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Essays on Tax Efficiency

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ABSTRACT

ESSAYS ON TAX EFFICIENCY

BY

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This dissertation addresses questions on tax and efficiency. In particular, the main research question in essay one is: what is the impact of state and local taxes as well as expenditure policies on the level, growth, and ratio of high wage workers in U.S. In particular, this essay tries to identify whether interstate differences in state-local level fiscal policies are the main driving force to attract high wage workers or not. Based on Roback (1982) and Epple-Plat's (1998) model, a theoretical model in presented in which the relationship appears as ambiguous. Empirically, current population survey (CPS) data is used to find out the impact of tax policies. In CPS data, I define high wage workers as one who has earnings greater than 75 percentile of U.S wage distribution. Additionally, Occupational Employment Statistics (published by Bureau of Labor Statistics) is used in which I characterize high wage workers as one who has wages greater than 75 percentiles of all workers in each occupation in the U.S. I include total number of high wage workers, growth of high wage workers, and ratio of high wage to total number of workers in the analysis and examine how fiscal policies affect different forms of high wage workers. The results show that state –local taxes are not the major factors to attract high wage workers although expenditure policies have a positive impact in some cases. I also check the validity of the results by incorporating different time periods, sets of high wage growing states,

and various other ways in order to define high wage workers. All the results are consistent with the main findings.

Essay two analyzes the impact of enforcement on tax evasion in U.S. Due to declining budget for enforcement in U.S, the tendency to evade taxes has gone up over the years. Recent data from Internal Revenue Service (IRS) reveals that tax evasion costs the Federal Government $458 billion between 2008 through 2010. This suggests that strong enforcement policies, as well as a rise, in the budget for enforcement are needed in U.S. I use original Allingham-Sandmo (1972) model in which they found a positive relationship between audit or enforcement and tax compliance. Using Individual Tax Model Data File for 2008 and annual state level data from 1980 to 2014, this paper finds that enforcement has a significant impact on tax compliance. There is a possibility that individuals may respond differently at various levels of income. Here I provide evidence that individual's responses vary at different stages of income. Furthermore, state level annual data indicates that higher level of enforcement expenditure does decrease the likelihood to avoid taxes.

Essay three uses the same theoretical model to examine the impact of sales tax evasion on macroeconomic indicators for a developing country Pakistan. The performance of Pakistan in terms of tax collection is very poor and the government is trying to minimize the loss from tax evasion by incorporating a VAT type general sales tax. Using a computable general equilibrium model, this essay explores the link between sales tax rate, tax gap in sales tax and enforcement level, evasion, and observe the consequences of the evasion on macroeconomic factors. In particular, we run two simulations in which the base case incorporates sales tax evasion of 25 percent and the modified case includes full compliance of the general sales tax. The outcome

indicates an increase in Real GNP growth rate, Tax-GDP ratio, and a reduction in the budget deficit.

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ACCEPTANCE

This dissertation was prepared under the direction of Sohani Fatehin's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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INTRODUCTION

Economists have devoted limited attention to understanding the effect of state level fiscal policies on the growth of high wage jobs. Over the last two decades, high wage jobs in the U.S., particularly high tech jobs, grew faster than lower wage jobs. There is a substantial literature that addresses the effect of state and local government taxes on state employment and other state economic conditions. But the existing research has not explored whether the effect of taxes differs by skill or wage level. Understanding what drives high wage job growth is an important issue for economic development and for designing state development policies aimed at influencing the growth of high wage jobs. We hypothesize that low taxes and the associated low public expenditure levels are attractive to lower-wage workers and firms that hire lower-wage workers but not to high-wage workers and firms that hire high-wage workers. This possibility is consistent with the positive income elasticity's found in studies of the demand for public services.

During the last few decades, both developed and developing countries have been struggling with the issue of low tax compliance. The presence of shadow economy, tendency to evade taxes deteriorates the compliance behavior. According to Tax Justice Network (2011), in 2010 US lost $337349 million as a result of the informal or the shadow economy. For developing countries, the picture is even worse. For example, Brazil lost $280111 million as a result of the shadow economy. The significant reasons for evasion or shadow economy are lower enforcement level, poor governance, complicated tax structure as well as tax filing method.

Tax evasion is an important topic to consider for economic development. The presence of evasion not only reduces public sector budget but also causes various distortions like lower economic growth, lower investment etc. Reduction of evasion will require the information about

causes of evasion. Therefore finding the determinants of tax evasion will be helpful for policy analysis. Furthermore, in the US, the recent recession has led to a reduction in government expenditure in tax administrative as well as in enforcement level. As a result, there will be lower compliance rate in the future. Thus, including enforcement parameter as one of the determinants of tax evasion will help to rethink about the recent budget cut. On the other hand, for any developing country, the problem of tax evasion leads to the huge budget deficit which can further reduce development expenditure. Therefore, finding out the impact of tax evasion on macroeconomic welfare may also help policy makers to justify the importance of enforcement.

This dissertation consists of three essays. The first essay examines the link between sub national level taxes and growth rate of high wage employment. Using state -level panel data from 1977 to 2012, our research investigates the relation between interstate differences in sub-national tax and expenditure policies and employment sorted by wage level, in particular workers with earnings above the 75^{th} percentile. We use the Current Population Survey to measure the number high-wage jobs in each state in each year. We use three alternative dependent variables: the number of high-wage workers in each state in each year, the year-to-year change in the number of high wage worker, and the ratio of high wage worker to the total number of workers. The principal independent variables reflect state and local taxes and expenditures per capita. We estimate several different models. We first estimate a set of fixed effect panel data models where employment is a function of tax and public expenditure variables and a set of control variables. However, because of the possible endogeneity between the level of taxes and expenditures and economic growth, we also use an instrumental variables model. We present several robustness tests and the results are consistent with our expectations.

In the second essay, we try to find the link between the responses of individuals in their reporting of income on tax returns and lower enforcement level. Since 2010, in the U.S. a significant budget cut for enforcement activities (almost 8 percent) has been observed. Using the Individual Tax Returns Model file for the year 2008 and annual state-level data from 1980 to 2014, this paper utilizes a traditional Allingham-Sandmo (1972) approach in order to identify the enforcement effect. We measure tax evasion in two ways. For individual-level data, tax evasion is measured by the position of the tax payer's within $100 tax bracket. We followed Slemrod's methodology to calculate tax evasion for each individual. Furthermore, for aggregate level data, evasion is measured by additional taxes and penalties recommended by Internal Revenue Service for each state and for each year. For enforcement variables, audit rate, enforcement budget, and the civil penalty assessed are used. In particular, this paper uses two stage least square methods as well as quantile regression methods in order to deal with the endogeneity issue as well as to take care of the various behavioral responses of the individuals at different points of income. The results indicate that lower enforcement level affects the compliance decision of the individual. However, there are significant differences in the responses at the individual level of analysis, and also there are notable differences in the responses at different stages of income.

The third essay is trying to investigate sales tax evasion scenario for a developing country Pakistan. Among the developing countries, Pakistan has the lowest tax-GDP ratio. On average, the tax-GDP ratio for Pakistan is close to 11 percent which is one of the lowest among other South Asian Countries. One of the reasons for this low tax-GDP is related to the high degree of tax evasion. In order to reduce this, the Government of Pakistan has adopted VAT (instead of sales tax). However, still in Pakistan VAT types sales tax evasion (in particular General Sales Tax gap) is observed. In this paper, we are trying to find out the impact of sales tax evasion on

macroeconomic output. We use a computational general equilibrium (CGE) model in which we incorporate an endogenous tax evasion. We run two simulations-one with the sales tax evasion of 25 percent and another with full compliance. The model is calibrated for 8 years. The results show an increase in the tax-GDP ratio as well as an increase in the compound annual growth rate of real GNP over the 8 periods.

CHAPTER ONE: THE EFFECT OF TAXES ON THE NUMBER AND GROWTH OF HIGH WAGE JOBS: EVIDENCE FROM TWO STATE LEVEL PANEL DATA SETS

1.1 Introduction

There is a long standing interest in measuring the effects of state fiscal policy on state economic growth, measured alternatively by employment, income, investment, and business locations. Since employment growth plays an important role in overall economic growth, much of the research on this topic has focused on the effect of fiscal variables on job growth. Researchers have found mixed results regarding the relationship between state fiscal policy and state job growth. Some researchers argue that traditional state tax policies are ineffective in promoting state job growth because state and local taxes are too small a percentage of business cost to affect the firms' decisions on location and employment. On the other hand, others argue that due to the development of technology and transportation infrastructure, businesses and workers have become more mobile, which has increased the effect of state and local taxes on business location decisions (Bartik, 1992). Recent studies, for example, Romer and Romer (2010), Barro and Redlick (2011) and Mertens and Ravn (2013), find that taxes and economic growth are negatively related. In recent times, this debate has gained importance among policymakers due to the large income tax cut observed in five states since 2010. [1] The stated objective of such tax policy is to increase economic growth[2]. At the same time, prosperous states like New York and California, have maintained high tax rate over the years.[3]

[1] Kansas, Maine, North Carolina, Ohio, and Wisconsin

[2] Governor Sam Brownback, "Tax cuts needed to grow economy," The Wichita Eagle, July 29, 2012, http://www.kansas.com/opinion/opn-columns-blogs/article1096336.html.

[3] In terms of GDP growth, New York was fifth highest and California was ninth highest among the states in 2014. On the other hand, GDP growth rate was 0.2% for Maine, 0.8% for Kansas. 2.1% for Ohio in 2014-2015 which was lower than the national average.

The existing research on job growth has focused on the effect of taxes on the state employment growth without regards to how that effect might differ by skill or wage level. While states generally welcome any new job, states are especially interested in attracting new high wage jobs since such jobs are thought to produce more revenue than the cost of the services provided. Therefore, high-wage job growth is an important issue for economic development and state development policies that may influence their growth.

The principal objective of this paper is to address the question: what is the impact of state-local taxes on the level and growth of high-wage jobs? In particular, we focus on how high skilled workers sort themselves across states in response to state tax differences. Although the literature on the effect of taxation on economic growth is quite large, no research has been conducted that examines the impact of taxes on the level and growth of high-wage jobs at the state level. Thus, this paper contributes to the literature by considering difference in job growth across states as a result of migration of high wage workers. Figure 1.1 shows the presence of migration among high wage workers. Although the migration rate for high skilled workers is higher for within counties movement[4], overall there is a declining trend of migration.

The general approach to the question of the effect of taxes on employment and economic growth starts with the basic premise that higher taxes are a disincentive to employment. However, it could be that low taxes and the associated low public expenditure levels are attractive to low-wage workers but not to high-wage workers and firms that hire high-wage workers. We present a theoretic model in which the relationship between state fiscal policies and the location preference of high skilled labor is ambiguous.

[4] In Current Population Survey Data, three types of migration are included. 1. Moved within county, 2. Moved within states, different county, and 3. Moved between states.

To address this question empirically, we construct two employment panel data sets. The first data set is constructed from the Annual March Demographic Supplement of the Current Population Survey (CPS), 1977 through 2012. We define high wage for each year as the annual wage in excess of the 75 percentile of individual wages for the entire U.S[5]. The second employment data set is derived from the occupation files of the Bureau of Labor Statistics. Because the occupation codes changed, our panel is limited to the period 1999 through 2012. We define high wage for each occupation in each year as the wage at the 75 percentile of all workers in that occupation in the U.S. We measure the annual number of high wage workers in each state in each year, the year-to-year annual change in the number of high-wage workers, and ratio of high wage workers to the total number of workers. Along with state-local total tax revenues, we also address the separate impact of four different taxes (property tax, general sales tax, total income tax, and corporate net income tax) on the level, growth and ratio of high skilled workers. We measure taxes in per capita terms as well as per dollar of personal income.

We estimate several different models. We first estimate a set of fixed effect panel data models where high-wage employment is a function of taxes and public expenditure variables and a set of control variables. However, there is a possibility of endogeneity since economic growth affects the level of taxes and expenditures and at the same time, taxes and expenditures affect economic growth (Srithongung & Kriz, 2014). Therefore, we use a model with instrumental variables in an attempt to obtain interpretable causal inference.

We find that the level as well as the growth of high wage employment are negatively, but statistically insignificantly related to the measurement of the state and local taxes for most of the

[5] Hawaii and Alaska are excluded from the analysis.

estimations. We also conduct several robustness tests and find that our results hold up. These results imply that state tax policies are not the main driving force in determining the distribution of high skilled labor across states, even though it may be that low skilled workers are affected by the state fiscal policies. And state expenditure policies may have some positive impact on high skilled workers. This finding is consistent with the interstate migration analysis. For example, between 2008 and 2012, interstate migration from New York (a high income tax rate state) to Florida (a no income tax state) was three times larger for workers below $50,000 earnings than for workers above $100,000 earnings.

The remainder of this paper proceeds as follows. The next section contains a review of literature that address the relationship between state fiscal policy and state economic growth. Section 3 discusses the theoretical framework. Section 4 discusses the data and the empirical methods used. Section 5 presents the empirical results using the CPS and BLS employment data set. Last section 6 concludes.

1.2. Literature Review

The research on the effect of taxes on economic growth is extensive. There are several surveys of the literature, Bartick (1992), Phillips and Goss (1995), Wasylenko (1997), and Buss (2001). We focus on the more recent literature, key articles, and papers that are particularly relevant to the issue we address. Research differs in terms of how the economic growth is measured, for example, income, employment, manufacturing employment, etc. The research also differs in term of which taxes are considered, how the level of taxes is measured, and how public expenditures are incorporated into the empirical analysis. And, of course, research differs in terms of what geography, time period, what control variables, and econometric techniques that are used.

1.2.1 Tax and Income Growth

Research on the effect of taxes on income growth is inconclusive, with some papers finding positive effects and others finding negative effects. Many of the studies conclude that taxes have small, negative effects on economic activity, particularly if the tax revenue is used to fund transfer payments. Seminal work by Helms (1985) measures the effect of state and local taxes on state personal income. He accounts for budget balancing and uses property taxes, other state-local taxes, user fees, federal source revenues as tax variables and health, highways, local schools, higher education, and other expenditures as spending variables[6]. Using data for 48 states from 1965-1979 and applying fixed effect, instrumental variable, as well as generalized least square method, he finds negative significant impact of state taxes on state personal income and positive significant impact of spending on health, highways, and education on state personal income. The spending impact is larger than the impact from tax resulting in a positive net impact of tax financed increase in government services.

Subsequent studies also indicate negative association between state tax[7] and state income growth. Mullen and Williams (1994) find that higher state marginal tax rate limits state output growth. Reed (2008) finds a negative effect of the tax burden on state income growth. He estimates the model for different time periods, different geographical regions and uses various estimation techniques[8]. Results from all the analysis show that raising total taxes to fund non-welfare expenditure exerts a negative effect on growth, both in long run and short run.

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[6] He excludes sales tax from revenue side and welfare spending from expenditure side to maintain budget constraint identity.

[7] Several studies employ different measures of tax. Theoretically, marginal tax rates (MTR) distort relative prices, resulting in a welfare loss. However, it is difficult to observe MTR in most cases. Therefore, studies also use average tax rates (Engen and Skinner, 1992).

[8] E.g. pooled OLS with time and state fixed effect, fixed effects, random effects, generalized methods of moment, and dynamic panel data estimation.

In particular, he finds that a one percentage point increase in taxes for the current five year period results in 1.37 percent lower growth in that period's per capita personal income.

Using different types of taxes may also have different impacts on the economy, and hence on growth. In theory, investment and capital formation should be affected more by corporate taxes whereas income taxes should have larger effects on individual labor supply and savings behavior. Both of these taxes impose taxes on future consumption. Some studies have found that corporate and personal income taxes have larger negative effects on economic growth than other taxes (Holcombe and Lacombe 2004, Lee and Gordon, 2005). On the other hand, Miller and Russek (1997) find negative impact on real per capita economic growth if sales taxes or other taxes are used to finance transfer payments and positive impact when corporate income taxes are used to finance transfer payments. Stokey and Rebelo (1995) show that a consumption tax does not affect the return on capital, and thus, should not affect investment, output and productivity. In addition, they also show that property taxation lowers the return on reproducible physical capital and on non-reproducible land. Therefore, increases in property tax rates that lower the return on capital will reduce growth. In another study, Kneller, Bleaney and Gemmell (1999) distinguish between taxes that distort labor and investment decisions (defined as taxes on income and property) and non-distortionary taxes, which include consumption taxes. They conclude that while the former reduces economic growth, the latter does not. Additionally, they find that productive government spending benefits economic growth. Similar results were observed by Widmalm (2001), and Gemmell, Kneller and Sanz (2006).

Using state level data from 1972 to 1998, and incorporating fixed effect model, Tomljanovich (2004) finds that higher tax rates reduces state per capita output levels and growth

in the short run. However, long run growth is unaffected by changes in state tax rates, changes in state public spending, and by changes in federal aid. In a recent study, Gale, Krupkin and Rueben (2015) use Reed's (2008) model and estimate the impact of tax revenues and income tax rates on economic growth for the period 1977-2011. For the tax variables, they use total tax, property tax, personal income tax, corporate, sales and other taxes. The economic activities they consider are per capita real personal income growth, firm's per capita formation growth, and the employment population ratio. Using ordinary least square method, they find that results are sensitive to different time periods e.g. the effect of tax is negative for the period 1977-1991, and is positive for 1992-2006. For the whole period (1977-2011), the effect of tax revenues as well as top tax rates is not significant.

A few studies consider the possibility of a nonlinear effect of taxes on economic growth. Using five-year interval data from 1962 to 1997, Bania et al. (2007) estimate nonlinear effects of taxes. They observe a non-monotonic impact of tax financed expenditures on growth. They conclude that taxes increase growth at the beginning, but once government fiscal policies crowds out private investment, growth falls.

Most of the studies examining the effect of tax on economics growth are biased due to endogeneity issue. The reverse causality arises because economic conditions affect the level of state government taxes and expenditure, while taxes and expenditures also affect economic conditions. To deal with this, several papers use lagged variables techniques, first different method, or federal tax changes as instrumental variables (Yamarick 2000, Brown, Hayes and Taylor, 2003, Barro and Redlick 2009). In a more recent study, Srithongung and Kriz (2014) use Panel vector Autoregressive method to solve the endogeneity issue. They use 48 continental state level data from 1970 to 2010 and find negative impact of taxes on state income growth in the

short run. They also find that public capital spending has a positive effect on income growth, both in the short run and in the long run.

1.2.2 Tax and Employment

Several papers examine the effects of taxes on employment growth. Mofidi and Stone (1990) studies the effects of tax burden and expenditures on the growth of manufacturing employment from 1962 to 1982. Like Helms (1985), they omit transfer payments and find that taxes that fund transfer payments have a negative effect, while expenditures on health, education, and infrastructure have positive effects on employment.[9] However, they do find little to no impact on employment when an increase in taxes are associated with an increase in spending on health, education, and highways. In a more micro level study, Dalenbergh and Partridge (1995) use data for 28 metropolitan areas for 15 periods to analyses micro economic interactions. They measure the effect of taxes on total employment and on some disaggregate level of employment (e.g., manufacturing employment). Using ordinary least squares, they find that taxes are negatively related to employment growth after controlling for the government budget constraint. On the other hand, Wheat (1986) finds insignificant impacts of taxes on manufacturing employment growth. He further notes that the most important explanatory factors are markets, state amenities, and unionization. Furthermore, in another study Reed and Rogers (2004) consider the effect of a 30 percent reduction in personal income taxes over period 1994 and 1996 in New Jersey, and find no significant difference in employment between New Jersey and the control states. More specifically, using difference-in-differences method, they find that the increase in employment in New Jersey as compared to other states is not statistically significantly different from zero.

[9] Holding taxes constant

Similarly, Goff, Lebedinsky, and Lile (2012) examine the effect of tax revenues on per capita gross state product (GSP) growth from 1997 to 2005. Using matched pairs analysis of cross sectional data, they find that a reduction in corporate taxes does not increase employment or wages. However, an increase in corporate taxes does result in lower employment and wages.

Migration of workers can also affect overall state employment. Various papers discuss the effect of taxation on the migration of workers, in particular the migration of elderly. Conway and Houtenville (2001) study the relationship between elderly migration and state fiscal policies. They argue that along with the cost of living and climate factors, states with no sales tax on food and lower spending on welfare influence the decision of migration. Bakija and Slemrod (2004) focus on the rich (mainly elderly people) and the impact of state sales taxes and estate taxes on the number of federal estate tax return filed. They find that high estate taxes and sales taxes have negative impact on the federal estate tax returns files in a state. Yang and Warner (2011) use an evidence of natural experiment in New Jersey[10] and estimate the elasticity of migration using a difference-in-differences method. The results show lower elasticity and indicate that migration is higher for people at the retirement age, and people living on investment income.

On the other hand, Kleven et al. (2013) measure the effect of income tax (preferential foreign tax scheme) on the migration of top earners using Danish Administrative data. They estimate large elasticity of migration among foreigners and argue that the scheme has doubled the number of highly paid foreigners.

In summary, the existing empirical evidence regarding the relationship between taxes and economic growth is very large and yields mixed results. Moreover, in the case of employment growth, studies focusing on total employment or on manufacturing employment find negative

[10] An increase in income tax rate on top income earners by 2.6% points to 8.97%.

weak association between state tax and state employment. Despite a large and important literature on economic growth and taxes, the effect of taxes on overall high-wage jobs has gone unnoticed. In fact, there exists no evidence that addresses the issue of how taxes effect the sorting of high wage workers across states. Moreover, estimating causal effects remains an important question due to reverse causality between employment growth and state fiscal policies. Therefore, this paper contributes to the literature by implementing an instrumental variable method that aims to estimate causal evidence on the effect of state fiscal policies on state wise sorting of high skilled workers.

1.3 Theoretical Framework

The empirical literature discussed above is based on the implicit assumption that employment is driven by the demand for workers by firms. But in equilibrium, the supply of and demand for workers are equal. Thus, we model employment as being determined by the supply of workers. Therefore, our question of interest is whether inter jurisdictional differences in taxes have a differential effect on the choice of residential jurisdiction for high-wage workers. This question can be framed in the context of the sorting of workers across jurisdictions. There are two streams of literature that present sorting models that are relevant to the basic question with which we are concerned. One stream is generally associated with Roback (1982) model of amenity evaluation, while the second stream is the sorting and capitalization literature that flows from Tiebout (1956).

Roback (1982) presents a model of sorting of workers across jurisdictions that differ in terms of their amenities. Her theoretical model has no role for government. She assumes that amenities cannot be changed and that there is only one type (defined by skill and tastes) of

worker.[11] Since in equilibrium, utility has to be the same across all jurisdictions, wage rates and land rental rates adjust to bring that about, while still ensuring that labor demand equals labor supply in all jurisdictions. Since wage rates differ across jurisdictions, income also differs.

Tiebout outlines a sorting model in which households have different preferences for tax-public good packages, jurisdiction offer alternative tax-public good packages, and household locate in that jurisdiction that offer the household's preferred tax-public good package. Extensions and applications of the Tiebout model are substantial; see Ross and Yinger 1999 for a review of the literature. Epple and Platt's (1998) paper comes closest to modeling our environment. Epple and Platt develop a sorting model in which households differ by income and preferences. Unlike in Roback model's, in Epple and Platt's model a household's income is given and does not depend on the jurisdiction in which the household is located. The public good in the Epple and Platt model can be considered as equivalent to the amenity in Roback's model. However, unlike Roback, Epple and Platt allow the level of the public good, as well as the tax rate required to finance the public good, to vary with the makeup of the jurisdiction, with the amount of the public good being determined by a social choice mechanism.

Neither Roback (1982) nor Epple and Platt (1998) model an environment in which wage rates differ across workers and jurisdictions, and tax rates and the levels of public good differ across jurisdictions. We modify Roback's model by requiring that governments finance the quantity of amenities (public goods) and by assuming that workers are heterogeneous, differing in their skill levels. We modify Epple and Platt's model by allowing the wage rates to differ across jurisdictions.

[11] In an extension of her model, Roback (1988) allows for two types of worker who differ in their skill level.

Consider a world of multiple jurisdictions and workers. Each jurisdiction provides a fixed amount of a public good, which is financed by an income tax. Workers make choices over jurisdiction of residence and their consumption bundle.

First, consider workers. We assume that there is a fixed number of workers and that each worker provides a fixed amount of labor, i.e., there is no labor-leisure choice. We assume there is an integer number K of worker types that differ in their skill level, and thus in their productivity. Let s_k denote the skill level of worker k, which we take to be the effective amount of labor provided by that worker. Let $s_1 = 1$, and $s_i > s_j$ if $i > j$.

We assume that workers of different skill levels are perfectly substitutable at a fixed constant rate equal to their relative skill level; for example, firms can substitute two workers with skill level equal to 1 for one worker with skill level equal to 2. Thus, labor supply in any jurisdiction equals the sum of workers weighted by their skill level. The labor supply is as follows, as shown in equation 1.

$$L_j = \sum s_k L_{kj} \qquad [1]$$

where L_j is the total effective labor supply in jurisdiction j, and L_{kj} is the number of workers of type k in jurisdiction j.

In any jurisdiction, the wage per unit of skill is equal for all workers in that jurisdiction. The relationship between skill level and the wage rate is thus given by

$$w_{kj} = s_k \cdot w_{1j} \qquad [2]$$

where w_{kj} is the wage in jurisdiction j for worker of type k, and w_{1j} is the wage in jurisdiction j for workers with skill level $s_k = 1$.

Workers make two decisions. They choose the jurisdiction in which to live and which consumption bundle to purchase. We assume there are three goods that enter a worker's utility function, a private numeraire good *X*, rented land, denoted l, and the jurisdiction provided public good, denoted *G*.[12] Utility for worker of type *k* in jurisdiction *j* is given by

$$U_{kj} = (X_{kj}, l_{kj}; G_j) \quad [3]$$

where *X* is the private good, *l* is land, and *G* is the public good. A workers in jurisdiction *j* maximizes utility subject to the following budget constraint,

$$(1 - \tau_j)w_{kj} = X_{kj} + r_j l_{kj} \quad [4]$$

where τ is the tax rate on earnings in jurisdiction *j*, *r* is the land rental rate, and l is the land rented by the worker. The price of *X* is one in all jurisdictions since we take *X* to be a uniform good sold in all jurisdiction and is the numeraire good. Land is owned by absentee landlords who use their rents to purchase *X*. A worker locates in the jurisdiction that yields the worker her maximum utility.

