Massification and Diversification as Complementary Strategies for Economic Growth in Developed and Developing Countries

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Numerous microeconomic studies demonstrate the significant individual returns to tertiary education; however, little empirical evidence exists regarding the effects of higher education massification and diversification agendas on long-term macroeconomic growth. The researchers used the Uzawa-Lucas endogenous growth model to tertiary education massification and diversification agendas in 176 countries using World Bank, EdStats, and UIS data from, 1995-2014. The long-run propensity of economic growth to tertiary education enrollments was found to be positive and significant. Thus, the empirical findings suggest that massification of tertiary education has a significant effect on long-run economic growth when diversification policies complement massification initiatives.
***Keywords*:** higher education, massification, diversification, economic development, endogenous growth, macroeconomics

Introduction

Tertiary education improves human capital, which is a key component to improving economic growth as measured by GDP (Deutsch, Dumas and Silber, 2013; Ganegodage and Rabldi, 2011; Hanushek, 2013; Holmes, 2013; Jensen, 2010; Shrivastava & Shrivastava, 2014). Research on education and economic growth addresses two main issues: microeconomic studies measure the individual returns to education (Arnold, Bassanini & Scarpetta, 2011; Card, 1999; Harmon, Oosterbeek & Walker, 2003; Krüeger & Lindahl, 2001; Pasacharopoulos & Patrinos, 2004; Stevens & Weale, 2004), and macroeconomic studies measure the relationship between education and economic growth. Numerous microeconomic studies demonstrate the significant individual returns to tertiary education (Card, 1999; Harmon, 2011; Harmon et al., 2003) however, little empirical evidence exists regarding the effects of country-level massification and diversification agendas on a country's long-term macroeconomic growth (Altbach & Knight, 2007; Bashir, 2007; Guri-Rosenblit, Sebkova and Teichler, 2007; Lien, 2008; Mohamedbhai, 2008). Massification agendas are policies engaged to increase total tertiary education enrollments and believed to improve economic growth (Holmes, 2013), and diversification policy efforts seek to engaged various types and levels of tertiary education to provide greater tertiary education options to meet all tertiary level demands (Kintzer & Bryant, 1998; Levin, 2001; UNESCO, 2003; Wang & Seggie, 2013). Such evidence is especially consequential for policymakers in developing countries who must make decisions about the allocation of limited resources to meet excess demand for tertiary education (Mohamedbhai, 2008).

The extent to which higher education policymakers in developing countries pursue massification and diversification agendas respectively reflects basic assumptions about what combination will increase a country's economic growth through investment in human capital, the economic value of "people's innate abilities and talents plus their knowledge, skills, and experience that make them economically productive" (World Bank n.d., para. 44). Massification agendas focus on improving human capital through expansion of tertiary education enrollment (Mohamedbhai, 2008); diversification agendas focus on improving human capital by investment in various levels and types of tertiary education that serve a wider array of students (Kintzer & Bryant, 1998; Levin, 2001; UNESCO, 2003; Wang & Seggie, 2013). Increased human capital leads to increased productivity which is the measure of economic growth (GDP). Tertiary education positions countries for sustainable economic growth and social mobility, as well as produces individual and societal benefits contributing to national prosperity (Browne Review, 2010; Naidoo, 2009). Economic researchers have identified the need for further analysis on the role of tertiary education in macroeconomic growth in developing countries due to inconclusive results (Holland, Liadze, Rienzo, & Wilkinson, 2013).

Economic growth through increased higher education has become an established agenda in all society (Wolf, 2002). The purpose of this study is to examine the effect of country-level massification and diversification agendas through a longitudinal analysis of macroeconomic growth from in 176 countries using World Bank, EdStats, and UIS data from, 1995-2014. Endogenous growth, derived from optimal behavior of agents in economic models, is used in macroeconomic research to model factors that contribute to sustainable long term growth (Kibritcioglu & Dibooglu, 2001). It refers to internal factors that influence economic growth, not outside the economy (Pascharpopoulos & Patrinos, 2004). Accordingly, the researchers examined two questions posing three hypotheses:

> H1. Total tertiary education enrollments will have a significant effect on overall economic growth (GDP).
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> H2. University tertiary education enrollments will have a significant effect on economic growth (GDP) more than two-year tertiary education enrollments.
>
> H3. Total tertiary education enrollments will exert a significant effect on economic growth (GDP) in developing countries compared with developed countries.

