Investment in Graduate and Professional Degree Education: Evidence of State Workforce Productivity Growth

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The purpose of this study was to estimate the effects of investment in graduate and professional education on the subsequent growth in state workforce productivity. The independent variables of this study were investment in master's degree education, investment in doctoral degree education, investment in professional degree education, initial productivity, and economic activity of different industrial sectors. The dependent variable was the subsequent growth in state workforce productivity for the period of 1990 - 2000. Aggregate data from several federal sources were used. Using the above mentioned variables, a growth model was developed to estimate the effects of independent variables on the dependent variables. Findings indicated that cumulative investments in master's degree education, doctoral degree education, and professional degree education significantly affect the subsequent growth of state workforce productivity.

Keywords: Public benefits; graduate education; professional education; higher education; productivity growth; state workforce.

Introduction

Investment in higher education yields both private and public benefits (Cohn and Geske, 1990; Leslie and Brinkman, 1988; Paulsen, 2001b, 2001c; Pascarella and Terenzini, 1991; Pencavel, 1993; Schultz, 1963; Solmon and Fagnano, 1995). An example of a private benefit would be the substantial additional earnings that accrue to a college graduate compared to a high school graduate (G. Becker, 1992; College Board, 2006; Fossey, 1998; Murphy and Welch, 1989; Paulsen, 1998, 2001b), while an example of a public benefit -- also known as a social or external benefit -- would be an increase in overall productivity of a state's workforce that results in additions to everyone's income rather than only the income of the individuals investing in higher education (Baumol, Blackman and Wolff, 1989; Leslie and Brinkman, 1988; Paulsen, 1996a, 1996b, 2001c; Pencavel, 1993).

Existing data show that earnings for graduate and professional degree holders are higher than those of bachelor's degree holders. A report from the U.S. Census Bureau shows that over the course of their working lives, adults are likely to have higher earnings as they become more educated (U.S. Census Bureau, 2002). While high school dropouts have the lowest expected lifetime earnings compared, professional and doctoral degree holders have the highest. Data from the Bureau of Labor Statistics (2005) reveal that while the median weekly earnings for bachelor's degree holders is $916, the median weekly earnings for masters, professional and doctoral degree holders are $1102, $1377, and $1398 respectively. Existing literature also demonstrate that private returns due to the investments in graduate and professional education have always been positive (Lindsay, 1973; McMahon & Wagner, 1981, 1982; Sloan, 1970). While returns to graduate degree education were found to vary, returns to the investments in professional degree education were found to be highly profitable (Lindsay, 1973; Sloan, 1970).

Problem Statement

Over the past thirty years, graduate and first-professional enrollments in degree-granting institutions have increased considerably. According to NCES (2006) data, between 1976 and 2004, enrollment in graduate programs increased 62 percent (from 1.3 to 2.2 million), while enrollment in professional programs increased 37 percent (from 244,000 to 335,000). Enrollments in both graduate and first-professional programs are projected to continue increasing, with graduate enrollment expected to reach 2.6 million and first-professional enrollment to reach 437,000 by 2015 (NCES, 2006). Accordingly, degree attainments in graduate programs and professional degree programs have increased substantially. According to the Digest of Education (2005), in the 1976-77 academic year, 316,602 students were awarded master's degrees while 33,126 students were awarded doctoral degrees and 63,953 students were awarded professional degrees by degree-granting institutions. In the 2003-04 academic year, these numbers increased to 329,395, 23,055, and 40,872 respectively.

Despite the increased number of graduate and professional students enrolled in the institutions of higher education in the United States, it is very surprising that there has not been much research done to explore the issue of investing in higher education at the graduate and professional degree levels. A number of taxonomies and reports of empirical evidence of the public or social benefits–both tangible and intangible--of investment in higher education have appeared in the literature (Baum & Payea, 2004; Bowen, 1977; Cohn & Geske, 1990; College Board, 2005; Institute for Higher Education Policy, 1998, 2005; Pascarella & Terenzini, 1991; Perna, 2005; Solmon & Fagnano, 1995; Wolfe, 1995) and a number of studies have provided evidence of public benefits in terms of computed social rates of return (McMahon, 1991; McMahon & Wagner, 1982), estimates of economic impact, and estimates of the contribution of higher education to economic growth (Fatima & Paulsen, 2004; Leslie & Brinkman, 1988; Paulsen &Fatima, 2007). Unfortunately, very few studies have been conducted to estimate the returns for graduate and professional degree education (Lindsay, 1973; McMahon & Wagner, 1981, 1982; Sloan, 1970).

The contribution of higher education to economic growth has been the focus of many studies documenting the public or social benefits of higher education. A number of well-crafted studies of this nature have now been conducted using a cross-section of national economies (Barro & Sala-i-Martin, 1992, 1995; Baumol, Blackman & Wolff, 1989). However, instead of studying the effects of higher education on economic growth in a cross-section of national economies, the present study examines the effects of investment in higher education at graduate and professional levels using comparatively recent data on growth in workforce productivity for a cross-section of 50 state economies in the U.S. over a 10-year period of growth, thereby building and expanding upon a relatively new line of inquiry in the higher education literature (Fatima & Paulsen, 2004; Paulsen, 1996a, 1996b; Paulsen & Fatima, 2007). In particular, the *purpose* of this study is to estimate the effects of investments in master's degree, professional degree, and doctoral degree education on the subsequent growth in workforce productivity in the 50 individual state economies during the period of 1990-2000.

Significance of the Study

A study investigating the contributions of graduate and professional degree education to state workforce productivity is significant on several grounds. First, if the United States is to enjoy continued economic prosperity, it must continue to advance the productivity of its workforce. The findings of this study provide researchers, policy analysts, policy makers, and practitioners with potentially important information and insights about how investment in graduate and professional degree education impacts the growth of state and national productivity in general and the growth of state workforce productivity in particular. Second, given the existence of public or external benefits to investment in graduate and professional education, public expenditure on graduate and professional degree education is very important in order to maintain standards of social efficiency in the allocation of state and national resources and equity in the distribution of costs and benefits for graduate and professional degree education consumers. Findings of this study regarding the existence and magnitude of public benefits attributable to investment in graduate and professional education provide a potentially strong rationale or justification for sustaining or expanding public expenditure on higher education at graduate and professional levels. Third, a search of the literature on economic impacts of higher education revealed that very few studies have examined the effects of investment in graduate and professional degree education on the subsequent growth in workforce productivity in state economies (Fatima, 2002). So, the findings of this study serve to advance the knowledge and understanding about the existence and nature of the public benefits of investment in higher education at graduate and professional levels in state economies, the magnitude of the effect of investment in graduate and professional education on subsequent growth in state workforce productivity, and as a result, the benefit-cost ratio associated with public investment in higher education at graduate and professional levels.

Literature Review

Different approaches have been identified to measure the impact of higher education on productivity or economic growth (W. Becker, 1964, 1975, 1993; Denison, 1967, 1979; Schultz, 1961). One approach is called growth accounting. This approach is based on the concept of an aggregate production function, which links output (Y) to the input of physical capital (K) and labor (L) (Denison, 1967, 1979). Another approach that attempts to measure the impact of education on productivity or economic growth consists of viewing education as an investment in human capital (W. Becker, 1964, 1975, 1993; Schultz, 1961). Because the present study conceptualizes expenditure on higher education as a form of such investment, the theory of human capital serves as an important and useful theoretical framework and foundation for this study.

