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# Fiscal Policies and Subnational Economic Growth in Mexico

**Arwiphawee Srithongrung**
Hugo Wall School of Public Affairs
Wichita State University, USA.
Email: Arwiphawee.Srithongrung@wichita.edu

**Isaac Sánchez-Juárez**
Department of Social Sciences
Universidad Autónoma de Ciudad Juárez, Mexico.
Email: isaac.sanchez@uacj.mx

**ABSTRACT:** This study investigates the effects of taxes and public investment on economic growth of Mexican states. The subnational government finance data were drawn from 32 states during the period of 1993 to 2011. Correcting for long-term trends and isolating cointegration effects between economic growth and public finance, the empirical results indicate that taxes have negative effect on growth and the effect can be seen in both transitory and permanent manners. As predicted by growth theory, the effects of public investment on subnational growth are statistically significant and positive in both short and long-runs. On the other hand, we find that educational accomplishment negatively relates to growth. Foreign direct investment does not have any significant effect on subnational economic growth. In general, the results imply that an appropriate fiscal policy (equilibrium between public investment and taxes) is required to boost economic growth in this country.

**Keywords**: Mexico, economic growth, taxes, public investment, states.
**JEL Classifications**: O11, O23, O47, R11.

## 1. Introduction

The role of fiscal policies (i.e., taxes and spending) in subnational economic growth has been focused in numerous studies around the world, partly because there are mixed results for both impacts of taxing and spending on growth, depending on model specifications and estimation techniques. Furthermore, given that subnational governments use both their own revenue sources and the resources from central government to finance public spending, it is necessary to understand in what way taxes and spending affect local growth. The purpose of this study is to: 1) to investigate the *partial effe*cts of taxes and public investment on subnational economic growth when the another side of fiscal policies is alternatively controlled for, and 2) to understand the *partial effects* of other exogenous variables in neoclassical growth model including education levels, population and foreign direct investment when fiscal policies are accounted in the model.

The "partial effect of taxes" refers to the true effect of taxes themselves on economic growth, holding the partial effect of public spending constant. Conventional beliefs and macroeconomic theory asserts that the true partial effect of taxes themselves should be negative, given that taxes distort economic agents' production and consumption choices and, as a consequence, deadweight loss occurs in the private markets where taxes are levied. Several empirical studies at the subnational levels in the United States found negative effects of taxes on growth; and hence; the empirical findings confirm conventional beliefs. In the case of Mexico there are few studies that have addressed this issue and from here the originality of this paper.

Theoretically, public investment is expected to exhibit positive effects on growth given that public infrastructure such as road, bridges, water and sewerage systems and telecommunication infrastructure are important production factors (see for example, Mankiw et al., 1992; Barro and Sala-i-Martin, 2004). However, several empirical studies at the subnational levels both in the United States (for example; Garcia-Mila et al., 1996; Holtz-Eakin, 1993), and elsewhere (see for example, Devarajan et al., 1996; Sánchez and García, 2014) found either negative or insignificant effects of public infrastructure spending or public capital stocks on growth. The wrong and insignificant signs of public investment coefficients maybe due to several reasons including using inappropriate econometric approaches to analyze the panel data (Kennedy, 2008).

Previous studies on the effects of public spending on growth, including those of Helms (1985), Mofidi and Stone (1990); Kneller et al. (1999); Tomljanovich (2004) and Bania et al. (2007) have addressed the issue of controlling another sides of fiscal policies as described above. However, to our knowledge, none of these papers has satisfactorily corrected econometric problems especially for integration problem that can be inherent characteristics of macroeconomic growth data. Cointegration occurs when each of the time series data including taxes, spending, and economic growth levels contain strong unit roots and unfortunately all of the data series that have unit roots are simultaneously correlated; and hence, sharing the same or similar trends. Several studies tried to correct unit roots but fails to address the cointegration problems (see for example Reed, 2008). Panel Vector Auto Regression (PVAR) method is recently used by several studies for subnational growth to control for cointegrated trends in macroeconomic data (see Blanchard and Perotti, 2002 and Srithongrung and Kriz, 2014). However, the underlying assumption for PVAR method is that all variables in the model is endogenously determined by the rest of the variables in growth model. Thus, the method is not appropriate for the model that incorporates some exogenously determined variables such as population growth and foreign investment.

