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The Consequences of Poor Tax Administration: Collections, Growth, and Corruption

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THE CONSEQUENCES OF POOR TAX ADMINISTRATION: COLLECTIONS, GROWTH, AND EVASION

BY
CHANDLER BLALOCK MCCLELLAN

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

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2013

ACCEPTANCE

This dissertation was prepared under the direction of the candidate'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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ABSTRACT

THE CONSEQUENCES OF POOR TAX ADMINISTRATION:
COLLECTIONS, GROWTH, AND EVASION

BY

CHANDLER BLALOCK MCCLELLAN
March 2013

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This dissertation examines three different aspects of tax administration's effect on tax revenue collection, economic growth, and tax evasion. By understanding the role of good tax administration, policymakers can pursue effective tax reform, increase tax revenues efficiently, and minimize the impact on taxpayers.

The first study examines shortfalls in tax revenue, or the tax gap. The tax gap arises for a variety of reasons and understanding the root causes of the gap is a necessary first step in reducing or eliminating the gap. This study examines the contribution of four factors to the tax gap: willful tax evasion, errors in filing taxes, incompetence in the tax administration, and tax collector corruption. By combining firm level data from 79 countries with macroeconomic variables, this study finds that complexity leading to unintentional tax evasion and poor tax administration are significant drivers of the tax gap. Tax reform that reduces tax code complexity and increases the quality of tax administration services provides the largest marginal gains in reducing the tax gap.

The second study uses the same data set to examine the effects of tax enforcement measures and tax revenue shortfall on economic growth. Lower tax revenues have a

theoretically mixed effect on growth as they create more disposable income for investment, but simultaniously reduce funds for public goods. This study finds that while increased enforcement measures reduce growth, high tax revenue collection serve to increase growth. The results suggest that reforms focusing on increasing revenue without resorting to greater enforcement measures are desirable.

The final aspect of tax administration this work examines the the relationship between corrupt tax administration and tax evasion. Since this relationship is endogenous, causality is difficult to determine. Using an instrumental variable approach as well as propensity score matching, this study suggests that corruption drives evasion. As a result, policy makers should focus on ensuring an honest tax administration, thereby addressing both issues simultaneously.

Taken together, the results of this dissertation argue for tax reforms to focus on creating a high quality tax administration that focuses on a service paradigm of tax collection. Under the service paradigm, tax authorities provide greater assistance to tax payers, creating conditions favorable for compliance without relying on coercive enforcement measures.

Chapter 1: Introduction

Effective tax administration is an issue as old as taxation itself. The balancing act between maximizing tax revenues and minimizing the impact on the populace in which the state must engage was evident as early as 2350 BC, when the first recorded tax revolt displaced the Sumerian dynasty of the Ur-Nanshe. This revolt was triggered by both high taxes and a harsh and oppressive bureaucracy in which throughout the state "There were the tax collectors" (Burg 2004). Revolts due to harsh taxation policies are not the only concern for the state regrading tax administration. During its decline in the 3rd-4th century, the Roman empire, having placed the tax collecting power in the hands of the *praesides*, often found its tax revenue reduced as the more powerful and influential collectors failed to send their collections to the empire (Southern 2001). The history of taxation is replete with governments that have failed due to poor taxation administration and policies (Burg 2004).

Despite the millennia that have past since the Ur-Nanshe dynasty's downfall, today's policymakers are still grappling with the questions of effective tax administration. This work is an attempt to address some of those questions of tax administration. To effectively deal with an issue, a policymaker must first know it is an issue. The first portion of this study examines the determinants of the Value Added Tax (VAT) revenue shortfalls in an attempt to inform policymakers on where they should focus their efforts.

The VAT is an important source of revenue for a majority of the world's countries.

Like any tax, the VAT is subject to revenue shortfalls in which collected revenue is less than expected collections calculated by the tax rate and tax base. This tax gap arises for a variety of reasons and understanding the root causes of the gap is a necessary first step in reducing or eliminating the gap.

Chapter two examines the contribution of four factors to the tax gap: willful tax evasion, errors in filing taxes, incompetence in the tax administration, and tax collector corruption. The first two factors, willful evasion and tax errors, arise from actions taken by the taxpayer and can be addressed by the tax administration through higher levels of enforcement or enhancing of tax preparation aid respectively. The last two factors are tax administration shortcomings that can be dealt with through administration reform.

Using new firm level data allows the examination of the taxpayer factors, whereas before only the tax administration factors could be studied. By combining data from 79 countries with macroeconomic variables, this chapter finds that complexity leading to unintentional tax evasion and poor tax administration are significant drivers of the tax gap. Tax reforms that reduce tax code complexity and increase the quality of tax administration services provides the largest marginal gains in reducing the tax gap.

While these reforms would serve to increase tax revenue collections, whether an increase in revenue collection serves to promote economic growth is the next question this study seeks to answer. An extractive government may only care about maximizing revenue, but benevolent governments will attempt to maximize their citizens utility. In this respect, if the additional tax revenue from increased collections is more productively

employed by the private sector, the revenue increase will ultimately reduce utility.

The third chapter of this study examines an increase in revenue collections in light of a theoretical model that incorporates tax enforcement into an endogenous growth setting. Using the same data as the first part of this study and focusing on the VAT again, two enforcement factors, the probability of audit and the cost of evasion, are empirically tested to find their effects on economic growth. Additional analyses employing a panel of countries and incorporating tax collection efficiencies create a fuller picture of the effects of tax enforcement and administration on overall growth.

Consistent with the theoretical model, increased audits and higher evasion costs are associated with lower growth, as more resources are used in enforcing and evading the tax code. However, the theoretical model is shown to be incomplete, as results from examining the overall collection efficiency ratios show that reduced collections result in lower growth as well. These results suggest that focusing on enforcement factors to increase revenues may be detrimental to growth. Instead, other tax reforms that raise collection ratios more efficiently may result in higher growth.

The fourth chapter of this study deals with the relationship between tax administration corruption and evasion. While corruption and evasion often occur together, with tax evaders bribing tax officials to abet their evasion. Due to this simultaneity, the causal relationship between corruption and evasion is not clear. More corrupt societies could enable more tax evasion as corrupt officials seek more income or higher levels of tax evasion could drive corruption by offering more opportunity for

bribes. From a tax administration standpoint, understanding this relationship allows policymakers to address the underlying problem, corrupt officials or criminal taxpayers, and thus address both issues at the same time.

First, this chapter develops a theoretical model incorporating a corrupt tax administration and tax evasion costs into the standard expected utility model of tax evasion. The theoretical results show that a higher probability of being inspected by a corrupt auditor reduces declared income, but the bribe rate and the corrupt official's effectiveness in aiding evasion produce an ambiguous effect on evasion rates.

To empirically test these factors, this study uses the same data used in the previous chapters, but conducts the analysis at the firm level instead of the country level. Two methods are employed to deal with the potential endogeniety of evasion and corruption. The first is an instrumental variable approach that uses other types of corruption as an instrument for tax corruption and the second is a propensity score matching analysis in which the firm's experience with corrupt tax collectors is used as a treatment.