According to the human capital theorists, an individual student will choose to invest in higher education if the expected benefits from the college education exceed the expected or perceived costs associated with the college education (G. Becker, 1964, 1975, 1993; Mincer, 1993; Schultz, 1961). Human capital theory takes the view that the individual who takes part in education or vocational training benefits by increasing his or her individual productivity and thus increases his or her lifetime earnings. In support of this theory and its hypotheses, researchers have consistently found that the earnings differential between college and high school graduates is substantial and significant, and that enrollment behavior is quite responsive to changes in this differential (Berger, 1992; Freeman, 1976; Grubb, 1996; McMahon and Wagner, 1982; Murphy and Welch, 1989, 1992; Paulsen and Pogue, 1988). Private rates of return to the investment in higher education – based, in part, on earnings differentials -- have also been found to be substantial and significant (G. Becker, 1993; Cohn and Geske, 1990; Douglass, 1977; Johnes, 1993; Leslie and Brinkman, 1988; McMahon and Wagner, 1982; Perlman, 1973; Psacharopoulos, 1973), varying according to investment in different types and levels of higher education (G. Becker, 1993; Cohn and Geske, 1990; Douglass, 1977; Grubb, 1995, 1996; Johnes, 1993; Kane and Rouse, 1995; Lanaan, 1998; Leigh and Gill, 1997; Leslie and Brinkman, 1988; Lewis et al., 1993; McMahon and Wagner, 1982; Monk-Turner, 1994; Perlman, 1973; Psacharopoulos, 1973; Sanchez and Lanaan, 1998). Findings of these studies reveal that although rates of return to the investment in different levels of higher education are positive, investment in four-year college education appears to be the most attractive among postsecondary investments (G. Becker, 1993; Cohn and Geske, 1990; Douglass, 1977; Johnes, 1993; Leslie and Brinkman, 1988; McMahon and Wagner, 1982; Perlman, 1973; Psacharopoulos, 1973). Several studies also examined the economic value of graduate and professional degree education (Kiker & Wilder, 1975; Lidsay, 1973; Maurizi, 1975; Sloan, 1970; McMahon and Wagner, 1982). Findings of these studies reveal that private returns to graduate degree education were found to vary from 0.1 to 16.4 percent while returns to the investments in professional degree education were found to be highly profitable (13.3 to 25.5 percent).

In addition to private benefits, investment in higher education also produces social benefits. Numerous studies have demonstrated that the social rates of return -- which reflect the public or external benefits due to investment in higher education -- are substantial, significant, and larger than rates of return on investments in alternative interest-earning assets (Freeman, 1975; Leslie and Brinkman, 1988; McMahon, 1991; McMahon and Wagner, 1982; Murphy and Welch, 1989).

Investment in higher education also yields public or social benefits through its substantial contribution to the national economic or productivity growth (W. Becker, 1960, 1964; Denison, 1962, 1985; Paulsen, 1996a, 1996b; Pencavel, 1993; Schultz, 1961). Another type of public or social benefits due to the investment in higher education can also be demonstrated through the impacts of higher education institutions on local, state, or regional economic activity (Creech, 1991; Engler, Fiornberg, and Kuhn, 1980; Mason, 1983; Posey, 1990; Sawhney and Kaushik, 1971; Schimmelpfennig, 1983; Seybert, 1991; Simmons, 1992; Singleton, 1994; Stevenson, 1982; Taylor and Bryden, 1973; Wade, 1988; Weitzman, 1991). Finally, non-monetary social benefits due to the investments in higher education have also been documented in numerous studies (G. Becker, 1975, 1993; Bowen, 1977; Cohn and Geske, 1979, 1990; Douglass, 1977; Murphy and Welch, 1989; Pascarella and Terenzini, 1991; Solmon and Fagnano, 1995; Schultz, 1963; Weisbrod, 1968; Wolfe, 1995).

However, according to research and theory related to the economics of human capital and the public sector, individual students investing in higher education consider only private benefits while making investment decisions and ignore those public benefits that accrue to the society in general. As a result, these individual student investors would invest in an amount of higher education that would be less than the optimal amount for society, that is, there would be an under investment in higher education. In this instance, government intervention is needed to provide public subsidies to institutions (e.g. appropriations) and to students (e.g. Pell grants) to stimulate an increase in individual investment in higher education up to the socially optimum amount (Paulsen, 2001b, 2001c). Furthermore, public benefits, especially those arising because of growth in workforce productivity, would work as an incentive for government to invest more in higher education in the form of subsidies to both institutions and students.

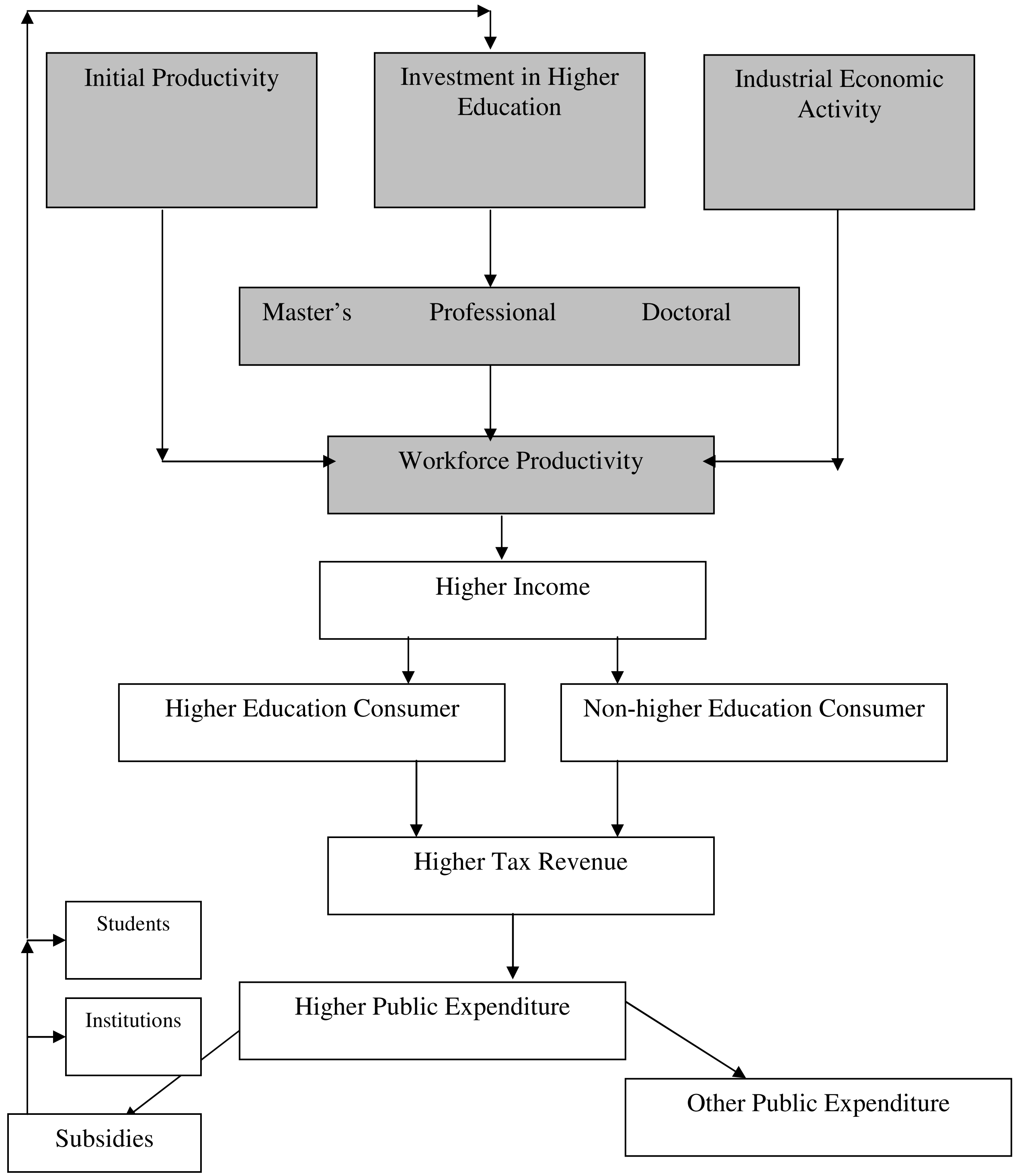
The literature on economic growth has revealed that growth in subsequent productivity is, in part, a consequence of initial productivity in the economy at the beginning of the period of analysis (Denison, 1962, 1967, 1979, 1984, 1985; Fatima & Paulsen, 2004; Jorgenson, 1984; Kendrick, 1961; Madison, 1987; Paulsen, 1996a, 1996b; Paulsen & Fatima, 2007; Pencavel, 1993). The economic growth literature has also demonstrated, in terms of convergence theory, that initial productivity is inversely related to subsequent growth in productivity (Barro, 1991; Barro and Sala-i-Martin, 1992; Barro and Sala-i -Martin, 1995; Baumol, 1986; Dowrick and Nguyen, 1989; Paulsen, 1996a, 1996b).

