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What Drives Productivity Growth at the Firm Level and Why is it that Some Firms Outperform their Peers?

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What Drives Productivity Growth at the Firm Level and Why Is It That Some
Firms Outperform Their Peers?

A capstone project submitted in partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

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Firms appear to outperform their peers when defined as exhibiting increased productivity growth. Specific factors have been shown to have a causal effect upon increased total factor productivity and thus the firm level with the implementation of: the use and diffusion of technological progress; diversification of firm assets through the acquisition of high productivity growth plant assets; the integration of information technology and information communications technology and the creation of innovative capacities and efficiencies. Likewise, specific factors have been shown to have a causal effect upon increased labor productivity and thus firm level productivity growth: the sharing of employee experiences and learned knowledge; increased human capital through the training and education of the firm’s employee base; access to a larger urban pool of highly skilled and educated workers; the retention of long term employees that add value through firm level knowledge and processes; and creating and maintaining a culture that fosters both innovation and shared employee knowledge.
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I. INTRODUCTION

SECTION 1. INTRODUCTION OF IDEA

Firms in every industry are confronted with the enormous challenges of managing complex relationships and processes, diverse business units, and for many, a global employee base. Simultaneously, though, they must also grow productivity. For decades, economists have been interested in identifying and measuring sources of productivity growth, but such exercises are not merely for academics. Being able to measure productivity and understand why it does or does not occur is of grave importance to firms. Understanding why productivity growth episodes occur affords firm management the ability to make decisions that foster future growth potential (Sharma et al, 2007). Yet, given that firms operate within similar objectives and constraints, some firms seem more adept at creating productivity growth than others.

This paper seeks to gather relevant research to determine the possible reasons that some firms appear to outperform their peers as defined by exhibiting higher performance in terms of productivity growth. To that end, productivity will be defined as the output from a production process, per unit of input. As such, the emphasis will...
not fall to allocative efficiency, which takes into account the cost of the input against the price of the end product. Nor, will the emphasis fall on profitability, which is the difference between the revenues gained from the end product after accounting for the expenses associated with producing it. Although these are topics worthy of analysis and backed by academic literature, this paper will instead focus on the two components that seem to lie at the heart of increased productivity growth as supported by research analyzed by the author. These components are total factor productivity and labor productivity as factors of productivity growth at the firm level. From the author’s perspective, both components lend a more transparent view into current firm performance and future growth potential because of their role in building the capacity for long run productivity gains. As factors of overall productivity growth, total factor productivity and labor productivity are actually complements, yet possess different impacts, which will be discussed throughout the paper.
Understanding why some firms outperform others is a constant, though understandable, pre-occupation at all levels within a firm. High productivity growth performance in any one year may well be ultimately due to a combination of many endogenous and exogenous factors, although persistent high performance is much more likely to signal deep seated sources of competitive ability and advantage for a firm. As a means of understanding and explaining firm performance, research often tends to pursue the definition of high performance through the lens of corporate accounting profitability, in an attempt to illuminate differences between firms over extended periods of time. However, choosing to view firm performance through the lens of profitability is flawed on several accounts because accounting profitability is often manipulated by firms to give the appearance of stable earnings over time (Geroski, 2005). Since perceived firm stability, in part, often drives investor confidence in a particular firm, the incentive on behalf of a firm to show steady profit growth is enormous. Investors also tend to gauge current perceived firm stability as a signal of future stability. Yet, according to Geroski (2005), superior accounting profitability may reflect any number of sources of competitive ability or advantage, and therefore is difficult to discern why it is currently occurring. The study found that when firms are viewed purely on profit data, it is difficult to discern whether high profit performers excel because they are good at differentiating their product or because they manage their costs well. Although an inordinate amount of focus among firms is universally
placed upon corporate accounting profitability, such a measure lacks the distinction of where the competitive advantage truly resides and as well can be a poor indication of a firm's ability to perform in the long run. Herein lays the greatest motivation and drive on this paper's author to better understand long run firm performance as instead measured through productivity growth. Increased interest for this study also stems from time spent within a highly competitive corporate setting, where extreme obsession with profitability loomed ever present within all levels of the organizations, yet consideration for long run sustained productivity growth was rarely voiced.

Traditionally, productivity growth is aggregated to illuminate macroeconomic growth patterns. As such, the rate of aggregate productivity growth in most economies is a modest several percentage points per year. Although it varies over time, it seems clear that at least some of this variability is systematic, with aggregate productivity growth noticeably pro-cyclical (Geroski et al, 2005). When viewed over one or more decades, some countries are persistently labeled high growth performers, while others are not. Aggregated growth statistics are quite meaningful, yet by definition, aggregation cannot provide detailed understanding of productivity growth performance at the firm level.

Whereas aggregated productivity growth data may appear relatively stable over time, by contrast productivity growth at the firm level may display extraordinary variability during the same time period. As Geroski (2005) sought to better understand
Firm level productivity growth patterns, what surfaced was an enormous variation in productivity growth rates at the firm level in any given year. The research also discovered that the range of productivity growth rates at the firm level did not seem to be as tied to cyclical business patterns as aggregated data tends to show. This firm level variation was found to be the case whether productivity growth was measured as the rate of growth of total factor productivity or as the rate of growth of labor productivity (Geroski et al, 2005). In fact, almost all the variation found in productivity growth rates was within firms as opposed to between firms – meaning that there was more variability within each firm over time than between firms in a similar industry over time. The study found that typical periods of high performance as measured by productivity growth lasted only two years, when comparing firms against each other over time.

