anna Salomons. 2011. "Explaining Job Polarization: The Roles of Technology, Globalization, and Institutions," University of Leuven, November.

Guenther, Gary. 2012. "Federal Tax Benefits for Manufacturing: Current Law, Legislative Proposals, and Issues for the 112th Congress."

Innis, Harold. 1956. "The Fur Trade in Canada." *University of Toronto Press*: Toronto.

Katz, Lawrence F., and Robert A. Margo. 2013. "Technical Change and the Relative Demand for Skilled Labor: The United States in Historical Perspective." No. w18752. National Bureau of Economic Research.

Komninos, I., D. Milossis, and N. Komninos. "Product Life Cycle Management A Guide to New Product Development."

Lee, Keun, Byung-Yeon Kim, Young-Yoon Park, and Elias Sanidas. 2013. "Big Businesses and Economic Growth: Identifying a Binding Constraint for Growth with Country Panel Analysis." *Journal Of Comparative Economics* 41, no. 2: 561-582.

Nord, Mark and Al E. Luloff. 1993 "Socioeconomic Heterogeneity of Mining-dependent Counties," *Rural Sociology*, 58, 492–500.

Pagano, Patrizio, Schivardi, Fabiano, 2003. "Firm size distribution and growth." *Scandinavian Journal of Economics* 105 (2), 255–274.

Papyrakis, Elissaios and Reyer Gerlagh. (2007) "Resource Abundance and Economic Growth in the United States," *European Economic Review*, 51, 1011–1039.

Ross, Michael L. 1999. "The Political Economy of the Resource Curse," *World Politics*, 51, 297–322.

Rosser, Andrew. 2006. "Escaping the Resource Curse," *New Political Economy*, 11, 557–570.

Sachs, Jeffery D. and Andrew Warner. 1999. "The Big Push, Natural Resource Booms and Growth," *Journal of Development Economies*, 59, 43–76.

Sokoloff, Kenneth. 1984. "Was the Transition from the Artisanal Shop to the Non‐Mechanized Factory Associated with Gains in Efficiency? Evidence From the Manufacturing Censuses of 1820 and 1850," *Explorations in Economic History* 21: 351-384.

Sokoloff, Kenneth. 1986. "Productivity Gains in Manufacturing During Early Industrialization: Evidence from the American Northeast, 1820-1850." In S. L. Engerman and R. Gallman, Eds. Long Term Factors in American Economic Growth, 51: Studies in Income and Wealth. Chicago: *University of Chicago Press.*

Watts, Michael. 2005 “Righteous Oil?: Human Rights, the Oil Complex and Corporate Social Responsibility,” *Annual Review of Environment and Resources*, 30, 373–407.

Weber, Bruce A., Emery N. Castle, and Allan L. Shriver. 1988 “The Performance of Natural Resource Industries,” in Rural Economic Development in the 1980s. Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture: Washington, DC, pp. 1–37.

Zelleke, Girma, and Abdulwahab Sraiheen. 2012. "Sources of Economic Growth in 31 Sub-Sahara African Countries for the Period 1975-2008: A Growth Accounting Approach." *International Journal Of Economics & Finance* 4, no. 10: 54-68.

APPENDIX

Listed below are the regression tables from the estimating the elasticity coefficients on capital and labor for the individual sectors including Other and MSA Total. These are the results displayed in Table 1.

Table 5. Manufacturing

Random-effects GLS regression			Number of obs = 478		
Group variable: ID			Number of groups = 46		
R-sq: within = 0.9205			Obs per group: min = 4		
between = 0.9922			avg = 10.4		
overall = 0.9910			max = 11		
			Wald chi2(2) = 15829.77		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.3401305	0.0062589	54.34	0	.3278634 .3523977
Labor	0.6645025	0.0102759	64.67	0	.6443622 .6846429
Technology	0.6660764	0.0536169	12.42	0	.5609892 .7711637
σ_u	0.06709381				
σ_e	0.0518522				
ρ	0.62606888	(fraction of variance due to σ_{ui})			