As with Roback, we assume that *X* is produced by firms using land and labor according to a constant returns to scale production function.[13] As noted above, good *X* is identical regardless of where it is produced. Roback allows production to depend on amenities, but for simplicity we assume that production does not depend on *G*. Given the constant returns to scale production function, the unit cost function, denoted *C*, can be expressed a function of skill adjusted wage rate and the rental rate of land, and will equal one in all jurisdictions[14] as follows

$$(w_{1j}, r_j) = 1 \quad [5]$$

[12] We do not consider housing consumption. We could assume that housing is a fixed bundle of land and capital.

[13] We ignore capital inputs by assuming that each unit of "labor" is a composite of a worker and a fixed amount of capital, and thus capital does not directly enter the analysis. We make this assumption for convenience, since allowing capital and labor to vary substantially increases the complexity of the model.

[14] since *X* is the numeraire

Thus, given the skill adjusted wage rate in a jurisdiction, the land rental rate in that jurisdiction can be determined from the common unit cost function.

We assume there are a given set of J jurisdictions. As do Roback and Epple and Platt, we assume that an individual works in the jurisdiction of residence and derives utility from the public good provided in the jurisdiction of residence only. Each jurisdiction is assumed to have the same amount of identical land, which is geographically immobile. Labor is assumed to be perfectly mobile across jurisdictions.

We assume that the level of public good in each jurisdiction has been set by the jurisdiction's government. We assume the level of the public good does not change and that the amount varies across jurisdictions. The public good is assumed to be fully congested (i.e., a publicly provided private good) and produced at a fixed per unit cost of one. Let G_j be the per capita amount of the public good. (This assumption differs from Epple and Platt, who allow the tax-public good package to be determined by a majority vote of residents in the jurisdiction.) In order to finance the public good, we assume that the jurisdiction imposes a tax on labor income at a flat rate. Given a requirement to balance its budget, the relationship between public service level and the tax rate in jurisdiction j is given by

$$(\sum_k L_{kj})\, G_j = \tau_j B_j \qquad [6]$$

where τ is the tax rate, and B is the tax base, which equals aggregate labor income, i.e., $B_j = wj \sum skLkj$. We can express the indirect utility function for a worker of type k in jurisdiction j as

$$V_{kj} = (1, r_j, (1 - \tau_k); G_j) \qquad [7]$$

where 1 is the price of X. After tax income is given by $y_{kj} = (1 - \tau_k)$.

We can rewrite [7] as

$$V_{kj} = ((1, r_j, y_{kj}; G_j), y_{kj} - (1, r_j, y_{kj}; G_j); G_j) \qquad [8]$$

Where $(1, r_k, ;)$ is the demand for land. We assume positive income elasticities of the demand for *X*, land, and *G*. We next generate properties of a worker's indifference curve in the (*r*, *y*) plane.

$$\left.\frac{dr}{dy}\right|_{V=\overline{V}} = -\left[\frac{\partial V/\partial y}{\partial V/\partial r}\right] = \frac{1}{l(1,r_j,y_{kj};G_j)} > 0 \qquad [9]$$

Equation 9 says that for a given *G*, the slope of *V* is positive. The second derivative of equation 9 with respect to *G* is given by

$$\frac{d^2r}{dydG} = \frac{-l_G(1,r_j,y_{kj};G_j)}{[l(1,r_j,y_{kj};G_j)]^2} \qquad [10]$$

The sign of $\frac{d^2r}{dydG}$ depends on the effect of *G* on the demand for l. There is no a priori reason to expect that *G* and l are complements or substitutes. If we assume that an increase in *G* results in an increase in l, then $\frac{d^2r}{dydG} < 0$. Let us consider this case. Assuming that l_G is positive for all values of *G*, then it follows that as *G* increases the slope of the indifference curve decreases. It further implies that the indifference curves exhibit single crossing.

In equilibrium, all workers reside in the jurisdiction that maximizes her utility, land markets clear, the governments balance their budgets. We do not prove the existence of an equilibrium but assume that an equilibrium does exist. We assume that in equilibrium there are workers of some skill level who reside in multiple jurisdictions. This requires that workers of that skill level be indifferent regarding the jurisdiction in which to reside. If the number of jurisdictions is smaller than the number of worker types, then there will be some, but not necessarily all, worker types who reside in multiple jurisdictions.

We are interested in under what conditions higher skilled workers will reside in jurisdictions that provide a larger amount of the public good. To address this, assume that initially there is only workers of one skill level (assumed to be $s_k = 1$) and multiple jurisdictions that offer different amounts of the public good. We assume that there is an equilibrium, which implies that the utilities of all workers are equal regardless of their residential jurisdiction. Under these assumptions it follows that $\tau_j = G_j/s_1 W_{1j}$.

Now suppose that a worker of a higher skill level enters and has to decide in which jurisdiction to live. We can answer this by considering which jurisdiction generates the higher utility for the new worker. If the marginal utility of *G* is greater the higher the skill level of the worker, the worker will choose to reside in a jurisdiction in which *G* is larger. This implies that we need to determine the sign of $\partial^2 V/\partial s \partial G$.

Since we are considering a small change in the number of workers in a jurisdiction, we can assume that prices and tax rates do not change. Differentiating equation 8 with respect to *s* and *G*, we obtain

$$\frac{\partial^2 V}{\partial G \partial s} = rw[(l_2(V_{12} l_2(-1) + V_{13}) + V_1(l_{22}(-1) + l_{23}] + w[V_{22}(-1) + V_{23}] + rw[l_2(V_{22}(-1) + V_{23}) + V_2(l_{22}(-1) + l_{23})] \quad [11]$$

where subscripts represent partial derivatives. It seems reasonable to assume that the first partial derivatives are positive and that the second partial derivatives and V_{12} are negative. It follows that the sign of $\frac{\partial V}{\partial G \partial s}$ thus depends on the signs of V_{13}, l_{23}, and V_{23}. V_{13} and V_{23} represent the change in the marginal utility of land and *X* as *G* changes, and l_{23} is the change in the effect of a change in *r* on the demand for land as *G* changes. If these terms are positive, then it can be

shown that $\partial^2 V/\partial G \partial s > 0$. This means that the higher skilled worker will choose a jurisdiction with the larger G (and higher τ). In other words, higher skilled workers prefer jurisdictions with greater G. Of course if V_{13}, l_{23}, and V_{23} are negative, then $\frac{\partial V}{\partial G \partial s}$ cannot be signed.

Thus, whether higher skilled workers locate in jurisdictions in which G (and τ) is larger is an empirical question. However, we do not observe high skilled worker's net benefit of choosing a jurisdiction. We only observe number of high skilled workers[15] for each state over the years. Here we are interested in how high wage workers sort themselves across different states. For the empirical analysis, we assume that jurisdictions with higher skilled workers are also jurisdictions with higher wages. But given that (w_j, r_j) implies that w_j and r_j are negatively related, it is feasible for jurisdictions with higher skilled workers to have lower wage workers. Thus, we might expect to find that higher skilled workers (perhaps reflected in a higher level of education) to local in jurisdictions with higher level of public good.

1.4 Data and Methodology

The analysis uses a panel data set consisting of the 48 continental U.S. states for years 1977 to 2012.[16] The primary variable of interest is employment in high wage jobs, which we define as one with wages equal to or greater than the wages at the 75 percentile of the U.S. wage distribution. Using employment data from the March demographic supplement of Current Population Survey (CPS) we determine the earnings at the 75 percentile level for all individuals in the U.S. 16 years of age and over who have positive annual earnings greater than $100.[17]

[15] Total number of high wage workers for each year is a function of total number of sample population for each year as higher sample population for a year should have higher wage workers compared to the year which has lower sample population. This issue is discussed in the robustness check section.
[16] Alaska and Hawaii are excluded from the analysis.
[17] The wage calculated from the CPS is slightly higher than the wage reported by the Census Bureau.
[18] State level data are available from 1998 to 2015.
[19] http://slfdqs.taxpolicycenter.org/pages.cfm

The 75 percentile wage is calculated for each year using person weights (Table 1.1). We create a high-wage dummy variable for all individuals that is equal to one if the individual's earnings are greater than or equal to the 75 percentile wage. We sum of this dummy variable for each state and each year 1977-2012. Furthermore, in order to verify the results with occupational characteristics, we also use Occupational Employment Statistics (OES) data published by Bureau of Labor Statistics from 1998 to 2012[18]. Because the occupation codes changed, our panel is only for the period 1999 through 2012. We define high wage for each occupation as the wage at the 75 percentile of all workers in U.S. in that occupation. We measure our dependent variable in three ways: annual number of high wage workers in each state in each year, the annual change in the number of high-wage workers, and ratio of high wage employment to total employment.

The focus of the research is on the effect of fiscal policy on high wage employment. For fiscal policy variables, we include various measures of state plus local taxes and expenditures, collected from the Urban Brookings Tax Policy Center's State and Local finance Data Query System (SLF-DQS).[19] Total taxes, property tax, general sales tax, income tax, and corporate net income tax, all measured real (2012 dollars) per capita as well as per dollar of state personal income are used as the tax variables. In the basic regression, we alternatively use total tax per capita and total tax per dollar of state personal income for the tax variable. However, since the effect of taxes may differ across specific taxes, we also estimate regressions that include property tax, income tax, corporate net income tax, and general sales tax, per capita as well as per dollar of state personal income.

To incorporate expenditures, we use total spending on education, health, highways, securities, air transportation, and transit utility. We define these spending categories as productive spending. To maintain a balanced budget restriction, we include all of the items in the

budget reported by US Census Bureau. Table 1.A1 in the Appendix shows the detailed descriptions of the fiscal policy variables.

There are missing values for the fiscal policy variables for years 2001 and 2003 for all states since the Bureau of the Census did not report state level data for those two years. In order to have a continuous data set, the average of the previous and following years' values is used for the missing values. All the expenditure variables are measured in real (2012 dollars) per capita terms.

We expect that high-wage employment will be affected by firm demand for high wage workers and factors that would attract high-wage workers to the state. To the extent that high wage jobs are compliments to other jobs, factors that affect the number of jobs in general will also affect high-wage jobs. Our control variables include several state level characteristics that reflect these three factors. Since we also include state and year fixed effects, we do not include variables that do not change over time, for example amenities such as being on the coast.

The variables that reflect factors that are thought to affect overall employment include measures of labor skill, cost of labor, and cost of energy. We hypothesize that the more skilled labor will promote more growth of employment, both overall jobs and high wage job. On the other hand, we expect that higher cost of production, e.g. energy cost, will reduce growth (Dalenbergh and Partridge 1995). Labor skill is measured by the percentage of persons 25 years of age and over with a bachelor degree or more. The data are from Census Bureau. Energy cost is measured as the average real price of electricity to industrial users, as reported by the U.S. Energy Information Administration. Since Gale et al. (2015) include the unemployment rate, we also include the unemployment rate, as measured by the January seasonally adjusted unemployment rate from the Bureau of Labor Statistics.

Several state characteristics are expected to affect the attractiveness for high wage workers. We include the following variables: heating degree days[18] (collected from U.S. Energy Information Administration), per capita crime rate (collected from the U.S. Department of Justice[19]).

Summary statistics are provided in Table 1.2.1. The mean value for property tax per capita is higher than all the other types of taxes. In case of productive spending, spending on education is higher (on average, it is $1566 for the whole period of 1977-2012. On average, 22 percent of labor has a bachelor degree or more. We also conduct the analysis for two sub periods (1977-2007, and 1977-2001) in order to check the validity of the relationship. For the two sub periods, property tax still dominates and no huge variation is observed from the total sample period.

We assume that employment in high wage jobs in each state is in equilibrium and equilibrium employment depends on both fiscal policy and non-fiscal policy variables. The basic regression equation is as follows

$$E_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 G_{it} + \sum \beta_k X_{it} + \mu_t + V_s + \epsilon_{it} \qquad (12)$$

where E_{it} is defined as employment in high wage jobs in state i in year t, T_{it} is the taxes per capita, G_{it} is the state–local government expenditure per capita, X is a set of non-policy variables, μ is a set of year dummies, V is a set of fixed state dummies, and ϵ is the error term. Year dummies are used to control for factors such as business cycle, change in federal policies, etc. that vary over time but not across states. State dummies are used to control for state specific factors like climate, natural resources, natural amenities, etc.

[18] Wasylenko and McGuire (1985) use average daily high temperature and average daily low temperature.
[19] http://www.ucrdatatool.gov/Search/Crime/State/StatebyState.cfm

We also estimate different variations of equation (12) as robustness checks. First we run the regression by only including fiscal variables (total state-local level taxes and expenditures) and total high wage employment while excluding other controls. The objective is to see whether inclusion of more controls fade out the effect of the policies or not. Second, we use the change in high wage employment as the dependent variable and change in both high wage employment and change in fiscal variables in separate regression[20].

Reed (2008) has shown that annual data may be sensitive to measurement error and that five year periods is suitable to reduce the bias of the results. Therefore, five year interval (non-connecting interval) changes are also used in separate regression and observations are spread out over these years. This will make serial correlation and measurement error less severe. Furthermore, Gale, et al. (2015) find that the relationship between economic growth and taxes are sensitive to time period used to estimate the regression. Different time periods may also influence the relationship between high-wage employment growth and fiscal policies. Therefore as mentioned before, we use two different time periods (1977-2007 and 1977-2001) in order to check the validity of the results.

Our procedure for measuring high wage employment means that in each year total U.S. high wage employment is 25 percent of total employment. That is not a problem since we are interested in where the high wage workers live. However, to allow the percentage of high wage workers to vary, as an alternative we measure high wage in each year as the wage at the 75th percentile in 1977 adjusted for inflation using the consumer price index.

[20] There are four specifications-1. Total high wage employment and total tax per capita 2. Change in high wage employment and total tax per capita 3. Change in high wage employment and change in tax per capita, and 4. Change in high wage employment and five years change in tax per capita

We estimate equation (12) by OLS as well as by a fixed effect model. Fixed effect model is preferable because it can control unobserved heterogeneity across different states. Even after ruling out within state time invariant difference through individual fixed effect, theoretically there is a possibility of reverse causality and hence endogeneity. Economic growth will affect fiscal policy decisions, which also in turn will influence growth. To control for this we use a two stage least square (2SLS) method and employ two types of instrumental variables that have been used in previous literature. The first reflects state government political characteristics and the second uses state demographic characteristics.

a) State Government Political Characteristics: It is empirically observed that political characteristics like state legislature controlled by Democratic Party and a Democratic State Governor are strongly associated to state government per capita general expenditure (Merrifield, 2000). Liberal government spends more than conservative government (Reed 2006; Krause, Lewis and Douglas 2013). It has been found that when Democrats control the state legislation, tax burden is higher (Reed 2006). Democratic controlled states are more likely to increase taxes when dealing with shortage of revenue (Alt and Lowry 1994). Therefore, the political characteristics of state government have a strong influence on both the tax and expenditure policies and these can be used as instruments for fiscal policies. Here we include a categorical variable for whether the state's governor is from the Democratic Party or not. Furthermore, we also use party control of state legislatures. Data on political variables from 1977-2008 are collected from Dubin (2008) and for the other years, the data is collected from the National Conference of State Legislators reports.

b) State Demographic Characteristics: The second type of instrumental variable comes from state demographic characteristics, and in particular, the age and poverty rate for the population. States with higher proportion of child's less than 16 years have higher demand for public school services and therefore have higher education expenditure (Bunch, 1993). Moreover, the largest portion of spending for state-local government is associated with elementary –secondary education. Therefore, proportion of children less than 16 has important influence on state –local finances. On the other hand, higher proportion of the elderly in the state may affect the demand for public goods by increasing the demand for welfare programs, health care or reducing the demand for public schools. (Bunch 1993; Painter and Bae 2001; Bae and Moone 1997). Furthermore, if the poverty rate is higher in the state, then state-local government are expected to have less revenue and therefore less expenditure. The data on demographic characteristics are taken from U.S. Census Bureau.

The IV model takes the following form

$$F_{it} = \alpha_0 + \alpha_1 \, Z_{it} + \sum \alpha_k X_{it} + \mu_t^f + V_s^f + u_{it} \qquad (13)$$

$$E_{it} = \beta_0 + \beta_1 \, \widehat{F_{it}} + \beta_2 \, G_{it} + \sum \beta_k X_{it} + \mu_t^S + V_s^S + \epsilon_{it} \qquad (14)$$

Equation (13) is the first stage regression, where F_{it} is the fiscal policy variables [21] while equation (14) is the second stage regression. Z_{it} indicates instrumental variables. Using the instruments requires that the instruments do not affect high wage employment through any pathways other than fiscal policies. We estimate the model both with state and year fixed effect. Standard errors are heteroskedasticity robust and clustered by states.

[21] Both the tax and expenditure variables are endogenous here and we are using two types of instrumental variables.

1.5 Empirical Analysis

We test the hypothesis that fiscal policies effect high wage employment. As a first step we report the simple correlations between the fiscal policy variables and high wage employment. Table 1.3 reports the correlation coefficients, while Figure 1.2 contains plots of high wage employment against the fiscal variables. From 1977 to 2012, total taxes, property taxes, and income taxes exhibit positive correlation, with values lying between 0.16 and 0.40. Other taxes and all types of spending have lower values of correlation with high wage employment level. The positive correlation coefficients on the tax variables suggest that high wage workers may move to states with higher taxes. But, there are many econometric issues that have to be addressed before we can draw such a conclusion.

1.5.1. Results (CPS Data)

Table 1.4 shows the effect of fiscal policies (e.g. total tax revenues, productive spending and social spending) on total high wage employment for the whole period (1977-2012). Here the dependent variable is total employment in high wage jobs and the fiscal variables are measured on per capita basis. All the specification includes year dummies although we do not report their coefficients. Here we present results without and with other state controls variables in order to find out whether different controls have affected the results or not. The first column of table 1.4 are the results from an OLS regression with no other control variables. The coefficient on the total tax revenues per capita is positive and statistically significant. Incorporating different control variables (column 2 of Table 1.4) also produce a similar relationship. The coefficient on the productive spending is negative and statistically significant which is contrary to our expectation. In terms of other control variables, crime rate per capita, average price of electricity, and unemployment rate have positive impact on high wage employment. We do not have any

priori belief about the sign of all of these coefficients, although it is expected that the crime rate and average price of electricity (cost of the firm) will have a negative impact of on employment.

There is a possibility of unobserved heterogeneity across states. Therefore in column 3 and column 4 we use fixed effect model with year dummies in order to account for this time invariant heterogeneity issues which could be related with the explanatory variables. The coefficient of tax variable is positive but statistically insignificant in column 3 and column 4. Productive spending also has an insignificant impact. One possible reason is that high skilled labor are not particularly sensitive to state–local government expenditures on education, health and highways, for example, they may getter better services from private sectors. Among the other variables, the crime rate has a positive and significant impact. Our theoretical framework implied that employment in high wage jobs may be positively affected by state tax revenues. The result from both OLS and fixed effect model are consistent with this. The signs on the tax and productive spending variables are positive, but statistically significant only in the first two columns.

We also estimate the model by using fiscal variables measured in per dollar of state personal income (Table 1.A4 in appendix). The OLS results are consistent with those reported in Table 1.4, but in the fixed effects model, the coefficient on the tax variable in negative. However, the impacts are still statistically insignificant.

Moreover, as mentioned in the methodology section, we cannot rule out the possibility of reverse causality. While state-local total tax revenues will affect the level of high wage employment, high wage industries could also influence state-local total tax. There is a possibility that high wage industries may lobby state government for lower tax burden. We tested the presence of endogeneity by using the Szroeter test (1978). Here all fiscal variables are correlated

with residuals (Table 1.A2 in Appendix). Furthermore, we also checked the endogeneity by using Woolridge Score Test (1995) and in most of the specifications we reject the null hypothesis of exogeneity. Therefore, OLS as well as fixed effect model cannot solve this problem. In order to deal with this endogeneity issue, we use 2SLS with state and year dummy, which not only eliminates time invariant unobserved heterogeneity but also addresses issues with time variant omitted variable bias, reverse causality and measurement error. Here we use two types of instrumental variables-state political characteristics and state demographic characteristics[22]. Political characteristics of Nebraska for our period of analysis is not available. Therefore, all the analysis using 2SLS method excludes Nebraska from the estimation[23].

Table 1.5 shows first stage results of the 2SLS method. The coefficient on the political characteristics have the expected positive sign, in particular the dummy for state democratic legislator has positive and significant impact on state total taxes. On the other hand, among the demographic characteristics percentage of people less than 16 years is significant and positive. The other two variables (poverty rate and percentage of people over 65 years) also have expected signs. F test for the joint significance of the instruments is also included in Table 1.5 in which F statistic is much larger than the standard of 10[24]. Therefore, the instruments are not weak (Stock, Wright, and Yogo, 2002). Furthermore, we use Woolridge Score Test, Kleibergen-Paap rk LM test and the Kleibergen-Paap Wald F statistics test. All of the results indicate that the instruments are not weak and are acceptable (Table 1.A3 in Appendix). The second stage results are shown in Table 1.6, where the first column shows the results without any other state controls and the

[22] Detailed of these variables are included in the methodology section.
[23] However, assuming that Nebraska has Republican State Political Characteristics, we estimate the equation with IV's and find no significant difference in coefficients.
[24] We further derive Angrist-Pischke First Stage F statistics and for both the endogenous fiscal variables, the value is greater than 10.

second column shows the results with several state control variables and the dependent variable is total number of high wage employment. Column one of Table 1.6 shows a negative relationship between total tax revenues per capita and total number of high wage jobs, although the relationship is not statistically significant. When we control for other state characteristics, the relationship does not change. Productive spending has a positive and statistically significant impact. Among other control variables, percentage with a bachelor degree or more (labor skill) has a positive impact, although insignificant. State amenities like heating degree days has a positive impact which is contrary to our hypothesis. Also the significant impact of heating degree days varies. In general total tax revenues per capita does not have any statistically significant impact on high wage employment.[25]

It is likely that tax variables measured in different forms should have similar impact on high wage employment. To test this, we also use total tax per dollar of state personal income (PDSPY), and productive spending per dollar of state personal income (PDSPY). Column 3 of table 1.6 shows the results with all the state control variables. The impact of the tax variable is consistent with column 2, where tax variable is measured by per capita basis.

Total employment in high wage industries is an important measure of the size of this high wage sector. However, this is only one measure and one specification. In addition to this, we use several other specifications. First, we use the change in high wage employment in a given state in a given year as the dependent variable, which can be interpreted as growth across states, and total taxes per capita as the main independent variable (specification 1). Second, we use the change in both high wage employment and the fiscal policy variables (specification 2) And finally, we use the change in high wage employment and five-year interval changes in the fiscal policy variables

[25] Due to small sample size, we also run IV-GMM and the results are not significantly different from IV-2SLS.

because annual data may be sensitive to measurement error and using five year interval may reduce the bias (specification 3). Table 1.7 only reports the coefficient of the fiscal variables from 2SLS estimation including state and year dummies. The coefficients of the three specifications using tax revenues per capita (columns 1, 2, and 3 of table 1.7) as well as three specifications using tax revenues per dollar of state personal income (column 4, 5, and 6 of table 1.7) are negative but insignificant in all of the regressions, while the sign of the productive spending changes. We further use the ratio of high wage workers to total number of employment as the dependent variables. The results (Table 1.A5 in Appendix) are not different than for the previous analysis. All the results indicate that the distribution of high wage workers across states is not influenced by state-local government tax policy.

Different taxes may have different impact on high wage employment. Therefore, here we use four different types of tax revenues, property tax, general sales tax, income tax, and corporate net income tax. Table 1.8 shows that the results vary with different taxes. The 1st and 2nd column of table 8 report the results for total high wage employment using different tax variables per capita, without and with other controls. Property taxes have an insignificant negative impact where as general sales tax has a positive impact on high wage employment. When taxes are measured by per dollar of state personal income (column 3 and 4 of table 1.8), then none of the taxes have a statically significant impact. Similar results are found when we use the ratio of high wage workers to total employment. Furthermore, we also run separate regressions for each of these four taxes and found similar kind of results (these are not reported).

1.5.1.1 Sub Period Analysis

In order to examine the robustness of the results, we test the model by using two different time period, 1977 to 2007 and 1977 to 2001. We choose the first period to find out whether any

changes in the economy in that time period (before the recent great recession) influences the stability of the results. Table 1.9 shows the results for different specification including the basic one and utilizes period from 1977 to 2007; we only report the coefficients for fiscal variables (measured in per capita terms). In all the specifications, total tax has no significant impact. On the other hand, productive spending has positive impact but is only significant in the first specification. We also checked the validity of the result by using fiscal variables measured as per dollar of state personal income and found consistent results.

Table 1.A6 in appendix shows the results of different specification for period 1977-2007 using four different types of taxes. Consistent with our previous findings, none of the fiscal variables has any impact on high wage employment. We also checked this by using tax variable measured by per dollar of state personal income and found similar relationship. For the other period (1977-2001), the results are consistent with the previous findings, which also confirms that the impact does not vary across the time period (Table 1.A7 in Appendix).

According to the Bureau of Economic Analysis, US economy faced its largest expansion after the recession in the early 1990's. New and cheaper computer technology improved productivity in all the sectors of the economy. Therefore, we run separate regression for year 1991 to 2012 and determine whether any changes in fiscal policy on that time may have a significant impact on job growth in the high wage sector (Table 1.A8 in Appendix). Only the income tax has a negative and statistically significant impact on high wage job growth in the basic specification. On the other hand, no taxes have an impact when both taxes and employment are measured by annual change as well as by five-year change.