Those firms that exhibited the longest periods of increased productivity over time also tended to display and the ability to innovate and superior financial performance. As part of the study, the ability to patent was used as a proxy for innovation with the noted caveat that innovation data can be difficult to acquire at the firm level. In the context then of ability to patent as a proxy, their findings have the implication that differences in productivity growth levels between comparable firms may be more determined by stability than flexibility in the long run. Stability in this sense is the ability to continually innovate in the long run over the ability to cut employees or costs in the short run.
The Geroski study also points to industry characteristics and their role in the persistence of superior productivity growth. In particular, the degree of competitiveness for a given industry can have a positive impact on productivity growth. Firms that operate in very competitive markets must work harder to increase their efficiencies and to reduce costs for survival. In the same way, a firm who has gained market power in an industry must continue to innovate to retain its market power and as a consequence, the organization bears the added stress of having to maintain or gain greater productivity growth. Any misstep in lost productivity equates to a competing firm dominating market share. Thus, market power dominance seems to have an adverse effect on productivity growth for firms, leading to shorter growth episodes. This may be due to the increased desire from competing firms to take back lost market share or due to new firms entering into a market now perceived as a growth opportunity. The theory that fast growing firms eventually lose the momentum of their productivity improvement measures is supported by evidence that high growth rates among firms rarely last longer than two years (Geroski et al, 2005). Intuitively, high productivity growth firms eventually run out of steam, although these firms are more likely to extend their growth episode beyond the first year.
II. METHODS

SECTION 1. PRODUCTIVITY GROWTH AS A FUNCTION OF TOTAL FACTOR PRODUCTIVITY

The Cobb–Douglas production function represents total output as a function of total-factor productivity, capital input, labor input, and the respective shares of capital and labor as inputs. While capital and labor are tangible inputs, total factor productivity exhibits intangible characteristics to include technological innovation and efficiency. As such, total factor productivity is that portion of output not explained by the amount of inputs used during production, and its level is determined by how efficiently and intensely the inputs are utilized (Comin, 2006). As an example, a farmer who experiences an unusually cooperative season of weather will tend to have higher agricultural output than would be associated with adverse weather. In this example, better weather is a component of total factor productivity in that it assists in crop input efficiency. Total factor productivity (from here forth known as TFP) plays a critical role in economic fluctuations, economic growth and per capita income differences. As a result, it is often seen as the real driver of growth within an economy and some data estimates reveal that while labor and capital investment are important contributors, total factor productivity may account for more than half of growth variations within
economies (Comin, 2006). Both technological innovation and efficiency are sub-sets of total factor productivity and share in its role as a driver of growth.

The neoclassical approach explains growth in terms of technological progress as measured by total factor productivity. The work of Robert Solow has been of major importance to the growth literature and derived the methodology for measuring technological progress as a residual after other inputs had been accounted for in the overall productivity growth function. Solow's work has become the basis for a theoretical approach known as growth accounting, which attempts to quantify sources of economic growth. In part, it views technological innovation as the primary force behind long-run fluctuations in the economy (Crepso, 2008). Because researchers view technological progress as an important source of economic growth, it is often used to explain the production decisions made by firms.

Through their study, Sharma et al, (2007) recognized that when attempting to measure firm productivity growth through total factor productivity, it was essential to identify which sources actually contribute to productivity growth. As such, their research sought to identify whether total factor productivity was attributed to efficiency gains or to technological progress. The study recognized that most academic research views inefficiency to exist when firms produce inside the production frontier, thus the farther one produces below this frontier the larger the inefficiency. In that line of
thinking, efficiency gains can be made when firms take corrective action to decrease the distance between their optimal frontier and their actual output and as a result, efficiency gains realized as firms decrease or close this gap. Notably the study finds that technological progress on the other hand, occurs when the production frontier itself shifts outward and that there is an important distinction between the two. Thus, efficiency gains are not sustainable without additional technological progress, as additional efficiency cannot recur once the frontier has been reached (Sharma et al, 2007).

Recognizing the difficulty associated with identifying actual sources of TFP growth, Sharma et al emphasizes the importance of decomposing TFP growth into efficiency gain and technological progress. This recognition came as a result of finding that previous research approaching this subject often labeled any deviation from the production frontier as inefficiency (Sharma et al, 2007). Their study created a methodology to incorporate and account for each of these two components of TFP growth while also allowing for a stochastic (random noise) environment. Their research produced a productivity index of firm level productivity growth using data from the lower 48 states during the years 1977 through 2000 to create a model that would consider random disturbances as a reason why production falls short of the technological frontier. The study aggregates firm level data by industry to determine why individual industries exhibited differing levels of higher productivity growth relative
to other industries. Because the research created a model to distinguish inefficiency from random disturbance, their results find that TFP growth is more attributable to outward shifts of the production frontier (technological progress) itself than by movement towards it (efficiency gains). Moreover, less variability was noticed in technological progress relative to changes in efficiency across industries (Sharma et al, 2007). Thus, the greatest TFP growth by industry was most attributable to technological progress whereas differences in TFP growth across firms seemed to indicate differences in efficiency changes. Other findings were that firms located in states with more human capital elicited higher levels of efficiency because of the ability to draw from a relatively larger pool of urban and educated population. One explanation is that firms in urban areas exhibit economies of scale and/or can become more specialized than their counterparts located in rural areas. This allows firms to produce more output with the same quantities of capital and labor (Sharma et al, 2007). The study used firm data from 1977 through 2000 and noted that the greatest declines in TFP growth were found for firms located within oil and coal producing states, while the greatest increases in TFP growth were found for firms located within larger financial sector states during the time period studied, with the financial firms exhibiting the greatest gains as an industry.