In this paper, we found that the standard panel data analyses controlling fixed or random effects are not enough to solve unit roots and cointegration problems in the subnational macroeconomic growth data. Because we found strong trends in subnational public investment data and strong cointegrating trends between public spending and growth, we chose Error Correction Model (ECM) suggested by Kennedy (1998) to correct unit roots and cointegration while estimating the effects of taxes and public investment on growth. Practically, we could use Panel Vector Auto Regression (PVAR) method as mentioned above; however given that PVAR assumes that all variables are endogenously determined by the other variables in the model; the method is not useful to analyze data in this study. In Mexico, public spending by subnational governments is not completely financed by state's own revenue sources; instead the spending is partially financed by Mexico's central government. Furthermore, given that other socio-economic variables such as education, population and foreign direct investment are specified based on exogenous growth model, PVAR is not chosen as appropriate method in this study. The results from ECM confirm theoretical hypotheses for the effects of taxes and public investment in both short-and long runs.

The paper is organized as follows. The next section describes theoretical background and major hypotheses. The third section presents testing model and data. The following section provides results and discussion. The final section presents conclusion.

## 2. Research Background

*The Effects of Taxes on Subnational Economic Growth*

Previous empirical results indicated that tax has a negative effect on growth (Holcombe and Lacombe, 2004; Mark et al., 2000; Reed, 2008). Theoretically, the negative effects may be either a direct effect of taxing, i.e., directly decreased citizens' income, or an indirect effect, i.e., tax creates deadweight loss in private markets.[1] However, some of the previous empirical results, especially for the studies that controlled for the effect of public spending in the same testing models, indicated that taxes had a positive effect on growth in the long-run (the growth-hills effect) (Bania et al., 2007) and corporate taxes had a positive effect on per capita real Gross State Product (GSP) (Tomljanovich, 2004). In the case of Mexico, some studies have found negative impact of taxes over economic growth using an

[1] Deadweight loss is the sum of consumers' and producers' surplus that disappears after tax prices increase since taxpayers change their behavior by withdrawing their consumption (in the case of sales taxes), production (in the case of individual labor and corporate output taxes), and decisions to obtain personal properties (in the case of property taxes). Christiansen (2007:25) argues that the appropriate way to determine the level of public goods provision is to evaluate the taxing regime: "taxes levied to finance public goods will inflict a loss of efficiency on society by inducing behavioral responses that are socially inefficient, even if privately rational. This is a social cost that must be added to the cost in terms of resources needed to produce the public goods".

OLS panel data model, but positive with fixed and random effects (Samaniego, 2014 and Caballero and López, 2012). Canavire-Bacarreza et al. (2013) using time series found that in Mexico "a shock that increases collection of personal income tax by two standard deviations reduces economic growth in the short run, with a recovery and even a slight positive effect in the long run (more than 3 years)." As asserted by Reed (2008), a part of these mixed results is relevant to different research methodologies. We add to this observation that another part of these mixed results is also relevant to the different underlying assumptions used in testing economic growth; namely, the "short-run" versus "long-run" growth.

As discussed by Diamond and Moomau (2003), tax rate affects the investment demand function by changing after-tax return on capital and the supply function of investment by enhancing incentives to save more. While the first creates negative effects on growth, the latter creates positive effects on growth. According to these authors, the partial effect of tax itself is unfortunately still unclear as to whether the results will be positive or negative because the partial effect of taxes depends on the increasing level of saving and the decreasing level of investment. This opaque understanding for the roles of public finance on private investment and economic growth creates such arguments as whether public spending crowds out private investment (in Mexico see for example Calderón and Roa, 2006). With this line of debating, we expect to choose an appropriate empirical economic growth model that allows testing of the two sides of government fiscal policies. This attempt is not new given that several studies, including those by Helms (1985), Mofidi and Stone (1990), Kneller et al. (1999), Tomljanovich (2004), and Bania et al. (2007) have addressed this issue. However, as mentioned above, these studies failed to control for cointegration that tends to create the wrong signs in econometric models (Kennedy, 2008).

Furthermore, in addition to the relevancy to government spending, the net effects of taxes on growth might depend on the pre-existing condition of the taxing system. According to Christiansen (2007), there are two cases of an initial taxing system: optimal and sub-optimal systems. The first asserts that the relationship between tax burden and government revenues is *non-linear* as portrayed by an inverted U shape. In this case, the taxing system is optimal in the Pareto efficiency definition, given that it is impossible to increase the tax rate without making anyone worse off. Under this optimal case, increasing the tax rate does not change the socially-aggregated utility, and thus, taxes have *no significant impact* on private markets. This is because the loss experienced by the group subject to a higher tax burden would be compensated by the benefits gained by the group receiving the benefits from public goods.