Economic activity in different industrial sectors has also been found to have significant effects on growth in productivity. In an effort to better understand the growth of productivity in the United States, some economists have turned to measures that capture the varying patterns of economic expansion or contraction across diverse industrial sectors in their research (Barro and Sala -i –Martin, 1992; Denison, 1989; Jorgeson, Kuroda, and Nishimizu, 1995). Their investigations have usually disaggregated gross domestic or gross state product into economic activity in anywhere from eight to twelve different industrial sectors of the economy. So it is important to control for the impacts of the diverse patterns of economic activity in various industrial sectors in studies of national or state workforce productivity.

Conceptual Framework

Based on a review of these related literatures, it can be concluded that growth in state workforce productivity is dependent on three primary factors: investment in master’s, professional, and doctoral education; initial productivity; and economic activity in different industrial sectors. The relationships between growth in workforce productivity and these primary factors are presented as part of the conceptual framework displayed in Figure 1 below. More particularly, these key factors and their relationships are emphasized in the color "gray" in Figure 1. While initial productivity is likely to have a negative impact on growth in state workforce productivity, due to the convergence hypothesis, both investments in master's degree education, professional degree education, doctoral degree education, and advances in the economic activity of different industrial sectors are likely to have positive impacts on subsequent growth in state workforce productivity.

Figure1. Conceptual Framework



Research Design

In this study, the purpose was to investigate the effects of cumulative investment in master's degree education, professional degree education, and doctoral degree education on growth in state workforce productivity between 1990 and 2000. Accordingly, the growth of workforce productivity between 1990 and 2000 for state i ($GROWTH_{00/90i}$) was measured as the percent change in the real (inflation-adjusted) gross state product divided by the number of individuals in the labor force - age 16 years and over - between 1990 and 2000. Cumulative investment in master's education ($MASTED_{90i}$) was measured as the number of high school graduates -- age 25 and over -- who had masters' degrees divided by the total number of high school graduates – age 25 and over – in 1990 for state i. Cumulative investment in professional education ($PROFED_{90i}$) was measured as the number of high school graduates -- age 25 and over -- who had professional degrees divided by the total number of high school graduates – age 25 and over – in 1990 for state i. Cumulative investment in doctoral education ($DOCTED_{90i}$) was measured as the number of high school graduates -- age 25 and over -- who had doctoral degrees divided by the total number of high school graduates – age 25 and over – in 1990 for state i. Therefore, $MASTED_{90i,}$ $PROFED_{90i}$, and $DOCTED_{90i}$ measure a state's cumulative investment in master's, professional, and doctoral education in 1990 – that is, as of the year that marks the beginning of the ten-year period of analysis for this study. Therefore, these measures of cumulative investment in master's, professional, and doctoral education for each state in 1990 would also account for the net migration of students and graduates between states that had occurred up to the first year of the period of analysis. Furthermore, controls for migration of students and graduates between states during the period of analysis are discussed in detail below.

In order to accurately estimate the effects of the initial cumulative investment in higher education in 1990 on subsequent growth in workforce productivity between 1990 and 1999, it is necessary to control for the effects of the initial level of workforce productivity among the states. Therefore, a measure of initial productivity was included in the model. The variable $PROD_{90i}$ represents the initial level of workforce productivity in state i at the beginning of the period of analysis, in 1990. Following Fatima & Paulsen (2004), Paulsen (1996a, 1996b), and Paulsen & Fatima (2007), the initial productivity of the workforce for the period of 1990 was measured as the real gross state product divided by the number of the total labor force in state i at the beginning of the period of analysis in 1990. The variable $PROD_{90i}$ controls for the effects of a wide range of factors other than cumulative investments in higher education that worked in combination to determine the level of workforce productivity in each state in 1990 at the beginning of the ten-year period of analysis. For example, $PROD_{90i}$ would control for the net effects of cumulative investments in other factors influencing workforce productivity, such as literacy and high school education, various forms of technical and corporate training, and the many varieties of new technologies in various industries.

As discussed in a previous section, economic activity in the different industrial sectors also has impacts on the growth of state workforce productivity. In order to measure the effect of investment in higher education on the subsequent growth in state workforce productivity, it is important to hold constant the effects of expansions and contraction in economic activity in individual states during the period of analysis. Additionally, aggregate disturbances or shocks can cause differential effects on the gross state products of different states. For instance, shifts in the relative prices of agricultural products or oil might have a greater effect on the growth of workforce productivity in states with heavy industrial concentrations in these industries than in those states which are not heavily concentrated on these industries (Barro and Sala-i-Martin, 1992, 1995; Paulsen 1996a, 1996b). To estimate, and control for, the effects of such fluctuations, a complex and comprehensive measure of economic activity was constructed following Barro and Sala-i-Martin (1992) based on a measure of the sectoral composition of gross state product in each state. The sources of gross state product were broken down into ten categories, each representing a separate and substantial industrial sector of a state's economies: agriculture; mining; construction; manufacturing; transportation and public utilities; wholesale trade; retail trade; finance, insurances, and real estate; services; and government and government enterprises. This complex measure captures the subtle patterns of changes, both expansions and contractions, in each of ten industries that contribute to each state's gross state product and its growth during the period of analysis. For state i, the variable ECONACT below was calculated as follows:

$$\text{ECONACT} = \sum_{j=1}^{10} W_{ijt}.\log\left[\frac{Y_{j.t+T}}{Y_{jt}}\right] \quad \ldots\ldots\ldots(1)$$

where i = 1…51 states, j = 1…10 industrial sectors, and t = 1…10 years; W_{ijt} is the weight of industrial sector j in state i's gross product at time t, which is 1990; T is the final year of the growth period, which extends from 1990 to 2000, i.e., T = t + 10 = 2000, and Y_{jt} is the total gross state product per capita for the country originating in sector j at time t. In summary, ECONACT constitutes a measure of the percentage growth or decline in economic activity -- that is, gross state product per capita -- for state i between 1990 and 2000. The measure is primarily based on two components. First, it is based on the percentage growth or decline in the total gross state product of the nation originating from each of ten distinct industries between 1990 and 2000. Second, the percentage growth or decline in economic activity for state i is computed as the weighted average of the percentage growth in each of the ten industries across the nation. The "weights" for each state represent the shares of its gross state product that originate in each of the ten separate industrial sectors. Following the work of Barro and Sala-i-Martin (1992), this comprehensive measure of state economic activity in the period of analysis is capable of capturing a wide range of state-to-state variations in the economic activity which could potentially explain some variation in growth in workforce productivity during the nine-year period of analysis for this study.

For example, patterns of migration of college students and graduates between states that occurs during the period of analysis are likely to be consistent with, responsive to, and therefore and correlated with the job market signals associated with, and generated by, expansions and contractions in those sectors of state economies where the labor force typically comprises substantial portions of college-educated workers. Therefore, the effects of such migration during the period of analysis are likely to be accounted and controlled for, in large part, by this complex and comprehensive measure of expansions and contractions in ten distinct industrial sectors in each state's economy between 1990 and 2000.

The model of growth in workforce productivity estimated in this study is represented by the equation 2 below.

$GROWTH_{00/90i} = b_0 + b_1PROD_{90i} + b_2MASTED_{90i} + + b_3PROFED_{90i} + b_4DOCTED_{90i} + b_5ECONACT_{00/90ij}$ ....(2)

where,

i = 1 ....51 states, j = 1...10 industries, and

$GROWTH_{00/90i}$ = growth in workforce productivity from 1990 to 2000 in state i,

$PROD_{90i}$ = the initial level of workforce productivity in state i in 1990,

$MASTED_{90i}$ = cumulative investment in master's degree education in 1990 in state i,

$PROFED_{90i}$ = cumulative investment in professional degree education in 1990 in state i,

$DOCTED_{90i}$ = cumulative investment in doctoral degree education in 1990 in state i,

$ECONACT_{00/90ij}$ = percentage growth – expansion or contraction -- in economic activity in state i from 1990 to 2000

b_0 = a constant which is the net effect on growth of workforce productivity due to other influences which are not specified or controlled for in the equation,

b_1 = the effect on productivity growth due to an increase of one-unit in PROD (expected relationship: $b_1 < 0$),

b_2 = the effect on workforce productivity growth of a one-unit increase in the MASTED variable in the year 1990 (expected relationship: $b_2 > 0$),

b_3 = the effect on workforce productivity growth of a one-unit increase in the PROFED variable in the year 1990 (expected relationship: $b_3 > 0$),

b_4 = the effect on workforce productivity growth of a one-unit increase in the DOCTED variable in the year 1990 (expected relationship: $b_4 > 0$),

b_5 = the effect on productivity growth due to an increase of one unit in ECONACT (expected relationship: $b_5 > 0$).