Research by Schoar (2002) sought to examine plants within firms to find whether firms who diversify have an advantage over their non-diversified counterparts. The study noted that productivity growth as measured by TFP was far greater for those who were diversified. Yet, while newly acquired plants increase a firm’s productivity, existing
plants show a slight productivity decline, as increases in diversification can be associated with a decline in the firm's overall productivity. In other words, diversified firms tend to experience a new toy effect, whereby management shifts its focus to the newly acquired plant at the expense of existing divisions in the short run (Schoar, 2002). As a whole, the findings indicate that diversified firms have a productivity advantage over their standalone counterparts as they increase productivity in their acquired assets. With each diversifying move, however, these firms may lose a bit of their existing productivity advantage if too much focus is shifted away from existing assets.
SECTION 2. PRODUCTIVITY GROWTH AS A FUNCTION OF LABOR PRODUCTIVITY

Labor productivity is also an important component of productivity growth and is often described as the amount of goods and services that a laborer produces in a given amount of time or on a larger scale, as the ratio of a volume measure of output to a volume measure of input (Minetaki et al, 2001). Volume measures of output are typically total product. Labor inputs are most commonly measured as the number of hours worked by a firm’s workforce or the total number employed within the firm. Labor productivity varies as a function of other input factors and the efficiency with which the factors of production are used, therefore firms with greater human capital resources exhibit higher labor productivity. The success of a firm is often characterized in its particular market by the growth of productive capacity per employee and the growth of the total number of personnel employed. As such, firms tend to monitor internal metrics of productivity per employee as compared to their competitors.

When attempting to answer why some companies have greater productivity growth than others, some firms show a capacity to generate more value added per employee while also decreasing the number employed. Solvay et al (1998) found evidence that firms in this situation are better able to adapt to the effects of cycles in the economic environment through labor utilization instead of using price mechanisms of their end products or services. Rising productivity and falling employment often
suggests a firm that organizationally has high quality research activity. In general, firms that exhibit strong technological performance through innovation are also able to generate productivity improvements in the long run. An example of such a firm is General Electric, who managed to create high productivity while simultaneously lowering its employee base during more than a decade period of time (Solvay et al, 1998). Intel, on the other hand, is an exceptional case of contrast. Intel showed a high level of productivity growth while simultaneously increasing the number of employees retained. As a firm, Intel was able to accomplish this because they were gaining a dominant position within a rapidly enlarging market. According to Solvay et al (1998), this is only possible when a firm takes a dominant position in a technology relative to its peers.

Another interesting example of contrast is retail giant Walmart. This firm offers an example where a firm shows fairly constant value add per employee which is accompanied by strong growth in the number of employees retained. Rising profits along with an increasing employment base, yet static labor productivity, convey a firm that has managed to generate profit growth through sales growth rather than labor productivity growth. This is likely due to their ability to produce a high quality marketing structure. This scenario has allowed Walmart to generate additional sales with little or no high quality research. Findings also illustrate that Apple had engaged in increasing employment, yet experienced declining labor productivity growth during the
1980s. By the 1990s employment had stabilized yet productivity growth continued to decline while profitability fell. This is indicative of inadequate firm sales and shows that the firm lacked sufficient quality research and development to create growth.

Key insights from the findings of Solvey et al, (1998) are that firms who show weak labor productivity, yet simultaneously grow their employment base, suggests a firm that is reliant upon a high quality marketing structure in order to maintain profitability. Firms that exhibit strong labor productivity growth with a declining employment base reflect a high quality research structure. Less frequent is the firm that exhibits high labor productivity growth and simultaneous increases in employment, which suggests strong research performance and the ability to gain market share. Finally, a firm that exhibits decreased labor productivity growth and a decreased or static employment base indicates poor research, inadequate sales or both (Solvay et al, 1998). Beneficial to understanding from what point firms are producing allows insight into how wage growth is affected. As noted, both General Electric and Intel displayed strong technological performance. As a result, both firms were also able to provide growth in wages and salaries. Analysis across the range of companies considered showed a clear positive correlation between the growth of productive capacity due to increased labor productivity and the growth of wages and salaries (Solvay, 1998). Because growth of labor productivity requires innovation and adaptation by employees of an organization, it tends to be reflected in strong growth of employee compensation.
This is in turn self-reinforcing as firms that pay higher wages and salaries are able to attract more productive and better educated employees.

Employees are vital contributors to a firm’s overall success because worker knowledge and their skill sets are the greatest source of competitive advantage for 21st century firms (Kochan, 2003). Through their knowledge and effort, workers add differentiation and value to a firm. Firms benefit when they retain top talent because as employees stay with a given firm, they accumulate historical knowledge vital to firm structure and operation. Given this perspective, employees also put a significant portion of their own human capital at risk. Workers who are forced to find new employment frequently lose up to 20 percent in wages and the value of non-pecuniary benefits. In this way, employees absorb significant risk. Yet, firms that reward employees for high performance and length of service show greater productivity growth than their counterparts (Kochan, 2003).
SECTION 3. SUMMARIZING THE EFFECTS OF TOTAL FACTOR PRODUCTIVITY AND LABOR PRODUCTIVITY

In summary, sections 3 and 4 has looked at productivity growth at the firm level in order to evaluate why productivity growth performance may vary based on given certain firm specific characteristics or behaviors. When firms are viewed purely using profit data, it is difficult to infer whether high profit performers excel because they are good at differentiating their product, manage their costs well, or are able to gain market share in other ways such as through innovation. As firms work to create greater innovative capacities through research and development, advertising, and organizational changes, these intangibles are not calculated in standard accounting profitability measures.

As research by Geroski found, high productivity growth firms seem to exhibit greater stability as defined by sustained innovation capabilities in the long run, versus flexibility in cost cutting and labor contraction in the short run, with the ability to innovate a marker for increased productivity growth - especially as it relates to extended periods of growth over competing firms.

As contrasted against aggregated productivity growth data, there is actually more variability within individual firms when looking at rates of productivity growth
over time than between firms during the same time period. This point illuminates the variability of firm productivity growth performance that exists within given markets and that this variability is not merely a result of purely cyclical business exposure. Industry characteristics also play a key role in how firms perform since some industries are highly competitive which adds substantial pressure to those firms who choose to operate within them. Industry characteristics also drive the size of the firm that is able to compete due to capital intensity and economies of scale required. Production that requires highly repetitive processes or large scale production runs will fall to firms that are technologically proficient and able to manage the costs associated with them. Firms that diversify show greater potential for productivity growth as they gain the innovative and competitive capacities of other plants or firms through diversification.