As Christiansen (2007) has pointed out, the key to understanding why aggregated social utility does not change when the tax system is efficient is to understand the consequences of having an efficient tax system at the initial point (or the term "self-selection constraints" defined by Christiansen). If the taxing system is efficient or optimal in terms of having a broad base[2] and being non-discriminatory,[3] then there is no incentive for economic agents to change their behavior in terms of labor supply or consumption demands to avoid increased taxes. If the tax system is narrow and discriminatory, as in the latter case of the sub-optimal taxing system, there is incentive for some groups in the society to avoid a tax burden by withdrawing labor supply or substituting the highly taxed goods with lower taxed ones. This is where the deadweight loss mentioned previously occurs.

In the suboptimal taxing system, the relationship between tax burden and government revenue is *linear*, given that changing the tax burden changes the socially aggregated utility according to the Pareto inefficiency definition: it is possible to change tax rates to make someone better off without making anyone worse off (Christiansen, 2007). According to Christiansen (2007), under this sub-optimal regime, increasing the tax rate alters the socially aggregated benefits in terms of net gain or net loss; also, there is a different cost in using taxes from different sources to fund *the same* public project. That is, some tax sources that have under-exploited since the beginning (or suboptimal according to the Pareto efficiency definition) can exhibit a social net gain, while some tax sources that

[2] A broad-base taxing system means that taxes are applied equally across all activities, goods, and services that are substitutable in the same classes.

[3] A non-discriminatory taxing system means that taxes are applied unequally in terms of effective tax rate to different income classes in the society.

have been over-taxed since the beginning can exhibit a social net loss when used to fund the *same* public project. It should be noted that the quality of the taxing system has nothing to do with the initial level of the tax burden; thus, non-linearity in terms of the initial level of the tax does not apply under this assumption.

Regarding the implications of the above concepts, if the coefficient of taxes is statistically significant, then the taxing system of a jurisdiction is inefficient at the beginning, thus exhibiting either positive or negative net effects depending on net-gain or net loss in using such a tax to fund different types of public spending. If the coefficients of the taxes are insignificant, then the taxing system of such jurisdiction is efficient since the beginning.

Empirically, Reed (2008) has shown that under a robust estimation by using 5-year interval differenced data, tax burden exhibited negative effects through all estimation techniques, including pool OLS with fixed state and time effects, fixed effects, random effects, general moment method, and dynamic panel data estimation. Testing the long-run effects of taxes on personal income growth, Bania et al. (2007) found that taxes exhibited positive effects on growth during the initial period, and then negative effects on growth during the later period. Bania et al.'s (2007) full specification of government budget constraint omitted productive spending (which consists of all government spending except health and welfares and other transfers), used average data within five-year intervals (instead of differenced data which test short-run effects), and used leveled data of tax rate to personal income augmented by the squared term of tax rate to test "long-run growth hills." Bania et al. (2007) concluded that in the long-run, taxes used to fund productive expenditure which were omitted in the test have a positive net effect but later on exhibit negative net effects, depending on the taxing level during the beginning stage. Unlike other studies, Bania et al. (2007) used the Barro-type endogenous growth model, which assumes non-linearity in estimating parameters (instead of variable values) as an underlying framework to test the endogenous effects of government fiscal policy.

Based on the previous empirical results, we assert that the taxing system at the subnational levels in Mexico is unlikely to be optimal; thus, the positive or negative net effects of taxes are likely the case. As Christiansen (2007) puts it, even with well-defined social objectives and well-established decision-making institutions, failure to achieve an optimal taxing system will occur due to asymmetric information in the decision-making process, let alone political, institutional, and administrative constraints. Therefore, for this study, our first hypothesis is that taxing exhibits negative effects on economic growth both in short and long runs given that there is a social cost in producing public services and the cost paid by private sector affects saving and investment decisions.