Existing aggregate data, from both state and federal levels, were used to examine and test the hypotheses about the relationships between the dependent and independent variables. For the cross-section analysis, all 50 states plus the District of Columbia were examined for the period from 1990 through 2000. Therefore, data on each variable was needed for each state for these two years. Fortunately, there were no missing data detected for any of the above-mentioned variables.

Data on both independent and dependent variables were collected from different sources. Data on real gross state product for the 50 states and the District of Columbia for the years of 1990 and 2000, data on real gross state product for ten industrial sectors, and the amount of real gross national product originating in each of these industrial sectors were accumulated from the web page http://www.bea.doc.gov/bea/regional/gsp/ sponsored by the Bureau of Economic Analysis (U.S. Department of Commerce). Data on the total number of persons with bachelor degrees and the number of total high school graduates – age 25 and over -- in 1990 for each state and the District of Columbia were obtained from the web site: http://www.census.gov/prod/www/abs/decenial.html sponsored by the U.S

Census Bureau (2000). Data on the total population and total number in the labor force for 1990 and 2000 came from the U.S. Census Bureau, Statistical Abstract of the United States (2000).

Multiple regression analysis techniques were used to examine the relationships between the growth in state workforce productivity between 1990 and 2000 and initial cumulative investment in higher education in 1990, while controlling for the effects of the initial level of state workforce productivity in 1990 and the percentage growth or decline in the economic activity of state economies between 1990 and 2000, as discussed at length above. All analyses were conducted using SAS-PC for Windows, version 8.

Findings

Table 1 provides the descriptive statistics for all variables in the model. The findings of this study revealed that the average growth of workforce productivity between 1990 and 2000 (GROWTH) for the 50 states and the District of Columbia was 21 percent with a standard deviation of 11 percent. The maximum growth of state workforce productivity was 42 percent (New Hampshire) while the minimum growth for state workforce productivity from 1990 to 2000 was calculated as -21 percent (Alaska). The average value for the initial level of workforce productivity (PROD) in 1990 for the 50 states and the District of Columbia was $52,654 with a standard deviation of $17,277. The maximum initial level of state workforce productivity was $152,802 (Washington, DC) while the minimum level of initial state workforce productivity in 1990 was $39,389 (Mississippi). Table 1 also presents the average initial investment in master's degree education (MASTED), professional degree education (PROFED), and doctoral degree education (DOCTED) across the 50 states and DC in 1990, and indicates that on average 6 percent of high school graduates -- age 25 and over -- had earned master's degrees, 2 percent had earned professional degrees, and 1 percent had earned doctoral degrees with a standard deviation of 2 percent, 1 percent, and 1 percent respectively. While Washington, DC has the highest investment in all levels of higher education, i.e. master's education (13 percent), professional education (7 percent), and doctoral education (3 percent), Delaware has the lowest investment in all levels of higher education, i.e. master's education (3 percent), professional education (.6 percent), and doctoral education (.3 percent). Finally, Table 1 indicates that the mean percentage growth in economic activity (ECONACT) from 1990 to 2000 – based on a weighted average of economic activity in each of 10 industrial sectors -- was 20 percent with a standard deviation of 3 percent. While Illinois has the highest percentage growth in its economic activity (22 percent), Alaska has the lowest percentage growth (6 percent) between 1990 and 2000.

Table 1.
Descriptive Statistics for the 50 states and the District of Columbia

Variables	N	Mean	SD	Min	Max
GROWTH	51	0.21112	0.10596	0.21134	0.41627
PROD	51	52653.7	17277.0	39389.4	152801
MASTED	51	0.06012	0.01802	0.02715	0.13017
PROFED	51	0.02172	0.00845	0.00680	0.07102
DOCTED	51	0.00997	0.00453	0.00352	0.03417
ECONACT	51	0.19722	0.03133	0.06836	0.22215

Productivity Growth and Investment in Masters Degrees

One of the central research questions for this study was "What is the relationship between the initial (1990) cumulative investment in master's degree education in the states and the subsequent growth in state workforce productivity between 1990 and 2000?" Table 2 presents the results of the regression analysis, including the findings relevant to this research question. The results indicate that the initial investment in master's education in 1990 had significant effects ($t=3.60$, $p=.0008$) on the subsequent growth in state workforce productivity between 1990 and 2000. The magnitude of the coefficient of MASTED was 2.816. Therefore, all else equal, each 1 percentage point (.01) increase in a state's cumulative investments in master's education in 1990 was associated with a 2.816 or .02816 percentage point increase of the subsequent growth in state workforce productivity from 1990 to 2000. And furthermore, because the average growth in state workforce productivity (GROWTH) from 1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 1.69 percentage point increase in GROWTH would constitute an increase of 8.26 percent (1.69/21.11 = .0800 or 8 percent) in an average state's growth in workforce productivity.

Table 2.

Multiple Regression Analysis of the Effects of Initial Productivity, Investments in Masters Degrees, and Industrial Economic Activity on the State Workforce Productivity Growth (N=51)

Variables	Parameter Estimate	Standard Error	t Value	P Value
INTERCEPT	-0.30435	0.11492	-2.65	0.0110
PROD	-0.00118	0.00093421	-1.27 .	0.2116
MASTED	2.81636	0.78160	3.60*	0.0008
ECONACT	2.07088	0.43085	4.81*	<.0001

* = Significant at the .001 level. $R^2 = 0.4770$

The findings of this analysis also indicate that there is a significant relationship between ECONACT and GROWTH. The economic activity – expansion or contraction -- in 10 industrial sectors of state economies was found to be directly and significantly related to growth in state workforce productivity (t=4.81, p=.0001). The magnitude of the coefficient of ECONACT was 2.070. Therefore, all else equal, each 1 percentage point (.01) increase in ECONACT was associated with a 2.070 or .0207 percentage point increase in GROWTH between 1990 and 2000. Furthermore, because the average growth in state workforce productivity (GROWTH) from 1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 4.07 percentage point increase in GROWTH would constitute an increase of 24.8 percent (4.07/21.11 = .19279 or 19.28 percent) in an average state's growth in workforce productivity.

Finally, the remaining research question in this study was concerned with the relationship between the initial workforce productivity in the states in 1990 (PROD) and the subsequent growth in workforce productivity (GROWTH). As explained in an earlier section, PROD was expected to be inversely related to GROWTH, in line with the convergence hypothesis. However, findings – presented in Table 2 -- indicate that PROD was not significantly related to GROWTH in this study. Therefore, the findings of this analysis do not support the convergence hypothesis as valid among state economies, an outcome that is examined in a subsequent section.

Productivity Growth and Investment in Professional Degrees

The research question regarding investment in professional degrees is concerned with the relationship between the subsequent growth in state workforce productivity and the cumulative investment in professional degrees. Table 3 presents the results of the regression analysis. The results indicate that in this analysis, investment in professional degrees (t=2.78, p=.007), and economic activity of 10 industrial sectors (t=4.36, p=<.001) had significant effects on the subsequent growth in state workforce productivity. The magnitude of the coefficient of PROFED was 6.474. Therefore, all else equal, each 1 percentage point (.01) increase in a state's cumulative investments in professional education in 1990 was associated with a 6.474 or .0647 percentage point increase of the subsequent growth in state workforce productivity from 1990 to 2000. Furthermore, because the average growth in state workforce productivity (GROWTH) from 1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 1.29 percentage point increase in GROWTH would constitute an increase of 8.26 percent (1.29/21.11 = .0611 or 8 percent) in an average state's growth in workforce productivity.

Table 3.