The results from these analyses suggest that corruption drives higher levels of evasion. A culture of corruption creates the opportunities for and reduces the stigma associated with breaking the tax laws. Without that culture, tax evasion rates would fall and governments would collect more in tax revenue. By focusing reforms on creating a better tax administration, policy makers can address both problems and reduce both corruption and evasion.

While this study attempts to answer these questions regarding tax administration, it is important to note the shortcomings which limit the power and scope of this analysis. The data used are from surveys of firms from mostly developing countries. As a result, the main tax being analyzed is the VAT. While an important tax, the VAT is not the only tax, and thus generalization of the results to all taxes is problematic. Next, the structure of the data sources does not always allow the most sophisticated analysis to be performed. Consequently, these results may be capturing other phenomena which may be at work and not the relationship being examined. Finally, data availability, not all of the factors identified in the theoretical models can be examined and the factors that are examined could always be measured with better methods and measurement. As a result, a great deal remains for future work.

Despite these shortcomings and taken together, the results of these three chapters indicate that good tax administration is vital. In this respect, they are consistent with a wide body of literature that affirms the importance of tax administration (Bird 2004). Further they suggest that tax administration reforms should be implemented with a view to not only make the administration as honest and competent as possible, but also to make it more taxpayer friendly. This too is in line with an emerging strand of the literature on tax reform (Alm and Martinez-Vazquez 2003).

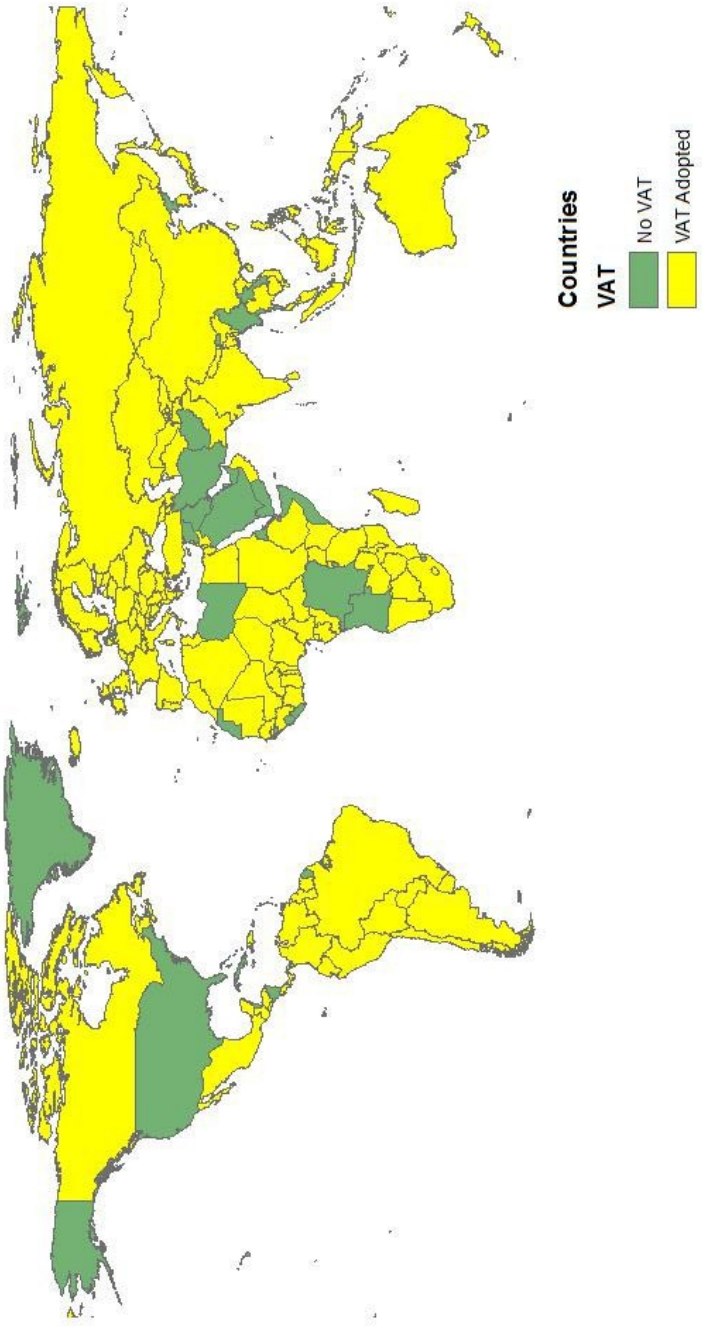
Chapter 2: Mind the Gap: A Decomposition of VAT Collection Efficiency

Introduction

Since its inception in the 1950's in France, the Value Added Tax (VAT) has grown to become a major source of revenue for most world governments. The popularity of the VAT lies in several perceived advantages that include vast revenue potential, enhanced compliance and administrative attributes, and economic efficiency effects. Currently, VATs raise 20% of government revenue and cover over 4 billion people (Keen and Lockwood 2010). Every OECD country, with the exception of the United States, implements a VAT, as do the major economies of China, Russia, and India. As such, a VAT is levied on a significant portion of the world's consumption.

The widespread adoption of the VAT has not yet slowed. First introduced in developed European countries, it is now implemented in over 140 countries (see Figure 2.1). Several countries that have not yet introduced a VAT are on the verge of doing so, particularly in the Caribbean and Middle East regions. Despite past resistance to the VAT, even in the United States pressures to increase federal revenue have recently prompted policy makers to broach the idea of instituting a VAT. Beyond the national sphere, the VAT is also becoming an important source of sub-national revenues, with several Indian states and Canadian provinces having implemented VATs in the recent past.

Figure 2.1: Countries with a VAT



Despite the central importance of the VAT to government revenues, any shortfall between expected revenue and actual revenue collected may adversely affect government operations. The VAT gap, or the difference between expected and actual revenue, varies widely from country to country. Estimates of the tax gap from EU-25 countries range from 1% and 2% of theoretical revenues in Lithuania and Estonia respectively to 23% and 30% in Hungary and Greece, with an average gap of 12% (Reckon LLP 2009). This 12% gap represents over € 106 billion, or approximately $147 billion, in lost revenue to European Union (EU) governments. Other studies have estimated compliance ratios, or actual revenue collection divided by the tax rate times private consumption, that range from 10-114% (Martinez-Vazquez and Bird 2011).

As is demonstrated by the variation in tax gaps, the quality of tax administration may vary widely across countries. The efficiency of a tax authority has several implications for a country's tax policy. Low revenues from weak administration could lead to higher tax rates designed to boost revenues which will also increase deadweight loss associated with taxation. Alternatively, different tax structures may be adopted in an effort to find the "right" structure, leading to increased costs if the final structure is more complex than necessary. If these policy changes do not address the fundamental weakness in tax administration that make changes seemingly necessary, then the changes could make a country worse off.

Tax collections can fall short of expected revenues for several potential reasons. Previous studies have examined the role of various factors such as tax structure and

resources available for administration. This study focuses on two potential channels by which a shortfall can occur that have not been extensively studied in the literature, tax evasion and tax administration quality.

Firms, faced with remitting a VAT based on their sales, have an incentive to avoid the tax and thus increase their profit, despite the fact that they will get back a credit for the VAT paid on the inputs of production. In the absence of tax enforcement, the taxed entity will theoretically pay no taxes, thereby maximizing its profit. This lack of compliance will lead to a shortfall in government revenue, with full non-compliance leading to zero revenue. To counter this behavior, the taxing authority must enforce compliance through audits and penalties, with better enforcement leading to higher collections.