This article is organized as follows: First, we outline research on the link between tertiary education massification and diversification agendas and economic growth. Second, we describe the Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) endogenous growth model used to examine the effect of country-level massification and diversification agendas. Third, we present the results of our analysis. Finally, we conclude with the implications for policy for non-governmental organizations and governments to maximize economic growth through tertiary education investment in developing countries, as well as identify areas for future research. In this study, a developing country is one categorized by The World Bank with low- middle or low gross national income (GNI) per capita. Economic growth refers to extensive quantitative change or expansion of a country's economy through the utilization of more resources, e.g., human capital, and measured as the percentage increase in GDP (World Bank, 2004).

Massification and Diversification Agendas and Economic Growth

To improve human capital, economists, non-governmental organizations, and governments focus on significant findings that link tertiary education investment and economic growth (Cutright, 2014; Ganegodage & Rambaldi, 2011; Hanushek, 2013; Holmes, 2013; Jensen, 2010; Mellow & Katopes, 2009). Emphasis on the role of human capital in economic growth has prompted international organizations and governments to promote tertiary education initiatives (Holmes, 2013). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) initiative focuses on global tertiary education attainment, especially in developing countries (UNESCO, 2010, 2014). The Browne Report in the United Kingdom (UK) emphasizes domestic tertiary education attainment as a means to promote economic growth (Browne Review,

2010). Such policies have generated unprecedented global demand for tertiary education, especially in developing countries (Hanushek, 2013).

Research measuring the spillover effects of tertiary education massification on economic growth is inconclusive, as few studies have analyzed the effects of tertiary education investments on economic growth (Holland et al., 2013). Cohen and Soto (2007), Hartwig (2014), Lucas (1988), and Romer (1990) demonstrate positive effects of investment in education on economic growth, but Benhabib & Spiegel (1994), Bils and Klenow (2000), Holmes (2013), and Pritchett (2001) non-significant effects. Similarly, studies from Barro and Lee (2010), Holmes (2013), Keller (2006), Krüeger & Lindahl (2001), Loening (2005), and Pegkas (2014) find greater significance with combined secondary and tertiary education investment. Thus, while tertiary education is believed to meet excess demand, supply skilled workers, promote innovation, and increase individual quality of life bringing about social and economic benefits (McNeil and Silim, 2012), it may provide significant effects in developing countries compared with developed countries (Greiner et al., 2005; Krüeger & Lindahl, 2001).

Massification initiatives have expanded access to tertiary education around the world (Allais, 2013) and have challenged the traditional form of tertiary education where institutions were elite centers providing education for selected individuals (Hornsby and Osman, 2014; Trow, 2000). Massification agendas have tended to focus on four-year tertiary education due to the prestige associated with university level degrees, especially in developing countries (Bashir, 2007; Castro, Bernasconi & Verdisco, 2001; Roggow, 2014; Wang & Seggie, 2013; Woods, 2013; Zhang & Hagedorn, 2014).

Developing countries need tertiary education to provide relevant academic programs and pedagogical practices (Lane, 2010; Lane & Kinser, 2011; McBurnie & Ziguras, 2007; Wildavsky, 2010) that promote economic development by improving human capital. Massification of four-year tertiary education is believed to provide greater returns on investment than specialized or vocational subjects (Psacharopoulos, 1985) by providing theoretical framework and generating knowledge (Schroeder and Hatton, 2006). Further, four-year tertiary education provides active research agendas on issues relevant to the respective country. However, a narrow focus on tertiary education trade limits the propensity for economic growth, especially in developing countries (Wang & Seggie, 2013). A tertiary education market over-saturated by four-year education provides education accessible only to upper socioeconomic citizens or citizens having passed entrance exams and admission criteria given scholarships (Altbach, 2013; Altbach & Knight, 2007; Bashir, 2007; Mello & Katopes, 2010; Naidoo, 2009).