1.5.1.2 Subgroup Analysis

In this section, we explore the effects of taxes on high wage job growth for particular states. Table 1.A10 in appendix shows the results only for 16 states[26]. In those 16 states the ratio of high wage employment as percent of total employment is more than 21 percent (Table 9a in Appendix). The results show that total taxes per capita have a negative and statistically significant impact on total high wage employment using the original specification. However, in the other three specifications, there is no significant impact. In addition, we also run separate regression for the four different taxes; the results are consistent to the previous findings. We also explore this by using tax per dollar of state personal income; the impacts are very similar. Furthermore, we also test the validity of the results by estimating the model only for nine states, i.e. Massachusetts, Connecticut, New York, New Jersey, Illinois, Michigan, Maryland, Vermont, and Washington, where the ratio of high wage employment to total employment is more than 30 percent. Only total tax per dollar of state personal income has negative and significant impact on change in total high wage employment, whereas in the other specification, the effect is insignificant (table 1.A11 in appendix). Moreover, taxes do not have any significant impact when measured on per capita basis.

Moreover, we also take care for differences by geographic area. We divided the U.S. into two regions; east and west[27] and run separate regression on these two regions. The east region has much more high wage industries than the west region. However, applying different specifications to both of these region does not change the impact.

[26] Delaware, Massachusetts, Connecticut, New Jersey, California, Virginia, New York, Colorado, Minnesota, Maryland, Texas, Georgia, Kansas, Illinois, Utah, and Washington

[27] East state is equal to one if state is in the following census region: New England, Middle Atlantic, South Atlantic, or East South Central. West state is Mountain, Pacific. The results are not reported here.

1.5.2 Results (BLS Data)

The concentration of high wage jobs is higher in the professional, scientific, and technical service sector. Offices of physicians, corporate, offices of lawyers, and regional managing offices industries have the greatest number of high wage jobs. On the other hand, in terms of occupation, general and operation managers, accountants and auditors are also considered as high wage occupations (Rex, 2006). We use Occupational Employment Statistics data published by Bureau of Labor Statistics to take control for different occupational characteristics. The data using 75^{th} percentile wage shows that high wage workers are mainly concentrated in the major occupational categories of management, business and financial occupations, health care practitioners and technical occupations, health care support, life, physical, and social science occupations, legal occupations, computer and mathematical related occupations, and sales and related occupations. Table 1.10 shows 2SLS results using different specifications and various taxes measured on per capita basis. In most of the cases, we find results which are consistent to our previous findings using CPS data. Total tax as well as four different taxes do not have any statistically significant impact on high wage employment when endogeneity issue is taken care of. Furthermore, we also ran regression similar to those reported in Table 1.11 with fiscal variables measured in per dollar of state personal income. The results of this regression (not reported) is consistent with Table 1.10.

We tested the validity of our results by also using 90^{th} percentile wage of all workers in each occupation. In most of the cases, high wage workers fall in broad categories of management, computer and mathematics occupation, health care practitioner and health services, legal, office and administrative support. The results (not reported) show that when we control for

endogeneity issue, the results are insignificant. In general, all the previous results indicate that high wage workers are less sensitive to change in tax policies[28].

1.5.3 Further Robustness Check

There is a possibility that total number of high skilled workers will increase if there is an increase in total sample population in some years. However, in our study, we are focusing on the sorting of high wage workers across states. To justify our findings, we did two kind of robustness check. Firstly, we take top 75th percentile wage for 1977 (starting year) and use that wage adjusted for inflation for all other years. We calculate the number of high wage workers and estimate the same 2SLS model with total taxes and other four types of taxes. The results indicate no significant differences from previous analysis. Secondly we take some high income earned occupational categories[29] and estimate the model with 2SLS method. The previous results still hold up.

1.6 Conclusion

Public economists as well as policy makers are interested in the effect of fiscal policies on state economic growth. After the recent recession, they are now more concerned about the growth of employment and in particular with the growth of high skilled labor since high skilled labor can bring more revenue than low skilled workers. In this paper, we estimate the impact of state fiscal policies on the distribution of high wage workers.

We developed a simple general equilibrium model in which high skilled workers may prefer to go to a state that gives them higher level of public goods. However, their preference

[28] In most of the cases, the coefficient of productive spending is higher than the coefficient of tax which also indicate a positive net effect of fiscal policies on high wage employment, although the impact is insignificant.
[29] We chose major occupation categories from BLS data and used those occupation categories as a criteria for defining high wage workers.

depends on factors for which there is no priori belief. Therefore, theoretically, it is difficult to identify the direction of the impact of state fiscal policies on the migration of high skilled workers. Empirically, using Helms (1985) balanced budget model, we estimate the impact on the sorting of high skilled workers of both fiscal policy and non-policy variables. The results show that in most of the cases, the tax impact is negative while the spending impact is positive, resulting in a positive net impact of fiscal policies on high wage employment. However, the tax impact is insignificant in all the cases. Therefore, the findings indicate that high skilled workers are not sensitive to state-local tax and expenditure policies.

We further check this finding by using the change in the number of high skilled workers across states and also by using ratio of high skilled workers to total number of workers. We also show that including different types of taxes does not affect the results. Moreover, using different time periods and group of high income states do not influence the findings.

In general, the sorting of high skilled workers are not strongly tied to state-local government fiscal policies. Strategies like investing in skill level education and increasing the number of well-educated workers may help state-local government to achieve more economic growth.

Table 1.1: 75th percentile income for each year

Year	75 percentile income
1977	$12,550
1978	$13,500
1979	$14,922
1980	$16,000
1981	$17,000
1982	$19,000
1983	$20,000
1984	$20,500
1985	$22,050
1986	$24,000
1987	$25,000
1988	$25,000
1989	$26,000
1990	$28,000
1991	$29,000
1992	$30,000
1993	$30,000
1994	$31,200
1995	$32,994
1996	$34,000
1997	$35,000
1998	$36,000
1999	$38,000
2000	$39,500
2001	$40,000
2002	$42,500
2003	$43,385
2004	$45,000
2005	$45,000
2006	$48,000
2007	$50,000
2008	$50,000
2009	$52,000
2010	$52,000
2011	$53,632
2012	$55,000

Note: 75^{th} Percentile is calculated by using US Wage Distribution for each year

Table 1.2.1: Summary Statistics (Year 1977-2012)

Variables	Mean	Std. Dev.	Min	Max
High Wage Jobs (% of total employment)	24.04	0.05	10.97	39.16
Low Wage Jobs (% of total employment)	48.04	0.06	20.01	80.34
Total Tax per capita	2678.92	1500.06	479	7892
Property tax per capita	832.54	568.7	60	3002
General sales tax per capita	101.8	86.83	0	2416
Corporate net income tax per capita	614.14	430.81	0	729
Total income tax per capita	652.06	549.04	0	3254
Productive Spending per capita	2206.9	1319.43	404	7543
Labor skill (% with bachelor degree)	22.68	5.54	4.2	40.4
Average price of electricity	6.33	2.23	1.95	17.11
Heating degree days	4933.8	1638.95	1650	7558
Crimes Per Capita	0.45	0.34	0.01	6.54
Urban population (%)	68.87	14.75	31.05	96.74
Poverty rate (%)	12.99	3.78	2.9	27.2
Less than 16 years old (%)	27.52	3.87	20	41.6
Greater than 65 years old (%)	12.65	2.69	7.49	32.94
Unemployment rate (%)	6	2.13	2.1	17.9
State personal income (log)	18.56	1.66	16.25	21.31
Party affiliation of state governor '*	0.527	0.499	0	1
Party affiliation of state legislator	0.524	0.489	0	1

Note:* party affiliation of state governor =1 if state governor is democratic and vice versa

Table 1.2.2: Summary Statistics (Sub period i: Year 1977-2007)

Variable	Mean	Std. Dev.	Min	Max
High Wage Jobs (% of total employment)	23.94	5.46	10.97	39.16
Low Wage Jobs (% of total employment)	47.50	6.46	20.00	80.39
Total Tax per capita	2411.18	1383.17	479	7871
Property tax per capita	739.49	508.08	60	2781
General sales tax per capita	558.22	404.26	0	2275
Total income tax per capita	590.59	512.09	0	3234
Corporate net income tax per capita	94.95	81.13	0	729
Productive Spending per capita	1935.23	1188.02	404	6700
Labor skill (% with bachelor degree)	21.97	5.32	4.2	40.4
Average price of electricity	5.99	1.9	1.95	14.11
Average earnings in manufacturing sector	29.51	11.49	9.22	67.04
Heating degree days	4956.58	1649.94	1802	7558
Crimes per capita	0.47	0.35	0.01	6.54
Urban population (%)	68.08	14.63	31.05	96.19
Poverty rate (%)	12.86	3.84	2.9	27.2
Less than 18 years old (%)	28.13	3.76	20.29	41.6
Greater than 65 years old (%)	12.56	2.83	7.49	32.94
Unemployment rate (%)	5.8	2.03	2.1	17.9
State personal income (log)	18.5	1.05	16.25	21.25
Party affiliation of state governor '*	0.53	0.49	0	1
Party affiliation of state legislator	0.53	0.49	0	1

Note:* party affiliation of state governor =1 if state governor is democratic and vice versa

Table 1.2.3: Summary Statistics (Sub period ii: Year 1977-2001)

Variable	Mean	Std. Dev.	Min	Max
High Wage Jobs (% of total employment)	23.87	5.46	10.97	38.83
Low Wage Jobs (% of total employment)	47.44	6.66	20.00	80.39
Total Tax per capita	1992.06	1131.69	479	6206
Property tax per capita	612.89	415.27	60	2441
General sales tax per capita	460.12	334.51	0	2041
Total income tax per capita	484.14	429.45	0	2470
Corporate net income tax per capita	82.49	68.33	0	475
Productive Spending per capita	1539.18	935.5	404	5183
Labor skill (% with bachelor degree)	20.85	4.78	4.2	38.7
Average price of electricity	5.69	1.8	1.95	11.72
Average earnings in manufacturing sector	25.92	9.13	9.22	59.5
Heating degree days	5000.32	1664.32	1802	7558
Crimes per capita	0.48	0.38	0.01	6.54
Urban population (%)	67	14.39	31.05	94.63
Poverty rate (%)	13.09	3.99	2.9	27.2
Less than 18 years old (%)	28.95	3.66	20.29	41.6
Greater than 65 years old (%)	12.53	3.07	7.49	32.94
Unemployment rate (%)	6.01	2.15	2.1	17.9
State personal income (log)	18.42	1.05	16.25	21.12
Party affiliation of state governor '*	0.54	0.49	0	1
Party affiliation of state legislator	0.57	0.49	0	1

Note:* party affiliation of state governor =1 if state governor is democratic and vice versa

Table 1.3: Pairwise Correlation Coefficient

	High wage jobs	Total tax	Property tax	General sales tax	Total income tax	Corporate net income tax	Productive spending
High wage jobs	1						
Total tax	0.2902* (0.000)	1					
Property tax	0.3078* (0.000)	0.8739*	1				
General sales tax	0.1553* (0.000)	0.6900* (0.000)	0.4717* (0.000)	1			
Total income tax	0.3086* (0.000)	0.7552* (0.000)	0.5859* (0.000)	0.2579* (0.000)	1		
Corporate net income tax	0.3681* (0.000)	0.6207* (0.000)	0.5451* (0.000)	0.1601* (0.000)	0.7362* (0.000)	1	
Productive spending	0.1350* (0.000)	0.9259* (0.000)	0.7625* (0.000)	0.7137* (0.000)	0.6287* (0.000)	0.4779* (0.000)	1

Table 1.4: High wage employment –OLS and Fixed Effect estimation (1977-201) Dependent Variable: Total employment in High wage industries

VARIABLES	OLS	OLS	FE	FE
Total Tax Per Capita	0.239***	0.151***	0.0357	0.0322
	(0.014)	(0.013)	(0.0271)	(0.0245)
Productive Spending Per Capita	-0.233***	-0.129***	0.00872	0.00144
	(0.043)	(0.032)	(0.0196)	(0.0219)
Heating Degree Days		-0.008		0.0190
		(0.005)		(0.0131)
Unemployment Rate		30.87***		0.204
		(4.551)		(3.355)
Labor skill		4.956***		4.255
		(1.654)		(3.542)
Urban Population		8.631***		1.560
		(0.596)		(3.741)
Average price of electricity		7.120*		11.69
		(3.837)		(13.00)
Crime rate per capita		133.9***		19.47*
		(31.54)		(11.70)
Year Fixed Effect	×	×	×	×
State Fixed Effect			×	×
Observations	1,728	1,728	1,728	1,728
Number of States	48	48	48	48

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.5: First Stage Regression Results

Variables	Total Tax Per Capita	Total Tax Per Capita	Productive Spending Per capita	Productive Spending Per Capita
Democratic Governor	19.63	5.30	15.90**	12.88
	(17.40)	(17.10)	(8.34)	(8.26)
Democratic Legislator	193.62***	194.96***	23.30**	22.81**
	(24.09)	(22.73)	(10.90)	(10.79)
Poverty rate			-12.70***	-8.91***
			(2.49)	(2.87)
Above 65 years old			21.25***	21.35***
			(5.53)	(5.237)
Less than 18 years old			8.02***	6.45**
			(2.24)	(2.341)
Controls		×		×
F Statistics	423.86	446.20	25.64	100.04

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * significance at 10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.6: 2SLS Estimation with State and Year Dummy

Dependent Variable: Total employment in High wage sectors (tax, productive spending are endogenous)

VARIABLES	2sls	2sls	2sls
Total Tax Per Capita	-0.012	-0.017	
	(0.032)	(0.030)	
Productive Spending Per Capita	0.218***	0.134*	
	(0.065)	(0.078)	
Heating Degree Days		0.022***	0.000
		(0.007)	(0.000)
Unemployment Rate		1.376	-0.002
		(3.001)	(0.006)
Labor Skill		3.641	0.028***
		(2.722)	(0.004)
Urban Population (%)		0.276	0.001
		(1.336)	(0.003)
Average Price of Electricity		14.10**	0.0131
		(5.730)	(0.012)
Crime per capita		8.565	0.096***
		(7.085)	(0.027)
Total Tax (PDSPY)			-0.051
			(0.057)
Productive Capital Spending (PDSPY)			-0.095
			(0.087)
Year Fixed Effect	×	×	×
State Fixed Effect	×	×	×
Observations	1,692	1,692	1,692
Number of States	47	47	47

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.7: 2SLS Results (Three Specifications with fiscal variables measured in both per Δcapita and per dollar of state personal income) (1977-2012)

Dependent variable: Change in employment in high wage sectors

Variables	Change in employment	Change in employment	Change in employment	Change in employment	Change in employment
Total Tax per capita	-0.01				
	(-0.015)				
Productive Spending per capita	0.065				
	(0.051)				
Δ Total Taxes per capita		-0.128			
		(-0.133)			
ΔProductive Spending per capita		-0.1			
		(-0.194)			
Δ t-4 total tax per capita			-0.053		
			(-0.06)		
Δ t-4 productive spending per capita			0.001		
			(0.057)		
Total tax (PDSPY)				-0.024	
				(-0.034)	
Productive Spending (PDSPY)				0.073	
				(0.056)	
Δ Total Tax (PDSPY)					0.048
					(0.192)
Δ Productive Spending (PDSPY)					0.636
					(0.545)
Δ t-4 total tax (PDSPY)					-0.009
					(-0.032)
Δ t-4 productive spending (PDSPY)					0.039
					(0.108)
Control	×	×	×	×	×
Year and state Fixed Effect	×	×	×	×	×
Observations	1,645	1,645	1,504	1,645	1,645

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.8: 2SLS estimation with different taxes (1977-2012)

Dependent variable: Total Number of High Wage Employment

VARIABLES	total employment in high wage sectors	total employment in high wage sectors	total employment in high wage sectors	total employment in high wage sectors
Property Tax per capita	-0.0412	-0.334		
	(0.231)	(0.752)		
General Sales Tax per capita	0.424***	0.624*		
	(0.124)	(0.320)		
Total Income Tax per capita	0.029	0.076		
	(0.295)	(0.609)		
Corporate Net Income Tax per capita	-0.481	0.810		
	(0.562)	(2.122)		
Productive Spending per capita	0.282*	0.151		
	(0.153)	(0.204)		
Property Tax (PDSPY)			-0.997*	-11.76
			(0.542)	(54.69)
General Sales Tax (PDSPY)			0.416	3.307
			(0.263)	(14.53)
Income Tax (PDSPY)			0.292	1.117
			(0.315)	(5.391)
Corporate Net Income Tax(PDSPY)			-1.216	16.40
			(1.367)	(82.66)
Productive Spending (PDSPY)			0.366	5.774
			(0.232)	(27.97)
Controls	×	×		×
Year Fixed Effect	×	×	×	×
State Fixed Effect		×	×	×
Observations	1,692	1,692	1,692	1,692
Number of states	47	47	47	

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.9: 2SLS Estimation using all the specifications and Year 1977-2007

VARIABLES	Total Employment	Change in employment	Change in employment	Change in employment
Total Tax per capita	-0.027	-0.007		
	(0.036)	(0.018)		
Productive Spending per capita	0.220**	0.076		
	(0.095)	(0.082)		
ΔTotal tax per capita			-0.183	
			(0.182)	
Δ Productive Spending per capita			0.026	
			(0.207)	
Δt-4.total tax per capita				-0.077
				(0.072)
Δt-4productive spending per capita				-0.042
				(0.072)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×
Observations	1,457	1,410	1,410	1,269
Number of states	47	47	47	47

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.10: Regression Estimation Using BLS data and different Specifications (Full Year 1977-2012)

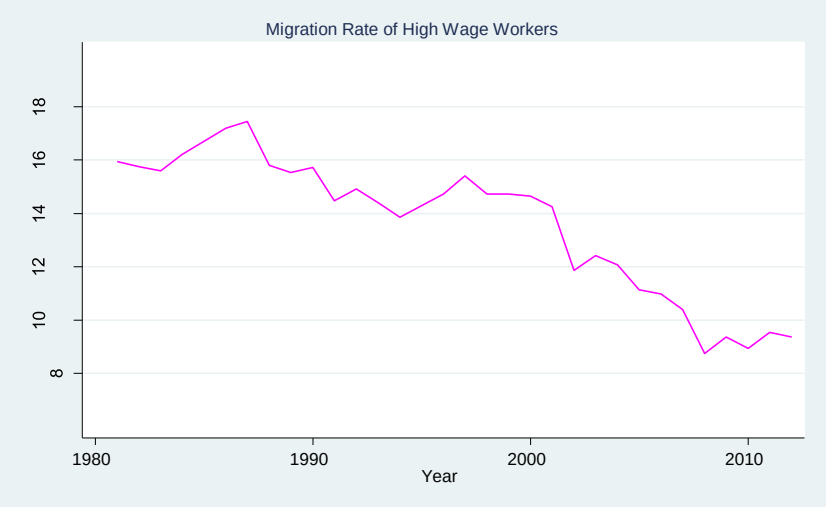
VARIABLES	Change in employment	Change in employment	Change in employment	Change in employment	Change in employment	Change in employment
Total Tax Per Capita	-147.3					
	(119.6)					
Productive Spending Per capita	226.0					
	(361.2)					
Δ Total Taxes per capita		-529.4*				
		(278.1)				
ΔProductive Spending per capita		-4.918				
		(628.3)				
Δ t-4 total tax per capita			-172.6			
			(198.4)			
Δ t-4 productive spending per			204.5			
			(165.4)			
				0.262		
Total Tax (PDSPY)				(0.167)		
				0.572		
Productive Spending (PDSPY)				(0.381)		
					0.647	
Δ Total Tax (PDSPY)					(0.492)	
					-0.160	
Δ Productive Spending (PDSPY)					(0.492)	
						0.435*
Δ t-4 total tax (PDSPY)						(0.251)
						-0.469
						(0.309)
Control	×	×	×	×	×	×
Year	×	×	×	×	×	×
and	×	×	×	×	×	×
state fixed effect						

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .0

Table 1.11: Regression Estimation Using BLS data and fiscal variables are measured by Per Dollar of State Personal income (Full Year 1977-2012)

VARIABLES	Total employment	Change in employment	Change in employment	Change in employment
Total Tax (PDSPY)	-0.351*	-0.262		
	(0.200)	(0.167)		
Productive Spending (PDSPY)	1.035**	0.572		
	(0.462)	(0.381)		
Δ Total Tax (PDSPY)			-0.647	
			(0.492)	
Δ Productive Spending (PDSPY)			-0.160	
			(0.492)	
				-0.435*
Δ t-4 Total tax (PDSPY)				(0.251)
				-0.469
Δ t-4 Productive spending (PDSPY)				(0.309)
Control	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level



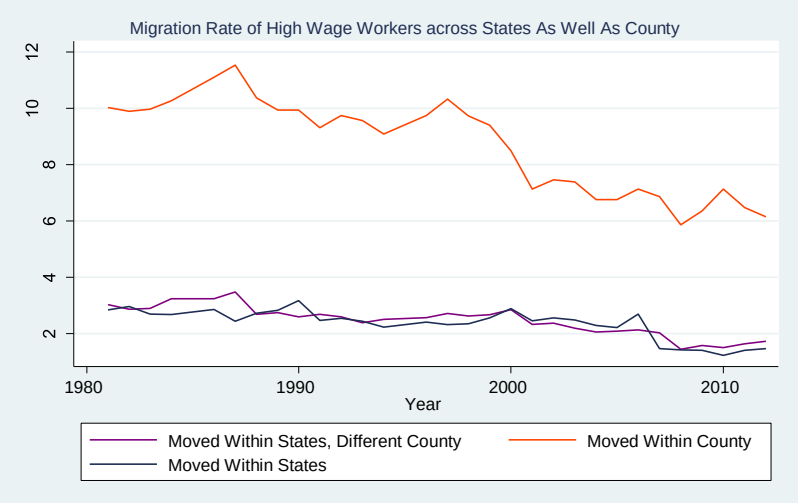


Figure 1.1: Average Migration Rate of High Skilled Workers

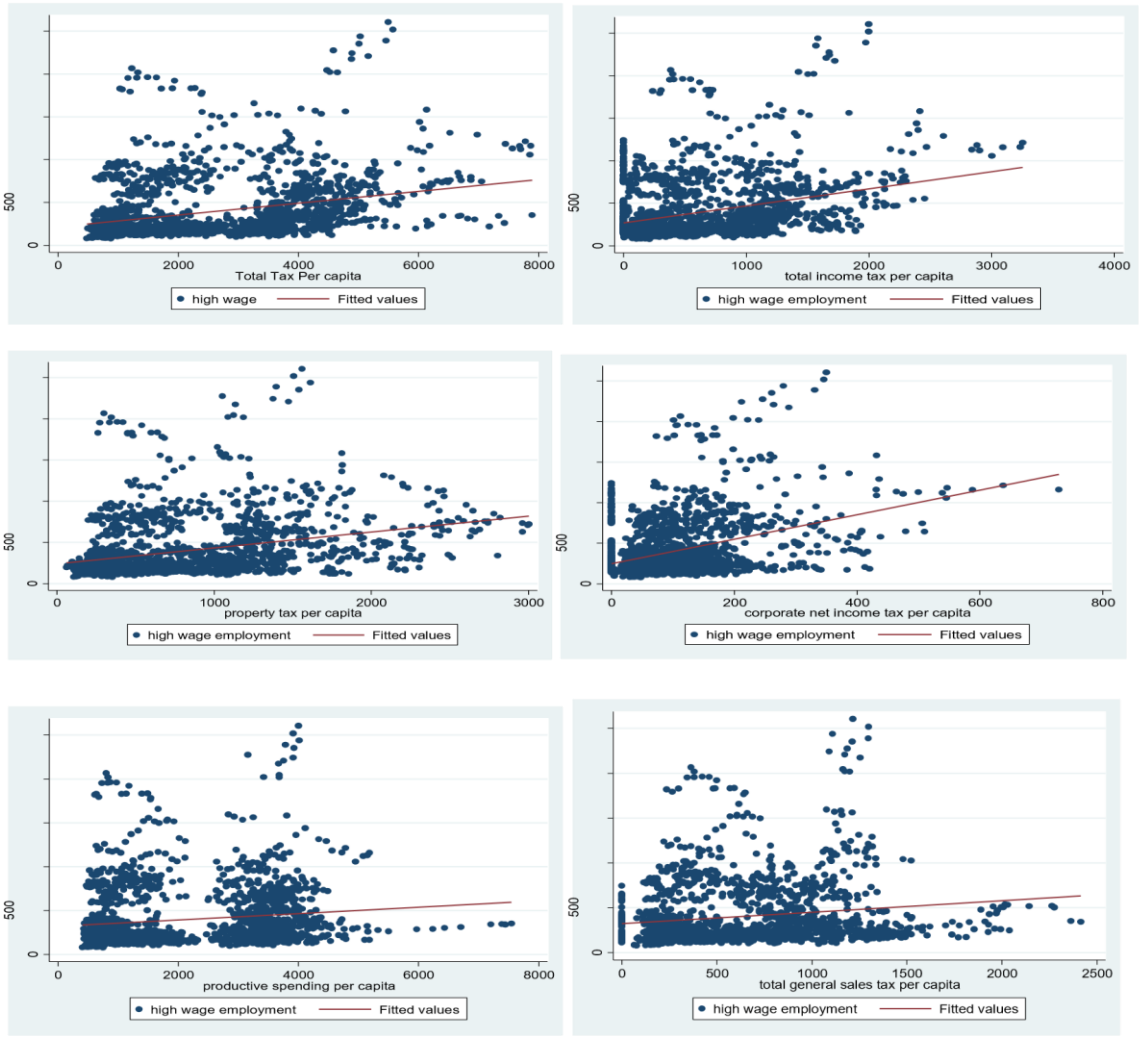


Figure 1.2: Scatter Plot of High Wage employment and Fiscal Variables

ESSAY TWO: TAX EVASION IN US: THE ROLE OF ENFORCEMENT

2.1 Introduction

One of the most common economic crimes in the USA is income tax evasion (Feinstein, 1991). Between 2008 through 2015, the US government lost around $458 billion due to tax evasion[30]. The criminal investigation department in the IRS is responsible for the investigation of any violations of tax laws. The goal of the IRS is to reduce criminal violations and to promote confidence in the tax system. However, over the years, the budget for these activities has declined. Since 2010, the IRS budget has been cut by nearly 8 percent. Moreover, the IRS workforce has been reduced by 9 percent's and the training budget has been reduced by over 80 percent's. Lower resources limit IRS ability to perform basic services as well as provide audit services for the tax payers, which can further reduce the trust in the tax system. For example, in 2010, IRS audited 1.1 percent's of the individual returns, where as in 2015 the rate was 0.8 percents. The ultimate result was lower revenue generation[31]. On the other hand, every dollar invested in IRS actually generates more than a dollar of revenue in return[32] . This evasion not only causes problems with the public sector budget, but also leads to economic distortions, such as reductions in public investment, increase in the budget deficit, lower economic development (Alm and Buckley 1998; Roubini and Sala-i-Martin 1995). Therefore, the policy makers should rethink about the linkage between lower enforcement activities and tax evasion scenario in US.