*The Effects of Public Investment Spending on Subnational Economic Growth*

Regarding capital investment, which is one of the main focuses in this study, the studies in the U.S. during the early period (Aschauer, 1990; Munnell, 1990; Costa et al., 1986) indicated significant and positive effects of public infrastructure spending or public infrastructure stocks on subnational growth. The models in these studies did not control for simultaneous effects between dependent and independent variables (Aschauer, 1990), state and time fixed effects (Aschauer, 1990; Munnell, 1990), fixed time effects (Costa et al., 1986), existing public capital stocks (Munnell, 1990; Costa et al., 1986), or public capital spending levels (Aschauer, 1990). These studies obtained significant and large effects of public capital on growth (elasticity ranging from 0.15 to 1.96). Furthermore, the adjusted r-squared in these models was extremely large (about 0.99), which signals autocorrelation due to uncontrolled unit roots in the time series data. When the flaws in these models were corrected, public capital stocks or spending exhibited significant but small effects on growth .01 for Holtz-Eakin and Schwartz (1995), using the Non-linear Seemingly Unrelated technique and .02 for Lobo and Rantisi (1999), using LSDV or insignificant impacts on growth for Garcia-Mila, McGuire, and Porter (1996), using the General Least Square method and the Two-Stage Least Square method, and for Moomaw et al. (2002) using LSDV. However, when a more recent method, such as the Vector Auto Regression (VAR) technique which corrects simultaneous effects between dependent and independent variables due to co-integration and persistent trends in the lagged residuals, was used, Pereira and Andraz (2003) again found that public investment had significant and positive impacts on private output.

For the types of capital spending, Lobo and Rantisi (1999) found that public capital stocks, total public transportation capital outlays, and total public capital outlays, excluding transportation, significantly and positively affected wage growth rates in 261 U.S. metropolitan areas during the period of 1977 to 1992. In the same study, Lobo and Rantisi (1999) found that total public sanitarian outlays significantly but negatively affected the wage growth rate in the same areas and during the same time period. Prior to the correction of endogeneity, Garcia-Mila and McGuire (1992) found that transportation systems, including highways and airports, have larger effects on state economic productivity relative to education than other types of infrastructure systems. Although these studies had some empirical flaws, they imply that different funding across infrastructure service function types yields different effects on economic outputs. Growth theories and empirical evidence (i.e. Vijverberge et al., 1997; Pinnoi, 1994) explain that public infrastructure increases productivity outputs by reducing private sector costs in the production process. This implies that different types of public spending that serve different functions for private production yield different social benefits for private outputs (for the case of Mexico check the works of Sánchez and García, 2014; Caballero and López, 2012; Hernández, 2010; Nuñez, 2006). Thus, the second hypothesis for this study is that when the negative effects of taxes and cointegration trends are isolated public investment spending is positively related to state economic growth in Mexico given that public infrastructure reduces private production cost. The next section presents testing model and data.

## 3. Methodology and Data

In their study on the role of government taxing and spending on growth, Kneller et al. (1999) suggested that a government's combined tax and service package is only one variable in the growth model; other non-fiscal variables, such as resource endowment, technological advancement in the local area, time period, and labor growth rates, are other inputs in the growth equation. Thus, Kneller et al.'s (1999:174) account of growth is:

$$\gamma = a + \sum_{i=1}^{k} B_i Y_{it} + \sum_{j=1}^{m} \gamma_j X_{jt} + u_t \quad (1)$$

Where; *Y* represents non-fiscal variables, *X* is a government's combined tax and spending policy, and *u* is error terms. Using the growth account by Kneller et al. (1999), equation (1) is rewritten:

$$\Delta \ln \gamma_{t,i} = a + b_1 \Delta \ln l_{t,i} + b_2 \Delta \ln n_{ti} + b_3 \Delta k_{t,i} + b_4 \Delta \tau_{t,i} + b_5 \Delta c_{t,i} + b_6 \Delta ntr_{,ti} + b_7 \Delta oex_{t,i} + \sum_{j=1}^{m-1} b_8 s_{it,i} + \sum_{j=1}^{m-1} b_9 t_{t,i} + \varepsilon_{t,i} \quad \ldots\ldots\ldots(2)$$

Where;

$\Delta \ln \gamma_{t,i}$ is an annual growth rate of real Gross Domestic Product (GDP) year *t*-1 to year *t* in state *i*

$\Delta \ln l_{t,i}$ is an annual change of labor quality measured by the changes in average level of educational accomplishment in year year *t*-1 to year *t* for state *i,*