Furthermore, four-year tertiary curricula are not designed to help recover from economic collapse or social dislocation (Schroeder & Hatton, 2006). Four-year tertiary education does not provide training for quick recovery of livelihoods and local economies or focus on immediate workforce training needs demanded by the labor market and community (Schroeder & Hatton, 2006). In addition, four-year institutions do not provide life-long learning to students not looking to attain a degree or developmental education to students not prepared for the rigors of college-level course work. Focusing solely on four-year baccalaureate institutions does not provide the flexible short-cycle, accessible, and affordable education system needed to promote core transformations increasing human capital to improve economic growth (Mellow & Katopes, 2010). Overcrowding tertiary education with four-year education fails:

> to address human capital needs of the productive sector, thereby constraining economic growth, productivity, and innovation. Existing employment opportunities go unmet; additional employment opportunities are not created; vast numbers of people in rapidly growing population end up unemployed and disillusioned. There is a desperate need for education approaches that integrate the institutions of education and the institutions of economic growth that link education programs to the needs of the market and the community in a manner that enriches both (Hewitt and Lee, 2006, p. 46).

This is particularly problematic for developing countries that have greater social disparity and limited infrastructure.

Policymakers have emphasized massification of tertiary education based on the belief that economic growth is attained through high levels of education (Allais, 2014), but massification policies have been inadequate to meet economic expectations and have failed to equalize learning opportunities (Liu, 2012). Limitations of massification policies led to diversification agendas to engage new and flexible short-cycle tertiary education models (Kintzer & Bryant, 1998; Levin, 2001; Wang & Seggie, 2012). Diversification agendas complemented massification agendas by expanding tertiary education with the design of fast response programs that meet economic and social needs in order to build a competent labor force, e.g., India establishing the U.S. community college model to meet tertiary education demands. Countries with limited tertiary education opportunities, especially developing countries, need to diversify their tertiary education options (Hewitt & Lee, 2006; Schroeder & Hatton, 2006). Therefore, massification and diversification policies on tertiary education are high on the agendas within many countries, especially in developing countries (Guri-Rosenblit, Sebkova & Teichler, 2007), in order to meet excess demand.

Methodology

The purpose of this study was to examine the effect of country-level massification and diversification agendas through a longitudinal analysis of macroeconomic growth from in 176 countries using World Bank, EdStats, and UIS data from, 1995-2014. The Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) endogenous growth model was utilized to examine the effect of country-level massification and diversification agendas. An econometric model blends economic theory, mathematics, and statistical inference providing policymakers the magnitude associated with economic theory. Economists engage econometric models to provide policymakers with an understanding of the likely effect of policy. Economic theory often has competing models capable of explaining the same recurring relationships (Ouliaris, 2012). Endogenous growth theory is significantly more robust than neo-classical growth theory due to the debate of convergance and the impact and access of technology (Arnold, et al., 2011; Hartwig, 2014), and the Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) model is the strongest of all the endogenous growth theories (Romer, 1994). Within endogenous growth theory there are competing theories of education by learning (Romer, 1986) and R&D (Aghion and Howitt, 1992; Romer, 1990), but they do not focus on the effect of education on economic growth. Therefore, the Uzawa-Lucas model (Lucas, 1988; Uzawa, 1965) endogenous growth model provided understanding into the effect of massification and diversification of tertiary education on economic growth.

The Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) model is a two-sector endogenous growth model resembling the neo-classical model designed by Solow (1956) and the initial endogenous growth models, or "AK" style growth models (Greiner et al., 2005; Jones, 1995; Lucas, 1988). Lucas (1988) adapted the Solow (1956) model with Uzawa's (1965) human capital component to account for the spillovers of human capital accumulation where educated workers advance economic growth by passing on knowledge and productive capabilities to other workers (Lucas, 1988; Holmes, 2013). Therefore, an increase in the investment of physical or human capital raises the steady state GDP growth rate (Hartwig, 2014).

The longitudinal design of this study engaged the Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) endogenous growth theory with an Arellano-Bond Dynamic Panel GMM (GMM) estimator designed for dynamic panel data with small time (t) and large (N). Previous research (Arellano & Bond, 1991; Carkovic & Levine, 2002; Hartwig, 2009; Roodman, 2008) engaged dynamic panels with similar specifications. We engaged the GMM model with a dynamic panel consisting of many countries and a small time component due to limited education data. The Arellano-Bond Dynamic Panel GMM exploits the time-series nature of the relationship between education and economic growth, and removes the fixed country-specific effect while controlling for endogeneity of all explanatory variables which can bias the estimated coefficients and standard error (Carkovic & Levine, 2002; Hartwig, 2009).