[30] IRS Report
[31] IRS Commissioner John Koskinen says the budget cuts are costing the government between $4 billion and $8 billion a year in uncollected taxes.
[32] For every dollar invested in enforcement, it will generate almost $6 (the Budget of the United States Government, Fiscal Year 2017," Department of the Treasury)

The principal objective of this paper is to address the question: what is the impact of enforcement on the tax evasion tendency of the individual? In particular, we focus on how recent budget cut influences the level of income tax compliance. Although the literature on the effect of audit or enforcement on evasion is quite large, no research has been conducted that examines the recent budget cut issue as well as the responses of the individual at different income level to enforcement level in their reporting of income. There is a possibility that the tendency to evade taxes may differ across various ranges on income, since higher income individuals have more flexibility in their reporting decision due to having larger financial stability.

The common approach to the question of the effect of enforcement on tax evasion starts with the basic idea that higher level of enforcement may reduce tax evasion. However, the responses may vary with different income levels. We use the Allingham and Sandmo (1972) model of tax evasion in which the effectiveness of enforcement policies depend on several individual characteristics as well as how people react to this policies. Empirically we use Individual Tax Return Model File[33] (ITMF) for a single year (2008), and examine whether several enforcement activities affect the tendency to evade or not. Furthermore, other variables, e.g. marginal tax rate (MTR), tax payer's characteristics are taken into account in this analysis. ITMF's data helps us to explore the issue in individual income (wage and salary income, aggregate total income, etc.) perspectives. Along with OLS (Two stage least square), here quantile regression analysis is also used. Quantile regression helps to examine behavioral responses at different quintiles. Furthermore, we also use detailed panel data at state level from year 1980 to 2014 in order to examine whether enforcement has any impact on tax compliance in aggregate level or not and whether a lack of monetary support for IRS has any influence on that.

[33] A discussion of the data is provided in the data section.

We find that at annual level, cut in enforcement resources increases the likelihood to evade taxes. At the same time, an increase in MTR enhances noncompliance among the taxpayers. However, at the individual level, there is no significant impact of enforcement activities on tax evasion behavior. One reason may be related to the definition of tax evasion[34] which is sensitive to the assumption of reported income. Also, Slemrod (1985) argued that it may reflect the lower bound of tax evasion. This finding is consistent with the revenue generation. After the budget cut, 30 percent's less revenue is generated compared to previous five years. We further check the validity of the results with different time periods and find that after 2008, the impact is larger than the overall impact.

Therefore, this paper is important to the literature in several ways. First, this paper incorporates the recent budget cut for IRS and examines how that can change the behavior of the tax payer's.[35]Furthermore, instrumental variables approach is used to find out the causal impact of enforcement activities on evasion. Second, this paper also includes Quantile regression analysis along with Fixed effect and Instrumental Variable approach in order to find out whether the responses towards enforcement parameter changes with different income levels.

The remainder of this essay proceeds as follows. The next section contains a literature review on tax evasion. Section 3 discusses several programs by IRS and recent IRS budget cuts in enforcement. Section 4, 5, and 6 discuss the theoretical framework, data and empirical method. Section 7 contains summary statistics and empirical results. And finally, section 8 concludes.

[34] In both the cases (e.g. Individual as well as aggregate level data), tax evasion is measured by a proxy variable. More discussion is included in the data and methodology section.

[35] Here several enforcement parameters along with the budget is used which has not been included in the original paper of Slemrod (1985).

2.2 Literature Review

The literature on the effect of enforcement on tax evasion is extensive. Research differs in terms of both theoretical and empirical perspectives. Theoretically, research differs by various forms of utility function (e.g. risk averse, risk neutral) of the individuals. Empirically, studies vary in terms of how the evasion is measured, for example, tax gap analysis, the position of the taxpayers, additional taxes and penalties recommended by IRS, etc. The research also differs in term of how the audit rate or enforcement level is measured, and how the marginal tax rate is incorporated into the empirical analysis. And, of course, research differs in terms of partial equilibrium and general equilibrium analysis.

The theoretical literature on tax evasion is based on Allingham and Sandmo (1972)'s portfolio approach[36]. They analyzed the effect of tax rates, income of tax payers and various enforcement parameters on tax evasion and they found a negative association between unreported income[37] and penalty rate.

Later, a number of studies (Pencavel 1979, Cowell 1981, and Sandmo 1981) investigated the relationship between tax evasion and labor supply. In particular, Sandmo (1981) builds up a model in which the larger the penalty rate, the lower will be the supply of labor in the underground market which further causes a reduction in underreporting income. Other studies also consider the interaction of the taxpayers and tax authorities by making the probability of audit endogenous. For example, Andreoni, Erard, and Feinstein (1998); classified two models; one is a principal agent model in which the government declares the level of audit it makes, and another is a game theory model where the government or tax authority does not make any

[36] The portfolio approach is based on Becker's (1968) economic approach of crime.

[37] Although the relationship between unreported income and true income is ambiguous, they showed that relative risk aversion of the tax payer's utility function influences the effect of before tax income on unreported income.

commitment, and there occurs a strategic interaction between tax payers and tax authority. In these areas, the pioneering works have been done by Graetz, Reinganum, and Wilde (1986), and Reinganum and Wilde (1985). However, a clear cut connection between tax evasion and the probability of being caught is still unknown.

On the other hand, the empirical literature has not progressed due to lack of data on tax evasion. The IRS measures the tax gap through Tax Compliance Measurement Program (TCMP) which is based on audited returns. Several studies used tax gap information as a proxy for evasion. Using the 1969 Tax Compliance Measurement Program (TCMP)[38], Clotfelter (1983) estimates a Tobit model to test the impact of taxpayers' after-tax income, the tax rate, and several socio-economic and demographic characteristics on the level of tax evasion. He finds a positive and significant effect of after tax income and tax rates on tax evasion. Several other studies focus on the impact of audit and enforcement on evasion behavior. For example, Witte and Woodbury (1985) aggregate the 1969 TCMP data at the three-digit zip code level and find a negative relationship between lagged audit rates and evasion. Moreover, Beron, Tauchen, and Witte (1988) use 1969 TCMP data aggregated at the three-digit zip code level and find that the deterrence effect of the audit is small However, they use two stage least square method without incorporating MTR.

Furthermore, Tauchen, Beron, and Witte (1989) apply two stage least square method to the 1979 TCMP individual data and find the similar outcome. In another study, Dubin and Wilde (1988) divide the 1969 TCMP data set into seven audit classes. Their primary objective is to find out whether audit rate is endogenous and, if so, how it affects evasion among different audit classes. They find that the audit rate is an endogenous variable in four of the seven audit classes.

[38] Detailed description on TCMP is discussed in the next section.

Moreover, the effect of the IRS auditing strategies outweighs the deterrent effect in three of the four cases in which audit rates are endogenous. In addition, Martinez-Vazquez and Rider (2005) use 1985 TCMP data and examine the theoretical and empirical implications of accounting for different modes like targeted mode, untargeted mode. They find that the higher the level of enforcement effort, the higher will be the level of compliance in the targeted mode, and the higher the level of enforcement, the lower will be the level of compliance for the untargeted mode. However, overall they find a positive impact on tax compliance.

Others also use TCMP data to find out the determinants of tax evasion. For example, Feinstein (1991) uses 1982 and 1985 TCMP data and discusses the relationship between income, MTR, various socio economic characteristics of the tax payers and their evasion behavior. He finds a positive effect of marginal tax rates on tax gap. In another study, Joulfaian and Rider (1996) examine the relationship between marginal tax rates and evasion for low income households (in the presence of earned income tax credit) in which they define evasion as a possibility that taxpayers may over-report. However, they find that there is no relationship between misreported income (evasion) and marginal tax rates except for the case of proprietor's income.

On the other hand, using one fourth of the data from a random sample of the U.S. Treasury File for 1977, Slemrod (1985) assumes that taxpayers are randomly distributed across each quintile of the $50 tax brackets and then he looks at deviations of actual distributions from the 20 percent levels. He finds deviations which are consistent with the fact that people over claim deductions to move from the bottom of $50 bracket to the top of the lower $50 bracket. Therefore, the computation of evasion is based on the position of the taxpayer's taxable income within $50 tax bracket. He finds that the tendency to evade is related to higher marginal tax rates,

the presence of fungible items, being less than 65 years of age and being married. However, in his study, he did not include any enforcement parameters. In another study, Poterba (1987) finds a positive relation between marginal income tax rates and tax evasion which is consistent with Slemrod's findings.

However, the TCMP data is not publicly available to find out the possible reasons for tax evasion and relevant solutions. Therefore, some studies use state level data published by the IRS in order to find out the determinants of tax evasion. In one study, Dubin, Graetz, and Wilde (1987) use 1977-1985 data and find that the percentage of the adult population with high school degrees, per capita income, and the lagged audit rate positively affect taxpayers' noncompliance. Furthermore, there is a positive impact of audit rate on tax evasion. In their later study, they also find spillover effects of audit rates. Using the data for 1982-1991, Plumley (1996) found that criminal investigation activities of IRS are positively related to compliance. On the other hand, Ali, Cecil, and Knobelt (2001) mentioned about the endogeneity problem in their study and used pooled estimation method. However, they could not find any precise effect of audit rate. Later, Dubin (2004) used state level data from 1977-2001 and used budget per return, resources devoted to tax returns examination, and several state political characteristics as instrumental variable and found a positive impact of criminal investigation enforcement on compliance.

Later, some studies use general equilibrium approach in tax evasion. In one study, Dabla-Norris and Feltenstein (2005) analyses macroeconomic consequences of tax evasion and find that credit rationing from banks is the cost for the firms to evade taxes. As a result of credit rationing, aggregate investment will be low. Higher taxes encourage firms to evade whereas lower tax leads to unsustainable budget and trade deficits. They conclude that optimal taxes may occur some presence of underground economy. Using Russian economic data, Feltenstein et.al. (2012)

found that if the value added tax declines then the incentive to evade taxes for non-capital intensive sectors have been reduced. At the same time, capital intensive sectors would not enter into the underground economy even if the tax rate increases. In a more recent study, Feltenstein and Cyan (2013) develop a dynamic general equilibrium model, applicable to Pakistan and examine how optimizing agents evade taxes by operating in the underground economy. Their results show that increasing tax rates influences firms to enter into the underground economy.

In summary, empirical evidence from studies attempting to uncover the determinants of tax evasion is small but informative. However, past studies have shown some mixed evidence between tax evasion and audit rate. For example, for some cases, the relationship between audit rates and evasion is clear and significant, but not for all audit classes (Dubin and Wilde 1988), Furthermore, the effect of marginal tax on the level of compliance is always an issue for debate and empirical analysis (Yitzhaki 1974; Clotfelter 1983; Slemrod 1985; Dubin, Graetz, and Wilde 1987, 1990). Moreover, estimating causal effects between evasion and enforcement remains an important question due to reverse causality. Therefore, this paper contributes to the literature by implementing an instrumental variable method as well as quantile instrumental approach that aims to estimate causal evidence of the effect of audit rate as well as other enforcement parameters on tax payer's noncompliance behavior.

2.3 A Brief Description of Internal Revenue Service Tax Program and Enforcement:

2.3.1 Taxpayer Compliance Measurement Program (TCMP) and National Research Program (NRP)

Based on the examination of individual income tax returns for Tax Year 1963, the IRS started Taxpayer Compliance Measurement Program (TCMP) in 1964. It included thorough audits of the samples of individual income tax returns and it is done for every three years.

The sample size is approximately 50,000-55,000 individual tax returns for a given tax year. However, the IRS discontinued after 1988 TCMP study.

After that, the National Research Program (NRP) was formed to update measures of taxpayer compliance and audit selection. The goal of NRP is to find out a strategy in order to collect data for measuring payment, filing and reporting compliance. Based on random audits of 46,000 individual income tax returns for the Tax Year 2001, the first NRP was reported. The audits were completed by the end of 2004, and the IRS released this information in 2006. The NRP is different from TCMP in that it uses less invasive analysis while relying more on external data. These data are used to estimate the gross tax gap. The gross tax gap is defined as the difference between aggregate tax liabilities imposed by law for a tax year and the amount of tax that taxpayers pay voluntarily on time for that year[39]. In 2012, the IRS released new tax gap information for the year 2006. However, these data are not available to the public for research.

2.3.2 Tax Gap and Tax Enforcement Effort by IRS

The tax gap from individual income taxes has grown over the years. It was $29 billion in 1973 and jumped to $95 billion in 1992. For the most recent year 2006, the estimated tax gap was $450 billion (which is $345 billion in 2001). The gap consists of three major elements including underreporting of tax liability ($376 billion), non-filing of tax returns ($28 billion), and underpayment of taxes ($46 billion). In underreporting of tax liability, 63 percent are caused by individual income tax. Due to this gap, there is a huge loss of revenue which requires more attention from the tax authority as well as from policy makers.

The IRS plays an important role in ensuring fair tax laws as well as helping tax payers to comply with tax code. Therefore, tax enforcement actions are important to collect due taxes.

[39] US Department of Treasury, IRS

From 2001 to 2011, revenue collection due to enforcement action has increased by 63 percent (it was $33.8 billion in 2001 and was $55.2 billion in 2011). However, a fall in the collection of revenue is observed in 2008. One reason may be that in 2008, staffing for enforcement occupations declined by 1.1 percent per individual tax returns examined. IRS has taken a comprehensive strategy to minimize the tax gap and those strategies have four basic principles

1. Both unintended tax payers errors and intentional taxpayers evasion should be addressed
2. Sources of evasion should be targeted with specificity
3. Enforcement activities should be combined with a commitment to taxpayers service
4. Policy position and compliance proposals should be sensitive to taxpayers right

2.3.3 Budget Cuts

Over the years, the enforcement funding has been declining. According to the Treasury Department, each $1 spent on IRS enforcement results in $6 of additional revenues collected from taxes owed. Significant budget cuts have been observed since 2010. However, the enforcement budget has declined by 14 percent over the years. Enforcing tax laws and providing tax payer's services are the two most important services on which the IRS spends its budget. Due to the budget cut, the IRS has reduced its workforce in this area. The following figure (fig 2.1) shows the budget cut from 1980 to 2014. The number of employees for overall service in IRS has declined from 1995 whereas tax return file has increased day by day. In particular, from 2010 to 2014, the IRS has reduced its staff by 11 percent. However, the number of returns filed has increased in that time e.g. from 2004 to 2013, the number increased by almost 100%.

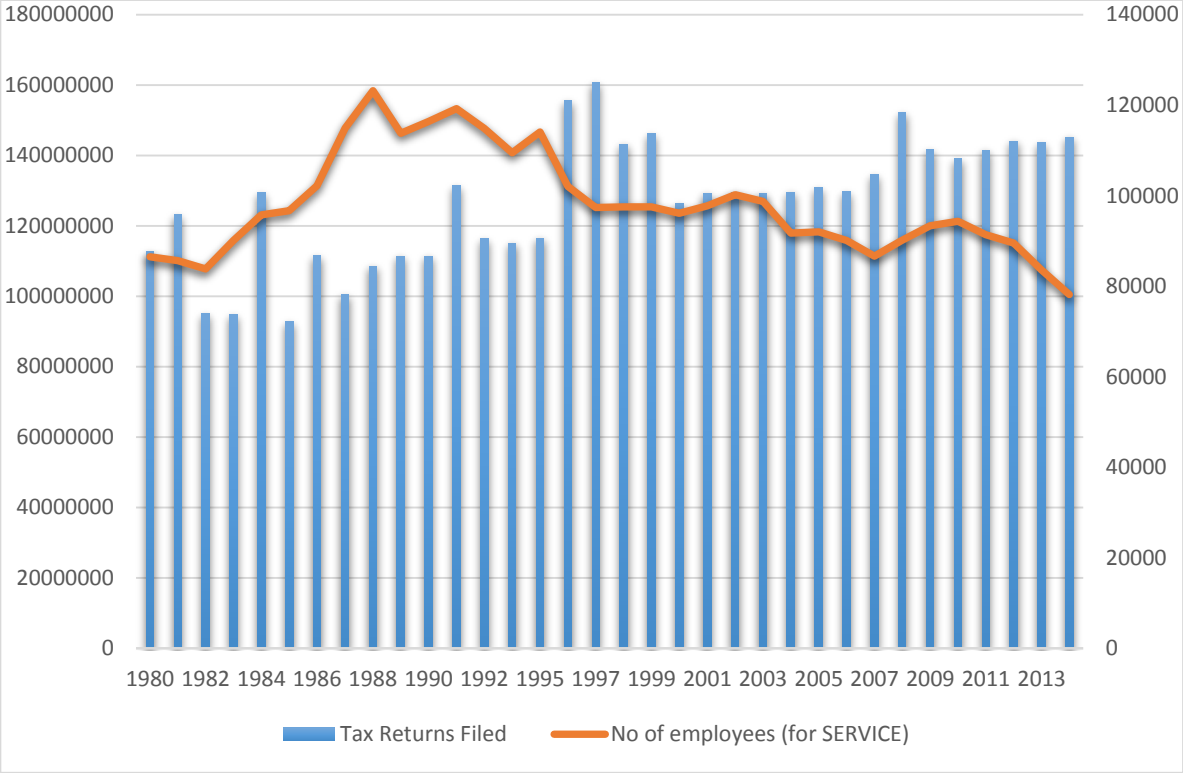


Figure 2.1: Tax Returns Filed and Number of Employees (1980-2014)

Source: IRS Data Book, IRS

And from 2010 to 2014, the number of employees has reduced by 15%. A significant reduction has been observed in terms of training IRS officials (by almost 87%). As a result, fewer audits are conducted which may also influence tax compliance behavior. Therefore, it is important to empirically find out the impact of this lower enforcement activities on tax compliance.

2.4 Theoretical Model

Given that the true tax base is only known to the tax payers, it is difficult to measure the actual amount of tax evasion. To provide a theoretical background for the empirical investigation, this paper uses original income tax evasion model by Allingham-Sandmo (1972). Suppose individual i knows his true income (Y) but the tax authority does not know it. Tax rate t_i is imposed on declared or reported income (R) and the difference between true income and reported income

(E = Y- R) is denoted as evasion (E). There is a detection rate P and if found guilty then he/she will be penalized at rate Ω. Both the understated income and evaded tax liability influence penalty rate. On the other hand, probability of detection (P) is related to 1) different actions (Æ) taken by the tax authority e.g. examinations, auditing, enforcement activities as well as the tax rate, 2) a number of exogenous characteristics of the tax payers (X), and 3) a set of evader's activities (B) which may reduce the chance of being penalized (Slemrod, 2012). Based on the above conditions, individual i's after tax income is as follows

$W_1 = Y_i - t_i(Y_i - E_i)$ If he or she is not caught while cheating (state 1)

$W_2 = Y_i - t_i(Y_i - E_i) - \Omega_i E_i$ if he or she is caught while cheating (state 2)

And individual i will maximize[40]

$$1 - p(E_i)U(W_1) + p(E_i)U(W_2) \qquad (1)$$

First order condition implies that

$$U'(W_2)\Big/U'(W_1) = (1-p)t_i\Big/p(\Omega_i - t_i) \qquad (2)$$

Equation (2) shows the relative price of income in the two states (Sandmo, 2004). The higher the level of detection or penalty rate, the lower will be the degree of evasion. Based on the solution of the taxpayer's utility maximization problem, the indicators of tax evasion results in the following functional form

$$tax\ evasion = f(\in_i)$$

where $\in_i$ is a set of characteristics including Æ , X , and B which influences the evasion decision of an individual. Certain characteristics (X) of an individual may make evasion more attractive.

[40] It is assumed that utility is increasing and concave indicating a risk averse tax payers.

For example, richer people tend to be more risk lover and therefore more likely to evade. On the other hand, it is believed that elderly people are more risk averse and are less likely to evade. However, other factors such as opinion about the fairness of the tax system, how tax revenues are going to be used, culture, tradition etc. also affect compliance behavior (Torgler, 2007). Moreover, the government as well as tax authorities choose tax and several enforcement activities[41] in order to provide public goods G. Following Slemrod and Yitzhaki (1987), we assume that the objective of the government is to maximize the social welfare function and social welfare function is a sum of the expected utilities of the representative households. The government as well as tax authorizes try to maximize the following function

$$\text{Max } W = \{1 - P(E_i)\}U(W_1) + P(E_i)UW_2 \qquad (3)$$

sub to $tY - (1-p)R = G + a(p)$ Where a(p) denotes resources which are used for detecting evasion. From the first order condition, it is observed that by increasing p, the government or tax collection agency can increase more revenue than the cost of doing it (Sandmo 1981, Slemrod and Yitzhaki 1987). The utilization of enforcement activities as well as penalty rate depends on X and how people will react to the choice of policies. Almost all the previous studies including Dubin, Graets, and Wilde (1990) used audit rates as the preventive mechanism. However, over the years, individuals audit rates has declined along with the expansion of several new enforcement programs e.g. Civil penalty assessed, examination and investigation program, which has been ignored by most of the studies. Moreover, enforcement activities are influenced by overall economic situation. Over the years recessions have cut budgets for enforcement activities and this may also influence tax evasion behavior and may reduce total revenue collection. Incorporating the enforcement activities along with audit rates for improving

[41] In our model, this is referred to as policy actions.

compliance in the tax evasion model and finding its impact with all other determinants may help policymakers to consider the importance of enforcement. Therefore, this creates a justification for empirical examinations.

2.5 Data

For micro level analysis, I am using 2008 Individual Tax Model Files (ITMFS) from the Statistics of the Income published by IRS. This data contains detailed information on several tax forms[42] and that information are collected from a stratified random sample of US taxpayers. The sample consists of 139651 records which are drawn from a population of a total of approximately 142 million tax returns record. Taxpayers identity information (e.g. name, SSN) are excluded from the file. Using ITMFs data is helpful because it provides vast information on items reported on tax returns. However, there are several problems in this data set. One is that this data set lacks information on any demographic characteristics. Moreover, information on individual characteristics is almost absent on the tax returns. However, an inclusion of state and marital status is helpful for the analysis. Besides the above mentioned shortcomings, the data set is important for the micro level measurement of tax compliance.

In this study, we measure tax evasion by the index defined in Slemrod's (1985) paper. In particular, the index is defined by the position of the taxpayer's taxable income within hundred dollar tax bracket[43]. Marginal tax rates (MTR) and some socio economics and demographic variables like marital status, age dummy, any adjustment taken place in calculating taxable income, adjusted gross income are also taken into account to find out the determinants (Slemrod, 1985). In order to calculate MTR, we include returns filed by a single person, and married

[42] form 1040, form 1040A, and form 1040EZ federal individual tax returns filed
[43] A detailed description of the Slemrod's methodology to compute evasion is included in the appendix.

couples filing jointly and separately[44]. Furthermore, Feinstein (1991) argued that two groups – Schedule C filer and Schedule F filers were viewed as higher than average evaders. However, there is no significant difference between fungible items (Slemrod, 1985) and Schedule C and F filers[45]. On the other hand, Clotfelter (1983) suggested using different forms of income e.g. wage and salary income and income from interest and dividend because these variables are subject to information reporting. Therefore, there is a possibility of underreporting. From ITMF data, total income is calculated as the sum of AGI, Social Security income not included in AGI, Dividend not reported in AGI, pension income not included in AGI, and statutory adjustment.

In order to increase voluntary compliance, along with audit rates, several enforcement programs are run by IRS. Audit rate as well as enforcement data are not available in ITMF data set. Therefore, tax return examined by different income level is used as audit rate and the data is collected from IRS data book 2008. In terms of enforcement parameter, two types e.g. enforcement costs (including investigation, examination and collection costs) and civil penalty assessed[46] are used. The data is collected from Annual Report published by IRS[47].

Estimating the importance of enforcement programs on compliance requires an analysis of time series observation over the years. Therefore, in the second part, I am using annual state data collected from Internal Revenue Service Data Book (published by Department of the Treasury, IRS) for years 1980 to 2014. The data book contains individual tax returns filed, tax returns examined, additional recommendations and penalties suggested by IRS based on the returns at the state level.

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[44] We exclude returns filed by head of the households.
[45] Fungible items includes itemized deductions, self-employment, partnership income, small business income, estate or trust fund, farm income. All of the items except itemized deductions are included in Schedule C and F filers.
[46] It is a sum of Delinquency, estimated tax, failure to pay, bad check, fraud and negligence.
[47] The report has only annual data. Therefore, we created state level data by multiplying percent's of state level tax returns filed to total returns and annual civil penalty assessed. It is measured in 000 dollars.

Here tax evasion is measured by a proxy variable which is defined as additional taxes and penalties recommended divided by a number of individual income tax returns filed. In our analysis, audit rate, as well as enforcement parameter, is important. Here it is measured by the number of income tax return examined divided by returns filed times 100. However, state level information[48] on tax returns examined and additional taxes and penalties reported is available from 1980 to 1999. For the rest of the period (2000-2014), I use a weighted average of the previous period and extrapolate the data by multiplying the weighted average at each state with annual tax return examined and recommended taxes. IRS has introduced several other enforcement factors for which the data is not publicly available.