Multiple Regression Analysis of the Effects of Initial Productivity, Investments in Professional Degrees, and Industrial Economic Activity on the State Workforce Productivity Growth (N=51)

Variables	Parameter Estimate	Standard Error	t Value	P Value
INTERCEPT	-0.21332	0.11959	-1.78	0.0809
PROD	-0.00203	0.00127	-1.60	0.1169
PROFED	6.47421	2.33293	2.78*	0.0079
ECONACT	1.97993	0.45413	4.36**	<.0001

* = Significant at the .01 level. ** = Significant at the .001 level. $R^2 = 0.4265$

The magnitude of the coefficient of ECONACT in this analysis was 1.979. Therefore, all else equal, each 1 percentage point (.01) increase in ECONACT was associated with a 1.979 or .0198 percentage point increase in GROWTH between 1990 and 2000. Furthermore, because the average growth in state workforce productivity (GROWTH) from

1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 3.9 percentage point increase in GROWTH would constitute an increase of 18.47 percent (3.9/21.11 = .18474 or 18.47 percent) in an average state's growth in workforce productivity.

Again, the remaining variable (PROD) in this analysis was not found to have significant relationship with GROWTH in this study. Therefore, the findings of this analysis do not support the convergence hypothesis as valid among state economies, an outcome that is examined in a subsequent section.

Productivity Growth and Investment in Doctoral Degrees

The research question regarding investment in doctoral degrees is concerned with the relationship between the subsequent growth in state workforce productivity and the cumulative investment in doctoral degrees. Table 4 illustrates the results of this regression analysis. The results indicate that in this analysis, each variable in this model, that is, initial productivity ($t=-2.22$, $p=.03$), investment in doctoral degrees ($t=4.8$ 4, $p<.0001$), and economic activity of 10 industrial sectors ($t=5.72$, $p<.001$) had significant effects on the subsequent growth in state workforce productivity. The magnitude of the coefficient of DOCTED was 15.44. Therefore, all else equal, each 1 percentage point (.01) increase in a state's cumulative investments in doctoral education in 1990 was associated with a 15.44 or .1544 percentage point increase of the subsequent growth in state workforce productivity from 1990 to 2000. And furthermore, because the average growth in state workforce productivity (GROWTH) from 1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 1.54 percentage point increase in GROWTH would constitute an increase of 7.3 percent (1.54/21.11 = .073 or 7.3 percent) in an average state's growth in workforce productivity.

Table 4.

Multiple Regression Analysis of the Effects of Initial Productivity, Investments in Doctoral Degrees, and Industrial Economic Activity on the State Workforce Productivity Growth (N=51)

Variables	Parameter Estimate	Standard Error	t Value	P Value
INTERCEPT	-0.28645	0.10530	-2.72	0.0091
PROD	-0.00201	0.00090868	-2.22*	0.0316
DOCTED	15.44042	3.19058	4.84**	<.0001
ECONACT	2.27988	0.39852	5.72**	<.0001

* = Significant at the .05 level ** = Significant at the .001 level. $R^2 = 0.4929$

The magnitude of the coefficient of ECONACT in this analysis was 2.279. Therefore, all else equal, each 1 percentage point (.01) increase in ECONACT was associated with a 2.279 or .02279 percentage point increase in GROWTH between 1990 and 2000. Furthermore, because the average growth in state workforce productivity (GROWTH) from 1990 to 2000 for the 50 states and the District of Columbia was .2111 or 21.11 percent, a 4.49 percentage point increase in GROWTH would constitute an increase of 21.27 percent (4.49/21.11 = .2127 or 21.27 percent) in an average state's growth in workforce productivity.

The remaining variable (PROD) was found to have a significant relationship with GROWTH in this analysis. As explained in an earlier section, PROD was expected to be inversely related to GROWTH, in line with the convergence hypothesis. The findings – presented in Table 4 -- indicate that PROD had significant negative effects on GROWTH in this model. Therefore, the findings of this study do support the convergence hypothesis as valid among state economies, an outcome that is examined in a subsequent section.

Discussion and Conclusion

The findings of this study indicate that there is a significant relationship between a state's initial investment in master's education; professional education; doctoral education; and the subsequent growth in the state's workforce productivity. This result is consistent with the findings of previous studies (Fatima & Paulsen, 2004; Paulsen, 1996a, 1996b; Paulsen &

Fatima, 2007), and with the predictions of human capital theory regarding the anticipated effects of investments in higher education (G. Becker, 1993; Paulsen, 2001b, 2001c). Higher education degree programs are designed to train graduates in the skills of production of knowledge, diffusion of knowledge, and transmission of knowledge, which are high-level and widely generalizable skills (W. Becker and Lewis, 1993). According to the good practices of learning outcomes assessment, graduates from bachelor degree education should be able to apply, produce, diffuse, transmit, analyze, synthesize, generalize, and evaluate knowledge and skills (Allen, 2004; Suskie, 2009; Walvoord, 2004). Graduates from masters, doctoral, and professional educational programs are more likely to increase productivity among co-workers, employers, or employees through the above-mentioned skills. Therefore, the contributions of these higher levels of education are more likely to be significant in the subsequent growth of state workforce productivity. Again, this is consistent with the assumption, discussed in the previous section that more educated people are more productive because they are more skilled in high-level and more widely generalizable knowledge.

The changes in the economic activity of 10 industrial sectors in each state economy – either expansions or contractions – were also found to have significant and positive effects on the growth of state workforce productivity. These findings are consistent with the findings of previous studies (Barro and Sala-i-Martin, 1991, 1992, 1995; Paulsen, 1996a, 1996b). The substantial magnitude and significance of the coefficient for the economic activity variable indicates the importance of having such controls in models designed to estimate the effects of investment in higher education on growth in workforce productivity.

In this study, the initial level of state workforce productivity was found to have significant inverse effects on the subsequent growth of state workforce productivity when included with DOCTED, but it was not found to have the significant negative effects on the subsequent growth of state workforce productivity when included with MAST and PROF that convergence theory would predict. However, it is interesting to note that, in this study, the initial level of productivity was found to have a significant and inverse relationship with the subsequent growth in state workforce productivity in all models when the changes in the economic activity of state economies during the period of analysis were not controlled for in the regression model. The finding that initial workforce productivity was significant before but not after controls for economic activity were included in the model is consistent with the convergence hypothesis that the economies of less developed countries or states tend to catch up with the economies of more advanced nations or states in terms of per capita income or product (Barro, 1991; Barro and Sala-i-Martin, 1992; Barro and Sala-i -Martin, 1995; Baumol, 1986; DeLong, 1986; Paulsen, 1996a, 1996b). One possible explanation for this is that the economic activity variable used in this study was a comprehensive measure that is likely to have captured, and perhaps accounted for, at least some of the greater growth in the initially less productive economies and smaller growth in the initially more productive economies that would have been consistent with the convergence hypothesis.

Potential Limitations of the Study

One potential limitation of this study is based on the fact that the migration of college graduates between states that could occur during the ten-month period of analysis are not explicitly accounted for in any of the data or measures included in the models. It is also likely that the estimate of an individual state's "investment" in higher education (master's, professional, and doctoral) used in this study includes some graduates from other states that have migrated to their state over time and excludes some graduates from their own state's higher education system that have moved to other states over time. However, the design of the study addresses these potential challenges – not ideally with data that one hopes would become available one day – but by other means available within the data and measures utilized in this study. First, the patterns of migration of college students and graduates between states that occur during the period of analysis are likely to be consistent with, responsive to, and therefore correlated with, the job market signals associated with, and generated by, expansions and contractions in those sectors of state economies where the labor force typically comprises substantial portions of college-educated workers. Therefore, the effects of such migration during the period of analysis are likely to be accounted and controlled for, in large part, by this complex and comprehensive measure of expansions and contractions in ten distinct industrial sectors in each state's economy between 1990 and 2000.

Another possible limitation of the research design used in this study might have included the problem of heteroscedasticity, which is likely to occur when estimation techniques are applied to the analysis of cross-sectional data. To detect the presence of heteroscedasticity in the multiple regression models, Glejser's (1969) test for heteroscedasticity was conducted. This process was repeated for each independent variable and each combination of independent variables in the regression models.