Increased enforcement does not guarantee an elimination of tax collections shortfalls. The amount of tax revenue collected depends not solely on how well a tax authority enforces compliance or how well the authority is funded, but also on how efficiently a tax authority operates in collecting payments. Even assuming zero tax evasion, if the tax authority is not competent or is corrupt, then tax revenues will fall short of the expected value. Understanding which issue, evasion or administration, is causing revenue shortfall is a first step in effective tax reform. While evasion and administration are linked, with lax or corrupt administration leading to increased evasion and high levels of evasion creating a culture in which corruption is tolerated or perhaps spurring tax administration reform, the greatest marginal benefit in reform comes from

addressing the most pervasive issue.

In addition to its bearing on tax administration reform issues, an understanding of the tax gap also has implications for studies of tax evasion. Studies that use the compliance ratio to examine tax evasion ignore the second component of the tax gap, thereby attributing the entire gap to evasion (e.g. Matthews 2003). This potentially creates problems for these studies if the compliance ratio is low due to tax administration issues and not evasion. This study seeks to decompose the tax gap for the VAT to determine the amount that is attributable to taxpayer factors such as evasion and mistakes and which portion arises from tax authority issues of corruption or incompetence.

Literature Review

There is a relatively small body of literature examining the causes of the VAT tax gap that has grown in recent years. Early attempts at explaining collection efficiency focused on the tax rates and base (Bogetic and Hassan 1993). While addressing an important concern regarding narrow versus wide bases, which is discussed below with regard to collection efficiency ratios, this study is fairly limited in scope. Bogetic and Hassan only focus on the complexity of the tax system as represented by multiple tax rates and bases. They found that more complexity and narrower bases reduce tax collection efficiency. While giving some evidence for the policy prescription of a wide base with a single rate, this approach does not address other factors potentially affecting shortfalls, including evasion and administration effectiveness.

Jack (1996) compares the experiences of VAT adoption in several Central and Eastern European nations. He found two distinct groupings of high and low efficiency countries, the study attributes the difference to the treatment of government purchases and other exemptions. Every country's tax code will address different aspects of taxation in different ways with the result that in no two countries will have the exact same base. This study illustrates that different tax bases could lead to significant differences in tax gap measures. Should one country exempt a certain type of consumption from taxation, its tax gap will seem higher than another country that does not exempt that type of consumption, regardless of evasion or administration issues. However, as Jack (1996) also notes, there are other drivers of the tax gap, including administration and evasion issues, that must be studied in addition to tax structure. By focusing on taxpayer and tax administration factors, my study supplements these works in exploring the causes of tax revenue shortfall. Due to the lack of tax structure measures in the datasets used, this study is unable to also account for the factors Bogetic and Hassan and Jack identify. However, so long as the structural factors are orthogonal to taxpayer and administration factors, then unbiased results will be estimated.

In a case study of Ukrainian VAT efficiency Bird and Gendron (2006) ascribe decreases in collection efficiency to degradations in tax administration quality and changes in tax policy that narrowed the Ukrainian tax base. The authors assumed no increases in evasion activity over their study period and note that while the Ukrainian gap is comparable to with countries such as Italy and Uruguay, it is much higher than the gap

for countries with tax administrations that are generally recognized as competent, such as Chile and the UK.

Incorporating both the VAT rate, the number of different rates, and administration costs, Agha and Haughton (1996) find that higher rates and different rates reduce collections while administration resources and experience with the VAT serve to increase collections. Again, as with other studies in this vein, the evasion decision made by the household is assumed to be solely a function of resources available to the tax authorities. As such, this study does not give any consideration to disentangling these effects.

Aizenman and Jinjarak (2008) examine the VAT gap in light of political economy considerations. The theoretical basis for their study rests on the traditional enforcement framework in which higher tax enforcement leading to higher collections. They suggest that tax enforcement is neglected in times of political change, thus leading to higher tax gaps. While finding that higher levels of development and political stability reduce the tax gap, the authors fail to identify the driving factors behind the smaller tax gaps. Given the enforcement framework, these factors, such as changes in the probability of audit and fine rates, encompass both tax evasion and administrative issues.

Esteller-Moré (2005) modeled tax administration at the regional level in Spain. Positing that administration efficiency depends on inputs, such as the number of tax inspector, which in turn depends on political considerations from the central government, this study includes a number of variables capturing tax administration resources. The author attempts to deal with the evasion issue by assuming that evasion is only a function

of enforcement resources and variables. While there is strong relationship between the two variables, evasion rates are not fully determined by tax administration resources. A number of studies have identified other factors, such as tax morale, that affect evasion rates (Alm and Torgler 2006, Cummings, Martinez-Vazquez, McKee and Torgler 2009, Torgler 2007). By focusing only on administrative factors affecting tax evasion, this study gives little insight into these other factors and thus does not complete the picture of compliance.

Ebrill et al. (2001) also forgoes attempting to disentangle these effects. They estimated a reduced form models using tax rates and other wider economic variables. This study found that economies that have higher tax rates, are more open to trade, are more literate, and have more experience with the VAT have higher collections. The author extrapolates that the literacy measure captures a higher quality workforce available for the tax administration. They note, however, that literacy is a rather crude proxy for this administration quality.

Despite the importance of the VAT to national government revenues, only a small body of literature has studied the determinants of the tax gap. The literature that does address the factors affecting the gap tends to focus on elements of the tax structure and administration or other macroeconomic factors. When the role of the taxpayer's decision to evade is considered, it is assumed to be endogenously determined by tax administration factors. As a result, the current literature largely ignores exogenous changes in evasion rates as a determinant of the tax gap. By failing to account for this

effect, the current literature is subject to omitted variable bias issues. This study attempts to address this issue by including measures of tax administration efficiency and taxpayer evasion, thereby disentangling the effects and providing further insight into the structure of the tax gap.

Theory and Methods

Tax revenue can fall short for a variety of reasons. Firms can choose to understate sales revenue or overstate deductions, thereby reducing their tax liability and taxes paid (Tanzi and Shome 1993). Additionally, complex tax regulations could result in accounting mistakes or discourage filing, leading to discrepancies between actual and reported income. Likewise, the tax authorities could contribute to revenue shortfalls in a number of ways. Corrupt tax agents will seek to appropriate tax revenue for themselves, thereby reducing the amount of tax revenue available to the central government. Further, poorly trained or funded tax agents will not be adequately equipped to fully collect all revenue due. The combination of tax evasion and poor or corrupt tax administration results in a significant portion of tax revenue shortfall.

Following Allingham and Sandmo (1972), the motives for firms or individuals to evade taxes have been grounded in an expected utility framework. In this framework firms and individuals seek to maximize expected utility which is generally a function of their respective profit or wealth levels. In both cases, illicit reduction of tax liability will increase profit or wealth levels, which results in higher utility levels. The cost of

reducing tax liability is the expected value of the penalty from being caught evading taxes, resources used in evading taxes and various non-pecuniary costs such as damage to reputation or guilt associated with failure to comply with a moral code or societal norms. Facing this tradeoff, a rational agent will evade taxes at the level where his marginal benefit from evasion equals the marginal costs.