$\Delta \ln n_{t,i}$ is an annual change in the number of population in year *t*-1 to year *t* for state *i,*

$\Delta \ln k_{t,i}$ is an annual change in private investment measured by the ratio of foreign direct investment to GDP in year *t*-1 to year *t* for state *i,*

$\Delta \tau_{t,i}$ is annual change in tax burden measured by the ratio of total taxes (including income, sales, and property) to GDP in year *t*-1 to year *t* for state *i,*[4]

$\Delta c_{t,i}$ is annual change in the ratio of public investment (i.e., government capital outlays) to real GDP in year *t*-1 to year *t* for state *i,*

$\Delta ntr_{t,i}$ (omitted) is annual change in the ratio of total non-tax revenue including intergovernmental revenue and and other central government grants sent to state governments to GDP in year *t*-1 to year *t* for state *i,*

$\Delta oex_{t,i}$ (omitted) is annual change in the ratio of annual state government expenditure on operational spending to real GDP year *t*-1 to year *t* for state *i,,*

[4] We followed Reed (2008) in measuring percent of tax and spending to personal income by using the fiscal variables in year *t* and personal income variable in year *t-1* given that the fiscal data were recorded according to fiscal year and the personal income data were recorded according to calendar year.

As shown in the equation description above, we following Kneller et al. (1999)'s budget constraint model by omitting a category in revenue and expenditure which are $\Delta\, ntr_{t,i}$ and $\Delta\, oex_{t,i}$, respectively to avoid perfect collinearity within taxing and spending categories.

*Endogeneity, Unit Roots and Cointegration Problems in Panel Data*

Endogeneity relationship between dependent variable (annual change in GDP growth) and independent variables (annual changes in the ratio of tax and public investment to GDP) may exist if the variables on the left and the right hand sides of the equation come from the same time period. To control for endogeneity, one-period lagged independent variables are specified to create an overlapped space between fiscal policies and compound growth of GDP in the subsequence periods. This is standard approach to deal with endogeneity (e.g. see Garcia-Milla and McGuire, 1992; Tomljanovich, 2004; Dye and Feiock, 1995; Bleaney et al., 2001).

Table 1 presents summary statistics for the data used in this study. Empirical estimations were carried out using panel data for the period 1993 to 2011 for the 32 Mexican states. All monetary data are in Mexican Pesos and in constant value based year 1993 to control for inflation effect.

**Table 1. Summary Statistics**

| Variable | Total Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Gross Domestic Product (in Million Pesos, Real Value Based Year 1993) | 608 | 46,700,000 | 59,400,000 | 5,859,721 | 376,000,000 |
| Average Education level (Year) | 608 | 7.68 | 1.10 | 4.53 | 10.63 |
| Total Population | 608 | 3,127,930 | 2,675,375 | 353,348 | 15,200,000 |
| Foreign Direct Investment (Pesos, Real Value Based Year 1993) | 608 | 1,520,000,000 | 5,200,000,000 | 1,310,000,000 | 55,900,000,000 |
| Total Taxes (Pesos, Real value Based Year 1993) | 608 | 727,000,000 | 2,000,000,000 | 2,437,989 | 17,300,000,000 |
| Total Public Investment (Pesos, Real value Based Year 1993) | 608 | 394,000,000 | 424,000,000 | 4,904,238 | 3,500,000,000 |
| Ratio of Total Public Investment to Total GDP (in Million Pesos) | 608 | 0.00001 | 0.00001 | 0.00000 | 0.00006 |
| Ratio of Total Taxes to Total GDP (in Million Pesos) | 608 | 0.00002 | 0.00004 | 0.00000 | 0.00030 |
| Ratio of Total Foreign Direct Investment to Total GDP (in Million Pesos) | 608 | 0.00002 | 0.00003 | -0.00002 | 0.00023 |
| Ratio of Total Public Investment to Total GDP | 608 | 10.6 | 8.8 | 1.0 | 62.0 |
| Ratio of Total Taxes to Total GDP | 608 | 16.5 | 43.9 | 0.0 | 296.0 |
| Ratio of Total Foreign Direct Investment to Total GDP | 608 | 17.1 | 25.2 | -23.0 | 232.0 |

Table 2 presents unit root test and cointegration statistics. As presented in the table four of six variables including GDP, public investment, taxes and education contain unit roots. As presented in Table 2, cointegration exists for the series of log GDP and public investment, the series of log GDP and taxes, and the series of GDP and education. To circumvent the unit root and cointegration problems, we used Kennedy's (2003) ECM technique, which relies on using differentiation to purge the serial correlation whereby data in the current year are explained by data in the previous year. To control for cointegration, which is the relationship between the X variables and Y (i.e., when the X values increase, Y increases), the ECM model includes an error correction term. The error correction terms are the difference between dependent variable y and each independent variable X. These error correction terms catch the effects of cointegration between X's and Y so that the coefficients of the main variable take only the effects of unit change within that variable into account, rather than including the cointegration effects.