Furthermore, total factor productivity seems to have a significant positive impact on firm productivity growth due to its role in innovation and efficiency. It is for this reason that total factor productivity may account for more than half of growth variations between economies. Technological innovation seems to exceed efficiency gains as a source of productivity growth as innovation has the ability to push a firm’s production function outward, while efficiency gains allow movement toward it. However, both are required for growth, as a firm must continually work to maintain or gain efficiencies while simultaneously innovating. The highest levels of firm productivity growth seem to be found in those firms who can incorporate innovation and as well,
retain high quality human capital resources. Often the success of a firm can be characterized in its particular market by the growth of productive capacity per employee.

High productivity growth firms show a capacity to generate more value added per employee while also decreasing the number employed. Solvay et al (1998) found that firms who generate more value added per employee are more adept at adjusting to the implications of cyclical macroeconomic changes through labor utilization instead of using price mechanisms of their end products or services.
III. RESULTS

SECTION 1. TECHNOLOGICAL ADVANCEMENT FUELS PRODUCTIVITY GROWTH

Standard theory of the firm suggests that in a competitive environment firms are the size which minimizes their cost structure (Miller, 1986). Firm size in large part is determined by each industry. Industries where small firms have a distinct cost advantage tend to be dominated by small firms and respectively, larger firms should dominate where they have a cost advantage. What ultimately determines the size of a firm in a particular industry is of great importance for firm management as certain size structures may not be attainable due to industry constraints.

Many studies have examined variables that compare large and small firms within an industry typically with the intent to measure the advantage or disadvantages of large firms over small firms (Miller, 1986). Productivity growth among small businesses in particular, regardless of respective industry, has long filled market niches and sparked economic innovation inviting other firms to follow. Knowing this, one study sought to understand where small firms hold a distinct advantage. Miller’s research (1986) looked at several measures of labor input, such as labor costs per dollar of value added, worker
hours per dollar of value added, and employees per dollar of value added. These labor input measures were examined for both large and small firms using the ratio between large firm labor productivity values and small firm labor productivity values. For the purposes of the study, small firms were defined as less than 250 employees and labor productivity was defined as value added per employee. In all cases studied, research showed that the more labor that small firms required in relation to their larger firm counterparts, the lower the respective small firm's share of output. The study notes that small firm share can be increased if the organization is able to achieve labor productivity higher than that of its larger firm counterparts and conversely, would decline if firm labor productivity is lower than that of large firms. The latter tends to be more typical because of large scale production economies that many larger firms possess over their smaller firm peers. These economies of scale give large firms the ability to engage in highly repetitive, large batch, mechanized processes for their end products. The study found that small firm productivity averaged only 90 percent of large firm productivity for 405 industries examined (Miller, 1986). Obviously, an increase in small firm share of output could be achieved if small business productivity could be brought up to that of other larger firms.

The most important determinant of firm size within a given industry appears to be its capital intensity. Intuitively, the more capital intense an industry, the smaller the share of small businesses found within it. There is an engineering reason for this
relationship between firm size and capital intensity. In most industries, the lowest cost way of producing a large amount of product is through a highly mechanized process. Most highly repetitive operations can be mechanized. Mechanization of repetitive processes are only worth doing if the identical operation will be performed many times, permitting the high cost of the machinery to be recovered. Thus, in the case of a very large production run, technology will favor large scale production in highly mechanized factories. With such large economies of scale, large firms have a cost advantage and production becomes concentrated in them (Miller, 1986). Conversely, large scale production processes are by their very nature cumbersome and lack flexibility. The distinct advantage created through large mechanized processes also creates a distinct disadvantage in that small incremental changes to production are often costly and difficult to make. This disadvantage for large businesses becomes instead the advantage for small businesses which are adept at quickly adapting to shifts in demand preferences, filling niche markets, and meeting needs that prove too costly for large firms. Small firms also possess advantages where information can be exchanged quickly within a more shallow hierarchical firm structure, and where changes in demand can be recognized and translated through the organization.

According to Solvey et al, (1998), capital intensity increases potential firm capacity because of innovation’s role in creating financial surplus - surplus that can be later used for firm investment. In this sense, growth in potential capacity from
technological innovation permits growth in actual productive capacity. The innovation effect, embedded within total factor productivity, is a result of expenditure on research and development and its ability to raise potential capacity for a firm. Furthermore, given that labor productivity and total factor productivity are factors of productivity growth, embedded within labor productivity is the experience effect. This is labeled as such because as the potential productivity of each worker in a firm rises through experience, so too does the accumulated firm experience and productivity rise (Solvay et al, 1998). Both the experience and innovation effects allow for increased technological progress on which the firm is able to draw. However, although much focus and attention is often given to research and development, the ability to patent, the role of high-tech industries, some evidence supports the notion that it is more probable that the diffusion and use of technology is a far greater determinant of productivity growth. A general consensus has emerged in academic literature with respect to faster growth in the United States being traced largely to sectors that use new technologies, rather than those that produce them (Griffith, 2007).

Recent research by Kruger (2008) has sought to better understand the structural changes that occur when sectors or industries grow faster than others over the long run. This creates shifts in the share that these sectors or industries have in total. For the study, the relationship between total factor productivity growth and the value added shares for those industries experiencing faster productivity growth was examined using
firm data within the US manufacturing sector. Value added in this sense is similar to return on labor and return on capital as a measure of contribution to factors of production. As distinguished from employment, real value added shares of industries is measure as the contribution to economy wide GDP (Kruger, 2008). The results of the study found that industries with higher productivity growth appear to be a result of firms reaching a relatively larger value added share for a given initial input as compared to their slower growth peers. This gives strong support for the positive relationship between value added share dynamics and productivity growth, because as firms are able to increase their value added shares, productivity growth is also boosted.