While the economic agent's rational decision making process will result in tax evasion, another source of shortfall in tax revenue stemming from the actions of the taxed are legitimate mistakes in tax computation. In addition, tax code complexity also tends to increase compliance costs as more time and resources are spent dealing with tax regulations. As compliance becomes more difficult, taxpayers may opt to forgo preparing a full return and only remit what can easily be calculated. Further, a more complex tax system offers more opportunity for tax avoidance. For example, British exemptions on low priced imports such as CDs and DVDs allowed online retailers to forgo as much as £130m in tax remittances in 2011 (Bowers 2011). Such increases in tax avoidance arising from more complex tax systems also serves to increase the tax gap.

Conversely, increases in complexity could result in more revenue. Errors in calculation could also easily increase a taxpayer's liability. It has been estimated that approximately 8% of filers in the United States overpay their taxes (Smith and Kinsey 1987). Given a utility function increasing in wealth, it seems likely that this overpayment is the result of mistakes in calculation. Additionally, Torgler (2003) argues that increased complexity enhances notions of equity and that equity and tax compliance are

complementary. The three effects of broader tax bases, over calculation of taxes and enhanced equity, work to decrease the tax gap, thus tax code complexity creates an ambiguous effect on the tax gap. Empirical work on the effects of complexity on compliance has yielded inconclusive results, with Vogel (1974) finding a negative effect and Clotfelter (1983) finding a negative effect for non-business returns. Likewise, complexity has been shown to increase VAT compliance costs as well (Hansford, Hasseldine and Howorth 2003). However, Clotfelter also found no effect on business returns, as do Forest and Sheffrin (2002) for a wider population of tax returns. Complexity in the VAT has also been shown not to affect compliance (Biabani and Ramezani 2011). Regardless, in attempting to explain the components of the tax gap, the complexity of the tax code and the potential mistakes arising from that complexity should be taken into account.

Differentiating between intentional and unintentional tax evasion is an important distinction to make from a policy standpoint. If the root cause of evasion is primarily intentional, then strengthening enforcement policies, such as increasing the fine or audit rates, could be pursued as these measures have been shown to reduce evasion. However, if most evasion is the result of unintentional tax errors, then these policies might not be as effective at reducing evasion. Policies aimed at increasing education about the tax system or tax reforms to reduce the complexity of the tax system would be more efficient methods of reducing the tax gap.

In addition to the two types of taxpayer evasion, intentional and unintentional,

that must be considered when examining the tax gap, the activities of the tax administration must be taken into account. The theoretical literature on tax administrations identifies several channels by which weak tax administration can contribute to the tax gap problem (Bird 2004). Corrupt tax officials can appropriate revenue before it reaches the government, thereby exacerbating the official tax gap. Limited resources and budget constraints can prevent the tax administration from fully collected all due taxes. Finally, given the monopoly the tax administration has on tax collections, there is a lack of incentive to innovate and seek better tax collection strategies.

Corruption in the tax administration can lead to significant shortfalls in the amount of tax revenue that ultimately reaches the government. Corruption in the tax administration can be viewed as a principal-agent problem. The principal, the government, must designate agents, the tax collectors, to administer the tax system and ensure revenue flows to the government coffers. However, the agent's incentives are not always aligned with the principal's goals. In addition to engaging in rent seeking behavior to increase his own utility, agents in developing countries can be subject to familial or tribal pressures to provide patronage due to their lucrative position (Fjeldstad 2006). Poor working conditions or low pay could also induce the agent to engage in corruption activities such as accepting bribes to ignore evasion or outright appropriation of tax revenue. This corruption serves to increase the tax gap, and should be accounted for in any examination of the tax gap.

Even if a tax administration is not corrupt, shortfalls in the necessary resources to enforce the tax regulations will hamper its efforts to collect all taxes due. The tax administration apparatus can be viewed as a firm where inputs such as labor and infrastructure are used to produce the output of tax revenue. As such, a successful tax administration must have the appropriate level of inputs to fully function (Bird 2004). Particularly in developing countries which typically have low civil services salaries and limited levels of investment in public infrastructure, it is difficult to recruit qualified and educated staff and provide them with the tools, such as computers, to efficiently carry out their tasks (Devas, Delay and Hubbard 2001). Given such resource constraints, tax administrations can not fully perform audit activities or even collection activities. As a result, tax revenue that would be collected by a fully funded tax administration is forgone and the tax gap widens.

While all these factors contribute to the tax gap, each problem's solution has separate policy implications. To disentangle the tax gap, this study will rely on several different measures in an attempt to isolate the effect of each factor. Based on the discussion above, the tax gap in country i can be written as:

$$G_i = WE_i + UE_i + C_i + A_i + O_i \qquad (1)$$

where G_i is the tax gap, WE_i is the amount of willful evasion, UE_i is unintentional evasion, C_i is shortfall due to corruption, A_i is shortfall due to lack of resources by the tax administration, and O_i are other factors such as multiple tax rates or narrowed bases. To disentangle the effects of these components, it is necessary to determine how prevalent

these factors are and what their contribution is as a share of the tax gap.

Three VAT efficiency ratios relating actual collections to potential collections can be calculated depending on which tax base is chosen: the gross collection measure based on private consumption expenditure, the VAT efficiency ratio based on GDP, and the C-efficiency ratio based on total consumption expenditure (Martinez-Vazquez and Bird 2011). While the base for each ratio is consumption, each measure is differentiated on how consumption is measured. The gross collection ratio is based on private consumption expenditure and is calculated as:

$$GC = \frac{R_v}{\tau_{vat} * Cons_P} \qquad (28)$$

where GC is the efficiency ratio, R_v is the total actual revenue collected from the VAT, and τ_{vat} is the standard tax rate for the VAT and $Cons_P$ is private consumption expenditure. Similarly, the VAT efficiency ratio and the C-efficiency ratio are calculated as:

$$VE = \frac{R_v}{\tau_{vat} * GDP} \qquad (29)$$

$$CE = \frac{R_v}{\tau_{vat} * Cons_T} \qquad (30)$$

where GDP and $Cons_T$ are gross domestic product and total consumption expenditure respectively. In each ratio, the denominator gives the total theoretical amount of VAT revenue.

Due to a variety of factors, the actual revenue collected may fall short of this theoretical total. None of the tax bases used in these ratios are actual bases for

functioning VATs. Exemptions and zero-ratings narrow the base and multiple tax rates change the actual denominator further. Despite these measurement difficulties, ratios closer to one still indicate a smaller tax gap while larger gaps are accompanied by smaller ratios.