Marginal tax rate is also important for analysis. The data for average MTR is collected from Bureau of Economic Analysis. For other socio economic and demographic variables at the state level, e.g. unemployment rate, a number of manufactured employed are also included in the estimation as these variables reflect an opportunity to evade (Dubin, 2004). Social norms can also play an important role in compliance behavior. If a society has high income inequality then there are poor social norms which may also enhance the tendency to evade taxes. Here we are using Gini coefficient as a measure of inequality. Moreover, retail trade employment, proprietor's employment, service employment are used. The data is collected from Bureau of Economic Analysis. Besides these, the percent of nonwhite population, and people aged 65 or more are also taken into account. Data are collected from US Census.

Table 2.1.1 shows descriptive statistics of some important variables using ITMF's data. Here information is reported by different income class e.g. 1st decile reports poorest 10 percent's whereas 10th decile reports richest 10 percent's of the sample population. Aggregate gross income

[48] IRS does not have information for all states. The list of the states and districts is included in Appendix.

has larger standard deviation indicating greater disparity among the tax payers. MTR, as well as the audit rate, are higher for higher income class. However, there is less variation of audit rate among the lowest income class (first five deciles). The pairwise correlation between tax evasion and several enforcement parameters indicate positive correlation which suggest that individuals tend to evade more with higher enforcement. But, there are many econometric issues that have to be addressed before we can draw such a conclusion.

Table 2.1.2 presents summary statistics using state level annual data. The average per return evasion is $4123.36 over the sample period. The average audit rate is 1.13 percent. The average marginal tax rate is 27 percent although it varies between 14 and 40 percent across states and years. The average budget per return examined is $1656.72 and the budget per return has reduced by almost 12 percent after 2008.

2.6 Empirical Method

The effect of enforcement on evasion is estimated by the following model

$$Yi = \alpha + xi'\beta + \gamma Z_i + \in_i, \quad (5)$$

Where evasion (position of the tax payer's in $100 tax bracket) is the outcome of interest, x_i is audit rate (measured as %) or any enforcement variable[49] (measured in 000 dollars), Z_i is a vector indicating individual characteristics including MTR, a dummy variable for elderly which is equal to 1 if elderly deduction is claimed and 0 otherwise, a dummy variable for marital status (married 1, and 0 otherwise), a dummy variable for fungible items. Dummy for fungible items is created if taxpayers have at least one of the following characteristics-any adjustment to income, itemized deduction, self-employment income, partnership income, small business income, and estate or trust

[49] We used civil penalty assessed and total enforcement cost as other forms of audit or enforcement variables.

income. Furthermore, we also include income from work (e.g. wage and salary income), and income from the dividend.

Our hypothesis is that the higher the audit rate or enforcement forces the lower will be the rate of evasion. Aside from audit rate, we think that MTR is likely to have a positive impact on evasion although it might vary with different income class. Besides these two important variables, the impact of individual's socio economic and demographic variables is as follows- elderly people are less willing to evade taxes than younger people[50]. Moreover, the presence of fungible items in the taxable income calculation makes evasion more likely to happen. On the other hand, for some variables e.g. marital status, earnings, interest, and dividend income, it is difficult to find any straight forward relations. The basic model (1) is estimated by using OLS.

Moreover, using only one year data may not give us the true picture of enforcement and evasion. Also, the definition of tax evasion may generate a lower bound of the true tax evasion behavior. Therefore, the following panel data model is used at state level.

$$Yit = \alpha + xit'\beta + \gamma Z_{it} + \mu t + V_s \in_{it}, \quad (6)$$

Where Yit is defined as additional taxes and penalties recommended divided by the number of individual income tax returns filed in state i in year t, xit is audit rate which is measured by the number of income tax return examined[51] divided by returns filed times 100 . In separate regression, we also use IRS administrative budget (includes processing, investigation, and enforcement) as xit. Zit is other state specific characteristics including state average marginal tax rate, μ is a set of year dummies, V is a set of fixed state dummies and ϵ is the error term.

[50] Most of the previous studies found that elderly people are risk averse and therefore they have higher tendency to report their true income.

[51] However, there is a possibility that the probability of audit is not random by nature and this may affect the outcome.

Year dummies are used to control for factors such as business cycle, population, and change in federal policies, etc. that vary over time but not across states. State dummies are used to control for state specific factors.

However, it may generate inconsistent results due to endogeneity problem of audit rates and enforcement parameters. The definition of audit rate is endogenous by nature (Dubin, 2004). Audit rate not only affects tax payers position to the tax bracket and therefore evasion but also IRS allocates resources based on its perceptions of tax payers noncompliance. For enforcement parameters, a similar relationship has been observed. A possible solution of this type of problem is to use IV estimation. Previous studies used the budget as instrumental variables e.g. Dubin, Graetz, and Wilde (1990) used IRS budget per return filed and a number of information returns per tax returns filed as instruments. However, those instruments are weak since both district budget and information returns vary with the perception of tax payer's compliance. In another study, Beron, Tauchen, and Witte (1992) used a number of returns filed per IRS employee in a given district. However, the variable also seems to affect compliance directly. Therefore, in this study, I use political affiliation of the President of United States, the party affiliation of state Governor, and a composition of the chamber of commerce of US senate and congress as instrumental variables. Alm and Yunus (2009), Schulz and Wood (1998) argued that audit rate, as well as enforcement parameters, are largely governed by representatives of IRS to elected officials. If there is democratic majority then audit as well as enforcement will be lower. The reason is that Democrats are more likely to be stated to favor general public as opposed to Pro Corporation or rich people. The data on political variables from 1977-2008 are collected from Dubin (2008) and for the other years, the data is collected from the National Conference of State

Legislators reports, and Congressional Research Service Report. The validity of the IV's is checked by Sargan (1958) test and found that instruments are valid.

The IV model takes the following forms

$$xi = \alpha_{FS} + \partial_{FS} PA + \gamma_{FS} Z_i + \in_i \quad (7)$$

$$Yi = \alpha_{SS} + \hat{x}\imath\beta + \gamma_{SS} Z_i + \in_i \quad (8)$$

The first stage regression is shown by equation 2 where PA refers to the instrumental variables. Equation (3) gives the second stage regression with coefficients denoted by the SS.

Distribution of income may have different impacts on individual responses. And least square method will not be able to capture the true impacts. Therefore, in this paper, we further use quantile regression analysis (Koenker & Bassett 1978, Koenker & Hallock, 2001).[52] Although the most familiar form of quantile regression is median regression, here we use 20th, 40th, 60th and 80th quantile in order to find out the responses of individuals at different points in the distribution of income. Furthermore, we use instrumental quantile regression model in order to deal with the endogeneity issue related to the enforcement parameter.

2.7 Results and Discussion

2.7.1 Using ITMF's DATA

Table 2.3 shows the impact of enforcement on taxpayer's position of taxable income. Taxpayer's position within $100 tax bracket is represented by an index variable which takes the values from 0 to 100. The indicator of tax evasion is sensitive to the assumption of reported income (rather than reported tax) and thus it may measure a lower bound of the actual extent of evasion (Slemrod, 1985).

[52] A brief description of the Quantile Regression is discussed in the appendix.

Column (1) uses OLS techniques and shows that while MTR has positive impact indicating the higher the tax rate, the higher will be the tendency to evade, audit rate has a positive impact on evasion. However, the nature of the audit rate which a simple OLS is unable to control for may generate a biased result. Thus, we use other enforcement variables e.g. enforcement cost, and the civil penalty assessed in column (2) and column (3). It is noted that using these two variables reduces number of observations due to incorporating state level information. In ITMF's data set, state level information is given only for individuals who has AGI less than equal to $200000[53]. With these two variables, enforcement has a negative impact on the tendency to evade although the effect is not statistically significant. All the columns control for the presence of fungible items, wage and salary income, interest and dividend income, marital status, and elderly people. Reported income variables such as wage and salary income, interest and dividend income have a positive influence on the tendency to evade. Moreover, married couples are more likely to evade than unmarried ones. In all those columns, robust standard errors are used in order to take care of the heteroskedasticity issue. Furthermore, state dummies are taken in to account in table 2.4 in order to deal with state specific characteristics. However, all the enforcement variables show positive impact on tax evasion which is contrary to our hypothesis.

While simple OLS estimates the impact of enforcement on the tendency to evade, there may be a possibility of endogeneity (discussed in the methodology section) which will not be captured by using other enforcement variables. Since we have only one endogenous variable e.g. enforcement (it is measured by either return examined or by enforcement cost or by the civil penalty assessed) and we use two instrumental variables, the model is over identified.

[53] Therefore using state level information limits the estimation only to certain level of income (mostly excludes higher level of income).

For that, Sargan's (1958) and Basmann's (1960) test is used. The test statistic is reported in appendix table 2.A3. It shows that instruments are valid.

In order to reduce the bias due to endogeneity problem, two stage least square method is used. Table 2.5 and 2.6 reports the results from 2SLS. The ITMF data is only for one year, and therefore, here state governor party affiliation and state legislator democratic affiliation are used as instruments. First stage results (Table 2.5) show that state level political characteristics have some relation with enforcement activities. In particular if the state governor is democrat and if the state legislator is democratic, it is less likely to have strong enforcement activities. The second stage results show that the coefficients for all the enforcement variables are negative although insignificant. On the other hand, the higher the MTR, the possibility to report income in the higher bracket of lower taxable income is also higher. Similarly, married couples are likely to evade more than others. Furthermore, all the reported income variables show higher tendency to evade. Therefore, two major outcomes are: MTR has a positive impact on the tendency to evade, and enforcement, as well as audits, do not have any significant impact on the evasion behavior. One of the major shortcoming of using political characteristics of the state legislators as instrumental variables is that it excludes information about individual who has higher AGI of $200000 in ITMF's data set. All the previous studies argued that higher income people are more likely to evade than lower income. Excluding a larger portion of the higher income people may bias the outcome.

Different income levels may influence the tendency of taxpayers to evade taxes and thus may have reacted differently with the enforcement programs. To account this issue, we use quantile regression for 0.2, 0.4, 0.6 and 0.8 quantiles[54]. Calculation of each quantile is based on

[54] I also tested for 0.5, 0.7 and 0.9 quantile and the results do not show much variation.

total comprehensive income[55]. The effect of enforcement parameters on different income classes in shown in table 2.7. For 0.2 quantile income level, audit rate (measured by returns examined) has a negative insignificant impact on evasion. For other income classes, it has positive impact although insignificant. For example, a one percentage point increase in the audit rate decreases the tendency to evade taxes by 0.235 points for an individual in the 0.2 quantile. For higher quantile groups, the relationship is positive although their tendency to evade taxes has declined. Moreover, enforcement cost and civil penalty assessed has an insignificant impact on evasion. When enforcement is measured by a civil penalty assessed and enforcement cost, the tendency of individuals to evade taxes varies at different points of income distribution. For example, with quintile regression at 0.2 and 0.4 quantile of total income, the coefficient estimates of the enforcement cost as well as civil penalty assessed show negative relationship although insignificant. However, for upper quantile, it shows positive and very negligible impact.

There still exists a possibility of endogeneity due to the definition of the audit rate. Therefore, IV-Quantile regression method[56] is used here. The results are shown in Table 2.8, 2.9, and 2.10. For an individual in the 0.2 quantiles, a one percentage point increase in returns examined reduces individual's tendency to evade taxes by 1.90 points. However, with 0.60 quantile level, the tendency increases. All the effects are insignificant. On the other hand, marginal tax rate tends to have a larger impact for higher income class. However, due to lower observation in the upper quantile [57], no precise results has been observed. On the other hand, for marital status, the coefficients are generally positive for all income types indicating that married couples tend to evade more than unmarried ones and the coefficient do not vary much with

[55] Total comprehensive income =Aggregate Income, SSI not included in AGI, Dividends not included in AGI, Pension Income, Capital Gains and Statutory Adjustment.
[56] Kaplan and Sun (2012); "Smoothed Estimating Equations for Instrumental Variables Quantile Regression"
[57] State specific variables are only included for AGI<=200000.

different income class. In addition, elderly people tend to evade more when they are in the lower quantile of income which is contrary to our belief. However, for the upper level of income, the results are consistent with the expected sign that elderly people tend to evade less. We observe similar type of results when enforcement is measured by the civil penalty assessed and also by enforcement cost.

Furthermore, we also calculate quantile based on AGI and wage and salary income. In all the cases, we found a negative insignificant impact of enforcement on tax evasion, especially for 20^{th} and 40^{th} quantile class (Table 2.A4 in Appendix). In a separate regression, we also use interest income, dividend income, and capital gains income to calculate different quantiles. The results do not vary significantly.

The graphs in the appendix show the comparison between OLS and quantile coefficients. The dotted line is OLS confidence interval. It appears that linear regression slope is not sufficient to describe the relationship between evasion and its determinants. In particular, when audit rate is measured by return examined the upper quintiles are below the least square estimates. In most of the cases, OLS is insufficient to measure the true relationship between different points in income.

In general, the impacts of enforcement on tax evasion varies with different income level. The responsiveness of the individual in their reporting of income is declining at higher income level due to different enforcement activities. Moreover, responsiveness is higher for lower quantile income level (quantile level 0.2 and 0.4). However, in all the cases, the responsiveness is insignificant. Possible reasons may be related to data constraint at the state level and the definition of tax evasion. The results may indicate the impact at the lower extent.

2.7.2 Using IRS Aggregate Data

Therefore, we also estimate the model with aggregate data at the state level. In the aggregate data set, we are using two types of enforcement variables-audit rate (measured by tax return examined per tax return filed) and enforcement budget at the administrative level. Enforcement budget is only available at the annual level and here annual data is used to calculate the budget for each state based on tax return examined at each state. Other control variables are unemployment rate, MTR, employment in the manufacturing sector, employment in retail past, employment in proprietors, services, GINI coefficient, elderly people, and percentage of nonwhite people.

Table 2.11 shows the results for both fixed effect and random effect model without incorporating endogeneity issue. Both the enforcement variables have an insignificant impact on tax evasion. However, we choose fixed effect model based on Hausman Test (1978).
In order to control for endogeneity issue, we use two stage least square method. And we have three instruments- political affiliation of the President of United States, party affiliation of state Governor, and a composition of chamber of commerce of US senate and congress, and one endogenous variable. Therefore, there may be a possibility of over identifying estimation and in order to test this, we use Sargan (1958) and Basmann (1960) test. The test statistics show that instruments are valid. Table 2.12 shows first stage results of the 2SLS method. The coefficient on the political characteristics have the expected sign, in particular the coefficient on the party affiliation of the U.S. President, and the ratio of Democratic to the Republican in both the chambers of the U.S. Congress show that the presence of Democrat government increases the tendency to evade more by reducing the audit or enforcement activities. F test for the joint significance of the instruments is also included in Table 12 in which F statistic is much larger

than the standard of 10[58]. Therefore, the instruments are not weak (Stock, Wright, and Yogo, 2002). Furthermore, we use Woolridge Score Test, Kleibergen-Paap rk LM test and the Kleibergen-Paap Wald F statistics test. All of the results indicate that the instruments are not weak and are acceptable.

Table 2.13 shows two stage least square results with two enforcement variables. Both the audit rate and enforcement budget have a negative impact on tax evasion indicating that the higher the level of enforcement, the lower will be the tendency to evade. However, the significance of the coefficient varies between 5 and 10 percent level. These results are similar to previous studies (Tauchen, Witte, and Beron 1989; Dubin, Graetz, and Wilde 1990; Alm and Yunus 2008). Our results confirms that the lower budget for enforcement for IRS is the reason to have low tax compliance over the years and policy makers should advocate for increasing resource support for IRS.

For other variables, average marginal tax rate shows a positive impact[59]. Some sources of income may enhance more tax evasion tendency than other. In order to incorporate this, we are using income from proprietorship, services, retail trade, and manufacturing employment. We find that retail past, proprietorship income as well as being employed in the service increases the tendency to evade. On the other hand, the percentage of nonwhite population is positively related to tax evasion which is consistent with the findings of Tauchen, Witte, and Beron (1989). The positive relationship between the rate of unemployment, the Gini coefficient and the level of evasion suggests that evasion becomes higher during the economic recession, and evasion is

[58] We further derive Angrist-Pischke First Stage F statistics and for both the endogenous fiscal variables, the value is greater than 10.
[59] Here we are using average marginal tax rate for federal and state government.

higher in a society with high inequality. These findings are similar to most of the previous studies (Dubin, Graetz, and Wilde 1990).

We further check our results by using MTR square, and also different time period. Using MTR square along with MTR does not change the previous outcomes. In the US, there is a significant reduction in enforcement budget from 2009. Therefore, in a separate regression, we estimate the causal relationship between tax evasion and enforcement from period 2009 and onwards. The results (Table 2.14) indicate a significant increase of tax evasion due to this budget cut. In particular, the responsiveness towards noncompliance actually increases. Furthermore we also use enforcement budget as well as audit rate of the previous year. Our goal is to find out whether enforcement activities in the previous year has any different impact on evasion. The results are consistent with our previous findings.

Generally, the effect of enforcement on evasion is negative. The higher the level of enforcement, the lower will be the degree of evasion. However, in case of ITMF's data, the impact is insignificant. One reason may be related to the fact that the instrumental variables lack information on individual's who has income greater than $200000. Another reason may be related to the definition of tax evasion in which evasion is calculated based on reported income rather than reported tax. Slemrod (1985) argued that if evasion is based on reported income then it will generate a lower bound estimate of evasion, rather than the true picture of evasion. On the other hand, at the aggregate level, our hypothesis holds up.

2.8 Conclusion

The responsiveness of taxpayers in filing their income taxes depends on many factors. One of the important factors is related to the overall enforcement activities taken by the tax authority. Therefore, the government policy makers, as well as tax authorities, are always

interested in estimating the causal impact of enforcement on tax compliance. Over the years, tax noncompliance has gone up. After the recent recession, policy makers are now more concerned about the growth of noncompliance and in particular how the federal budget cut can deteriorate the noncompliance even more since lower resources for IRS can also decrease enforcement activities and services to tax payers. In this paper, we estimate the impact of several enforcement parameters on the tendency to evade taxes.

We used Allingham and Sandmo (1972) tax evasion model in which there is a negative relation between tax evasion and enforcement. And we find that tax evasion depends on individual characteristics, government policies as well on social norms. Furthermore, the government can increase the revenue by increasing enforcement activities. Empirically, we use individual level data for year 2008 and aggregate state level data from 1980 to 2014. The results show that in most of the cases, the enforcement impact is negative. However, due to endogenity we use instrumental variables and those variables are weakly defined in case of individual level data. As a result, at the individual level we find imprecise impact although negative. On the other hand, the responses can vary at different income level. Therefore, we further use quantile regression analysis and our results confirm divergence in tax payer's responses across different income level towards enforcement activities. On the other hand, at the aggregate level, we find a negative significant impact of enforcement activities on tax evasion. Therefore, the findings indicate that enforcement as well resources devoted to enforcement play an important role to reduce tax evasion. We check the robustness of the results by using different time periods, previous enforcement budget etc. We find that the results vary with different time period.

In U.S. IRS is responsible for collecting revenue. For IRS, a dollar spent generates more than one dollar in revenue. However, recent cuts in IRS budget have deteriorated the tax

compliance situation. Our results confirm that more resources in enforcement activities can reduce tax evasion. Therefore, policy makers, as well as the government, should take proper policies to increase budget for IRS in order to maximize voluntary compliance as well as maintaining tax payer's rights, facilitating tax services, and minimizing tax payer's burden.

Table 2.1.1: Summary statistics by Income class

Total Income Class	AGI	Wage and Salary Income	Interest Income	Dividend Income	Audit Rate	Marginal Tax rate
1Mean	17702.47	15251.52	296.702	259.8136	9.23	11.6741
SD	6710.18	19704.78	1524.963	1739.446	0.7	2.359744
2Mean	35246.29	28762.88	727.1921	584.9439	9.4	14.17121
SD	8052.097	32293.77	3091.263	3253.704	1.21	3.772145
3Mean	55936.66	41327.78	1482.587	1317.889	9.62	17.01232
SD	11578.25	34440.8	7001.279	9763.991	1.75	4.964046
4Mean	88190.41	58203.22	3337.652	3188.62	9.83	19.66354
SD	17877.65	46314.8	17306.22	12362.87	2.02	5.381731
5Mean	154025.5	96087.41	6303.155	7566.249	10.06	25.10133
SD	32226.43	77979.64	24179.9	22668.02	2.46	4.106941
6Mean	256572	144403.5	11502.63	15129.74	10.25	29.64547
SD	59619.71	125836.4	37033.3	44150.84	2.67	4.419631
7Mean	467853.2	226792.9	24373.23	30279.75	10.53	33.21873
SD	134650.8	222074.3	71181.49	84661.53	3.17	3.700074
8Mean	887518.4	371745.9	45340.74	56761.1	10.95	34.37375
SD	243675.9	384359.7	118481.1	142825.9	3.89	2.749887
9Mean	1589631	630709	68649.19	90682.38	11.32	34.71886
SD	372986.1	675583.4	178590.6	235149.6	4.2	1.807665
10Mean	6683046	1832701	298316.1	478259	11.34	34.90214
SD	1.43E+07	4859808	1408196	2596293	4.34	1.079265

Table 2.1.2: Summary Statistics

Variables	Mean	Standard Deviation
Evasion (Per return $)	4123.36	1695.72
Audit Rate	1.13	1.86
IRS Budget	20200000	33600000
MTR	27.03	3.43
% of Proprietors in Total Employment	2.07	2.25
% of Retail Trade in Total Employment	2.06	2.09
% of Service Sector in Total Employment	2.06	2.43
% of Elderly	15.02	2.06
% of Non-white people	13.16	8.79
Unemployment Rate	6.14	2.15
Gini Coefficient	0.56	0.04
Party Affiliation of State Governor	0.48	0.5
House Democratic Ratio	0.53	0.05
Senate Democratic Ratio	0.5	0.46

Table 2.2: Pairwise Correlation Coefficient

	Tax Evasion	Returns Examined	Civil Penalty Assessed	Cost of Enforcement
Tax Evasion	1			
Returns Examined	0.0547* (0.000)	1		
Civil Penalty Assessed	0.0143 (0.1316)	0.0249* (0.0085)	1	
Cost of Enforcement	0.0136* (0.0053)	0.0239* (0.0115)	0.9996* (0.000)	1

Table 2.3: Tax Evasion: OLS Estimation

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Primary Independent Variables: Returns Examined, Cost of Enforcement and Civil Penalty Assessed

VARIABLES	OLS	OLS	OLS
Returns examined	0.101*		
	(0.059)		
MTR	1.520***	1.530***	1.530***
	(0.046)	(0.046)	(0.046)
Presence of Fungible Items	-0.930*	-0.794	-0.794
	(0.530)	(0.528)	(0.528)
Wage and Salary Income	0.725***	0.743***	0.742***
	(0.219)	(0.220)	(0.220)
Interest Income	0.251**	0.245**	0.245**
	(0.123)	(0.123)	(0.123)
Dividend Income	0.421***	0.430***	0.430***
	(0.121)	(0.122)	(0.122)
Marital Status	6.244***	6.270***	6.271***
	(0.672)	(0.675)	(0.675)
Elderly people	-0.235	-0.254	-0.254
	(0.559)	(0.560)	(0.560)
Cost of Enforcement		-0.227	
		(0.287)	
Civil Penalty Assessed			-0.222
			(0.287)
Observations	11,221	11,158	11,158

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.4: Tax Evasion: OLS Estimation with State Fixed Effect

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Primary Independent Variables: Returns Examined, Cost of Enforcement and Civil Penalty Assessed

VARIABLES	OLS	OLS	OLS
Returns examined	0.107*		
	(0.059)		
MTR	1.520***	1.528***	1.528***
	(0.046)	(0.046)	(0.046)
Presence of Fungible Items	0.824	0.714	0.714
	(0.533)	(0.531)	(0.531)
Wage and Salary Income	0.667***	0.693***	0.693***
	(0.221)	(0.221)	(0.221)
Interest Income	0.227*	0.221*	0.221*
	(0.124)	(0.124)	(0.124)
Dividend Income	0.425***	0.439***	0.439***
	(0.121)	(0.122)	(0.122)
Marital Status	6.384***	6.415***	6.415***
	(0.676)	(0.679)	(0.679)
Elderly people	-0.300	-0.335	-0.335
	(0.562)	(0.563)	(0.563)
Cost of Enforcement		1.481	
		(2.470)	
Civil Penalty Assessed			1.481
			(2.470)
State Dummy	×	×	×
Observations	11,221	11,158	11,158
Sargan & Basmann Chi Square (1)	0.37	1.42	1.39
	(P=0.54)	(P=0.23)	(P=0.23)

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.5: First Stage Regression Results

VARIABLES	Returns Examined	Cost of Enforcement	Civil Penalty Assessed
Democratic Governor	-0.190**	-0.352**	-0.359**
	(0.082)	(0.018)	(0.018)
Democratic Legislator	0.162	-0.081**	-0.071**
	(0.985)	(0.016)	(0.016)
MTR	0.056**	0.002**	0.002**
	(0.011)	(0.001)	(0.001)
Marital Status	0.332***	-0.105***	-0.099***
	(0.098)	(0.025)	(0.020)
Presence of Fungible Items	0.925	-0.048	-0.048
	(0.0.08)	(0.017)	(0.016)
Wage and Salary Income	0.667***	0.693***	0.693***
	(0.221)	(0.221)	(0.221)
Interest Income	0.227*	0.221*	0.221*
	(0.124)	(0.124)	(0.124)
Dividend Income	0.425***	0.439***	0.439***
	(0.121)	(0.122)	(0.122)
Marital Status	6.384***	6.415***	6.415***
	(0.676)	(0.679)	(0.679)
Elderly people	-0.300	-0.335	-0.335
	(0.562)	(0.563)	(0.563)
State Dummy	×	×	×
F statistics	32.85	64.20	65.97

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.6: Tax Evasion: Two Stage Least Square Estimation

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Primary Independent Variables: Returns Examined, Cost of Enforcement and Civil Penalty Assessed

VARIABLES	2sls	2sls	2sls
Return Examined	-2.472		
	(2.150)		
Marital status	5.472***	6.354***	6.358***
	(0.995)	(0.689)	(0.688)
Elderly People	0.0497	-0.248	-0.248
	(0.653)	(0.560)	(0.560)
Marginal tax rate	1.398***	1.527***	1.526***
	(0.124)	(0.046)	(0.046)
Wage and Salary Income	0.546*	0.708***	0.707***
	(0.283)	(0.226)	(0.226)
Interest Income	0.0567	0.228*	0.228*
	(0.207)	(0.126)	(0.126)
Dividend Income	0.280	0.423***	0.423***
	(0.183)	(0.122)	(0.122)
Presence of fungible items	3.051	0.754	0.752
	(2.052)	(0.533)	(0.532)
Cost of Enforcement		-0.663	
		(1.448)	
Civil Penalty Assessed			-0.702
			(1.421)
Score Chi Square (1)	0.115	1.432	1.397
	(0.733)	(0.231)	(0.237)
Observations	11,158	11,158	11,158

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.7: Tax Evasion: Quantile Regression (OLS)

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)

Variables	Quantile Results			
	0.2	**0.4**	**0.6**	**0.8**
Returns Examined	-0.235	0.131**	0.0001	0.0010
	(0.174)	(0.047)	(0.0000)	(0.0010)
Civil Penalty Assessed	-0.780	-0.107	0.0011	0.0020
	(0.509)	(0.141)	(0.0002)	(0.0003)
Enforcement Cost	-0.781*	-0.108	-0.0050	0.0002
	(0.499)	(0.213)	(0.0065)	(0.0002)
Controls	×	×	×	×

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level;
** significance at the .05 level; *** significance at the .01 level

Table 2.8: Tax Evasion: Quantile Regression (2sls)

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Major Independent Variable: Returns Examined

VARIABLES	0.2	0.4	0.6	0.8
Return Examined	-1.901	-1.612	1.024	0.000
	(2.234)	(1.563)	(0.658)	(0.000)
Marital status	3.413 ***	7.362***	4.887***	1.666**
	(1.070)	(1.201)	(0.457)	(0.887)
Elderly People	3.136**	2.286**	-0.763**	ne
	(1.213)	(0.885)	(0.325)	
Marginal tax rate	1.234 ***	2.410***	1.576***	0.555**
	(.1563)	(0.204)	(0.054)	(0.295)
Wage and Salary Income	.0001	0.000	0.0001	ne
	(000)	(0.000)	(0.000)	
Interest Income	.0000	0.000	0.000	ne
	(.000)	(0.000)	(0.000)	
Dividend Income	.000	0.000	0.000	ne
	(.000)	(0.000)	(0.000)	
Presence of fungible items	2.075	1.588	1.029	ne
	(2.770)	(1.578)	(0.670)	

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level. Ne stands for very negligible impact.