Of particular note in Kruger’s analysis is the observation that a structural change seemed to take place for the period 1958–1996, as the computer revolution left a distinct imprint upon value added shares and showed exceptional growth for some core industries (Kruger, 2008). This lends insight into the enormous growth potential that could be realized through technological innovation for areas of the economy yet to embrace such investment. The increased competitive edge gained as a result of total factor productivity growth in this sense shows the significant influence on the process of structural change that has been gained through diffusion of computing technology during the computer revolution and intensity of the use of computer applications (Kruger, 2008). As such, these processes can theoretically be applied to other industries or economies seeking growth potential. TFP growth of individual firms dominated
aggregate labor productivity growth and secondarily, structural change in the form of reallocation of employment also contributed considerably to aggregate labor productivity growth (Kruger, 2008). The effects of structural change tend to be more pronounced when it is measured in terms of changing value added shares rather than changing employment shares. These results are especially apparent in high technology goods producing industries, defined as semiconductors, computers, computer software, communications equipment and telecommunications services and internet services (Corrado, 2007). Thus, the results of the research strongly suggest that the computer revolution is an important aspect of the association of structural change as a determinate of aggregate productivity growth.

Schoar (2002) explored the effect on firms of moves towards or away from diversification. There appears to be a substantial difference in firms that are already diversified versus the dynamic effect of becoming diversified. A productivity premium is associated with firms seeking to diversify because they are cash abundant and are able purchase more productive plants, even though subsequently they may in time run these plants down. If diversified firms are more efficient at running their operation, the productivity of the assets they acquire should be higher than if they are not diversified. It appears that after the change in ownership, productivity of acquired plants increases. The positive effect may be due in part to reallocation of newly acquired plants being placed under the acquiring firm’s most superior management talent. This finding
corroborates numerous studies that point to a decline in market value of the firm to be acquired just preceding the acquisition (Schoar, 2002).
SECTION 2. TECHNOLOGICAL ADVANCEMENT AS INFORMATION AND COMMUNICATION EXCHANGE

One of the biggest technological changes of recent years has been the revolution in information and communication technology (here forth known as ICT) and its positive impact on productivity growth, as noted in research by Griffith (2007). Computing components have become faster, smaller, and relatively less expensive, while simultaneously becoming more flexible in their ability to connect expansive networks. The term ICT is often times synonymous with the term information technology or IT, but ICT has an extended component that combines the use of telephony with computer networks to create a single seamless communications network. These technologies and other changes in technical complements to computers have led to very rapid growth in demand for ICT. Corporate investment in these new technologies has risen rapidly in the United States and many other industrialized economies, and has contributed greatly to aggregate productivity growth. The most important finding is that patterns in technology investment growth seem to be mirrored in growth statistics as measured in GDP (Griffith, 2007). The use of ICT has also changed the boundaries within which a firm can operate, giving way to the use of external trade channels once not available. By outsourcing, firms are able to increase productivity through the use of specialized service providers who can exploit economies of scale or scope, have greater incentive and/or ability to innovate, and who offer core competencies in niche areas. As an example, through the use of ITC, outsourcing allows firms to utilize the services of
contracted labor or other services that were previously only performed within the firm’s location. Such services are now no longer location specific and can be performed by labor around the globe. Of note is that as ITC becomes more important for the production process of a firm, outsourcing agents will have a greater incentive to recoup their investment costs and provide more efficient use of their investment to firms in order to compete (Griffith, 2007).

Ultimately, technologies that reduce a firm’s internal transactions costs, as well as the number of market transactions required to perform an activity enhance productivity. This has been especially true for call centers, business processes such as finance and accounting, supply chain management, and research and development. Incorporating new technologies also affords firms the ability to reduce hierarchical structures, transfer information more efficiently, reduce bureaucratic waste, and make crucial decisions more quickly. Such activities also require complementary investments in human or organizational capital. For this reason the adjustment to greater ICT investment has been slower for some firms with reluctance to bear these up-front costs. This may be one of the reasons that European countries have continued to lag behind the United States in GDP (Griffith, 2007).

During the second half of the 1980s, the growth performance of Organization for Economic Co-operation and Development (OECD) countries underwent a marked
change in growth performance. According to research by Inklaar et al (2007), this was the first time since World War II that labor productivity growth in most European Union (EU) member countries fell behind that of the United States. Whereas average annual labor productivity growth in the US accelerated between 1987 and 1995, the EU-15 experienced a decline in their productivity growth rate. The downward trend of the growth rate in the EU-15 continued, although at a slightly slower rate, from 1995 through 2005. The study also noted that similar to the United States, a few countries such as Australia and Canada have also experienced significant improvement in productivity growth during the late 1990s. The striking acceleration in US output and productivity growth was found to be attributed to the role of ICT (Inklaar et al, 2007). Most notably, the services sector of the US economy has strongly benefited from the increase in ICT use. When compared with Europe, the United States has shown greater embracement of ICT investment and production and the productive use of ICT during the late 1990s. Of note, the study caveats that the reasons for the limited impact of new technology, innovation and structural reforms on economic growth in Europe as not fully understood (Inklaar et al, 2007).

There does appear to be a distinction between the Anglo-Saxon countries such as Australia, Canada, the United Kingdom and the United States from that of continental European countries such as France, Germany and the Netherlands. In the Anglo-Saxon countries, services have contributed more to labor productivity growth since 1995 than
ever before. Only part of the increase in labor productivity growth gained in the service sector can be traced directly to ICT investment. This investment is also attributed as a cause to higher total factor productivity growth. The study notes that what seems to separate the US from Canada and Australia is the fact that the US shows a higher TFP level in services. Ultimately, the study finds that US firms as an aggregate have embraced ICT investment and thus have added to the productive capacity of the overall US economy in a way that other countries have not attained. Although the study illuminates differences in macroeconomic outcomes made possible through TFP growth, it has powerful implications for productivity growth potential at the firm level. For firms that are either under invested in ICT or under-utilize current ICT investment, strategies that bolster greater innovative capacities through increased investment in such technologies could realize increased firm level productivity growth.