Correction for endogeneity bias by removing fixed effects is most commonly done through the first difference of all variables to eliminate individual effects (Hartwig, 2009), but since our dynamic panel data has gaps there was missing transformed data. We engaged the forward orthogonal deviations transformation as proposed by Arellano and Bover (1995) instead of the first difference of all variables. We therefore, augment the initial regression with panel estimates. Further, we engaged a Granger-causality with the GMM to determine the causal relationships between variables in the economic model.

The methodology tests the model in two separate fashions: (a) to test the effects of massification and diversification on economic development, (b) to test the effects of diversification on economic development, and (c) to test the effects of tertiary education between developing and developed countries. We engage total tertiary education enrollment in one model to test the effects of massification and diversification on economic development. Total tertiary education includes university and community college tertiary education. However, Massification has focused on university tertiary education (Bashir, 2007; Castro, Bernasconi & Verdisco, 2001; Roggow, 2014; Wang & Seggie, 2013; Woods, 2013; Zhang & Hagedorn, 2014). Thus, we augment the model to engage two separate variables, university tertiary education enrollment and community college tertiary education enrollment, to test massification of four-year university tertiary education helping determine the effects of diversification.

Data Collection

Data obtained from The World Bank provided a population of 228 developed and developing countries with GDP per capita, Gross Fixed Capital Formation readily available. Data on tertiary education is scarce with many developing countries just recently providing information to UNESCO. Combining economic data and tertiary education enrollment data yielded a sample of 176 developed and developing countries.

The World Bank provides economic and education data pertinent to the Uzawa- Lucas endogenous growth model (Lucas, 1988; Uzawa, 1965). The model requires data on economic growth and the investment in physical capital and human capital. GDP per capita and Fixed Capital Formation, economic growth, and physical capital investment, respectively, were attained through the World Bank. Human capital has been measured in various ways, e.g., school enrollment rates, years of schooling, government education expenditures (Barro, 1991; Hartwig, 2015; Mankiw et al., 1992). Researchers used tertiary education enrollment from UNESCO as the proxy for human capital formation. Tertiary education enrollment was segmented from UNESCO's ISCED definitions where ISCED 6 and 7 are university tertiary enrollments and ISCED upper secondary and post-secondary non-tertiary education are community college tertiary enrollments. Total tertiary education was the sum of university and community college tertiary enrollments. Country classification, determining developing and developed countries, utilized a dummy variable based on a rolling five-year average coding classification as demonstrated in Table 1.

Table 1

Classification Coding

Classification	Code	Developing Country
Low income	1	1
Low middle income	2	1
Upper middle income	3	0
High income	4	0

Data Analysis

The Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) model:

$$Y = F(K, N^e)h^a \quad (1)$$

is based on a production function where K is total capital, N^e is effective labor, and h^a is human capital or the skill level of a worker (Lucas, 1988). The model is based on a reduced-form production technology production function of:

$$y(t) = \bar{A}k_t, \bar{A} = A\psi^{1-\alpha} \quad (2)$$

where y(t) is growth, A is technology, ψ is the ratio of h/k (which is constant and equal to $1 - \alpha/\alpha$), and k_t is capital and labor input (Jones, 1995). A dynamic relationship of Equation 2 augments to:

$$g_t = A(L)g_{t-1} + B(L)i_t + \epsilon_t \quad (3)$$

where A(L) and B(L) are two lag polynomials with roots outside the unit circle, g_t represents GDP growth in period t, i_t is the rate of investment in period t, and ε_t is a stochastic shock (Jones, 1995). Equation 3 includes contemporaneous values of the capital formation variables and thus should engage a modified Granger test (Hartwig, 2014). The modified Granger-test equation yields:

$$X_{it} = \mu_i + \sum_{l=1}^{m} \beta_l X_{it-l} + \sum_{l=0}^{m} \delta Y_{it-l} + \sum_{l=0}^{m} \psi Z_{it-l} + u_{it} \quad (4)$$

where the growth rates of real GDP per-capita for real physical investment per-capita and human capital investment per-capita are X_{it}, Y_{it}, and Z_{it} respectively. N countries (i) are observed over T periods (t) and Hartwig (2014) allows for country specific effects with u_i and the disturbances u_{it} assumed to be independently distributed across countries with a zero mean. We augmented Equation 3 and Equation 4 to test the hypotheses of this longitudinal research.