Table 2.9: Tax Evasion: Quantile Regression (2sls)

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Major Independent Variable: Civil Penalty Assessed

VARIABLES	0.2	0.4	0.6	0.8
Civil Penalty Assessed	-1.723	-0.871	0.315	0.0001
	(1.508)	(0.855)	(0.285)	(0.000)
Marital status	3.967 ***	6.030***	5.251***	1.558**
	(0.960)	(1.071)	(0.324)	(0.8870)
Elderly People	3.321**	1.876**	-0.681**	ne
	(1.468)	(0.632)	(0.255)	
Marginal tax rate	1.340 ***	2.522***	1.633***	0.5415**
	(.078)	(0.134)	(0.025)	(0.2302)
Wage and Salary Income	.0001	0.0001	0.0001	ne
	(000)	(0.000)	(0.0001)	
Interest Income	.00002	0.0002	0.0002	ne
	(.00003)	(0.0002)	(0.0002)	
Dividend Income	.00001	0.0001	0.0001	ne
	(.00001)	(0.0000)	(0.0001)	
Presence of fungible items	1.0007	0.8150	1.0290	ne
	(1.4895)	(0.7800)	(0.6706)	

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level. Ne stands for very negligible impact.

Table 2.10: Tax Evasion: Quantile Regression (2sls)

Dependent Variable: Tax Evasion (Measured by the Position of the Tax Payers with $100 Tax Bracket)
Major Independent Variable: Enforcement Cost

VARIABLES	0.2	0.4	0.6	0.8
Return Examined	-1.723	-0.871	0.415	0.000
	(1.455)	(0.610)	(0.311)	(0.000)
Marital status	3.458 ***	7.030***	4.887***	1.667**
	(0.960)	(0.946)	(0.457)	(0.887)
Elderly People	3.321**	1.475**	-0.763**	ne
	(1.239)	(0.524)	(0.325)	
Marginal tax rate	1.310 ***	2.532***	1.625***	0.522**
	(.115)	(0.120)	(0.031)	(0.295)
Wage and Salary Income	.0001	0.0001	0.0000	ne
	(0000)	(0.000)	(0.000)	
Interest Income	.00000	0.0002	0.0002	ne
	(.00000)	(0.0002)	(0.0002)	
Dividend Income	.00001	0.0001	0.0001	ne
	(.00001)	(0.0000)	(0.0001)	
Presence of fungible items	1.0003	0.8150	0.8373	ne
	(1.304)	(0.7800)	(0.2127)	

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level. Ne stands for very negligible impact.

Table 2.11: Tax Evasion: Fixed Effect and Random Effect Model

Dependent Variable: Tax Evasion (Additional Taxes and Penalties Recommended divided by number of individual tax returns filed)

Variables	FE	RE
Returns Examined	0.0352	0.0140
	(0.060)	(0.059)
Unemployment Rate	0.0018**	0.0018***
	(0.0007)	(0.0005)
Elderly People	0.00001**	0.000001
	(0.000)	(0.00000)
MTR	0.0005	0.00005
	(0.0004)	(0.00036)
Manufacturing Emp.	-0.0103***	-0.0099***
	(0.0017)	(0.0017)
Retail Trade Sector	0.00522	0.0055
	(0.0032)	(0.0033)
Proprietors Emp.	-0.0042	-0.0038
	(0.0030)	(0.0029)
Service Emp.	0.0066***	0.0064***
	(0.0005)	(0.0005)
GINI coefficient	0.0415	0.0553*
	(0.0480)	(0.0315)
Non White People	-0.00017	-0.00017
	(0.0001)	(0.00014)

Note: Standard Error are heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.12: First Stage Regression Results

VARIABLES	Returns Examined	IRS Budget
Party Affiliation of US President	-0.205**	-0.187**
	(0.098)	(0.050)
Democratic State Governor	-0.001	-0.011
	(0.001)	(0.230)
Ratio of Democrats in US Senate	-0.085**	-0.076**
	(0.042)	(0.028)
Ratio of Democrats in US Congress	-0.055***	-0.019***
	(0.008)	(0.002)
Controls	×	×
State Dummy	×	×
F statistics	37.19	58.39

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.13: Tax Evasion: Two Stage Least Square Estimation

Dependent Variable: Tax Evasion (Measured by Additional Taxes and Penalties Recommended divided by number of individual tax returns filed

VARIABLES	2sls	2sls
Returns Examined	-0.176**	
	(0.073)	
Unemployment Rate	0.0010	0.0009*
	(0.0007)	(0.0005)
Elderly People	0.0001	0.0001
	(0.001)	(0.0001)
MTR	0.0010*	0.0012***
	(0.0005)	(0.0004)
Manufacturing Emp	0.0057	0.0094
	(0.0090)	(0.0074)
Retail Trade Sector	0.0023	0.0047
	(0.0070)	(0.0084)
Proprietors Emp.	0.0025	0.0004
	(0.0047)	(0.0057)
Service Emp.	0.0006	0.0008
	(0.0007)	(0.0006)
GINI coefficient	0.0273	0.103
	(0.0647)	(0.0679)
Non White People	0.0085***	0.0092***
	(0.0031)	(0.0019)
IRS Budget		-0.105*
		(0.020)
State Dummy	×	×
Year Dummy	×	×

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 2.14: Tax Evasion: Two Stage Least Square Estimation (year 2009-2014)

Dependent Variable: Tax Evasion (Measured by Additional Taxes and Penalties Recommended divided by number of individual tax returns filed)

VARIABLES	2sls	2sls
Returns Examined	-4.407**	
	(1.996)	
Unemployment Rate	0.153	0.0233
	(1.402)	(0.0376)
Elderly People	0.0005	0.0005
	(0.0005)	(0.0004)
MTR	0.384	0.0155
	(2.928)	(0.0291)
Manufacturing Emp	0.808	0.146
	(0.695)	(0.110)
Retail Trade Sector	0.514	0.361
	(0.432)	(0.263)
Proprietors Emp.	1.291	0.243
	(1.11)	(0.197)
Service Emp.	0.163	0.0404
	(.484)	(0.0406)
GINI coefficient	10.33	0.714
	(9.63)	(1.892)
Non White People	0.0705	-0.0204***
	(0.396)	(0.00717)
IRS Budget		-0.230*
		(0.180)
State Dummy	×	×
Year Dummy	×	×

Note: Standard Error are Heteroskedasticity robust. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

ESSAY THREE: THE MACROECONOMIC IMPLICATOPNS OF SALES TAX EVASION IN PAKISTAN

3.1 Introduction

Tax evasion is a severe problem for developing countries where informal sector accounts for almost 40 percent of GDP. Higher tax evasion results in lower funds for public sector investment and therefore leads to lower economic growth. Lack of information and imperfectly observed transactions may cause evasion. Therefore, true reporting, verified documents, and strict enforcement rules can be used to reduce this problem (Kopczuk and Slemrod 2006, Kleven et.al. 2009, Kleven et.al, 2010). The value added tax (VAT) is believed to facilitate tax enforcement through a built-in incentive structures (Agha, A., and Haughton 1996, Kopczuk and Slemrod 2006). As a result, several countries including Pakistan have adopted this form of tax[60]. The goal is to improve the tax compliance scenario.

Among these developing countries, Pakistan has the lowest tax-GDP ratio (near 11 percent) in the world. Around 7 million Pakistanis are estimated to be eligible to pay taxes but in reality less than 0.5 million pay taxes. Therefore, tax reform is a very important agenda for Pakistan. In Pakistan, most of goods are subject to a VAT rate of 17%[61] (also known as General Sale's tax). In terms of VAT or general sales tax, major areas of concerns are i. Registration Issues, ii. Fake and Flying Invoices, iii. Fraudulent Refunds, IV. Undervaluation and fictitious sales, v. Misuse of concessions and VI. Weakness in Data Processing[62]. Most likely, evasion occurs in these areas. Besides corporate income tax evasion in Pakistan, sales tax evasion is one of the growing concerns for policy makers as well as for the government.

[60] The sales tax in VAT mode has been in place since 1996.
[61] For six products-soybean meal; oil cake and other solid residues; direct reduced iron; oilseeds meant for sowing;, cotton; and plant and machinery not manufactured locally, the rate is 5 percent's.
[62] A detailed discussion of these issues are included in Appendix.

The objective of the paper is to find out the potential distributional impact of sales tax evasion by using the output of a Computable General Equilibrium (CGE) Models and to analyze the macroeconomic outcome e.g. Real GNP, Tax-GDP ratio, Budget Deficit, Investment etc. A particular characteristic of the CGE model is that it incorporates tax evasion as an endogenous outcome of optimizing behavior by the different sectors of the economy. Given Pakistan's relatively low rate of overall tax collection, as well as high statutory tax rates, it is important to compare the outcome from two scenarios-one with sales tax evasion, and another without sales tax evasion. The results of the simulations may indicate the importance of strong enforcement and tax administrative structure for Pakistan.

The remainder of this paper proceeds as follows. The next section contains a modeling of tax evasion based on previous literature in the context of the general equilibrium model. Section 3 discusses a brief overview of General Sales Tax or VAT in Pakistan. Section 4 presents the general equilibrium specification, section 5 shows numerical results of the simulations of the alternative effective sales tax rate in the CGE model. Last section 6 concludes.

3.2. Modeling Tax Evasion

Tax evasion is a severe problem in Pakistan. According to a recent IMF's report (IMF Country Report No.16/2, 2016)[63], the tax capacity of Pakistan is estimated to be 22.3 percent's of GDP implying a tax revenue gap of more than 11 percent's or Rs 3.3 trillion. Although the revenue collection has gone up from 8.7 percent's of GDP in 2005-06 to 10.6 percent's of GDP in 2015-16, still it is one of the lowest in South Asia. In terms of VAT, Ahmad (2011)[64]found that out of 86 countries that have a VAT types sales tax, the efficiency ratio[65] of the VAT in

[63] Pakistan Selected Issues, International Monetary Fund, 2016
[64] Ahmad (2011), "Why is it so difficult to implement a GST in Pakistan"
[65] Efficiency ratio = total vat revenue as % of GDP/ Vat Standard Rate

Pakistan is very low (27%). Recently, the Federal Board of Revenue in Pakistan has discovered a fraud of Rs9.8 billion in sales tax, which was done by issuing fake invoices for obtaining input adjustments and refunds. Thus Pakistan can be used as a country study in which there is a high amount of sales tax evasion, as well as low tax-GDP ratio

Here we model sales tax evasion, audit and self-enforcing mechanism in the original Allingham-Sandmo model (1972). The approach is similar to Pomeranj (2010) who model VAT evasion for a developing country. In the model, an individual chooses evasion E[66] given that there is a detection rate P and if found guilty then he/she will be penalized at rate Ω. Here Ω is a function of evaded tax or underreport income. Therefore, individual i's expected net of tax income is

$W_1 = Y_i - t_i(Y_i - E_i)$ If he or she is not caught while cheating (state 1)

$W_2 = Y_i - t_i(Y_i - E_i) - \Omega_i E_i$ if he or she is caught while cheating (state 2)

And individual i will maximize[67]

$$1 - p(E_i)U(W_1) + p(E_i)U(W_2) \qquad (1)$$

The first order condition implies a negative relation between detection and evasion (Sandmo, 2004). VAT[68] has a self-enforcing mechanism in which firms have asked their suppliers for true receipts in order to deduct input costs from VAT bill (Pomeranj, 2010). This mechanism creates an incentive for paper trails or records of documents. In another paper, Bird and Gendron (2007) argued that in the case of inter-business trade in VAT, buyers and sellers have conflicting interests in which buyers want to exaggerate buying price in order to inflate deductions although

[66] Evasion is defined as the difference between true income and reported income
[67] Risk neutral individual
[68] In terms of VAT, income is calculated as the difference between sales and inputs cost.

sellers want to underreport sales in order to reduce the liability of tax. Therefore, the risk of the cross check can reduce the probability of false reporting. Following Kleven et al (2010), here the probability of detection is a function of probability of audit (a) in which probability of audit (a) depends on set of actions taken by the tax authority (examination, enforcement, tax rate etc.), and probability of cross checks (c) for transactions with a paper trail. In their paper, c is close to 1 for a developed country; Denmark. However, Pomeranj (2010) argued that for developing countries, most of the documents are actually kept in paper and tax payers keep all the information about transactions which makes the cross check even more expensive. Therefore, for a developing country c is significantly lower than 1. Therefore, in terms of VAT, equation 1 will become

$$1 - p\,\{E_i(a,c)\}U(W_1) + p\{E_i(a,c)\}U(W_2)^{69} \qquad (2)$$

Here, the probability of detection is an increasing function of both probability of audit and probability of cross check implying that the higher the level of enforcement, the higher will be the chance for audit, and the higher will be the detection rate.

In case of developing countries, firms can evade taxes without any fear for detection because, in those countries, enforcement activities by the government are very weak and also corruption rate is very high (Shleifer and Vishny, 1993). Although Pakistan has some penalty rates for sales tax evasion, there is no such strong enforcement e.g. jail. On the other hand, Pakistan has VAT type's sales tax and the format of the VAT in Pakistan is a type of General Sales Tax. Therefore, the probability of cross check is also low. As a result, the evasion in sales tax in Pakistan is increasing day by day (Federal Board of Revenue Reports, 2016). Information on different forms of enforcement as well as different levels of cross checks are not available for Pakistan and

[69] Pomeranj (2010) further assumes that cross check is a function of the likelihood of creating paper document by the trading partners. However, in our paper, we keep it simple.

therefore we will just assume a simple linear function where detection or evasion is a function of enforcement. And enforcement expenditure is a part of total government expenditure. The higher the level of enforcement, the lower will be the degree of evasion. Furthermore, for sales tax, if a firm evades tax then this will increase the profitability of the firm which in turn will be captured by the corporate income tax. Because of this complicated structure, there is less information available for sales tax evasion. Using an input-output model, Ahmed and Rider (2008) estimated the sales tax gap or evasion for Pakistan for 2004-05 and they found that the sales tax gap or evasion lies between 25 to 30 percent of actual sales tax revenue. Furthermore, Bird and Gendron (2007) estimated GST gap[70]. It was 63.9 percent in 2002-03 and is increased to 75 percent in 2010-11.

3.3. A Brief Overview of VAT in Pakistan

During 1980's, the government of Pakistan decided to replace the sales tax by VAT and in 1990's, they introduced VAT types General Sales Tax (GST). Originally, it had destination based characteristics and was limited to goods. Later, in 2000, certain services were included in GST. In 2003-04, there were five different rates, i.e. 2%, 15%, 18%, 20% and 23%. However, due to multiple rates, and administrative difficulties; cost of compliance have increased. Therefore, a uniform standard rate of 15% was taken in 2004. Moreover, in 2009-10, the standard rate increased to 16 percent and again it increases to 17 percent in 2010-11. However, some goods have zero rates e.g. goods supplied to diplomats, privileged person and organization, some goods are exempted e.g. basic foods like wheat, rice, edible oil, fruit, lifesaving drugs, and some goods have reduced GST rates, e.g. Importation or supply of black tea, agricultural tractor etc.

[70] The GST gap is defined as the difference between GST actually collected and that which is potentially collectible if all final household consumption were taxed at the standard GST rate (Hassan, B., & Sarker, T. (2012))

The GST-to-GDP ratio has decreased from 4.0% in 2002/03 to 3.5% in 2010/11. Besides, GST-GDP ratio, the revenue performance can also be seen by Gross Collection Ratio (GCR) which is calculated as the ratio of actual GST collection to the potential GST collection[71]. The GCR value for Pakistan declined from 36.1% in 2002-03 to 25.0% in 2010-11. Significant number of exemptions, lack of compliance, and weak enforcement are the probable causes of this low performance of GST in Pakistan.

3.4. A General Equilibrium Specification

A dynamic general equilibrium model is developed in which a shadow economy is generated endogenously. Here we follow the model developed by Feltenstein, A., Lopes, L. T., Porras Mendoza, J., & Wallace, S. (2013). Suppose there are n discrete time periods and in each period, an agent optimizes over a two time period horizon. For example, in period t, an agent optimizes given prices for period t and t+1 and at period t+2, an agent re-optimizes for period t+2 and t+3. The structure of our model is such that we can use Pakistan as a numerical example.

Production

There are 8 factors of production and 3 types of financial assets:

1-5	Capital types	9.	Domestic currency
6.	Urban labor	10.	Bank deposits
7.	Rural labor	11.	Foreign currency
8.	Land		

The five types of capital correspond to five aggregate nonagricultural productive sectors which are stated below:

SECTOR 1=LIGHT
MANUFACTURING
SECTOR 2=HEAVY INDUSTRY
SECTOR 3=ELECTRICITY,WATER,
SEWAGE

[71] Potential collection is defined as the GST collection without any evasion. All final consumption including private as well as general government are used to calculate GCR. The formula to calculate GCR is [Revenue from VAT/(Total Consumption*Vat rate)]*100

SECTOR 4=TRANSPORT
SECTOR 5=HOTELS, HOUSING, HEALTH
SERVICES

In order to determine intermediate and final production at time t, an input output matrix A_t[72] (50 x 50) is used. The matrix is taken from *Samwalk* 2010, the most recent social accounting matrix for Pakistan developed in Debowicz et al (2013), where the tab PSAM2C is used to derive the matrix representing 2010 technology. The IO matrix is 50x50, but in order to simplify computations we have aggregated the matrix to 27x27, where row and column 27 represent a single aggregate import. For each sector, a sector special value added is created using land and rural labor for agricultural sector and capital and urban labor for nonagricultural sector. The weights in the valued added function are derived from PSAM2C.

We can specify firm's problem as follows. LetY_{ki}^{j}, Y_{Li}^{j}be the inputs of capital and urban labor which are used to *j* th nonagricultural sector in period *I* and we assume that in period *i* , there is an outstanding stock of government infrastructure denoted by Y_G. We further assume that public infrastructure may be used to increase the productivity of the private sector. Therefore, value added in sector *j* in period *i* is given by:

$$va_{ji} = va_{ji}\left(y_{ki}^{j} y_{Li}^{j} Y_{Gi}\right) \qquad (3)$$

In period *i*, sector *j* pays income taxes on inputs of capital denoted by t_{Kij} and on labor, given by t_{lij}. Here we interpret capital tax as a tax on firm profits, and labor tax as a tax on personal income that is withheld at source. Because, production function exhibits constant returns to scale, there is no pure profits, and corporate income tax is treated as a tax on returns to capital.

[72] Here we use a most recent Social Accounting Matrix (SAMWALK 2010) for Pakistan.

We further assume that sectoral investment functions are uniform across the 5 types of sectoral capital and is given by the value added function for the construction industry, taken from the SAM. However, due to different rates of return to capital in different sectors, rates of investment will differ (Feltenstein et al, 2017)

Consumption

Consumers are categorized by 18 different ways and each of which has two types, either urban or rural labor. They have initial allocations of 5 capital types, land, financial assets; money, bonds, and foreign exchange. In SAMWALK2010, the 18 categories are

1. Urban quintile 1
2. Urban quintile 2
3. Urban other
4. Medium farm Sindh
5. Medium farm Punjab
6. Medium farm Other Pakistan
7. Small farm Sindh
8. Small farm Punjab
9. Small farm Other Pakistan
10. Landless Farmer Sindh
11. Landless Farmer Punjab
12. Landless Farmer Other Pakistan
13. Waged rural landless farmers Sindh
14. Waged rural landless farmers Punjab
15. Waged rural landless farmers Other Pakistan
16. Rural non-farm quintile 1
17. Rural non-farm quintile 2
18. Rural non-farm other

Two types of consumers have different utility maximizing functions, and different endowments. The consumers maximize their consumption and leisure choice in each of the period. Feltenstein and Cyan (2013) solved the Cobb Douglas maximization problem and the problem is as follows

$$\max U(x), x = (x_1, x_{Lu1}, x_{Lr1}, x_2, x_{Lu2}, x_{Lr2}) \quad (4)$$

Such that

$$(1 + t_i)P_i x_i + P_{Lui}x_{Lui} + P_{Lri}x_{Lri} + P_{Mi}x_{Mi} + P_{Bi}x_{Bi} + e_i P_{Bfi}x_{Bfi} = C_i \text{ (4a)}$$

$$P_{k1}K_0 + P_{A1}A_0 + P_{Lu1}L_{u1} + P_{Lr1}L_{r1} + P_{M1}M_0 + r_0 B_0 + P_{B1}B_0 + e_1 P_{BF1}B_{F0} + TR_1 = N_1$$

$$P_{k2}(1 - \delta)K_0 + P_{A2}A_0 + P_{Lu2}L_{u2} + P_{Lr2}L_{r2} + P_{M2}M_1 + r_1 x_{B1} + e_2 P_{BF2}x_{BF1} + TR_2 = N_2$$

$$C_i = N_i$$

$$\log P_{Bi}x_{Bi} - \log e_i P_{BFi}x_{BFi} = \alpha + \beta\left(\log r_i - \log \frac{e_{i+1}}{e_i} r_{Fi}\right) \quad (4b)$$

$$\log \frac{L_{ui}}{L_{ri}} = a_1 + a_2 \log \frac{P_{Lui} - P_{Lri}}{P_{Lui} + P_{Lri}} \quad (4c)$$

$$\log P_{Mi}x_{Mi} = a + blog(1 + t_i)P_i x_i \quad (4d)$$

$$P_{B2}x_{B2} = d_0 + d_1(1 + t_2)P_2 x_2 + d_2\left[\frac{r_2 - \pi_2}{1 + \pi_2}\right] \quad (4e)$$

Where:

P_i = price vector of consumption goods in period *i.*

x_i = vector of consumption in period *i.*

C_i = value of aggregate consumption in period *i* (including purchases of financial assets).

N_i = aggregate income in period *i* (including potential income from the sale of real and financial assets).

t_i = vector of value added tax rates in period *i.*

P_{Lui} = price of urban labor in period *i.*

L_{ui} = allocation of total labor to urban labor in period *i.*

x_{Lui} = demand for urban leisure in period *i.*

P_{Lri} = price of rural labor in period *i.*

L_{ri} = allocation of total labor to rural labor in period *i.*

x_{Lri} = demand for rural leisure in period *i.*

a_2 = elasticity of rural/urban migration.

P_{Ki} = price of capital in period *i.*

K_0 = initial holding of capital. P_{Ai}

P_{Ai}= price of land in period *i.*

A_0 = initial holding of land.

δ = rate of depreciation of capital.

P_{Mi} = price of money in period *i.* Money in period 1 is the numeraire and hence has a price of 1.

x_{Mi} = holdings of money in period *i.*

P_{Bi} = discount price of a certificate of deposit in period *i.*

π_i = domestic rate of inflation in period *i.*

r_i, r_{Fi} = the domestic and foreign interest rates in period *i.*

x_{Bi} = quantity of bank deposits, that is, CD's in period *i.*

e_i = the exchange rate in terms of units of domestic currency per unit of foreign currency in period *i*.

x_{BFi} = quantity of foreign currency held in period *i*.

TR_i = transfer payments from the government in period *i*.

a, b, α, β = estimated constants.

d_i = constants estimated from model simulations.

The weights are derived from the SAM consumption data. Endowments are also taken from the SAM. Furthermore, there is a uniform money demand function across all consumers which depends on interest rates, inflation rates, and real income, and the parameters of the equation are taken from Qayyum, A. (2005).