Similar findings by Corrado (2007) noted that as productivity growth surged within the United States during the 1990s, so did the research on productivity. Most intently, researchers concentrated on estimating the contribution that information technology (here forth known as IT) was having on productivity, given the impact of greater availability of computing technologies as well as availability of aggregate macroeconomic data at the industry level. The term IT, as stated previously, is typically synonymous with ICT; however it is a bit broader in scope than ICT because it tends to concentrate more heavily on computer based information systems, the software that
supports them, and the role that data plays in firm information transmission. For Corrado, the research focus was the effect on total factor productivity growth created by IT producing industries and the role that IT played in increasing TFP growth. Insight from the study showed that TFP growth was found to be very high for IT producing industries as would be expected, but it was also found for service industries using IT during the 1990s (Corrado, 2007). With this insight, it was apparent that the resurgence in productivity growth for the US went beyond the production of IT itself and was also based, in part, to increases in TFP growth in some services industries as a result of strong IT use.

The greatest productivity growth for services industries was found in the business, financial and high technology industries; an interesting finding, given that US services industries had been experiencing declines in the growth rate of labor productivity for more than 20 years previous to the productivity resurgence of the 1990s. The IT capital that firms were acquiring is often cited as the reason for this resurgence, especially for the financial services sector, but research indicates that other factors, such as human capital development, also played an important role in the increased productivity experiences in the financial and business services industries more broadly (Corrado, 2007).
IT and ITC investment is most effective when firms also incorporate information management into the overall corporate culture. Therefore, firms must value information as a vital process in which employees share what they know with others. Incorporating information management into the overall corporate culture must become part of a firm’s information processing practices so that the firm can link its business strategies to external market realities, which are supported through ICT investment to build innovation capabilities (Marchand, 2010).

The difference in how companies are able to deal with complexity is directly related to how well they manage and use information, employee knowledge and information systems. High productivity growth firms systematically develop high quality information capabilities while also knowing how to use the information to their strategic advantage. By being able to operate more efficiently and effectively than their competition, high performing firms manage proactively to changes in market demand, fluctuations and shocks whether internal or external to the firm (Marchand, 2010). High performing firms seem to exhibit optimization of their information capabilities in five key areas: The first optimization is through organizational structure. Information capabilities play an integral role in eliminating redundancy and unnecessary organizational layers. By streamlining processes, minimizing management layers, facilitating communication and improving information monitoring, information capabilities afford more agile and flexible organizational structures. The second
optimization is through firm processes. As firms work to make processes both more efficient and effective, similar tasks can be coordinated or reduced across channels while physical processes can be replaced by electronic ones. Such processes include product delivery, order processing, servicing customers, accounts payable and receivable, and payroll and expense reporting. The third optimization is through firm employees. By optimizing human capital resources, firms can reduce the number of physical employees required to achieve the same desired results. In tandem, standardization of ways in which information is collected and communicated allows more efficient management of projects and control of functional tasks by labor. High performing firms also provide continuous training and education which reinforces and improves employees’ understanding of core business practices and helps to create a shared culture where employees learn from mistakes and leverage the experiences of their fellow employees. The fourth optimization is through external relationships. Strong partnering relationships with customers, suppliers, and vendors has become imperative to gaining a competitive advantage. Pooling knowledge and expertise both inside and outside the firm decreases the costs related to overproduction or underproduction. Firms who engage in information sharing between channels are more adept at collecting and analyzing data to better tailor products or services. The fifth and final optimization is through financial management. The more efficient firms are at collecting accounts receivable and avoiding excess inventory, the quicker cash flow can be realized. Companies that effectively manage information are most often the ones that evaluate investment risks, achieve optimal returns, leverage their global wealth,
and manage their balance sheet better than the competition (Marchand, 2010). As
such, these are all forms under which higher productivity can be realized, resulting in
higher firm performance relative to its rivals.
SECTION 3. SUMMARIZING TECHNOLOGICAL ADVANCEMENT AS A FUEL FOR PRODUCTIVITY GROWTH

In summary, the biggest technological gain of recent years has been the revolution in information and communication technology and its impact on productivity growth of firms. Greater investment in these technologies has, in part, allowed the US to overtake Europe and United Kingdom in its productivity growth trajectory. High productivity firms are those that have embraced the use of information through ICT and IT to incorporate greater TFP and labor productivity growth, giving firms the ability to reduce hierarchical structures, transfer information more efficiently, reduce bureaucratic waste, and make crucial decisions more quickly. Additionally, the innovation effect, embedded within total factor productivity, is a result of expenditure on research and development and its ability to raise potential capacity for a firm. Moreover, embedded within labor productivity, the experience effect is created as the productivity of each worker within a firm rises over time, so too does the accumulated firm experience increase. Both the innovation and experience effects allow for increased technological progress on which the firm is able to draw. The relationship between total factor productivity growth and the value added shares for firms experiencing higher productivity growth shows a positive correlation in that they tend to reach a relatively larger value added share for a given initial input as compared to their slower growth peers. As firms are able to increase their value added per input through TFP growth and labor productivity growth, overall firm productivity growth is
increased. Firms that were able to embrace the historic computer revolution have shown exceptional growth with an increased competitive edge gained as a result of total factor productivity growth that illuminates the significant influence of the computer revolution and intensity of computer applications. The effects of such structural change are most pronounced when measured in terms of changing value-added shares rather than changing employment shares and these results are especially driven by high-tech and durable goods producing industries, such as semiconductors, computers, computer software, communications equipment and telecommunications services and internet services.
IV. DISCUSSION

SECTION 1. CONSIDERATIONS UNDERSTATED IN PRODUCUTIVITY GROWTH RESEARCH STUDIES

High performing productivity growth firms also have highly engrained practices of ethical behavior. This means that they take voluntary actions beyond that which is required by law. Often, this behavior is labeled as corporate social responsibility (McWilliams et al, 2001). This is the idea that firms broaden their objectives beyond profit maximization of shareholder wealth to account for the interests of other stakeholder groups. An illustration of corporate social responsibility is the firm that takes action to monitor the labor conditions of outsourced production facilities. Firms tend to engage in these practices only when the perceived benefit outweighs the cost and the product can be easily differentiated by the consumer or end user as being a socially responsible product or service (McWilliams et al, 2001). Under these conditions, firms are most likely to engage in voluntary ethical behavior.