To test massification and diversification of tertiary education effects on economic growth, Equation 3 was augmented for human capital with $C(L)h_t$. Augmentation yielded the following augmented dynamic relationship of Equation 3. The modified Granger-test econometric model equation maintained the same as Equation 4. Thus the equations tested hypothesis 1:

> H_1: Total tertiary education enrollments will have a significant effect on overall economic growth (GDP).

$$g_t = A(L)g_{t-1} + B(L)i_t + C(L)h_t + \epsilon_t \quad (5)$$

$$X_{it} = \mu_i + \sum_{l=1}^{m} \beta_l X_{it-l} + \sum_{l=0}^{m} \delta Y_{it-l} + \sum_{l=0}^{m} \psi Z_{it-l} + u_{it} \quad (4)$$

To test the effects of tertiary massification through single tertiary education institutions and complementing the diversification research, Equation 3 and Equation 4 were augmented to by segmenting university and two-year tertiary education systems. Dynamic model and econometric model augmentation accounted for university and two-year tertiary education enrollments with $C(L)u_t$ and $\sum_{l=0}^{m} \psi Z_{it-l}$ and $D(L)j_t$ and $\sum_{l=0}^{m} \psi J_{it-l}$, respectively. The augmentation yielded the following equations to test H_2.

> H_2: University tertiary education enrollments will significantly effect on economic growth (GDP) more than two-year tertiary education.

$$g_t = A(L)g_{t-1} + B(L)i_t + C(L)u_t + D(L)j_t + \epsilon_t \quad (7)$$

$$X_{it} = \mu_i + \sum_{l=1}^{m} \beta_l X_{it-l} + \sum_{l=0}^{m} \delta Y_{it-l} + \sum_{l=0}^{m} \psi Z_{it-l} + \sum_{l=0}^{m} \psi J_{it-l} + u_{it} \quad (8)$$

The last augmentation of Equation 4 and Equation 5 tested the impact of tertiary education massification and diversification between developing and developed countries. An interactive dummy variable for country classification was added to test model based on country classification as the form of human capital and augmenting Equation 4 with a country classification dummy variable to test the impact of tertiary education on developing countries. The augmented equations utilized tested H_3.

> H_3: Total tertiary education enrollments will exert a significant effect on economic growth (GDP) in developing countries compared with developed countries.

$$g_t = A(L)g_{t-1} + B(L)i_t + C(L)h_t + \epsilon_t \quad (9)$$

$$X_{it} = \mu_i + \beta_i t_i + \sum_{l=1}^{m} \beta_l X_{it-l} + \sum_{l=0}^{m} \delta Y_{it-l} + \sum_{l=0}^{m} \psi Z_{it-l} + u_{it} \quad (10)$$

Dynamic panel lag model empirical results

Initial data analysis demonstrated 101 developing countries and 75 developed countries demonstrated some outliers in the data, specifically Mozambique, Niger, and Seychelles for GDP per-capita, Finland and the United Kingdom for fixed capital formation, and Norway and Tonga with total tertiary education enrollment. University and community college tertiary enrollments did not demonstrate significant outliers. Outliers in GDP per-capita, fixed capital formation, and total tertiary education enrollment, were maintained in the data for re-estimation dropping each outlier to demonstrate result sensitivity. Log transformation was conducted on all data to great a more normal distribution of the data and to create an elastic relationship.

Lag length utilized for the GMM was 2 per Roodman (2008) and Arellano and Bond (1991). The Akaike Information Criteria (AIC) is found conducting an Ordinary Least Squares (OLS) estimator with cross-section fixed effects for each respective lag and finding the global minimum value of the AIC. However, macroeconomic data does not decline smoothly resulting in a propensity to never find the true global minimum (Webb, 1985). The initial OLS conducted demonstrated a global minimum lag length of 1 with *AIC = 1.*44 compared to lag 0, lag 2, and lag 3 with *AIC* = 2.60, 1.72, and 1.87 respectively.