Table 6. Trade

Random-effects GLS regression			Number of obs = 518		
Group variable: ID			Number of groups = 48		
R-sq: within = 0.9748			Obs per group: min = 5		
between = 0.9974			avg = 10.8		
overall = 0.9966			max = 11		
			Wald chi2(2) = 36133.14		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.3274345	0.0045796	71.5	0	.3184586 .3364103
Labor	0.6803609	0.0074381	91.47	0	.6657826 .6949393
Technology	0.6057092	0.036439	16.62	0	.5342901 .6771283
σ_u	0.03459243				
σ_e|	0.02186727				
ρ	0.71448922	(fraction of variance due to σ_{ui})			

Table 7. Information

Random-effects GLS regression			Number of obs = 426		
Group variable: ID			Number of groups = 43		
R-sq: within = 0.9690			Obs per group: min = 1		
between = 0.9993			avg = 9.9		
overall = 0.9979			max = 11		
			Wald chi2(2) = 152888.23		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.4667151	0.0048328	96.57	0	.4572431 .4761871
Labor	0.5348647	0.0053519	99.94	0	.5243752 .5453542
Technology	0.7149779	0.0114224	62.59	0	.6925904 .7373654
σ_u	0.00849219				
σ_e|	0.03898002				
ρ	0.04531238	(fraction of variance due to σ_{ui})			

Table 8. Business Services and Finance

Random-effects GLS regression			Number of obs = 498		
Group variable: ID			Number of groups = 48		
R-sq: within = 0.9755			Obs per group: min = 1		
between = 0.9828			avg = 10.4		
overall = 0.9916			max = 11		
			Wald chi2(2) = 21184.44		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.4447771	0.0074396	59.79	0	.4301958 .4593583
Labor	0.5042916	0.0105297	47.89	0	.4836537 .5249295
Technology	1.085521	0.0478181	22.7	0	.9917996 1.179243
σ_u	0.10875946				
σ_e|	0.07068963				
ρ	0.70301146	(fraction of variance due to σ_{ui})			

Table 9. Health and Education

Random-effects GLS regression			Number of obs = 372		
Group variable: ID			Number of groups = 39		
R-sq: within = 0.9997			Obs per group: min = 1		
between = 0.9993			avg = 9.5		
overall = 0.9997			max = 11		
			Wald chi2(2) = 981947.05		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]
Capital	0.0663464	0.0009923	66.86	0	.0644016 .0682912
Labor	0.9294106	0.0012533	741.57	0	.9269541 .931867
Technology	0.2770796	0.0066982	41.37	0	.2639515 .2902078
σ_u	0.01403171				
σ_e|	0.00412383				
ρ	0.92049391	(fraction of variance due to σ_{ui})			

Table 10. Other

Random-effects GLS regression			Number of obs = 52		
Group variable: ID			Number of groups = 8		
R-sq: within = 0.6748			Obs per group: min = 1		
between = 0.9932			avg = 6.5		
overall = 0.9782			max = 11		
			Wald chi2(2) = 1040.89		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.1777409	0.0173647	10.24	0	.1437067 .2117752
Labor	0.822862	0.0334002	24.64	0	.7573988 .8883253
Technology	0.5808965	0.2627084	2.21	0.027	.0659976 1.095795
σ_u	0.05694433				
σ_e|	0.09308064				
ρ	0.27233974	(fraction of variance due to σ_{ui})			

Table 11. MSA Total

Random-effects GLS regression			Number of obs = 385		
Group variable: ID			Number of groups = 39		
R-sq: within = 0.8296			Obs per group: min = 4		
between = 0.9775			avg = 9.9		
overall = 0.9719			max = 11		
			Wald chi2(2) = 3695.11		
corr(u_i, X) = 0 (assumed)			Prob > chi2 = 0.0000		
Output	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Capital	0.0706121	0.0039642	17.81	0	.0628424 .0783819
Labor	0.9380362	0.0167011	56.17	0	.9053026 .9707698
Technology	0.2722647	0.1469422	1.85	0.064	-.0157367 .5602662
σ_u	0.09084556				
σ_e|	0.04131614				
ρ	0.82861107	(fraction of variance due to σ_{ui})			

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