Data

This study will use three separate data sources on taxes. The first data source, on compliance ratios, is the data compiled by Martinez-Vazquez and Bird (2011), covering 107 countries over a 19 year period from 1990 to 2008. To disentangle the effects of tax evasion, a second data source detailing firm level evasion is used. This study uses a combination of the World Enterprise Survey (WES) and the Business Environment and Enterprise Performance Survey (BEEPS), both gathered by the World Bank. This data set provides firm level data covering over 57,000 firms in 79 countries collected in several waves over an 8 year period from 1999 to 2009. Combining the Martinez-Vazquez and Bird data with the WES/BEEPS data results in a cross-sectional macroeconomic data set that can be used to examine the tax gap. In addition, this study uses the World Bank Development Indicator (WDI) data that covers similar aspects of taxation as the WES firm level data. This data source provides a robustness check of the firm level data in that it covers a slightly different set of countries and provides slightly different measures of the variables of interest. A listing of variables and descriptions used in the country-level analysis can be found in Table 2.1 and corresponding summary

Table 2.1: Description of Variables

Variable	Description	Source
ve	VAT Efficiency	Martinez-Vasquez and Bird (MV-B)
ceff	C-Efficiency	MV-B
gc	Gross Collection Efficiency	MV-B
obst_taxreg	Taxes are an obstacle to doing business (1-No Obstacle, 4-Major Obstacle)	World Enterprise Survey (WES)
law_govreg	Percentage of time dealing with government regulations	WES
complexity	Fitted values from Ordered Logit regression of obst_taxreg on law_govreg and controls	WES
reprt_sales	Percentage of sales reported for tax purposes	WES
tax_inform	If an informal payment to deal with taxes has been requested	WES
audit_prod	Adjusted audit productivity (Number of times an audited firm is visited by tax authorities regressed on firm characteristics)	WES
taxmeet	Average number of tax meetings	World Development Indicators (WDI)
taxbribe	Percentage of firms expected to give gifts to tax officials	WDI
taxevade	Percentage of firms that do not report all sales for tax purposes	WDI
taxprep	Time to prepare and pay taxes (Hours)	WDI
corruption	Corruption Perceptions Index Score	Transparency International
lnpop	Natural log of population	MV-B
educind	Education Index	MV-B
urbanshare	Share of population in urban area	MV-B
exper	VAT Experience	MV-B
developed	Developed Country	MV-B

statistics in Table 2.2. Further, Table 2.12 provides correlation coefficients for all variables.

From the firm's perspective, the VAT is a consumption tax levied at the point of sale, thus the base of the tax is company revenue. Willful evasion is measured at the firm level for each country through the WES/BEEPS surveys and is averaged based on the appropriate survey weights to obtain evasion at the national level. Direct survey questions regarding evasion are not typically reliable as respondents do not want to

implicate themselves in illegal activity. Therefore, the pertinent question asks firms what percentage of sales the typical firm in their area reports for tax purposes. By asking respondents in what level of evasion other firms engage, the responses are closer to actual values of evasion as the respondent's answer is informed by their own activities. As with all variables taken from the WES/BEEPS surveys, this measure of evasion, *reprt_sales*, is aggregated to the country level for inclusion in the main tax gap model. Average levels of evasion could be skewed by concentrated values, and not fully represent the levels of evasion in a country. To account for this, the corresponding WDI variable measuring evasion, *taxevade,* is examined. This is simply the percentage of firms that do not report all their sales for tax purposes. While this variable does not measure the extent of evasion as *reprt_sales* does, it gives a measure of the pervasiveness of evasion which is not captured by *reprt_sales* and is not skewed by large or small levels of reporting.

Unintentional evasion arising from complexity in the tax code will be estimated through a combination of two variables, the business's attitude toward the tax administration and the percentage of the firm's time spent on regulations. Alone, neither of these variables can isolate the effect of complexity of the tax code. The firm's attitude toward the tax administration, captured by asking the respondent if they find the tax administration as an obstacle to doing business, encompasses a number of factors, such as the firm's tax morale or the firm's previous experiences with the tax administration. One factor contributing to the firm's perception that the tax administration is an obstacle to doing business could be the complexity of the tax code.

Table 2.2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ve	93	48.545	22.434	0.057	98.449
ceff	87	59.651	24.586	0.083	115.976
gc	87	73.284	31.940	0.091	152.552
obst_taxreg	78	1.372	0.430	0.251	2.558
law_govreg	78	8.173	5.483	1.368	31.929
complexity	78	-0.976	0.696	-3.503	1.484
reprt_sales	78	78.859	16.528	32.565	97.031
tax_inform	78	25.360	21.807	0	84.974
audit_prod	78	-1.096	3.257	-5.494	20.184
taxmeet	96	2.368	2.036	0.240	15.230
taxbribe	96	26.866	22.961	0	84.520
taxevade	96	46.601	20.411	7.570	97.320
taxprep	103	385.029	276.370	76	2085
corruption	105	3.432	1.430	1.900	8.200
lnpop	98	13.917	1.325	10.789	18.525
educind	98	0.712	0.235	0.150	0.986
urbanshare	99	0.530	0.204	0.098	0.921
exper	95	16.558	10.295	0	49
developed	108	0.111	0.316	0	1

More complex tax codes necessitate higher compliance costs and could lead to more acrimony between taxpayer and tax administration as businesses struggle to comply. These factors increase the perception of taxes as being an obstacle to business. To separate the contribution of tax code complexity from the other factors affecting firm attitudes toward tax administration, the firm's perception of the tax administration is regressed on the firm's time spent on regulations.

Isolating the effect of tax code complexity can be accomplished through the use of a two stage regression technique. The variable containing the information of interest can

be written as $x = e + y$ where *e* is variation caused by the information of interest and y is the source variation caused by other factors. An approach using a variable, *z*, that is correlated with *e* but not *y* in a first stage regression of $x = \delta z + \mu$ results in $\hat{x} = \hat{\delta} z \sim e$. The fitted values of $\hat{x}$ contain only the information of interest as the confounding information, *y*, is contained in the error term of the first stage and is dropped when obtaining fitted values.

If all other influences on the firm's attitude toward tax administration are considered the "irrelevant" portion of the variable while the "relevant" portion is the effect of tax code complexity, then a variable that is correlated with tax code complexity but uncorrelated with the other factors can be used to isolate that effect.

The percentage of time spent on regulations can be used as such a variable for complexity. More complexity in the tax code implies not only a higher chance of mistakes, but also a greater deal of time spent on compliance. Thus, firms dealing with a complex tax code will also report spending more time on regulations. However, the firm's percentage of time dealing with regulations is not correlated with other factors, such as the tax rate faced, affecting the firm's attitudes. Thus, this study uses a first stage regression of the form:

$$\text{obst\_admin} = \alpha + \delta \text{ legal\_reg} + \gamma X \qquad (2)$$

where *obst_admin* is the measure of the firm's perception of the tax administration as an obstacle to doing business, *legal_reg* is the firm's reported percentage of time spent on regulations and *X* is a vector of control variables that includes a variety of firm

characteristics, and country and year fixed effects. The fitted values of *obst_admin*, now stripped of all variation except for that arising from tax complexities, are aggregated and used in the main equation to measure the effect of unintentional evasion on the country's tax gap.

Two methods are used to estimate the tax code burden. The main analysis estimates the first stage at the firm level, before aggregation. The *obst_admin* variable is a Likert scale variable with values from 1, indicating taxes are not an obstacle to doing business, to 4, indicating taxes are a large obstacle. To account for the nature of *obst_admin*, the main analysis first stage employs an ordered logit regression on *legal_reg* with a set of controls that includes the firm's level of sales, number of years in operation, legal organization type, ownership type, industry type, and country of operation. The fitted values from this regression are propensity scores, giving the probability the firm finds taxes an obstacle to doing business. Higher probabilities indicate a greater chance of the firm expressing greater antipathy toward taxes. After estimation, each firm's fitted propensity score, denoted as the variable *complexity*, calculated and aggregated to the country level. Not only does this allow instrumentation for *obst_admin*, but it also allows control of other firm characteristics that may affect attitudes toward taxes.