The Government

Personal income, corporate profit, value-added taxes, and import duties are collected by the government. The government finances the provision of public goods and gives some subsidy support too. Furthermore, the government also pays the interest rates on domestic and foreign loans. And the deficit is financed by monetary policy or borrowing from domestic or foreign countries.

The Foreign Sector

In the foreign sector, it is assumed that both the domestic and foreign price indices as well as world income determines aggregate demand for exports. The foreign sector produces imports which is considered as a single aggregate good. Demand for imports are generated from two sides-intermediate demand is coming from input output matrix whereas final demand is coming from consumers intertemporal choice mechanism.

Fiscal Parameters

The benchmark or base case tax rates are taken from KPMG (2012). We use Pakistan Statistical Yearbook for different levels of public expenditure. Moreover, in the model, we suppose that the current expenditure produced by the public sector incorporates a Cobb-Douglas function in which the shares of capital and labor are given by the aggregate shares of these factors in private production. The shares are taken from the Pakistan National Income Accounts. The public investment function, which determines public capital spending, is taken to have the same parameters as the private investment functions.

3.5. Simulations

3.5.1 Simulation

The model incorporates sales tax evasion as well as enforcement expenditure as part of government total expenditure. The objective is to simulate the model on the basis of most recent policy as well as technological parameters for Pakistan. Here we assume that all the fiscal policy variables e.g. tax rates, real public sector spending, deficit financing rules etc. remain constant for the 8 years (2013 to 2021) of the simulation. We further assume that there is managed exchange rate, and the exchange rate is devalued by 6 percent per year. In addition, the world inflation rate is 4 percent annually and world growth is 2 percent per year. In the baseline model, we assume the current scenario of Pakistan where there is sales tax evasion. Furthermore, we assume that the sales tax evasion is 25 percent. It is based on Ahmed and Rider (2008)'s sales tax gap analysis and Hasan and Sarkar (2012)'s Gross Collection Ratio analysis. With a 16 percent[73] general sales tax, the effective tax rate becomes 12 percent. The counterfactual full compliance simulation assumes zero evasion in the sales tax, so that effective general sales tax rate becomes

[73] The average sales tax is 16 percent from 2006 to 2016. It was 17 percent in 2014 and 15 percent in 2007.

16 percent. In all the simulations, enforcement spending is included as a part of current government spending. The simulation is then run for 8 periods and creates a number of macroeconomic variables.

3.5.2 Results (Base Line Model)

Here we focus on the macroeconomic effects, government budget as well as real income of different sectors of the economy. The results of the simulation are shown is Table 3.1. We find that the annual real growth average is 3.31 percent. The average inflation rate is 15 percent over the 8 years forward time horizon. Although the forward-looking growth rate is close to the current Pakistan growth rate, the inflation rate is significantly higher than the current rate. Furthermore, the budget deficit starts quite high and stabilizes at 7 percent of GDP. Finally, the trade deficit is gradually decreasing. One reason may be related to the assumption of the exchange rate devaluation.

Table 3.2 displays real incomes of the 18 consumers groups in period 8. Consumers 1-3 are urban, consumers 4-9 are the farm (either medium or small), consumers 10-15 are landless, and consumers 16-18 are rural non-farm. Among these different sectors, medium and small farms in Punjab are considerably wealthier than any other sectors. Here most of the sectors show growth over the 8 periods. However, landless farmers in Sindh, Punjab, and other Pakistan suffer from losses. The urban other sector experiences growth compared to small farms, and medium farms sector. On the other hand, the rural sector exhibits only slight growth.

3.5.3 Full compliance of the Sales Tax (No Evasion)

In the full compliance simulation, we assume that the effective sales tax is increased to 16 percent. There is no sales tax evasion which can occur due to strong tax administration and tax enforcement expenditure. However, data on tax administration and tax enforcement expenditure

is not available for Pakistan. Therefore, for this simulation we assume that enforcement is costless, and hence there is no increase in current public expenditure.

Real GNP is growing over the periods. However, real GNP in period 8 is slightly lower than real GNP in the base case. The compound annual growth rate of Real GNP between these two simulations show a slight increase (0.04 percent) in the full compliance case compared to the base case. Regarding inflation, the value ranges from 9 to 19 percent and the average (13.22 percent) is lower than the base case. The trade deficit is decreasing at a higher rate compared to the base case as consumption rises.

Figure 3.1 shows that full compliance has a significant effect on tax collection as a percent of GDP although, for the first 3 periods, both the base line and full compliance simulation indicates approximately similar tax-GDP ratio. As we would expect, no tax evasion in the sales tax increases the tax share as a percent of GDP. In the case of budget deficit, the deficit is reduced compared to the base case.

Table 3.4 displays the real income for different types of consumers. The real income shows increasing pattern across different types of consumers, in particular for urban, medium, small farms and rural non-farm consumers. However, all the landless farmers including waged rural landless farmers suffer from the loss. In addition, in all the cases, the growth of real income is lower than the base case. This is largely due to the fact that the consumption of different types of consumers are lower than the base case as they are now paying an effective tax of 16 percent (Table 3.5).

The interest rate has declined significantly compared to the base case. With no change in other tax rates e.g. capital tax and income tax, investment has increased in sector 2 (heavy

industry), and in sector 4 (transport). However, no significant change in investment is observed in other sectors (Table 3.6).

In general, we can say that from a macro perspective, full compliance of general sales tax is superior to the case with evasion. It results in higher tax-GDP ratio, higher compound growth in Real GNP, lower budget deficit, and lower interest rates. For a country like Pakistan where the government always suffers from huge budget deficit, full compliance will results in an improved budget scenario. However, from consumer perspectives, this may result in lower consumption, lower utility and lower income as in our model we are assuming that it is the consumer who is involved in sales tax evasion.

3.6 Conclusion

As a developing country, Pakistan faces problems e.g. low tax-GDP ratio, high amount of budget deficit, a high degree of tax evasion, as well as high degree of corruption. In order to increase the share of taxes in GDP, like many other developing countries, Pakistan has adopted the VAT type general sales tax. However, still the tax-GDP ratio is one of the lowest compared to any developing country and it is also lower than some least developed countries. Therefore, evaluating two scenarios- current tax evasion and no tax evasion in case of general sales tax will be helpful for policymakers as well as for the government to apply strict enforcement rules and to maintain a strong tax administrative structure.

Using a Social Accounting Matrix for Pakistan, this paper incorporates a dynamic general equilibrium model and examines the effects of changes to the tax compliance on growth, budget, and welfare. We find that the effects of full tax compliance to the sales tax have long lasting impact. There is an increase in tax-GDP ratio, a decline in budget deficit, a decline in interest rates, and an increase in investment in some sectors. However, consumers of different sectors

especially landless farmers and waged landless farmers are impacted negatively by this. Although growth of real income is observed in most of the sectors, the growth rate is lower than the tax evasion case. The positive impacts from full compliance can be used to overcome the loss in consumer utility and real incomes of different sectors.

In our model, the consumers are evading taxes by paying effective rates. However, in real scenario, sellers or retail sellers evade sales tax by faking invoices, giving receipts without including tax, or even by giving no receipt at all. However, within 18 categories of consumers, information about the sellers or owner of retail shops is absent. Therefore, extension of this research may consider incorporating evasion from the seller's part and then try to find out the proportion of sellers or retail shop owners among those 18 categories of consumers by using Pakistan Living Standard Measurement Survey, and Household Income and Expenditure Survey. Moreover, including the tax enforcement expenditure in the model would help to generate more accurate outcome.

Table 3.1: Base Case (Based on 2010)

YEAR	1	2	3	4	5	6	7	8
REAL GNP	100	99.13	101.58	104.48	112.22	114.9	119.57	122.88
NOMINAL GNP	100	118.46	154.75	174.91	229.8	261.67	328.79	375.58
PRICE LEVEL	100	119	152	167	204	227	274	305
INFLATION	0	19	27	9.8	22.15	11.27	20.7	11.31
TAX REVENUES/GDP	20.14	21.5	21.36	20.9	20.68	20	19.8	19
GOV. EXPENDITURES/GDP	34.55	34.1	30.4	28.9	27.8	27	26.5	26.7
GOVERNMENT DEFICIT	-14.41	-12.6	-9.04	-8	-7.12	-7	-6.7	-7.7
INTEREST RATE	20	5.4	5.3	4	4.71	4.24	4.54	4.34
EXPORTS/GDP	15.21	15.88	17.88	18.98	18.65	20.56	20.55	28.56
IMPORTS/GDP	20.68	20.23	19.57	19.25	18.21	18.13	18.01	16.36
TRADE DEFICIT/GDP	-5.47	-4.35	-1.69	-0.27	0.44	2.43	2.54	12.2

Table 3.2: Real Income by Sectors (Base Case)

REAL INCOME (PERIOD)	1	2	3	4	5	6	7	8
Urban quintile 1	3.03	3.68	5.86	6.42	9.65	10.66	14.47	16.12
Urban quintile 2	5.52	6.39	9.45	10.42	14.71	16.32	21.47	23.98
Urban other	26.72	32.81	51.19	56.10	84.38	93.22	126.58	141.05
Med farm Sindh	2.69	3.18	3.10	3.52	3.78	4.32	4.84	5.48
Med farm Punjab	23.89	28.68	31.26	35.33	40.35	45.94	54.00	60.95
Med farm OthPak	3.74	3.90	4.30	4.89	5.07	5.80	6.32	7.17
Small farm Sindh	5.83	6.62	6.98	7.88	9.14	10.39	12.35	13.93
Small farm Punjab	8.74	11.61	15.84	17.69	23.94	27.03	35.38	39.66
Small farm OthPak	5.02	5.89	7.56	8.47	11.07	12.51	16.05	18.01
Landless Farmer Sindh	2.53	2.76	1.76	2.03	1.70	1.97	1.72	1.99
Landless Farmer Punjab	3.31	3.40	2.05	2.37	1.83	2.13	1.65	1.93
Landless Farmer OthPak	1.37	1.60	0.95	1.10	0.95	1.11	1.01	1.16
Waged rural landless farmers Sindh	1.64	1.72	1.50	1.72	1.56	1.81	1.73	1.99
Waged rural landless farmers Punjab	3.41	3.63	2.63	3.03	2.46	2.86	2.39	2.78
Waged rural landless farmers OthPak	0.77	1.32	1.24	1.43	1.09	1.28	0.98	1.15
Rural non-farm quintile 1	1.67	2.00	1.46	1.66	1.73	1.98	2.16	2.45
Rural non-farm quintile 2	2.07	2.44	1.91	2.24	2.35	2.78	3.03	3.55
Rural non-farm other	6.93	7.59	7.91	9.42	11.02	13.01	15.26	18.01
TOTAL	108.88	129.22	156.95	175.72	226.78	255.14	321.37	361.37

Table 3.3.With No Evasion

YEAR	1	2	3	4	5	6	7	8
REAL GDP	98.11	97.77	99.71	102.61	110.38	113.02	118.21	121.04
NOMINAL GDP	91.89	108.2	135.12	152.27	194.48	219.1	269.39	301.75
PRICE LEVEL	93.65	110.67	135.5	148.4	176.19	193	227	249
INFLATION	0	18.17	22.43	9.51	18.71	10.03	17.55	9.39
TAX REVENUES/GDP	20.18	21.97	21.5	21.06	21.41	21.02	22.67	22.97
GOV. EXPENDITURES/GDP	36.78	34.53	30.93	28.98	25.57	27.12	27.18	27.45
GOVERNMENT DEFICIT	-16.6	-12.56	-9.43	-7.92	-4.16	-6.1	-4.51	-4.48
INTEREST RATE	19.48	5.28	4.388	3.68	4.23	3.55	3.48	3.2
EXPORTS/GDP	16.55	17.42	15.69	17.08	14.65	16.05	14.36	15.77
IMPORTS/GDP	21.17	21.25	19.6	18.8	17.53	16.91	16.31	15.72
TRADE DEFICIT/GDP	-4.62	-3.83	-3.91	-1.72	-2.88	-0.86	-1.95	0.05

Table 3.4 Real Income by Sectors (with no Evasion)

REAL INCOME (PERIOD)	1	2	3	4	5	6	7	8
Urban quintile 1	2.79	3.36	5.14	5.60	8.23	9.02	11.98	13.22
Urban quintile 2	5.19	5.93	8.36	9.18	12.62	13.90	17.85	19.74
Urban other	24.55	29.91	44.78	48.81	71.90	78.80	104.7	115.5
Med farm Sindh	2.57	3.01	2.79	3.16	3.28	3.72	4.02	4.52
Med farm Punjab	22.76	27.06	27.99	31.51	34.77	39.32	44.56	49.86
Med farm OthPak	3.66	3.77	3.94	4.46	4.46	5.08	5.31	5.99
Small farm Sindh	5.49	6.16	6.18	6.95	7.81	8.82	10.13	11.32
Small farm Punjab	8.08	10.63	13.79	15.32	20.14	22.53	28.64	31.72
Small farm OthPak	4.67	5.41	6.61	7.36	9.33	10.46	13.02	14.45
Landless Farmer Sindh	2.36	2.54	1.57	1.80	1.48	1.71	1.46	1.68
Landless Farmer Punjab	3.05	3.13	1.82	2.10	1.59	1.86	1.42	1.66
Landless Farmer OthPak	1.29	1.49	0.85	0.98	0.83	0.96	0.85	0.98
Waged rural landless farmers Sindh	1.60	1.65	1.39	1.59	1.40	1.61	1.49	1.70
Waged rural landless farmers Punjab	3.28	3.46	2.42	2.79	2.22	2.57	2.10	2.43
Waged rural landless farmers OthPak	0.77	1.31	1.18	1.36	1.02	1.19	0.90	1.05
Rural non-farm quintile 1	1.57	1.85	1.29	1.46	1.48	1.68	1.78	2.00
Rural non-farm quintile 2	1.91	2.23	1.66	1.95	2.00	2.34	2.48	2.89
Rural non-farm other	6.44	7.00	6.95	8.29	9.42	11.10	12.59	14.85
TOTAL	102.0	119.8	138.7	154.6	193.9	216.7	265.3	295.60

Table 3.5: Utility of All Types of Consumers

	Base Case			Full Compliance		
Period	4	6	8	4	6	8
Urban quintile 1	0.01	0.02	0.03	0.01	0.01	0.03
Urban quintile 2	0.02	0.03	0.05	0.01	0.02	0.04
Urban other	0.49	0.80	1.12	0.18	0.44	1.01
Med farm Sindh	0.02	0.02	0.02	0.03	0.02	0.02
Med farm Punjab	0.47	0.47	0.50	0.48	0.46	0.46
Med farm OthPak	0.02	0.01	0.01	0.02	0.02	0.01
Small farm Sindh	0.09	0.09	0.10	0.09	0.09	0.09
Small farm Punjab	0.15	0.21	0.27	0.08	0.13	0.24
Small farm OthPak	0.05	0.06	0.08	0.03	0.04	0.07
Landless Farmer Sindh	0.01	0.00	0.00	0.01	0.00	0.00
Landless Farmer Punjab	0.01	0.00	0.00	0.01	0.01	0.00
Landless Farmer OthPak	0.00	0.00	0.00	0.00	0.00	0.00
Waged rural landless farmers Sindh	0.00	0.00	0.00	0.00	0.00	0.00
Waged rural landless farmers Punjab	0.01	0.00	0.00	0.01	0.01	0.00
Waged rural landless farmers OthPak	0.00	0.00	0.00	0.00	0.00	0.00
Rural non-farm quintile 1	0.00	0.00	0.00	0.00	0.00	0.00
Rural non-farm quintile 2	0.00	0.00	0.00	0.00	0.00	0.00
Rural non-farm other	0.04	0.04	0.05	0.03	0.04	0.05

Table 3.6: Investment in Five Sectors

Year	2	4	6	8
Base Case				
Investment in Type 1 Capital	8.89	4.72	6	5.53
Investment in Type 2 Capital	0.16	0.21	0.23	0.24
Investment in Type 3 Capital	1.25	0.31	0.96	0.65
Investment in Type 4 Capital	2.74	1.18	2.78	2.57
Investment in Type 5 Capital	1.52	0.91	1.36	1.38
Full Compliance				
Investment in Type 1 Capital	8.85	4.72	5.95	5.47
Investment in Type 2 Capital	0.16	0.21	0.23	0.25
Investment in Type 3 Capital	1.25	0.27	0.96	0.55
Investment in Type 4 Capital	2.88	1.21	2.97	2.72
Investment in Type 5 Capital	1.53	0.88	1.35	1.34

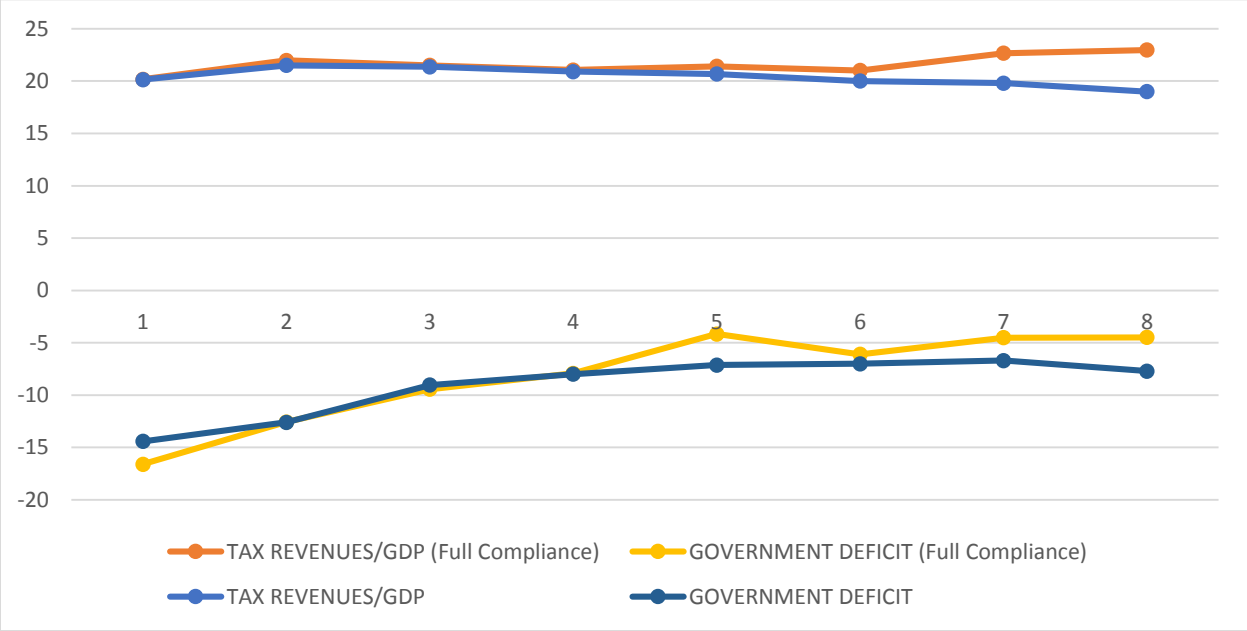

Figure 3.1: Tax Revenue to GDP Ratio and Budget Deficit to GDP Ratio (Base Line and Full Compliance)

APPENDIX 1

Table 1. A1: Detailed Description of the Fiscal Policy Variables

Fiscal Policy Variables	Operationalization for State Local Government Budget reported By U.S. Census
Tax	Total Tax
	Property Tax
	Corporate Net Income Tax
	General Sales Tax
	Total Income Tax
	License Tax (Excluded)
Other Revenue Sources (Excluded)	Miscellaneous general revenue
	Death and gifts
	Severance
	Documentary and stock transfers
	Other taxes
	Liquor store revenue
	Utility revenue
	Total intergovernmental revenue
Expenditure	Total Current Capital Spending on
	Education
	Health, hospital and human services,
	Highways
	Housing (Excluded)
	Public safety
	Community development (Excluded)
	Total current operational spending on
	Education, Health, highways, Housing and Public Safety (Excluded)
	Total transfers payment and income securities (Excluded)
	Public welfare (Excluded)
	Employment securities administration (Excluded)
	Insurance trust expenditure (Excluded)
	Veteran's services (Excluded)
Other Expenditures (Excluded)	Current spending on
	Liquor store expenditure
	Utility expenditure
	Government administration
	Financial administration
	General control and general public buildings
	Debt services and interests
	Total intergovernmental expenditure

Table 1.A2: Endogeneity Test (Szroeter Test, 1978)

Variables	Chi Square	df	P
Total Tax	50.7	1	0.000
Property Tax	81.12	1	0.000
General Sales Tax	95.71	1	0.000
Income Tax	72.14	1	0.000
Corporate Income Tax	252.41	1	0.000
Productive Spending	7.51	1	0.000

Note: Null hypothesis is variance of error term is not related to independent variable.

Table 1.A3: Validity test of Instrumental Variables

Test	Statistic	P value
Score Test (score χ^2)	1.566	0.668
Kleibergen-Paap rk LM statistic	16.438	0.000

The Score test verifies two points: whether instruments are uncorrelated with error term or not and equation is correctly specified or not. Kleibergen test verifies whether instruments are relevant or not. Here we use score test instead of Sargan test due to having robust and cluster standard error in the estimation.

Table 1.A4: High Wage Employment OLS and Fixed effect using fiscal variables measured by dollar of state personal income (1977-2012)

VARIABLES	OLS	FE
Total Tax (PDSPY)	0.055***	-0.001
	(0.010)	(0.020)
Productive Spending (PDSPY)	-0.069**	-0.0297
	(0.028)	(0.0314)
Heating Degree Days	0.000*	0.000
	(0.0001)	(0.000)
Unemployment Rate	0.049***	-0.002
	(0.007)	(0.008)
Labor Skill	0.026***	0.024***
	(0.003)	(0.008)
Urban Population (%)	0.022***	0.001
	(0.001)	(0.011)
Average Price of Electricity	0.005	0.015
	(0.006)	(0.029)
Crime per capita	0.313***	0.100***
	(0.062)	(0.031)
Observations	1,728	1,728
Number of states		48

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01

Table 1.A5: 2SLS Estimation using all the specifications and ratio of high skilled labor to Total employment as dependent variable

VARIABLES	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio
Total Tax per capita	0.001	-0.001						
	(0.001)	(0.000)						
Productive Spending per capita	0.001	0.001						
	(0.001)	(0.001)						
Δ total Taxes per capita			-0.001					
			(0.004)					
Δproductive spending per capita			0.005 (0.006)					
Δ t-4 total tax per capita				0.0002				
				(0.002)				
Δ t-4 productive spending per				-0.001				
				(0.002)				
Total tax per $ of personal income					1.164** (0.527)	-0.227 (0.437)		
Productive spending (PDSPY)					-0.268	0.476		
					(0.823)	(0.722)		
Δ total tax (PDSPY)							0.094	
							(2.063)	
Δ productive spending (PDSPY)							5.458	
							(5.813)	
Δ t-4 total tax (PDSPY)								-0.157
								(0.489)
Δ t-4 productive spending (PDSPY)								-0.452
								(1.572)
Control	×	×	×	×	×	×	×	×
Year Fixed Effect	×	×	×	×	×	×	×	×
State Fixed Effect	×	×	×	×	×	×	×	×

Note: PDSPY is per dollar of state personal income. Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 le

Table 1.A6: 2SLS Estimation using all the specifications and Year 1977-2007 and different taxes

VARIABLES	Specification 1 (level)	Specification 2 (change in HW)	Specification 3 (change in HW)	Specification 4 (change in HW)
Property Tax per capita	0.361	0.114		
	(0.902)	(0.219)		
General Sales Tax per capita	0.260	-0.052		
	(0.495)	(0.096)		
Total Income Tax per capita	-0.439	-0.112		
	(0.664)	(0.187)		
Corporate Net Income Tax per capita	-2.358	-0.347		
	(4.101)	(0.896)		
Productive Spending per capita	-0.052	0.039		
	(0.032)	(0.050)		
Δ Property Tax per capita			-2.257	
			(4.394)	
Δ General Sales Tax per capita			-0.695	
			(1.298)	
Δ Total Income Tax per capita			0.085	
			(0.808)	
Δ Corporate Net Income Tax per capita			-1.406	
			(8.162)	
Δ Productive Spending per capita			-0.037	
			(0.583)	
Δt-4. Property Tax per capita				2.297
				(15.61)
Δt-4. General Sales Tax per capita				0.592
				(5.035)
Δt-4. Total Income Tax per capita				-1.058
				(6.616)
Δt-4 Corporate Net Income Tax per capita				9.569
				(66.36)
Δt-4. Productive Spending per capita				1.042
				(7.375)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×
Number of states	47	47	47	47

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.A7: 2SLS Estimation using all the specifications and Year 1977-2001 and with total tax

VARIABLES	total employment	Change in employment	Change in employment	Change in employment
Total Tax per capita	-0.041	-0.007		
	(0.030)	(0.017)		
Productive Spending per capita	0.140**	0.036		
	(0.069)	(0.042)		
Δ.Total Tax per capita			0.167	
			(0.297)	
Δ Productive Spending per capita			-0.019	
			(0.131)	
Δt-4.total tax per capita				0.002
				(0.041)
Δt-4productive spending per capita				-0.014
				(0.040)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×
Number of States	47	47	47	47

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.A8: 2SLS Estimation using all the specifications and Year 1991 and above and total tax and different taxes

1. A8.1: Total Tax per capita

	Specification1	Specification2	Specification 3	Specification 4
VARIABLES	(level)	(change in HW)	(change in HW)	(change in HW)
Total Tax per capita	-0.074	0.012		
	(0.068)	(0.021)		
Productive Spending per capita	0.136**	0.028		
	(0.068)	(0.044)		
Δ Total Tax per capita			0.046	
			(0.164)	
Δ Productive Spending per capita			-0.461	
			(0.442)	
Δt-4.total tax per capita				-0.009
				(0.045)
Δt-4productive spending per capita				-0.124
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