**Table 2. Levin-Lin-Chu Unit Root and Cointegration Test Statistics**

| Ho: Panels contain unit roots | Number of panels: 32 | |
|---|---|---|
| Ha: Panels are stationary | Number of periods: 19 | |
| Autoregression parameter: Common | | |
| Panel means: Included | | |
| Time trend: Not Included | | |
| ADF Regressions: 1 lag | | |
| LR variance: Bartlett kernel, 8 lags average (chosen by LLC) | | |
| Unit Root Test | t-statistics | p-value |
| Log GDP | 0.286 | 0.612 |
| Public Investment | 1.391 | 0.917 |
| Taxes | 0.804 | 0.789 |
| Education | 3.589 | 0.999 |
| Foreign Direct Investment | -7.264 | 0.000 |
| Population | -4.254 | 0.000 |
| Cointegration Test | t-statistics | p-value |
| Log GDP - ratio of Public Investment to GDP | 13.328 | 1.000 |
| Log GDP - ratio of Taxes to GDP | 8.438 | 1.000 |
| Log GDP - log education | 5.315 | 1.000 |

Owing to use of the ECM technique, all variables in the model entered regression in difference values. The ratios of taxes and foreign direct investment, the mean of educational level, and total number of population are integrated at one level while real GDP value and the ratio of public investment are integrated two levels. The first difference in tax burden, capital stocks, education and population and the second difference of public investment and GDP growth are statistically determined by Bayes Information Criterion (BIC). BIC chooses the length of the difference interval by judging from the magnitude of increasing R2 and the decreasing sum of squared residuals when one more lag is added to the regressing lagged dependent variable against the current-year dependent variable (Stock and Watson, 2007). Due to unit root and cointegration correction, equation 2 is modified and re-written as shown in equation (3) below.

$$\Delta ln\gamma_{i,t} = b_0 + b_1(\Delta lnl_{i,t-1}) + b_2(\Delta lnn_{i,t-1}) + b_3(\Delta k_{i,t-1}) + b_4(\Delta\tau_{i,t-1}) + b_5(\Delta c_{i,t-1}) + (b_6 - 1)(ln\gamma_{i,t-1} - lnl_{i,t-1}) + (b_7 - 1)(ln\gamma_{i,t-1} - \tau_{i,t-1}) + (b_8 - 1)(ln\gamma_{i,t-1} - c_{i,t-1}) + \sum_{j=1}^{32} b_{10} + ar_{i,t-1} + u_{i,t} \quad \text{-------------(3)}$$

Where; $ar_{i,t-1}$ is one period lagged residuals or autocorrelation in the model.

Equation 3 presents the final testing model for this study. In this ECM equation, there are two sets of the independent variables. The first set comprises the differenced independent variables (e.g. $lnl_{i,t} - lnl_{i,t-1}$ ); the second set comprises the error correction terms (e.g. $ln\gamma_{i,t} - lnl_{i,t-1}$) that are added to restore equilibrium in the econometric model. In the ECM, when the error terms or the differenced values between dependent and independent variables in the previous period or series are added into the model, the unit roots of independent and dependent variables are canceled out (Kennedy, 2003). Meanwhile, the leveled data of these independent variables restore equilibrium lost due to the use of differenced independent values. The coefficient for the first set of independent variables, representing the difference between data for the previous and the current period, indicates the short-term effect of the independent variables on growth within the equilibrium model. The coefficients of the second set of independent variables, the error correction terms, were also derived from the regression models and are available on request. The coefficients of the error correction terms are significant at the 0.01 level. The significance of the error correction terms indicates that cointegration does exist in the testing models; however, this was controlled for by adding the error correction terms and residuals from unit root tests into the test equation. The regression results reported in the next section reflect the pure effects of fiscal policies on growth, because we control for unit roots in the time series data and for cointegration problems.