Panel unit root tests determining stationary time series reject the null hypothesis for all variables ($p < .05$) demonstrating proceeding with the Granger-causality test. Panel root tests are designed for longitudinal datasets with large time and cross section dimensions (Hartwig, 2009). Our longitudinal dataset has eleven time dimensions and may limit the effectiveness of the tests. However, all unit root tests for each variable rejected the null hypothesis ($p < .05$) and did not deter the utilization of the Granger-causality for the analysis.

The models were then tested for GMM assumptions, with the xtabond2 function in STATA (Roodman, 2008), to demonstrate the models were valid instruments to test the effects of massification and diversification of tertiary education enrollments on economic growth (Table 2). The Arellano-Bond test, AR(1) and AR(2), tests for first-order and second-order serial correlation and were validated by rejection of the null hypothesis for AR(1) and failing to reject the null hypotheses for AR(2). The Hansen J-test of overidentifying restrictions failed to reject the null hypothesis and provided a p-value below 1.0 and greater than .05 or .10 (Efendic et al., 2011; Roodman, 2007). The Hansen J-tests cannot reject the null hypotheses of exogeneity of all the difference-in-Hansen tests of exogeneity for GMM and IV instruments. Lastly, the F-tests of joint significance rejected the null hypothesis that independent variables are jointly equal to zero. All assumptions were met, demonstrating the models were valid instruments.

Table 2
Model Assumptions for Validation

	H1	H2	H3
Number of Observations	973	270	973
Number of Groups	149	85	149
Number of instruments	64	80	80
F-test of joint significance	F(21, 148) = 71.89, p > F = 0.000	F(24, 84) = 15.73, p > F = 0.000	F(22, 148) = 65.08, p > F = 0.000
Arellano-Bond test for AR(1)	z = -4.28, Pr > z = 0.000	z = -2.60, Pr > z = 0.009	z = -3.91, Pr > z = 0.000
Arellano-Bond test for AR(2)	z = -0.80, Pr > z = 0.421	z = -1.26, Pr > z = 0.209	z = -0.90, Pr > z = 0.366
Hansen J-test of overidentifying restrictions	chi2(42) = 47.28, Prob > chi2 = 0.266	chi2(55) = 52.52, Prob > chi2 = 0.570	chi2(57) = 66.67, Prob > chi2 = 0.179
Difference-in-Hansen test of exogeneity of GMM-1	chi2(36) = 43.12, Prob > chi2 = 0.193	chi2(47) = 48.25, Prob > chi2 = 0.422	chi2(50) = 61.09, Prob > chi2 = 0.135
Difference-in-Hansen test of exogeneity of GMM-2	chi2(6) = 4.16, Prob > chi2 = 0.655	chi2(8) = 4.28, Prob > chi2 = 0.831	chi2(7) = 5.58, Prob > chi2 = 0.590
Difference-in-Hansen test of exogeneity of "IV"-1	chi2(29) = 32.22, Prob > chi2 = 0.269	chi2(42) = 40.33, Prob > chi2 = 0.545	chi2(44) = 59.62, Prob > chi2 = 0.058
Difference-in-Hansen test of exogeneity of "IV"-2	chi2(13) = 14.06, Prob > chi2 = 0.369	chi2(13) = 12.20, Prob > chi2 = 0.512	chi2(13) = 7.05, Prob > chi2 = 0.900

Results

The results supported the first hypothesis: total tertiary education enrollments had a significant effect on overall economic growth. Table 3 outlines the results of the one-step system GMM estimation of massification of tertiary education. There was a significant ($p < .05$) and positive effect on the lag tertiary education enrollment, TertiaryEnrol (-2). A one unit improvement of tertiary education enrollment results in a .06 percent rise in GDP per capita. Hence, a ten percent improvement in tertiary education enrollment will result in a .6 percent increase in GDP per capita. Removals of outliers did affect the empirical model, but did not demonstrate a change on the effect of tertiary education enrollments on GDP per capita. Granger-causality was tested to identify if one variable precedes another, i.e., does a change in GDP per capita precede changes in tertiary education enrollments or does a change in tertiary education enrollments precede changes in GDP per capita. The results of the Granger-causality test demonstrated that tertiary education enrollments Granger-cause GDP growth per capita.