The second method is a standard two-stage least squares estimation. First, *obst_admin* and *legal_reg* are aggregated to the country level. Estimation then proceeds in the normal two-stage least square method, with *obst_admin* regressed on *legal_reg* and

the other variables from the country level in the first stage and the fitted values of *obst_admin* used in the second stage.

Alternatively, the WDI variable used to measure tax code complexity is the average number of hours spent preparing and paying taxes. As with the *complexity* variable, a larger number of hours preparing taxes can indicate a more complex tax code.

Corruption of the tax administration is determined by the number of firms that have been asked to engage in bribery of tax officials. This variable, *tax_inform*, is a direct measure of tax administration corruption and therefore captures the effects of corrupt administrators on the tax gap. Specifically, the WES/BEEP surveys ask if an informal payment has ever been requested in a meeting with tax officials. The corresponding WDI measure is the percentage of firms expected to give gifts in meetings with tax officials. An alternative measure, Transparency International's Corruption Perception Index, an aggregation of surveys and assessments used to gauge corruption perceptions, will also be used in additional specifications of the model to provide robustness checks and increase the power of the estimation.

Tax administration effectiveness is measured through the number of times firms are inspected during an audit for tax purposes. Effective tax administrations staffed by capable agents will need a minimum number of inspections to adequately understand and assess a firm's tax situation. Correspondingly, more efficient tax administrations, with high quality record collection and keeping, do not need to inspect as many firms as less efficient administrations that must rely on on-site inspections to fill gaps in their

information. In addition to asking if the firm has been audited in the past year, the WES/BEEP surveys also ask the number of times a firm is visited by tax authorities during the audit.

Using these two variables, an audit productivity measure can be constructed. Taking an audit as the output and the number of visits as an input, the audit productivity ratio is constructed as any other productivity ratio: the output divided by the input. This measure captures the effectiveness of the tax authorities in extracting information from the firm. If the authorities in a country collect the necessary information for tax enforcement in a single visit, then they can be considered more efficient than authorities from another country who need more than one visit to accomplish the same task.

However, this measure may not be fully comparable across countries. If one country engages in audits of large companies with more complex financial situations, while another country heavily audits smaller, less complex firms, then the first country will have more visits per audit than the second, regardless of the relative efficiencies of the respective tax authorities. Further, audit rates will also not be consistent across firm types within a country. Should a firm be subject to a simple audit or bribe the auditor, the number of visits will be low giving an inflated audit productivity measure.

To derive a more accurate measure of efficiency, the raw efficiency must be adjusted by firm factors to reflect the technical efficiency of the authority. By regressing the raw efficiency measure on firm characteristics and country fixed effects, the country specific technical audit efficiency can then be measured using the country specific

intercepts. A regression of the form:

$$AP_i = \beta FC_i + \gamma + \epsilon \qquad (3)$$

where *AP* is audit productivity as measured by the number of visits necessary to complete an audit for firm i, *FC* is a vector of firm i's characteristics and γ are country level fixed effects. The country level fixed effects coefficients measure the unconditional mean audit productivity rate for each country independent of any firm characteristics that would otherwise affect audit efficiency. These country level mean audit efficiencies provide a proxy for other aspects of the tax administration's operations, such as funding levels or education levels of employees.

The WDI data offers a more general measure, unadjusted for country and firm differences. Instead, the variable *taxmeet* simply measures the average number of times firms spend in meetings with tax officials. This is essentially the same measure that underlies the WES/BEEP variable of audit efficiency, or the raw audit efficiency of the country.

These four measures of tax evasion and tax administration are collected at the firm level and are aggregated to the country level. The survey collection was specifically designed to gather a sample representative of the population. In the case of evasion, complexity and corruption levels, a simple average of the variables will produce the appropriate economy wide average values. For audit productivity, the country level fixed effects from regression (3) gives the appropriate economy wide values. These values are then combined with the tax gap measures to form the main econometric specification of

(1):

$$G_i = \alpha + \beta_1 WE_i + \beta_2 UE_i + \beta_3 C_i + \beta_4 A_i + \gamma X + \varepsilon \qquad (4)$$

where *WE* and *UE* are the averages of the appropriate fitted values from first stage regressions, *C* is the average number of firms engaged in bribery of tax officials, *A* is country i's adjusted audit efficiency, and *X* is a vector of control variables. While these measures capture the variables of interest, they will not explain the entire tax gap G_i due to issues such as exemptions and zero ratings. However, so long as these tax structure issues are orthogonal to these variables, these measures will give unbiased estimates. Though the WES/BEEPS surveys provide over 56,000 observations at the firm level, aggregation and gaps in the data result in only 60-130 observations depending on model specification. As a result, to preserve the stability and power of the specification, the choice of control variables is somewhat limited.

While limited in number, the controls chosen each address some aspect of potential omitted variable bias. An educational index is included to account for the taxpayer's general cognitive ability to ensure the effect captured by tax code complexity is not due to poorly educated taxpayers. The educational index may also account for tax administration quality as lower educated tax collectors could result in reduced administration efficiency. Likewise, the country's VAT experience, as measured by the number of years the country has had the VAT, ensures the audit efficiency measures the authority's competence and not their familiarity with the code. A dummy variable for developed countries is included and controls for a variety of differences between country

types. Finally, the country's natural log of population and urban density are also included.

The expected sign for the willful evasion measure is actually negative since the survey response is the level of sales reported for tax purposes. Lower reporting of sales reflects higher levels of tax evasion and thus a higher tax gap. Unintentional evasion as measured by the complexity of the tax code will have an ambiguous effect as outlined above. The level of corruption and increasing inefficiencies of the tax administration as measured by number of inspections necessary per firm are both expected to have positive effects on the tax gap.

The estimation of this specification gives the marginal contribution to the tax gap of each factor. Country specific values of each independent variable will determine the actual share of the tax gap that can be attributed to that factor, and thus the appropriate policy response. However, if the marginal contribution of a factor is negligible, then policy makers with the goal of minimizing the tax gap should not expend much effort on improving that factor. For example, if tax code complexity is found to have no effect on the tax gap, perhaps because an increased base from more complexity cancels out the mistaken evasion, then policy makers would find more gains in reforming one of the other factors than in simplifying the tax code.

Results

Table 2.3 provides results from the first stage regressions isolating tax code burden and generating the country-specific unconditional audit probabilities. The ordered

logit first stage shows that time spent on government regulations is positively and significantly related to the firm's attitude toward taxes as an obstacle. This result is consistent with a more complex tax code requiring more time and resources to complete and thus creating a greater antipathy toward taxes. Additionally, a number of other controls, including the other variables used in the country level analysis, are significant.