1. A8.2: Different Taxes

	Specification1	Specification2	Specification 3	Specification 4
VARIABLES	(level)	(change in HW)	(change in HW)	(change in HW)
Property Tax per capita	0.529	-0.142		
	(0.426)	(0.139)		
General Sales Tax per capita	0.331	0.124		
	(0.304)	(0.099)		
Total Income Tax per capita	-0.711**	0.031		
	(0.298)	(0.097)		
Corporate Net Income Tax per capita	-0.712	0.475		
	(1.304)	(0.430)		
Productive Spending per capita	0.227	-0.100		
	(0.191)	(0.063)		
Δ Property Tax per capita			-0.449	
			(2.444)	
Δ General Sales Tax per capita			-0.278	
			(2.211)	
Δ Total Income Tax per capita			0.366	
			(1.788)	
Δ Corporate Net Income Tax per capita			2.310	
			(4.997)	
Δ Productive Spending per capita			-0.244	
			(1.097)	
Δt-4 Property Tax per capita				0.127
				(0.140)
Δt-4 General Sales Tax per capita				0.262
				(0.238)
Δt-4 Total Income Tax per capita				-0.103
				(0.197)
Δt-4 Corporate Net Income Tax per capita				-0.565
				(0.761)
Δt-4 Productive Spending per capita				-0.0665
				(0.195)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.A9: High wage employment as percentage of total employment (state wise average for all years)

Census/CPS Code for States	State Name	Percent's of total employment
11	Maine	19.06
12	New Hampshire	27.42
13	Vermont	20.16
14	Massachusetts	31.88
15	Rhode island	26.55
16	Connecticut	33.74
21	New York	29.55
22	New Jersey	34.45
23	Pennsylvania	26.93
31	Ohio	27.43
32	Indiana	23.90
33	Illinois	29.73
34	Michigan	31.08
35	Wisconsin	25.38
41	Minnesota	26.43
42	Iowa	20.01
43	Missouri	23.29
44	North Dakota	16.44
45	South Dakota	14.14
46	Nebraska	18.94
47	Kansas	22.27
51	Delaware	27.99
52	Maryland	33.88
54	Vermont	29.57

55	West Virginia	22.58
56	North Carolina	20.48
57	South Carolina	19.62
58	Georgia	23.91
59	Florida	21.64
61	Kentucky	21.49
62	Tennessee	20.02
63	Alabama	21.47
64	Mississippi	17.03
71	Arkansas	15.23
72	Louisiana	23.07
73	Oklahoma	20.23
74	Texas	22.28
81	Montana	17.24
82	Idaho	18.50
83	Wyoming	24.67
84	Colorado	28.51
85	New Mexico	20.19
86	Arizona	23.36
87	Utah	23.72
88	Nevada	25.24
91	Washington	29.70
92	Oregon	24.76
93	California	28.07

Table 1.A10: 2SLS Estimation using all the specifications for 16 states

	Specification 1	Specification2	Specification 3	Specification 4
VARIABLES	(level)	(change in HW)	(change in HW)	(change in HW)
Total Tax per capita	-0.221**	0.001		
	(0.058)	(0.025)		
Productive Spending per capita	0.253	-0.010		
	(0.226)	(0.151)		
Δ. Total Tax per capita			-0.027	
			(0.273)	
Δ. Productive Spending per capita			0.257	
			(0.558)	
Δt-4 Total Tax per capita				-0.028
				(0.098)
Δt-4 Productive Spending per capita				-0.037
				(0.350)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×
Observations	540	525	525	480
Number of states	15	15	15	15

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

Table 1.A11: 2SLS Estimation using all the specifications for 9 states

VARIABLES	Specification1 (level)	Specification2 (change in HW)	Specification 3 (change in HW)	Specification 4 (change in HW)
Total Tax per capita	0.0184	0.001		
	(0.047)	(0.019)		
Productive Spending per capita	0.213	-0.065		
	(0.230)	(0.095)		
Δ Total Tax per capita			-0.217	
			(0.471)	
Δ Productive Spending per capita			-0.107	
			(0.519)	
Δt-4 Total Tax per capita				0.092
				(0.141)
Δt-4 Productive Spending per capita				-0.003
				(0.103)
Controls	×	×	×	×
Year Fixed Effect	×	×	×	×
State Fixed Effect	×	×	×	×
Observations	324	315	315	288
Number of states	9	9	9	9

Note: Standard Error are Heteroskedasticity robust and clustered by state level. * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

APPENDIX 2

Note 2. A1: Slemrod's Methodology to Calculate Tax Evasion

Tax liability is a step function of taxable income and the step length is 50 dollars of income. For calculating tax liability, taxpayers at first look at the table based on marital status and then look at the column based on the number of exemptions and look at the rows based on the level of income (income bracket is $50). There are two types of evasion: primary and secondary evasion. Primary evasion is the amount of income understatement. If the household wants to evade then they will report a figure of taxable income near to the top of the next lowest bracket. Primary evasion decision problem for the household is as follows[74]

Max $\big(1-p(E,\Phi)\big)\,U\big(y-T(y-g)\big)+\big(p(E,\Phi)\big)U\Big(y-T(y)-\Omega\big(T(y)-T(y-E)\big)\Big)$ [75] (1)

The Utility function is strictly concave by assumption.

The first order condition associated with (1) is as follows

$\big(1-p(E*,\emptyset)\big)tU_f' = p(E*,\emptyset)\Omega tU_c' + \frac{\partial p}{\partial g}\,(E^*,\emptyset)(U_f - U_c)$ if E*>0

And $\big(1-p(0,\emptyset)\big) < p(0,\emptyset)\Omega$ if E*=0

If the evasion is successful, the utility is U_f and if the evasion is unsuccessful, the utility isU_c. Moreover, if optimal amount of primary evasion (E*) is zero then it indicates less than a fair gamble.

[74] Individual's after tax income is dependent on whether the tax payer's is being caught cheating or not. If he/she is not caught cheating then after tax income is $Y_A = y - T(y-g)$ and if she /he is caught then after tax income is as follows $y - T(y) - \Omega\big(T(y) - T(y-g)\big)$

[75] The probability of detection is a function of taxable income understated (E) and also some other characteristics of the type of evasion (Φ).Slemrod here mentioned that it is easier to detect understatement of wages and salaries by tax payers than overstatement of some other deductions.

On the other hand, secondary evasion is the increment to the understatement taken in response to the step nature of the tax tables. Suppose d is the number of dollars of understatement which is required to go to the next lowest income bracket then secondary evasion will occur if

$$\left[\left(1-p(d,\Phi)\right)U\left(y-T(y-d)\right)+\left(p(d,\Phi)\right)U\left(y-T(y)-\Omega\left(T(y)-T(y-d)\right)\right)\right]$$
$$-U\left(y-T(y)\right)>0$$

If ΔT is the tax saving due to secondary evasion then

$$\left(1-p(d,\Phi)\right)\left[U(y-T(y)+\Delta T)-U(y-T(y)\right]$$
$$+\left(p(d,\Phi)\right)\left[U(y-T(y)-\Omega\,\Delta T)-U\left(y-T(y)\right)\right]>0$$

The prediction from this model shows that households engaging in primary evasion also tend to evade taxes furthermore by secondary evasion. Slemrod (1985) argue that primary evader is concerned about the probability of detection, the gain if undetected and the loss if detected. If d is low then still there is some expected gain from secondary evasion even if p is positive. Therefore, the location of a household's taxable income within $50 bracket can be used as an indicator of tax evasion. For individual level data, tax evasion is measured by an index (index values lies from 1 to 50) derived from the location of a household's taxable income within $50 bracket. In this study, I am using $100 tax bracket to calculate the indicator of tax evasion.

Table 2.A1: IRS Districts and Regions by State

STATE	DISTRICT	STATE	DISTRICT
Alabama	Gulf Coast	Montana	Rocky Mountain
Alaska	Pacific North West	Nebraska	Midwest
Arizona	Southwest	Nevada	Southwest
Arkansas	Arkansas-Oklahoma	New Hampshire	New England
	Central California	New Jersey	New Jersey
	Los Angeles	New Mexico	Southwest
	Northern California		Brooklyn
California	Southern California		Manhattan
Colorado	Rocky Mountain		Upstate New York
	Connecticut-		
Delaware	Delaware-Maryland	North Dakota	North Central
Florida	North Florida	Ohio	Ohio
	South Florida	Oklahoma	Arkansas-Oklahoma
Georgia	Georgia	Oregon	Pacific North West
Hawaii	Pacific North West	Pennsylvania	Pennsylvania
			Connecticut-
Illinois	Illinois	South Carolina	North-South Carolina
Indiana	Indiana	South Dakota	North Central
Iowa	Midwest	Tennessee	Kentucky-Tennessee
Kansas	Kansas-Missouri	Texas	North Texas
Kentucky	Kentucky-Tennessee		South Texas
Louisiana	Gulf Coast	Utah	Rocky Mountain
Maine	New England	Vermont	New England
Maryland	Delaware-Maryland	Virginia	Virginia-West Virginia
Massachusetts	New England	Washington	Pacific North West
Michigan	Michigan	West Virginia	Virginia-West Virginia
Minnesota	North Central	Wisconsin	Midwest
Mississippi	Gulf Coast	Wyoming	Rocky Mountain

Source: The Internal Revenue Service

Table 2.A2. Examination Coverage: Individual Income Tax Returns Examined, by Size of Adjusted Gross Income, Fiscal Year 2008

Size of adjusted gross income [1]	Returns filed in Calendar Year 2007 (percent) [2]	Examination coverage in Fiscal Year 2008 (percent) [3]
All returns [4]	**100**	**1**
No adjusted gross income [5]	2.13	2.15
$1 under $25,000	40.51	0.9
$25,000 under $50,000	24.31	0.72
$50,000 under $75,000	13.44	0.69
$75,000 under $100,000	7.99	0.69
$100,000 under $200,000	8.69	0.98
$200,000 under $500,000	2.25	1.92
$500,000 under $1,000,000	0.43	2.98
$1,000,000 under $5,000,000	0.23	4.02
$5,000,000 under $10,000,000	0.02	6.47
$10,000,000 or more	0.01	9.77

[1] Adjusted gross income is total income, as defined by the Tax Code, less statutory adjustments—primarily business, investment, and certain other deductions.

[2] In general, examination activity is associated with returns filed in the previous calendar year.

[3] Represents the number of returns examined in Fiscal Year 2008 for each adjusted gross income (AGI) class, as a percentage of the total number of returns filed in Calendar Year 2007 for that AGI class.

[4] In addition to examinations of returns filed, IRS examined more than 158,000 cases in which no return was filed. These nonfiler cases were referred for examination by the Collections Program and the Automated Substitute for Return Program (ASFR). In the ASFR Program, IRS uses information returns (such as Forms W-2 and 1099) to identify persons who failed to file a return and constructs tax returns for certain nonfilers based on that third-party information. These nonfiler cases are excluded from the examination data in this table.

[5] Includes returns with adjusted gross income (AGI) of less than zero. AGI may be less than zero when a taxpayer reports losses or statutory adjustments exceed tot

SOURCE: Research, Analysis, and Statistics, Office of Research RAS:R

Table 2.A3: Over Identification Test

Variables	Sargan chi sqaure	Basmann chi sqaure
Return Examined	0.371 (P =0.542)	0.371 (P =0.542)
Enforcement Cost	0.392 (P =0.530)	0.392 (P =0.531)
Civil Penalty Assessed	0.441 (P =0.506)	0.440 (P =0.506)

Note: Null hypothesis is excluded instruments are valid, i.e. uncorrelated with the error terms and correctly excluded from the estimation.

Note 2. A2: Quantile Regression

The Quantile Regression model introduced by Koenker and Basset is a kind of location model where quantile $q \in (0, 1)$ and it splits the data into proportions q below and (1-q) above (Baum, 2013). This minimizes sum of residuals which is more robust to outliers than least square estimators. Quantile regression estimators is asymptotically normally distributed. The most popular form of quantile regression is median regression in which 50th quantile is measured. To be more specific, let $\widehat{y(x)}$ is the prediction function where $\widehat{y(x)} = \hat{\beta}\, xi$ and $e(x) = y - \widehat{y(x)}$ is the estimated residuals. Then in case of quantile regression, the loss associated with prediction errors $L(e) = |e|$ and optimal prediction minimizes $\sum|e|$ where the weight on the residuals depends upon the quantiles to be estimated. Therefore, the quantile regression estimator minimizes the following objective functions

$$Q(\beta_q) = \sum_{i:yi>xi'\beta}^{N} q|yi - xi'\beta_q| + \sum_{i:yi<xi'\beta}^{N} (1-q)|yi - xi'\beta_q|$$

It is solved by linear programming problems. Bootstrap procedures are used to estimate standard errors (as suggested by Buchinsky 1995).

Table 2.A3 : Under identification, over identification and weak instruments test

	Returns Examined	IRS Budget
Kleibergen Paap rk LM statistics	15.75	11.75
	(0.004)	(0.001)
Kleibergen Paap rk Wald F statistics	5.858	4.877
	(0.000)	(0.006)
Hansen J statistics	7.454	6.050
	(0.056)	(0.016)

Table 2.A4: Two Stage Quantile Regression (Based on Wage and Salary Income and AGI)

	0.2	0.4	0.6	0.6
Return Examined	-1.444	-1.643	0.855	0.005
	(2.333)	(1.288)	(0.549)	(0.031)
Enforcement cost	-1.723	-0.871	0.315	0.000
	(1.880)	(0.691)	(0.342)	(0.000)
Civil Penalty Assessed	-0.849	0.532	0.423	0.000
	(2.545)	(0.457)	(0.753)	(0.000)

Note: * Significance at the .10 level; ** significance at the .05 level; *** significance at the .01 level

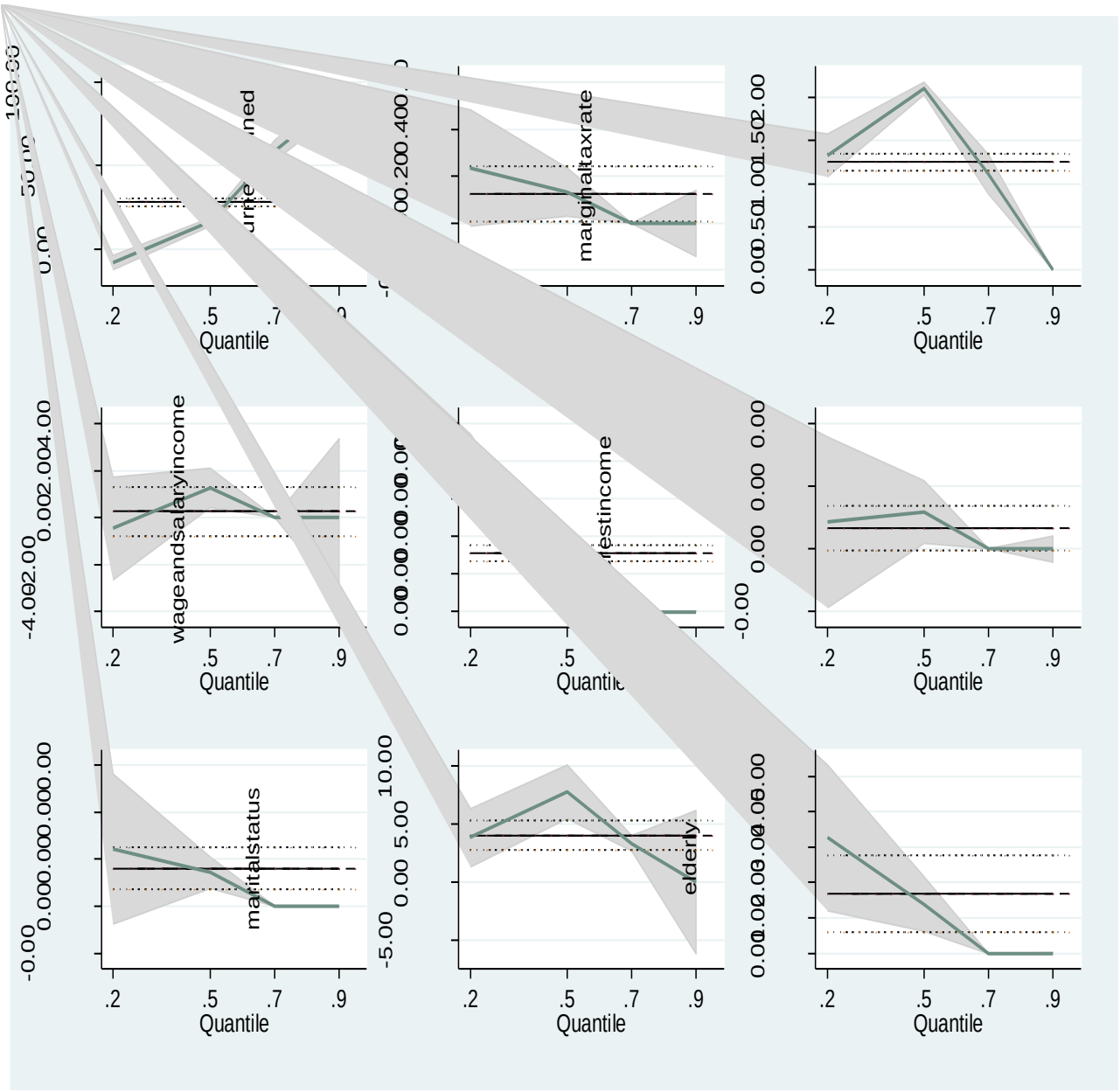

Figure 2.A1: Marginal Effects for estimated Quintile Regression and OLS (Return examined)

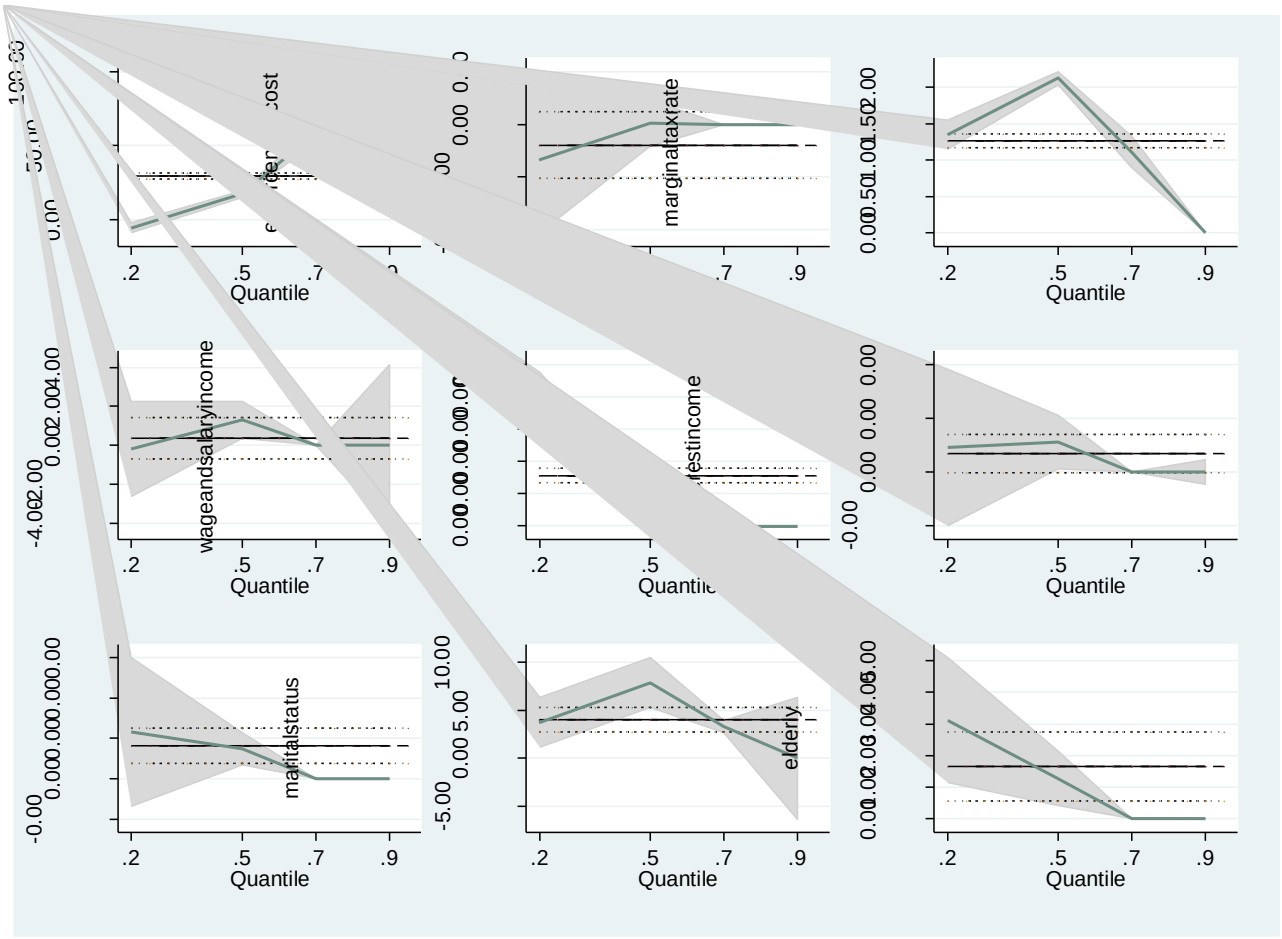

Figure 2.A2: Marginal Effects for estimated Quintile Regression and OLS (Enforcement Cost)

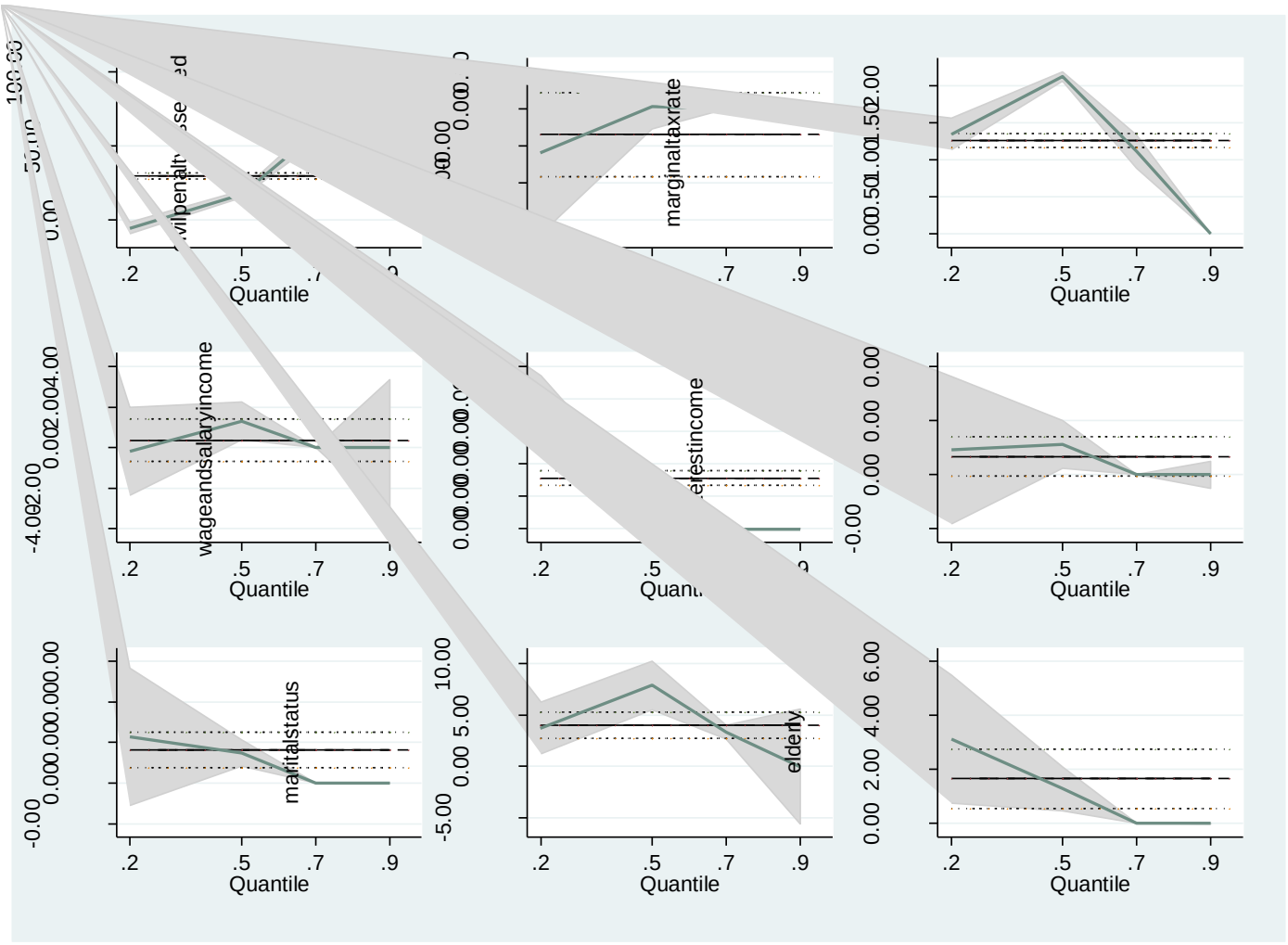

Figure 2.A3: Marginal Effects for estimated Quintile Regression and OLS (Civil Penalty Assessed)

APPENDIX 3

Note 3.A1 Definition of Several Issues in Sales Tax Evasion

a. Registration Issues: Sometimes, businesses remain unregistered e.g. wholesalers, dealers. They end up doing both sales tax and income tax evasion.

b. Fake and Flying Invoices – Invoices issued by dummy firm which only exist on paper. This type of firm shows fake purchases or purchases from other fake firms. On the other hand, some times, invoices are issued to parties other than the original sellers

c. Fraudulent Refunds – It includes refunds claimed from fake or flying invoice or transactions made by dummy firms.

d. Undervaluation and Fictitious Sales: Sometimes, firms are engaged in sales suppression. Audit of the firm cannot reveal the true picture.

e. Misuse of Concessions: Misuse of zero rating tax scheme as well as low tax scheme is also observed.

f. Weaknesses in Data Processing: The automation systems of Federal Board of Revenue in Pakistan delay detection of tax evasion. Automatic cross verification can reduce this problem.

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