## 4. Empirical Results and Discussion

Table 3 presents the results from the ECM model. Column 1 of the table presents the results from the base model in which fiscal variables, taxes and public investment were omitted as the based case to see the effect of production inputs on GDP. In the short-run, population is significant and has negative effect on GDP growth; population effect is no longer significant when public investment was added in to the model as shown in columns 3 and 4. This implies that total number of population decreases available resources for production inputs; however when public investment is added, production inputs are increasing and hence the effect of population is diminished. Like population, the average level of education accomplishment is significant and negatively affect GDP growth; however when public investment is added into the model, the effect of education becomes positive although insignificant in the short run, as shown in columns 3 and 4. In the long-run, it may be seen that educational accomplishment reduces GDP growth which is counter-intuitive finding given that educated workforce should help instead of hurt an economy. However, when considered that labor stock quantity and quality are substitutable by capital stock, the long-run negative effect of education on growth is possible.

Column 2 presents the partial effect of tax on real GDP growth when all production inputs are controlled for and public investment is omitted. As shown in the column, taxes exhibits negative effects on growth for both short and long-run. Given that tax variable enters the regression model in a form of ratio of tax to total GDP while the dependent variable log GDP is entered the model in a form of million pesos value (i.e., lny * 1,000,000), the interpretation for the coefficient of tax is calculated by $\frac{b_{tax}}{100}\%$.[5] As seen in column two, for every percent increase in tax burden, the total GDP drops for 1.03% in the short-run and this effect is carried on as the coefficient of the long-term trend for taxes is statistically significant at 0.01 level. This result is consistent with the conventional belief and theory that government tax collection produces a negative effect on growth because the private resources are transferred through the public and there is a deadweight loss in the free market.

Column 3 presents the partial effect of public investment on real GDP growth when all production inputs are controlled for and tax variable is omitted. As shown in the column, public investment exhibits positive effect on growth for both short and long-run. Given that public investment variable enters the regression model in a form of ratio of public investment to total GDP while the dependent variable log GDP is entered the model in a form of million Pesos value (i.e. lny * 1,000,000), the interpretation for the coefficient of tax is calculated by $\frac{b_{public\ investment\ ratio}}{100}\%$. As seen in column three, for every percent increase in public investment, the total GDP increase for 5.27% in the short-run and this effect is carried on as the coefficient of the long-term trend for taxes is statistically significant at 0.01 level. These findings correspond with the general belief that public capital outlay simply spurs the economy.

[5] See Stock and Watson (2010:268-269). The coefficient B in Log linear model is calculated such that 100 * B %. In this study, the ratio of tax to GDP was calculated by dividing total taxes to total GDP; while log GDP is entered regression model in a million pesos value. Thus the interpretation for the coefficients B for the ratio of taxes and public investment is divided by 1,000,000 before converting into percentage term.

**Table 3. Empirical Results**

| | Base Model Without Fiscal Variables | Taxes | Public Investment | Taxes and Public Investment |
|---|---|---|---|---|
| Dependent Variable: Difference Value of Real GDP, $\Delta ln\gamma_{i,t}$ | | | | |
| Constant | 3.848*** | 5.012*** | 0.457 | 2.948*** |
| | (0.687) | (0.482) | (0.874) | (0.592) |
| Change in Education Level, $\Delta lnl_{i,t-1}$ | -1.18 | -0.982 | 0.297 | 0.479 |
| | (1.142) | (1.14) | (0.990) | (0.986) |
| Change in Population Level , $\Delta lnn_{i,t-1}$ | -4.489*** | -14.51*** | 4.111 | 3.781 |
| | (1.873) | (1.861) | (2.878) | (2.844) |
| Change in Foreign Direct Investment , $\Delta k_{i,t-1}$ | 23.581 | 34.131 | -30.825 | -22.133 |
| | (95.535) | (95.33) | (91.888) | (91.694) |
| Change in Taxes, $\Delta\tau_{i,t-1}$ | --- | -103.34** | --- | -91.491** |
| | | (45.302) | | (41.82) |
| Change in Public Investment, $\Delta c_{i,t-1}$ | --- | --- | 527.96** | 527.094** |
| | | | (238.52) | (237.796) |
| Long-term trend for education level, | -0.576*** | -0.572*** | -1.130*** | -1.113*** |
| $ln\gamma_{i,t-1} - lnl_{i,t-1}$ | (0.094) | (0.093) | (0.136) | (0.134) |
| Long-term trend for taxes | --- | -0.446** | --- | -0.69** |
| $ln\gamma_{i,t-1} - \tau_{i,t-1}$ | | (0.090) | | (0.093) |
| Long-term trend for public investment | --- | --- | 1.045*** | 1.029*** |
| $ln\gamma_{i,t-1} - c_{i,t-1}$ | | | (0.149) | (0.148) |
| Model F-Stats | (4, 475) | (6, 474) | (6,474) | (7,441) |
| | 71.21 | 60.39 | 27.53 | 24.64 |
| Prob > F | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R-squared: | | | | |
| within | 0.428 | 0.433 | 0.304 | 0.031 |
| between | 0.081 | 0.081 | 0.023 | 0.024 |
| overall | 0.002 | 0.002 | 0.007 | 0.007 |
| | | | | |
| corr (u_i, Xb) | -0.99 | -0.99 | -0.98 | -0.98 |
| prob > F for the test that all u_i = 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| rho_ar $ar_{i,t-1}$ | -0.449 | -0.448 | -0.321 | -0.316 |
| Fixed Effect Included | Yes | Yes | Yes | Yes |
| Number of Observation | 512 | 512 | 480 | 480 |
| Number of Groups | 32 | 32 | 32 | 32 |