The second column of Table 2.3 details the audit productivity regression to isolate the country specific audit efficiency. The results of this regression show that larger firms in both terms of employment (*empfull*) and sales (*lnsales*) require a greater number of visits, while all legal organization types need more audit visits than the excluded category of listed companies, which are typically required to publicly disclose financial information. Once the firm characteristics of size, organizational structure, ownership, and industry are accounted, the remaining country fixed effects estimates (not reported for this table), reflect the technical audit efficiency of the tax authorities.

Table 2.4 reports the first stage results from regressions isolating the tax code burden using two stage least squares after aggregation to the country level. The first column reports results without the control variables and the second with the controls. Like the ordered logit at the firm level, the number of hours spent on regulations is positively and significantly related to the average antipathy toward taxes. However, the inclusion of the controls reduces the statistical significance of the effect to the 10% level.

Table 2.3: Firm Level First Stage Regressions

VARIABLES	Ordered Logit obst_taxreg	Audit Adjustment audit_prod
law_govreg	0.00967***	
	(0.00112)	
empfull	-0.000132***	0.000600**
	(3.80e-05)	(0.000266)
lnsales	0.0304***	0.229**
	(0.00809)	(0.0952)
yoper	0.000651	0.00424
	(0.000876)	(0.00417)
Closed Company	0.127	0.620**
	(0.0884)	(0.246)
Sole Proprietorship	-0.00441	1.123**
	(0.0938)	(0.496)
Partnership	0.0126	0.663**
	(0.0967)	(0.312)
Public Sector	0.155	1.882**
	(0.333)	(0.718)
Other Legal Org.	-0.0530	-0.469
	(0.119)	(0.518)
Domestic Private Ownership	-0.0388	0.368
	(0.0426)	(0.403)
State Ownership	-0.665**	-0.617
	(0.319)	(0.487)
reprt_sales	-0.00188***	
	(0.000553)	
tax_inform	0.706***	
	(0.0354)	
tax_inspec	0.187***	
	(0.0455)	
Cut 1	-1.464***	
	(0.268)	
Cut 2	-0.449*	
	(0.268)	
Cut 3	0.759***	
	(0.268)	
Constant		0.362
		(1.516)
Observations	41208	22386

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.4: Country Level First Stage Regressions

VARIABLES	obst_taxreg	obst_taxreg
reprt_sales	-0.002	0.003
	(0.002)	(0.004)
tax_inform	0.009***	0.010***
	(0.002)	(0.003)
audit_prod21	0.011	0.012
	(0.011)	(0.014)
lnpop		0.011
		(0.040)
educind		-0.350
		(0.360)
urbanshare		-0.211
		(0.365)
exper		0.014***
		(0.005)
developed		-0.027
		(0.194)
law_govreg	0.027***	0.024*
	(0.009)	(0.012)
Constant	1.070***	0.682
	(0.197)	(0.571)
Observations	64	62
R-squared	0.241	0.381

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The signs of these variables does not change with the addition of control variables, as demonstrated by columns 4-6. However, with the control variables, the significance of the variables changes slightly. While evasion was a significant contributor to the tax gap in specifications with no controls, it loses significance with the addition of the controls. Conversely, audit efficiency, a significant contributor to only the VAT Efficiency gap without controls, becomes significant for all tax gap measures with

controls. The coefficient for complexity, while reduced somewhat in magnitude from the non-control specifications, remains statistically significant at the 1% level whether controls are included or not.

Due to what the significant variables measure and how they are constructed from first stage estimates, interpretations of the marginal effects of the significant variables are difficult. The measure of complexity is the nation's average probability of finding taxes an obstacle due to the amount of time spent on taxes. Thus, a decrease in the probability of taxes being perceived as an obstacle to doing business arising from simplification of the tax code could result in reductions of 0.1 to 0.16 percentage points in the tax gap, depending on which measure is chosen. Audit productivity is a more straightforward measure. An increase in audit efficiency resulting in an average of one less visit per audit results in a reduction in the tax gap of between 1.09 and 1.26 percentage points.

The corresponding regressions with the WDI measures can be found in Table 2.6. Again, tax evasion and tax collector corruption are shown to increase the tax gap in every specification. Similarly, a greater number of tax meetings also reduce collection efficiency. The biggest difference between the two sets of measures comes from the tax complexity measure. With the WDI measures, this variable loses all significance and changes sign in the new specifications.

Though *taxprep* seems like a more straightforward measure of complexity than the one obtained from the WES data, this variable captures a number of different aspects of tax payment beyond tax code complexity. For example, this measure does not

distinguish between large and small companies. Large companies will spend more time on taxes than smaller companies, despite facing the same level of tax code complexity. However, evidence suggests there are large economies of scale for tax compliance costs, making the compliance burden heavier for smaller firms (Hudson and Godwin 2000).

Table 2.5: WES Data Results

VARIABLES	ve	ceff	gc	ve	ceff	gc
complexity	-10.100***	-13.147***	-18.652***	-9.743***	-11.627***	-16.017***
	(2.670)	(3.228)	(4.337)	(2.618)	(2.846)	(3.884)
reprt_sales	0.351**	0.463***	0.673***	0.293	0.124	0.168
	(0.134)	(0.148)	(0.178)	(0.198)	(0.207)	(0.244)
tax_inform	0.037	-0.013	0.003	0.086	0.079	0.102
	(0.124)	(0.132)	(0.164)	(0.128)	(0.133)	(0.167)
audit_prod21	-0.806**	-0.586*	-0.588	-1.086**	-1.094**	-1.255**
	(0.374)	(0.326)	(0.396)	(0.528)	(0.515)	(0.614)
lnpop				-4.344**	-5.014**	-6.173**
				(1.825)	(2.143)	(2.720)
educind				13.937	22.217	31.029
				(14.603)	(15.858)	(21.340)
urbanshare				10.842	30.787	38.766
				(20.383)	(22.135)	(29.805)
exper				0.141	0.211	0.188
				(0.276)	(0.331)	(0.452)
developed				-9.080	-5.034	0.739
				(7.361)	(10.059)	(14.145)
Constant	31.741***	37.428***	40.156***	76.627**	93.722***	113.378***
	(11.121)	(11.671)	(13.854)	(28.765)	(32.811)	(39.922)
Observations	67	64	64	65	62	62
R-squared	0.248	0.293	0.335	0.350	0.461	0.490

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The effect of larger firms, which tend to pay taxes, spending a large number of hours on tax preparation and smaller firms facing a higher compliance burden but spending less time on taxes, could result in the positive, though insignificant, relationship between tax preparation time and reported sales. As a result, this swing in results should be interpreted with care.

The significance of measures also changes somewhat from the WES regressions in the controlled regressions. While tax code complexity is no longer significant, tax authority corruption is now significant at the 5% level for two of the three tax efficiency measures. Tax administration efficiency is still significant, with the WDI measure significant at the 10% level for the C-efficiency and gross collection efficiency measures.

Magnitudes for these variables are similar to those of the WES variables. A one percentage point reduction in the number of firms being asked for bribe payments increases collection efficiency by 0.23 to 0.31 percentage points. On average, one more meeting with tax officials corresponds with a decrease of 2.09 to 2.69 percentage points in collection efficiency.