Table 3

Impact of Massification on Economic Growth

Variable	B	*t-value*	*p-value*
Constant	0.549	1.960	0.052
LogGDP (-1)	0.567	7.390	0.000
LogGDP (-2)	-0.049	-1.090	0.279
LogFixed	0.444	4.030	0.000
LogFixed (-1)	-0.228	-2.190	0.030
LogFixed (-2)	0.012	0.360	0.720
LogTertiary	-0.013	-0.280	0.777
LogTertiary (-1)	0.047	1.700	0.091
LogTertiary (-2)	0.062	2.700	0.008
Wald Test – Granger Causality – LogTertiary (-2)	F(1, 148)=7.27, Prob > F = 0.008		

The results did not support the second hypothesis: university tertiary education enrollments did not have a significant effect on economic growth (GDP) more than two-year tertiary education enrollments. Table 4 outlines the results of the one-step system GMM estimation for diversification of tertiary education. The empirical model engaged differentiated between university and community college tertiary education. Lag university tertiary education enrollments, LogUniversity (-2), and lag community college tertiary education enrollments, LogCC (-2), did not demonstrate a significant effect on economic growth. University and community college education provided a positive influence on economic growth, but neither was a significant effect on GDP per capita over the other. Outliers did not demonstrate an influence on the model. Granger-causality was also test on the lag university tertiary education enrollments and the lag community college tertiary education enrollments. The null hypothesis was not rejected, demonstrating no Granger-causality for each tertiary education enrollment. The results of the Granger-causality test demonstrated that neither university tertiary education enrollments, nor community college tertiary education enrollments, Granger-cause GDP per capita.

Table 4
Impact of Diversification on Economic Growth

Variable	β	*t-value*	*p-value*
Constant	0.997	2.630	0.010
LogGDP (-1)	0.245	1.590	0.115
LogGDP (-2)	-0.009	-0.090	0.930
LogFixed	0.326	2.970	0.004
LogFixed (-1)	-0.157	-1.160	0.250
LogFixed (-2)	0.094	1.440	0.154
LogUniversity	0.061	0.870	0.384
LogUniversity (-1)	0.012	0.240	0.813
LogUniversity (-2)	0.065	1.970	0.053
LogCC	0.028	0.660	0.512
LogCC (-1)	0.020	0.570	0.570
LogCC (-2)	0.031	1.160	0.249
Wald Test – Granger Causality – LogCC (-2)	F(1, 84)=.43, Prob > F = 0.512		
Wald Test – Granger Causality – LogUniversity (-2)	F(1, 84)=.77, Prob > F = 0.384		

The results did not support the third hypothesis: total tertiary education enrollments had a significant effect on economic growth (GDP) in developing countries as compared with developed countries. Table 5 outlines the results of the one-step system GMM estimation for impact of tertiary education on economic growth in developing countries. There was a significant ($p < .05$) and a positive effect on the lag tertiary education enrollment, TertiaryEnrol (-2). However, the country classification interactive dummy variable, Developing_Classification, was not signification ($p = .94$), demonstrating no difference on the impact of tertiary education massification on economic growth in developing countries compared with developed countries. Granger-causality was not affected. As a robust test, hypothesis 1 was estimated with each country classification. The results demonstrated non-significant positive effects on the lag tertiary education enrollment for both developing and developed countries.

Table 5
Massification Impact on Economic Growth (Country Classification)

Variable	B	*t-value*	*p-value*
Constant	0.552	1.980	0.049
LogGDP (-1)	0.620	8.190	0.000
LogGDP (-2)	-0.067	-1.550	0.124
LogFixed	0.308	2.880	0.005
LogFixed (-1)	-0.110	-1.220	0.225
LogFixed (-2)	0.004	0.120	0.907
LogTertiary	0.007	0.110	0.911
LogTertiary (-1)	0.037	2.150	0.033
LogTertiary (-2)	0.054	2.900	0.004
Developing_Classification	0.004	0.080	0.940

Discussion

The purpose of this study was to use a Uzawa-Lucas (Lucas, 1988; Uzawa, 1965) endogenous growth model to examine the effect of country-level massification and diversification agendas through a longitudinal analysis of macroeconomic growth from in 176 countries using World Bank, EdStats, and UIS data from, 1995-2014. The results supported the first hypothesis: total tertiary education enrollments had a significant effect on overall economic growth. The results did not support the second hypothesis: university tertiary education enrollments did not have a significant effect on economic growth (GDP) more than two-year tertiary education enrollments. The results did not support the third hypothesis: total tertiary education enrollments did not have a significant effect on economic growth (GDP) in developing countries as compared with developed countries. This section will discuss how the results relate to existing macroeconomic studies that have examined the effects of massification and diversification on a country's long-term macroeconomic growth, including implications for policy for non-governmental organizations and governments to maximize economic growth through tertiary education investment. We conclude with recommendations for further research.