When an ethical behavior is a required condition of business and not voluntary, the cost of compliance can be much higher for a firm, thus negatively impacting
productivity growth. One such example is the Community Reinvestment Act. This legislation placed significant constraints upon all federal regulated depository institutions and the industry to expand their mix of mortgage products to include a larger pool of moderate to low income household within the given institution’s communities. For financial institutions to produce what is seen by its communities as a socially responsible product, specifically home mortgage loans, no additional value was perceived by the end user, which translated into institutions bearing the entire cost structure of compliance with the Act, yet no additional revenue stream (Vitaliano, 2006).

Policy changes though, can be used to enhance firm productivity. Knowing that TFP growth occurs when the effectiveness of labor and capital inputs is increased, policies that seek to increase the level of education and/or experience (the human capital) of employees will improve firm productivity. Evidence suggests that TFP growth and output growth are positively associated (Moomaw et al, 1991) thus federal and/or state policies can be geared to increase the determinants of TFP growth to include improvements in educational quality, transportation and infrastructure, communication and computing technologies, and reward for innovation. States, in particular, can influence educational quality, transportation systems, and other productivity enhancing factors that create an environment under which a firm can financially gain.
An important consideration underexplored in the research literature is the extent to which firm productivity growth is disrupted as a result of Chief Executive Officer (CEO) selection (Naveen, 2006). For firms that chose outside selection, there is a significant potential for costly errors and missed opportunities during the period that it takes a new CEO to acquire necessary knowledge and company history after taking the reins. Such costs may include, but are not limited to, missed revenue opportunities, poor judgment due to lack of embedded knowledge, or making promises the organization cannot deliver adequately. New CEOs have the potential to over commit to customers, suppliers or verticals creating lost productivity as resources are shifted to accommodate over projected commitments. As Naveen (2006) noted, the more time it takes a CEO to learn the firm’s assets and customer base, the greater the succession costs associated with it. For this reason, studies show that choosing a candidate from inside the firm is the most cost effective option for firms and requires a continual succession plan in place (Naveen, 2006). The higher the operational complexity of the firm, the greater the potential succession costs associated with an outside candidate, especially with high technology firms. Highly complex firms magnify internal issues of resource allocation and disparate product markets, which requires firm specific human capital. As an added benefit, firms that choose inside candidates create an environment and culture that rewards promotion. When firms seek outside CEO appointments, it illuminates for the entire organization the reduced probability of promotion to top line management and results in a culture of lowered incentive to perform (Naveen, 2006).
Corporate culture is one of the most powerful conversations missing from productivity literature and its consideration for how culture underpins an entire organization’s ability to grow productivity. A firm’s culture must act as a catalyst in fostering and harnessing an organization’s innovation and learning, since these are the driving forces behind long run productivity growth. Variation between firms in their corporate culture can often explain the vast differences in the rates at which technological and innovative opportunities are translated into increased productivity (Solvay et al, 1998). Much of this variability can be linked to how employees add value and how that value is reinforced through corporate culture. The extent to which employee experience and knowledge creates additional innovation and increased productivity depends in part upon deep seated firm culture. Firms which exhibit poor performance both in terms of their ability to share experience knowledge and therefore achieve technological advancement will require a clear reassessment of how culture affects the firm (Solvay et al, 1998).

Since learning is at the core of an organization’s ability to assimilate information and gain shared experience knowledge from its employees, a corporate culture must reinforce the ability to take risk in making decisions. Not only the ability to take risk, but to learn from its successes and its failures. Firms that do not allow for mistakes produce a culture where decisions are either never made or are delayed, causing lost opportunity. Firms that share among employees internally their organizational mistakes
and missteps allow for organizational reflection and the ability to fail intelligently. Failing intelligently means that mistakes are something from which to learn, holding clues of not merely what went wrong, but why something went wrong. Often corporate culture either never discloses poor decision making or glosses over it out of firm management embarrassment. From a cultural standpoint, when employees learn that mistakes are not tolerated, it creates an organization plagued by indecisive inaction where analysis paralysis is so pervasive - potential opportunities are missed out of fear of risk taking. Knowing that innovation is the development and introduction of ideas that are transformed into new products, processes, or services, a culture that reinforces sharing learned experiences truly creates the greatest source of growth potential for a firm and the innovative life force of the organization. Thus, a culture of innovation is one that holds internal assumptions, values, and management practices that foster the development of ideas into new products, processes, and services (Cameron et al, 1999).