*Note: ** refers to .05 statistical significance level and *** refers to .01 statistical significance level

The last column of the table presents the net effect of taxes and public investment on real GDP growth when all production inputs and fiscal variables are controlled for. As shown in the column, public investment exhibits positive effect on growth for both short and long-run and tax exhibits negative effect on growth in both short and long-run. Given that public investment and taxes variables enter the regression model in a form of ratio of public investment to total GDP and the ratio of taxes to GDP, respectively, while the dependent variable log GDP is entered the model in a form of million

Pesos value (i.e., lny * 1,000,000), the interpretation for the coefficient of tax and public investment is calculated by $\frac{b_{public\ investment\ ratio}}{100}$ % and $\frac{b_{tax}}{100}$ %, respectively. As seen in the last column of the table, for every percent increase in public investment ratio, the total GDP increase for 5.27% in the short-run and for every percent increase in tax ratio, the total GDP drops for about 0.91 percent in the short-run. The effects of public investment and taxes are carried on as the coefficients of tax and public investment variables in the long-term trends are statistically significant at 0.01 level. It should be noted that the effects of each of the public investment is positive in all cases no matter tax is included or not included in the models although the coefficient of tax drops slightly from 1.03% to 0.91% when public investment is included in the model.

**5. Conclusions**

This paper investigates the effect of taxes and public investment on state economic growth in Mexico. This paper is different than the previous regional economic growth papers in that the estimation approach namely: Error Correction Model (ECM) is used to correct unit roots and cointegration that tends to occur in macroeconomic panel data. The cointegration can generate spurious correlation between public spending and GDP and taxes and GDP and tends to produce the wrong signs. Using budget constraint model as an underlying assumption for subnational economic growth model as suggested by Kneller et al. (1999), the empirical results indicate that tax has negative impact on GDP growth in both short and long-run, while public investment has positive impacts on GDP growth in both short and long-runs. The effects of taxes range between -1.03 percent to -0.91% for every percent increase to total GDP, while the effect of public investment is at about 5.27% for every percent increase to total GDP. Education accomplishment has negative impact on GDP in the long-run while has insignificant effect in the short-run. This result suggests that labor quality and quantity may be able to substitute for other production inputs such as public investment and the effect of input substitution can be seen only in the long-run.

For policy makers and government practitioners, especially at the subnational level in Mexico, the results in this study suggest that public finance can be used to stabilize regional growth while foreign direct investment is not useful in influencing growth. Given that foreign direct investment depends on the economies outside the Mexican states, it is difficult to intervene to enhance growth. Instead of focusing on economic development incentives to attract foreign investment, it may be more worthwhile to spend regional economic development effort by re-allocating public resources, especially on public infrastructure, into the states where needs are the most to allow the under-developed states to catch up with developed states and hence the growth is even out across the country. For literature the results adds to subnational growth literature that public investment is another inputs in production function. Furthermore, when the cointegration trend is controlled for, there is no evidence supporting the assumption that public investment crowds out private investment.

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