Glejser's (1969) test for heteroscedasticity involves estimating the squared error from the original regression model. Then the values for the log of squared error and the log of independent variable are calculated and a regression for each independent variable is run using log of squared error as the dependent variable and log of the independent variable as the independent variable. At this point the regression equation looks like the following:
log(squared error) = $a_0 + a_1$log(independent variable)
Glejser's (1969) test suggests that if the regression coefficient (a_1) for the independent variable is significantly different from zero, the null hypothesis of no heteroscedasticity should be rejected. This indicates that the error variance is different for each level over the independent variable. However, after conducting Glejser's (1969) test for heteroscedasticity for each model, using all independent variables, separately or in combination, no evidence of heteroscedasticity was found for any independent variable. Therefore, the error term was assumed to be homoskedastic, in keeping with the assumptions of regression analysis.

Finally, all multiple regression analyses are faced with the problem of multicollinearity as a potential limitation of the study (Stevens, 1996). The problem of multicollinearity influences the variance of the estimated regression coefficients and when the value of the standard error of parameters of independent variables increases, the parameter estimates become less efficient (Berry and Feldman, 1985). Considering the fact that this study involves a number of measures of investment in higher education at different academic levels, it was presumed that the problem of multicollinearity might occur in the analyses. To assess the presence of multicollinearity in each model, regressions were run in order to compute the tolerance values and variance inflation factors for the independent variables. The SAS PROC REG program produced the tolerance values and the variance inflation factors that allowed the researcher to conduct multicollinearity diagnostics on the regression model.

In the statistical literature on various forms of regression analysis, a tolerance level of less than .20 and a variance inflation level of more than 5 for any independent variable are problematic and represent causes for concern. If the level of tolerance value is less than .10 and variance inflation value is more than 10, it indicates a serious multicollinearity problem (Menard, 1995; Montgomery and Peck, 1992). The results of the multicollinearity diagnostics revealed that tolerance values exceeded the criterion level of .20 by a wide margin for all independent variables and the level of variance inflation did not even approach the criterion level of 5 for any independent variable. Of course, as expected, this was the case only so long as no more than one measure of investment in higher education was included in a single regression equation and estimation procedure. In many instances when two or more measures of investment in higher education were included in the same regression model, tolerance values and variance inflation factors approached or exceeded problematic or even severe levels. However, for all the models reported in this chapter, in which only one measure of investment in higher education was included, tolerance values and variance inflation factors indicated that multicollinearity was not a problem in the analyses.

Implications for Theory, Research, Policy and Practice

The results of this study offer important implications for policy-makers, for future research, and for higher education professional practitioners. They provide strong evidence of the existence of substantial public or external benefits due to the investments in advance education (master's, professional, and doctoral), thereby suggesting the presence of an underinvestment in these areas of education, a condition that will persist in the absence of appropriate subsidization to influence the enrollment and persistent behavior and individual decision-making of potential students. The results offer considerable support for the tenets of human capital theory and provide support for a rationale for more public investment in graduate and professional education. The findings also indicate that investments in graduate and professional education yield substantial public benefits. This suggests the existence of a substantial public demand for optimum investment in these education programs. If federal and state policy makers were to respond with effective subsidies for students and institutions, administrators and practitioners at the institutional level would need to decide how and to what extent they will respond. If increased federal and state aid is forthcoming in response to evidence of underinvestment in higher education at graduate and professional levels, this could affect institutional practices relative to persistent tuition inflation well in excess of the general rate of inflation in the overall economy. A substantial body of research has demonstrated that increased subsidies (appropriations) to public institutions reduce the upward pressure on tuition levels (Paulsen, 2001a, 2001c).

In addition, this study has several limitations which open the doors for future research in this area. The findings of non-significant effects of initial workforce productivity on the subsequent growth in state workforce productivity when controlling for economic activity of 10 industrial sectors (ECONACT), needs to be further investigated. As described in a previous section, the pattern of findings from this study indicated that initial levels of workforce productivity were significant before, but not after, comprehensive controls for expansions and contractions in economic activity were included in the model. Because of the comprehensive nature of the economic activity measure, it is likely that further investigation will yield support for the convergence hypothesis as found by Paulsen (1996a, 1996b).

This study used a cross-sectional data on the 50 states and the District of Columbia in order to estimate the effects of investment in graduate and professional education on a 10-year change in growth in workforce productivity. In order to have a better understanding of the role of these education and other determinants of growth in state workforce productivity, year-to-year changes needs to be observed which can be accomplished by conducting time-series analysis of data on year-to-year changes. One challenge with this approach that must be addressed as well is obtaining annual data for higher education investment.

Also this study was limited to only a 10-year period of time (1990-2000) to estimate the growth in state workforce productivity. A study with a longer period time is necessary to have more variation in the dependent and independent variables under analysis. For example, pooling of time-series and cross section data – that is for 50 states and the District of Columbia during the 1970s, 1980s, and 1990s – would permit a more comprehensive and compelling investigation of the effects of investments in graduate and professional education on workforce productivity, by providing more variation and a much larger sample size.

Furthermore, this study does not provide evidence that suggests subsidies would actually lead not only to increased enrollment in post-baccalaureate study, but also contribute to completion of these programs. However a substantial body of research demonstrated that increased subsidies (appropriations) to public institutions reduce the upward pressure on tuition levels and directly related to students' college choice and persistence (Farrell & Kienzl, 2009; Paulsen, 2001a, 2001c; St. John, Paulsen, & Carter, 2005; Titus, 2009). Nevertheless further investigations are needed focusing on differentiating the degree types (graduate; i.e., academic versus professional) to provide evidence that subsidies would lead to increased enrolment in these areas in order to justify the disparity in return rates.

In conclusion, the results of this study provide new and potentially influential sources of evidence of the existence of substantial public or external benefits due to the investment in higher education at graduate and professional levels, thereby indicating an under-allocation of our state and national resources to these types of education. The findings of this study indicate that investments in graduate and professional education increase the rate of growth in workforce productivity, which constitutes an unambiguous public or social benefit to investment in higher education. Higher education policy analysts, policy makers, and policy implementers can no longer afford to ignore this evidence in their decision making about federal, state and institutional financial policies and their assessment of the probable impacts of such policies on the higher education participation rates of students from diverse backgrounds.

References

Allen, M. J. (2004). *Assessing academic programs in higher education*. California: Jossey-Bass.

Barro, R. J. (1991). Economic growth in a cross section of countries. *Quarterly Journal of Economics*, 106 (3): 407-443.

Barro, R. J. and Sala-i-Martin, X. (1991). Convergence across states and regions. Brookings Papers Economy Activity, no. 1, pp. 107-182.

Barro, R. J. and Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*, 100 (2): 223-251.

Barro, R. J. and Sala-i-Martin, X. (1995). *Economic growth*. New York: McGraw-Hill, Inc.

Baum, S. (1996). *A primer on economics for financial aid professionals*. Washington, DC: National Association of Student Financial Aid Administrators.

Baum, S. (2001). College education: Who can afford it? In M. B. Paulsen and J. Smart (Eds.) (2001) *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.

Baum, S., & Payea, K. (2004). *Education pays: The benefits of higher education individuals and society*. New York: The College Board.

Baumol, W. J. (1986). Productivity growth, convergence and welfare: What the long-run data show. *American Economic Review*, 76 (5): 1072-1085.

Baumol, W.J., Blackman, S.A.B., and Wolff, E.N. (1989). *Productivity and American leadership: The long view*. Cambridge, MA: the MIT Press.

Becker, G.S. (1964). *Human capital: A theoretical and empirical analysis with special reference to education* (1st ed). New York: National Bureau of Economic Research.

Becker, G.S. (1975). *Human capital: A theoretical and empirical analysis with special reference to education* (2nd ed). New York: Columbia University Press.

Becker, G.S. (1993). *Human capital: A theoretical and empirical analysis with special reference to education* (3rd ed). Chicago: The University of Chicago Press.

Becker, W. E., (1990). The demand for higher education. In S.A. Hoenack and E.L. Collins (eds.), *The economics of American universities*. Albany: State University of New York Press.

Becker, W.E. (1992). Why go to college? The value of an investment in higher education. In W.E. Becker and D.R. Lewis (Eds.), *The economics of American higher education*. Boston, MA: Kluwer Academic Publishers.

Berger, M. C. (1988a). Predicted future earnings and choice of college major. *Industrial and Labor Relations Review*, 41 (3): 418-429.

Berger, M. C. (1988b). Cohort size effects on earnings: Differences by college major. *Economics of Education Review*, 7 (2): 375-383.