From the author of this paper’s perspective it cannot be stressed enough how corporate culture can slowly erode a firm’s ability to grow productivity. From personal experiences gained within an organization whose deeply embedded culture did not allow for mistake or misstep, employees turned productive energy into maintaining individual positions rather than collaborating collectively and sharing ideas. As a result, innovation could not flourish. When employees do not promote organizational productivity growth through learned experiences, but rather resort to protectionist
practices that isolate employee experiences, firm level directives slowly lose momentum as they filter through the entire organization. New innovative ideas are interpreted and perceived as potential threats to what culturally is considered safe or known by employees. Since the organizational culture had long rewarded decisions based on over-analysis, employees became increasingly leery of making decisions at all. Decision making was made with the least amount of risk, especially surrounding the firm’s customers or suppliers. Ultimately, organizational change could not be embraced without almost unanimous approval and consensus from large portions of firm management. For those employees whose ideas did not fall within the lines of unanimous consensus, their ideas were shut out completely, reinforcing the culture norm of low key, low risk compliance. With the increasing speed at which decisions are now required of firms in order to adapt to changes in demand preferences, resource inputs, cyclical business activity, and the rate at which technological advances are implemented, firms can no longer afford to harbor a culture that reinforces fear and indecision. At some point, indecision translates to obsolescence. Upending this type of corrosive culture is not an easy task and can be a slow, painful process, but is the only recipe for future productivity growth potential and is a topic of great interest to the author for another study.
To conclude, this paper has sought to gather relevant research to determine the possible reasons that some firms appear to outperform their peers when defined as exhibiting higher performance in terms of productivity growth. In so doing, the intent has been to illustrate the factors that cause overall firm level productivity growth to increase as a result of increased firm level total factor productivity and labor productivity. As such, this paper has provided support for the concept that both total factor productivity and labor productivity increase as a result of the creation and implementation of specific factors of individual firms. The following factors have been shown to have a causal effect upon total factor productivity and thus firm level with the implementation of: the use and diffusion of technological progress; diversification of firm assets through the acquisition of high productivity growth plant assets; the integration of information technology and information communications technology and the creation of innovative capacities and efficiencies. Likewise, the following factors have been shown to have a causal effect upon labor productivity and thus firm level productivity growth: the sharing of employee experiences and learned knowledge; increased human capital through the training and education of the firm’s employee base; access to a larger urban pool of highly skilled and educated workers; the retention of long term employees that add value through firm level knowledge and processes; and
creating and maintaining a culture that fosters both innovation and shared employee knowledge.

As the complexities of competitive pressures faced by firms grow, so does the quest for greater productivity growth. Being able to understand what drives productivity growth is essential for future growth potential. Recognizing that some firms are more adept at outperforming their peers, this paper has sought to gather relevant research that addresses possible reasons as to why some firms have indeed fared better in terms of productivity growth. The two components that have been examined through academic literature and research for this paper have been labor productivity and total factor productivity as factors of productivity growth.

Although much has been covered through the course of this paper in order to lend context and credibility to the given topic, it is this author’s perspective that what is most significant in the findings of scholars is also what is most overlooked by firms. As firms universally set out to turn a profit through market mechanisms, the very heart of what underpins their overall productivity growth is instead often overlooked, left instead to that of academic conversations. Regarding firm productivity, the most deeply embedded firm problems may well require answers that are the least quantifiable yet carry the greatest potential impact. In that vein, the most significant insights for this author are the roles that the culture of innovation and learning play out within an
organization and how they are inextricably tied to each other. Innovation isn’t merely the embracing of technological processes or new practices that reduce cost in some way – innovation is truly the development and introduction of ideas that are transformed into new products, processes, or services. The ability to innovate includes the ability to share information within an organization and to incorporate information management into the overall corporate culture. Differences in how firms deal with complexity is directly related to how well they manage and use information and employee knowledge along with their information systems structure. This means that firms must value information as a vital process so that employees share what they know with others. A learning organization is one that utilizes the experience effect to its fullest potential to yield high productivity growth. High productivity firms systematically develop high quality information capabilities to their strategic advantage enabling them to operate more efficiently and effectively than competitors. Given that organizations must translate innovative opportunities and learned experiences into increased productivity, firm culture truly underscores or undercut a firm’s productivity growth potential and is in need of further study.

A data summary follows the bibliography section of this paper that lists the author and the data variables used, along with the level of significance and corresponding sign for studies that used regression analysis. Control variables have
been excluded from the list. Some studies used other forms of analysis or built upon earlier regression data sets and those studies are not included in the summary section.
BIBLIOGRAPHY


## TABLE 1. DATA SUMMARY

<table>
<thead>
<tr>
<th>Author, publication year</th>
<th>Dependent variable</th>
<th>Independent variables (+ or -)</th>
<th>Statistically Significant level</th>
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<tr>
<td>Minetaki et al, 2001</td>
<td>Total Factor Productivity Growth</td>
<td>Growth in Value Added Inputs (+), Substitutability/Complementarity of IT &amp; Equipment (+), Production Force Labor Age (-), Firm Profitability (-), Ratio of IT Capital Stock (+)</td>
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<tr>
<td>Moomaw et al, 1991</td>
<td>Total Factor Productivity</td>
<td>Cost Changes in Productivity (+), Cost Changes in Labor (-), Local Tax Rate Changes (-), Unionization Levels (+), Agglomeration Effects (-)</td>
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<tr>
<td>Schoar, 2002</td>
<td>Total Factor Productivity</td>
<td>Diversification (+), Total Value of Shipments relative to Inventory(+), Plant Age (-), Productive Hours (+), Upstream Segment in Diversified Firm (+), Downstream Segment of Vertical Integration (+)</td>
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<tr>
<td>Chun et al, 2008</td>
<td>Productivity Growth</td>
<td>Quantity of Output (+), Quality of Output (+), Time (-), Price of Labor (+), Price of Materials (+), Capital Stock (-), Scale of production (+), Product Innovation (+)</td>
<td>10%</td>
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<td>Study</td>
<td>Category</td>
<td>Measures</td>
<td>Weight</td>
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<tr>
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<tr>
<td>Sharma et al, 2007</td>
<td>Efficiency</td>
<td>Human Capital (+), Level of Urbanization (+), Agricultural Effect (-), Manufacturing Effect (+), Financial Institution Access (+), Geographic Midwest (-), Geographic South East (+), Geographic Plains (-), Geographic Far West (+), Variance of Inefficiency (-)</td>
<td>5%</td>
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<tr>
<td>Gugler et al, 2005</td>
<td>Market Share</td>
<td>Accumulated Patents (+), Firm Size (+), Multi Channel (+), Outside Market Share Merger (-), Inside Market Share Merger (+), Regional Joint Venture (+)</td>
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<td>Inklaar et al, 2007</td>
<td>Labor Productivity</td>
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<td>Geroski et al, 2009</td>
<td>Growth Spell</td>
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<td>Kruger, 2008</td>
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<td>Miller, 1986</td>
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<td>Naveen, 2006</td>
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