This research supported the initial findings of Barro and Lee (2010), Holmes (2013), Keller (2006), Krüeger and Lindahl (2001), Loening (2005), and Pegkas (2014) on the positive effects investment in tertiary education has on economic growth. Our findings demonstrated a ten percent improvement in tertiary education enrollment resulting in a .6 percent increase in GDP per capita in the long-run were also in line with the findings of Hartwig (2014). Further, our findings considered the massification and diversification of tertiary education with the aggregation of university and community college tertiary education. The significant findings demonstrate that massification with diversification of tertiary education poses the ability to provide significant impact on economic growth.

Massification initiatives have focused on four-year tertiary education due to prestige associated with university level degrees (Bashir, 2007; Castro, Bernasconi & Verdisco, 2001; Roggow,

2014; Wang & Seggie, 2013; Woods, 2013; Zhang & Hagedorn, 2014) and the belief four-year tertiary education emphasis provides greater return on investment (Psacharopoulos, 1985). Our findings contradict the notion that emphasis on four-year tertiary education significantly impacts economic growth. The non-significant findings of university tertiary education or community college tertiary education demonstrate that a single tertiary education model does is not likely to promote a significant impact on economic growth. However, from the significant findings of total tertiary education, diversification increases tertiary education attendance rate and specialization (Shavit, Arum & Gamoran, 2007; Reimer and Jacob, 2011) thus massification with diversification poses greater economic growth. Greiner et al., (2005), Krüeger and Lindahl (2001), and Wang and Seggie (2013) state that tertiary education may provide a greater effect on economic growth in developing countries. The findings found there was no difference between developed and developing countries on the investment in tertiary education on economic growth. Therefore, developing countries should seek to implement the same tertiary education policies as developed countries.

Policies focusing on massification of tertiary education through the promotion of university education do not promote greater economic growth than massification with diversification policies. Engaging massification policies focusing on university tertiary education alone does not promote the ability for all students to attain education, such initiatives do not shift student demographics and academic levels from elite students to students of all ages, all backgrounds, and academic acumen (Mohamedbhai, 2008). Massification through university tertiary education hinders the ability to increase tertiary education enrollment by ten percent to achieve an increase in GDP per capita by .6 percent.

Massification through diversification promotes various levels and types of tertiary education, and is believed to offer greater tertiary opportunities to a wider array of students (Kintzer & Bryant, 1998; Levin, 2001; UNESCO, 2003; Wang and Seggie, 2013). Offering greater tertiary opportunities provides accessible tertiary education to all members of society yielded a greater propensity to increase tertiary education enrollment by ten percent. Thus, there is greater economic benefit to promote massification and diversification policies.

Further Research

There are at least two ways macroeconomic researchers might build on the results of this study. First, utilizing similar research techniques to this study, the empirical model could be re-estimated utilizing developing countries to determine if there is a significant benefit to developing countries to engage in importing U.S. community college education. Demand for tertiary education created a redistribution of trade in the tertiary education market (Bashir, 2007; Lien, 2008; Lane and Kinser, 2011; Tilak, 2011) resulting in innovative distribution methods known as transnational education (Altbach & Knight, 2007; Lien, 2008; Naidoo, 2009). Moreover, previous research has not differentiated between transnational methods of cross-border supply, consumption abroad, commercial presence, and presence of natural persons. As more data becomes available it will become increasingly important to expand this research to understand the impact of each respective mode of transnational education on economic growth and importing countries.

Second, researchers could estimate an educational production function for community college education in developing countries. The research could estimate efficiency in the production of community college education through the utilization of data from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC), a survey of skills such as literacy, numeracy, and problem solving. The research could expand upon the findings of Deutsch, Dumas, and Silber (2013) which utilized OECD's Programme for International Student Assessment (PISA), survey of skills and knowledge of 15-year-old students, to estimate an educational production function in Latin America.

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