Berger, M.C. (1992). Private returns to specific college majors. In W.E. Becker and D.R. Lewis (1992), *The economics of American higher education.* Boston, MA: Kluwer Academic Publishers.

Berry, W. D. and Feldman, S. (1985). *Multiple regression in practice*. Beverly Hills, CA: Sage Publication.

Bowen, H.R. (1977). *Investment in learning: The individual and social value of American higher education*. San Francisco: Jossey-Bass.

Bowen, H.R. (1980). *The costs of higher education.* San Francisco: Jossey-Bass.

Cohn, E. (1979). *The economics of education* (3rd ed). Cambridge, MA: Ballinger.

Cohn, E., and Geske, T.G. (1990). *The economics of education* (3rd ed). New York: Pergamon Press.

College Board, (2006). *Trends in college pricing.* Washington, DC: The College Board.

Creech, S. K. (1991). *The direct economic impact of Texas' expenditure on public baccalaureate and post baccalaureate education*. Unpublished doctoral dissertation, Texas A & M University, Texas.

Creech, S., Carpenter, S., and Davis, E. (1991). The direct economic impact of Texas' expenditure on public baccalaureate and post baccalaureate education. Paper presented at the meeting of the Association for the Study of Higher Education, Boston, MA.

Denison, E. F. (1962). The sources of economic growth in the United States. New York: Committee for Economic Development.

Denison, E. F. (1967). Why growth rates differ: Postwar experiences in nine Western countries. Washington DC: The Brookings Institution.

Denison, E. F. (1969). Accounting for slower economic growth: The United States in the 70s. Washington DC: The Brookings Institution.

Denison, E. F. (1984). Accounting for slower economic growth: An Update. In J. W. Kendrick (Ed.), *International comparisons of productivity and causes of the slowdown*, pp. 1-45. Massachusetts: Ballinger Publishing Company.

Denison, E. F. (1985). Trends in American economic growth, 1929-1982. Washington DC: Brookings Institutions.

Denison, E. F. (1989). Estimates of productivity change by industry: An evaluation and an alternative. Washington DC: The Brookings Institute.

Douglass, G.K. (1977). Economic returns on investments in higher education. In H.R. Bowen, *Investment in learning: The individual and social value of American higher education*. San Francisco: Jossey-Bass.

Engler, S., Fiornberg, J., and Kuhn, L. (1980). The economic impact of Louisiana State University System on the Louisiana economy. Association for Institutional Research Forum Paper, April, 1980.

Farrell, P. L. & Kienzl, G. S. (2009). Are state non-need, merit-based scholarship programs impacting college enrollment? *Education Finance and Policy* 4 (2), 150-174.

Fatima, N. (2000). *Investment in higher education and state workforce productivity*. Unpublished doctoral dissertation, University of New Orleans, LA.

Fatima, N., & Paulsen, M.B. (2004). Higher education and state workforce productivity in the 1990s. *Thought and Action: NEA Higher Education Journal* 20 (1), 75-94.

Fossey, R. (1998). The dizzying growth of federal student loan program: When will vertigo set in? In R. Fossey and M. Bateman (eds.), *Condemning students to debt: College loans and public policy*. New York: Teachers College Press.

Freeman, R.B. (1971). *The market for college-trained manpower: A study in the economics of career choice.* Cambridge, MA: Harvard University Press.

Freeman, R.B. (1975). Supply and salary adjustments in the changing science manpower market. *American Economic Review*, 65 (1): 27-39.

Freeman, R.B. (1976). *The overeducated American.* New York: Academic Press.

Freeman, R .B. (1977). The decline in economic rewards to college education. *Review of Economics and Statistics*, 59 (1): 18-29.

Freeman, R.B. (1980). The facts about the declining value of college. *Journal of Human Resource*, 15 (1): 124-128.

Grubb, W.N. (1995). Postsecondary education and the sub-baccalaureate labor market: Corrections and extensions. *Economics of Education Review* 14 (3): 285-299.

Grubb, W.N. (1996). *Working in the middle: Strengthening education and training for the mid-skilled labor force.* San Francisco: Jossey-Bass.

Hoenack, S.A. (1982). Pricing and efficiency in higher education. *Journal of Higher Education* 53 (4): 403-418.

Johnes, G. (1993). *The economics of education*. New York: St. Martin's Press.

Jorgenson, D. W. (1984). The contribution of education to U. S. economic growth. In E. Dean (Ed.), *Education and productivity*. Cambridge, MA: Ballinger Publishing Company.

Jorgeson, D. J., Kuroda, M., and Nishimizu, M. (1995). Japan-U.S. industry-level productivity comparisons, 1960-1979. In D. W. Jorgenson (Ed.), *Productivity: International comparisons of economic growth*, volume 2. Cambridge, MA: The MIT Press.

Kane, T.J., and Rouse, C.E. (1995). Labor-market returns to two- and four-year college. *American Economic Review* 85 (3): 600-614.

Kendrick, J. W. (1961). *Productivity trends in the United States*. Princeton: Princeton University Press.

Kiker, B. F. and Wilder, R. P. (1975). Economic aspects of educational television in the MBA program. AACSB Bulletin, 11, 1-10.

Lanaan, F.S. (1998). Descriptive analysis of students' post-college earnings from California community colleges. In J.R. Sanchez, and F.S. Lanaan (1998) (eds.), Determining the economic benefits of attending community college. *New Directions for Community Colleges* No. 104. San Francisco: Jossey-Bass.

Leigh, D.E., and Gill, A.M. (1997). Labor market returns to community colleges: Evidence for returning adults. *Journal of Human Resources* 32 (2): 334-353.

Leslie, L.L., and Brinkman, P.T. (1988). *The economic value of higher education*. New York: ACE/Macmillan.

Lewis, D.R., Hearn, J.C., and Zilbert, E.E. (1993). Efficiency and equity effects of vocationally focused postsecondary education. *Sociology of Education* 66 (1): 188-205.

Lindsay, C. M. (1973). Real returns to medical education. *Journal of Human Resource*, 9 (2): 331-348.

Mason, W. J. (1983). *The impact of the California State University on the economy of California*. Long Beach, California: California State University.

McMahon, W.W. (1982). Efficiency and equity criteria for educational budgeting and finance. In W.W. McMahon and T.G. Geske (Eds.), *Financing education: Overcoming inefficiency and inequity*. Urbana, IL: University of Illinois Press.

McMahon, W.W. (1991). Relative returns to human and physical capital in the U.S. and efficient investment strategies. *Economics of Education Review* 10 (4): 283-296.
McMahon, W.W., and Wagner, A.P. (1981). Expected returns to investment in higher education. *Journal of Human Resource*, 16 (2): 274-285.
McMahon, W.W., and Wagner, A.P. (1982). The monetary returns to education as partial social efficiency criteria. In W.W. McMahon and T.G. Geske (eds.), *Financing education: Overcoming inefficiency and inequity*. Urbana, IL: University of Illinois Press.
Menard, S. W. (1995). *Applied logistic regression analysis*. Thousand Oaks, CA: Sage Publications, Inc.
Mincer, J. (1974). *Schooling, experience and earnings*. New York: National Bureau of Economic Research.
Mincer, J. (1993). Human capital and earnings. In J. Mincer (ed.), *Studies in human capital: Collected essays of jacob mincer*. Brookfield, VT: Edward Elgar.
Monk-Turner, E. (1994). Economic returns to community and four-year college education. *Journal of Socio-Economics* 23 (4): 441-447.
Montgomery, D.C., and Peck, E.A. (1992). *Introduction to Linear regression Analysis*. New York: John Wiley and Sons.
Mortenson, T. G. (1998). How will we do more with less? : Public policy dilemma of financing postsecondary educational opportunity. In R. Fossey and M. Bateman (Eds.), C*ondemning students to debt: College loans and public policy*. New York: Teachers College Press.
Mumper, M. (2001). State efforts to keep public colleges affordable in the face of fiscal stress. In M. B. Paulsen and J. Smart (Eds.) (2001), *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.
Mumper, M. (1996). Removing College Price Barriers. Albany, NY: State University of New York Press.
Murphy, K.M., and Welch, F. (1989). Wage premiums for college graduates: Recent growth and possible explanations. *Educational Researcher* 18 (1): 17-26.
Murphy, K.M., and Welch, F. (1990). Empirical age-earnings profiles. *Journal of Labor Economics* 8 (2): 202-229.
Murphy, K.M., and Welch, F. (1992). The structure of wages. *Quarterly Journal of Economics* 107(1): 285-326.
Musgrave, R.S., and Musgrave, P.B. (1973). *Public finance in theory and practice*. New York: McGraw-Hill.
Musgrave, R. S. and Musgrave, P. B. (1984). *Public finance in theory and practice* (4th ed), New York: McGraw-Hill.
National Center for Educational Statistics (1996). Digest of Education Statistics. Washington D.C.: U.S. Department of Education.
National Center for Educational Statistics (2000). Digest of Education Statistics. Washington D.C.: U.S. Department of Education.
National Center for Educational Statistics (2002). Digest of Education Statistics. Washington D.C.: U.S. Department of Education.
National Center for Educational Statistics (2006). Digest of Education Statistics. Washington D.C.: U.S. Department of Education.

Pascarella, E.T., and Terenzini, P.T. (1991). *How college affects students*. San Francisco: Jossey-Bass.

Paulsen, M.B. (1996a). Higher education and productivity: An afterword. *Thought and Action: NEA Higher Education Journal* 12(2): 135-139.

Paulsen, M.B. (1996b). Higher education and state workforce productivity. *Thought and Action: NEA Higher Education Journal* 12(1): 55-77.

Paulsen, M.B. (1998). Recent research on the economics of attending college: Returns on investment and responsiveness to price. *Research in Higher Education* 39(4): 471-489.

Paulsen, M.B. (2001a). Economic perspectives on rising college tuition: A theoretical and empirical exploration. In M. B. Paulsen and J. Smart (Eds.) (2001), *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.

Paulsen, M.B. (2001b). The economics of human capital and investment in higher education. In M. B. Paulsen and J. Smart (Eds.) (2001), *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.

Paulsen, M.B. (2001c). The economics of the public sector: The nature and role of public policy in the finance of higher education. In M. B. Paulsen and J. Smart (Eds.) (2001), *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.

Paulsen, M. B., & Fatima, N. (2007). Higher education and growth in state workforce productivity, 1980-2000: Evidence of the public benefits of college. In F. Columbus (Ed.), *Higher education research perspectives*. New York: Nova Science Publishers, Inc.

Paulsen, M.B., and Pogue, T.F. (1988). Higher education enrollment: The interaction of labor market conditions, curriculum and selectivity. *Economics of Education Review* 7(3): 275-290.

Pencavel, J. (1993). Higher education, economic growth, and earnings. In W.E. Becker and D.R. Lewis (eds.), *The economics of American higher education*. Boston, MA: Kluwer Academic Publishers.

Perlman, R. (1973). *The economics of education*. New York: McGraw-Hill.

Perna, L. W. (2005). The benefits of higher education: Sex, racial/ethnic, and socioeconomic group differences. *The Review of Higher Education* 29 (1), 23-52.

Posey, E. I. (1990). Georgia State University spending patterns and the Atlanta economy 1989. Atlanta, GA: Georgia State University, Office of Institutional Research.

Psacharopoulos, G. (1973). *Returns to education: An international comparison.* Amsterdam: Elsevier-Jossey-Bass.

Psacharopoulos, G. (1975). Earnings and education in OECD countries*. Paris: OECD.*

Psacharopoulos, G. (1981). Returns to education: An updated international comparison. *Comparative Education* 17(3): 321-341.

Psacharopoulos, G. (1985). Returns to education: A further international update and implications. *Journal of Human Resource*, 20 (4): 583-604.

Sanchez, J.R., and Lanaan, F.S. (1998) (eds.). Determining the economic benefits of attending community college*. New Directions for Community Colleges* No. 104. San Francisco: Jossey-Bass.

Sawhney, P. and Kaushik, S. (1971). Report on the impact of Boston University on the local economy of Boston. Boston, MA: Boston University, Office of Institutional Research.

Schimmelpfennig, H. R. (1983). A study of the economic impacts of Bismarck Junior College. Bismarck, ND: Bismarck Junior College. (ERIC Document Reproduction Service NO. ED 229057).

Schultz, T.W. (1961). Investment in human capital. *American Economic Review* 51: 1035-1039.

Schultz, T.W. (1963). *The economic value of education*. New York: Columbia University Press.

Seybert, J. (1991). The economic impact of Johnson County Community College on the Kansas City metropolitan area, 1988-89. Overland Park, KS: Johnson City Community College. (ERIC Document Reproduction Service No. ED 336135).

Simmons, F. B. (1992). The University of Akron and its economic impact on its community. Akron, OH: University of Akron. (ERIC Document Reproduction Service No. ED 335854).

Singleton, R. G. (1994). *A study of the economic impact of Floyd College on its local economy and a comparison of that impact to the economic impact of Bevill State Community College on its local economy*. Unpublished doctoral dissertation, University of Alabama, Tuscaloosa.

Sloan, F. A. (1970). Lifetime earnings and physician's choice of specialty. *Industrial and Labor Relations Review*, 24 (1): 47-56.

Solmon, L. C. (1975). The relation between schooling and savings behavior: An example of the indirect effects of education. In F. Juster (Ed.), *Education, income, and human behavior*. New York: McGraw-Hill.

Solmon, L. C. and Fagnano, C. L. (1995). Benefits of education. In M. Carnoy (Ed.), *International encyclopedia of economics of education*, 2nd edition, pp. 114-124. Oxford: Elsevier.

St. John, E. P., Paulsen, M. B., & Carter, D. F. (2005). Diversity, college costs, and postsecondary opportunity: An examination of the financial nexus between college choice and persistence for African Americans and whites. *The Journal of Higher Education* 76 (5), 545-569.

Stevense, J. (1996). *Applied multivariate statistics for the social sciences*. New Jersey: Lawrence Erlbaum Associates Publisher.

Stevenson, M. (1982). The impact of community colleges on Oregon's 1980-81 economy. Gresham, OR: Mt. Hood Community College.

Stiglitz, J.E. (2000). *Economics of the public sector* (3rd ed.). New York: W.W. Norton.

Suskie, L. (2009). *Assessing student learning: A common sense guide*. California; Jossey-Bass.

Taylor, G. C. and Bryden, J. P. (1973). The economic impact of the University of Denver on the state of Colorado. Denver, Colorado: Industrial Economics Division, Denver Research Institute, University of Denver.

Titus, M. A. (2009). The production of bachelor's degrees and financial aspects of state higher education policy: A dynamic analysis. *Journal of Higher Education* 80 (4), 439-468.

Toutkoushian, R. K. (2001). Trends in revenues and expenditures for public and private higher education. In M. B. Paulsen and J. Smart (Eds.) (2001) *The finance of higher education: Theory, research, policy, and practice*. New York: Agathon Press.

U.S. Bureau of the Census (2000). Statistical Abstract of the United States. Washington DC: U.S. Bureau of the Census.

U.S. Department of the Commerce (2001). Bureau of Economic Analysis. Retrieved on October 20, 2009 from: http://www.bea.doc.gov/bea/regional/gsp/.

U.S. Department of the Commerce (2001). Bureau of Economic Analysis. Retrieved on October 20, 2009 from: http://www.census.gov/prod/www/abs/decenial.html

U.S Department of Labor (2005). Bureau of Labor Statistics. Retrieved on October 20, 2009 from: http://www.bls.gov/cps/wlf-table17-2005.pdf

Wade, H. (1988). *A study of the economic impact of Walker State Technical College on the local economy with implications for use by other Alabama two-year institutions*. Unpublished doctoral dissertation, University of Alabama.

Walvoord, B. E. (2004). *Assessment clear and simple: A practical guide for institutions, departments, and general education*. California; Jossey-Bass.

Weisbrod, B.A. (1968). External effects of investment in education. In M. Blaug (ed.), *Economics of education I*. Baltimore, MD: Penguin Books.

Weitzman, S. M. (1991). The economic impact of the community college system on the state of Florida. Gainesville: Inter-Institutional Research Council, University of Florida.

Wolfe, B.L. (1995). External benefits of education. In M. Carnoy (ed.), *International Encyclopedia of Economics of Education* (2nd ed.). Tarrytown, NY: Elsevier.