To further explore the role of corruption in tax collection, Tables 7 and 8 detail the same specifications but with Transparency International's Corruption Perceptions Index in lieu of the WES and WDI measures of tax official corruption. This broader measure of corruption, while less precise with respect to tax payment, provides a robustness check for the previous specifications. The substitution of the corruption index for the tax corruption measures does not greatly affect point estimates for the other variables.

Table 2.6: WDI Data Results

VARIABLES	ve	ceff	gc	ve	ceff	gc
taxprep	-0.007	0.003	0.007	0.002	0.010	0.018
	(0.009)	(0.010)	(0.013)	(0.007)	(0.009)	(0.012)
taxevade	-0.205	-0.264*	-0.399**	-0.049	-0.024	-0.059
	(0.132)	(0.146)	(0.185)	(0.114)	(0.120)	(0.144)
taxbribe	-0.134	-0.200*	-0.235	-0.157	-0.225*	-0.306*
	(0.107)	(0.116)	(0.146)	(0.115)	(0.123)	(0.155)
taxmeet	-1.383	-1.961**	-2.634**	-1.771	-2.089	-2.691*
	(0.934)	(0.894)	(1.177)	(1.417)	(1.289)	(1.528)
lnpop				-4.955***	-4.616**	-6.252**
				(1.618)	(2.021)	(2.553)
educind				27.097*	33.240**	44.943**
				(14.422)	(14.755)	(18.072)
urbanshare				12.319	20.743	24.848
				(19.991)	(20.067)	(24.964)
exper				-0.398*	-0.382*	-0.611**
				(0.227)	(0.223)	(0.287)
developed				-2.601	4.604	13.477
				(6.431)	(7.785)	(10.294)
Constant	68.550***	81.291***	102.215***	109.262***	103.028***	133.748***
	(8.236)	(9.179)	(11.763)	(24.977)	(32.384)	(40.176)
Observations	83	79	79	81	77	77
R-squared	0.097	0.130	0.143	0.368	0.412	0.455

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The WES variables of *complexity* and *audit_prod*, reported in Table 2.7, continue to show the same magnitudes and significance as in earlier specifications. Moreover, for the VAT efficiency, tax evasion also becomes significant at the 10% level. This suggests a relationship between tax evasion and tax administration corruption. Any specific effects of collusion between cheating firms and corrupt tax officials are split between the

two measures in earlier specifications. With the broader measure of corruption, these specific effects are accounted for by the tax evasion measure alone.

The broader measure of corruption is significant at the 5% level for all three measures of collection efficiency when estimated with the WES variables. A one point increase in corruption perceptions, indicating a decrease in corruption in the society, results in a 3.52 to 5.97 percentage point increase in collection efficiencies. However, when paired with the WDI data, the corruption index is not a significant determinant of the tax gap. For these regressions, reported in Table 2.8, the only variable that remains significant is *taxmeet*, the measure of tax official's efficiency. This remains negative at the same magnitude as other specifications.

Table 2.9 reports results of the second approach to isolate the complexity of the tax code from the two WES variables *obst_taxreg* and *law_govreg*. This approach involved aggregating the two WES variables to the country level, then following a 2SLS approach to isolate complexity from the firm's attitudes. In this approach, signs and magnitudes of the other three variables of interest remain similar to previous specifications. However, this measure of complexity generates much larger estimates (in absolute values) than firm level estimation of *complexity*.

Table 2.7: WES Data Results with Corruption Perceptions Index

VARIABLES	ve	ceff	gc	ve	ceff	gc
complexity	-10.742***	-13.339***	-18.468***	-10.130***	-12.370***	-17.086***
	(2.536)	(3.210)	(4.515)	(2.431)	(2.628)	(3.629)
reprt_sales	0.400***	0.465***	0.660***	0.347	0.160	0.208
	(0.148)	(0.157)	(0.190)	(0.212)	(0.209)	(0.250)
corruption	-1.880	-0.285	0.215	-3.521*	-4.472**	-5.973**
	(1.840)	(2.071)	(2.652)	(1.893)	(1.979)	(2.524)
audit_prod21	-0.809*	-0.591	-0.520	-1.284**	-1.402**	-1.612**
	(0.432)	(0.396)	(0.488)	(0.599)	(0.575)	(0.701)
lnpop				-5.247**	-6.122**	-7.423**
				(2.103)	(2.344)	(2.969)
educind				12.167	21.485	30.610
				(14.984)	(15.583)	(21.400)
urbanshare				18.963	43.552*	54.893*
				(20.228)	(21.862)	(29.252)
exper				0.100	0.166	0.144
				(0.267)	(0.303)	(0.414)
developed				-1.468	5.281	14.522
				(7.061)	(9.459)	(13.737)
Constant	36.161***	38.166***	40.119**	96.975***	118.633***	143.791***
	(11.171)	(12.460)	(15.160)	(33.568)	(36.300)	(45.140)
Observations	65	63	63	63	61	61
R-squared	0.251	0.288	0.330	0.360	0.490	0.518

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This alternative estimation also changes several variables' statistical significance. Only audit productivity is significant for the VAT efficiency estimation. Further, the statistical significance for *obst_taxreg* is diminished, only reaching the 10% significance

Table 2.8: WDI Data Results with Corruption Perception Index

VARIABLES	ve	ceff	gc	ve	ceff	gc
taxprep	-0.008	0.004	0.010	-0.001	0.007	0.014
	(0.010)	(0.011)	(0.014)	(0.008)	(0.010)	(0.013)
taxevade	-0.168	-0.208	-0.298	-0.073	-0.061	-0.100
	(0.152)	(0.172)	(0.215)	(0.126)	(0.136)	(0.166)
corruption	1.195	3.083	5.270*	-1.635	-0.449	0.165
	(2.059)	(2.316)	(2.982)	(1.796)	(1.950)	(2.448)
taxmeet	-1.456	-1.962**	-2.391**	-2.519*	-2.855**	-3.598**
	(0.932)	(0.897)	(1.156)	(1.319)	(1.180)	(1.433)
lnpop				-5.889***	-5.428**	-7.189***
				(1.779)	(2.122)	(2.663)
educind				14.916	19.619	27.299*
				(13.020)	(12.999)	(15.961)
urbanshare				26.002	34.781*	41.894*
				(18.884)	(19.745)	(24.645)
exper				-0.347	-0.265	-0.440
				(0.233)	(0.241)	(0.311)
developed				0.104	4.197	11.412
				(5.942)	(7.782)	(10.390)
Constant	59.361***	61.979***	70.621***	128.792***	115.545***	144.946***
	(14.598)	(16.291)	(20.572)	(29.470)	(36.209)	(45.316)
Observations	81	78	78	79	76	76
R-squared	0.074	0.118	0.153	0.352	0.384	0.422

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

level for two of the three specifications. This is likely due to the weak correlation between *obst_taxreg* and *law_govreg* in the first stage with included controls. Under this approach, reducing the probability of antipathy toward taxes by simplifying them leads to an increase in collection efficiency of between 0.4 and 0.5 percentage points. While

these results buttress earlier results, the larger sample size at the firm level make the prior estimates preferable.

***Table 2.9: WES Data Results with 2SLS for* obst_taxreg**

VARIABLES	ve	ceff	gc	ve	ceff	gc
obst_taxreg	-19.962	-33.486	-52.259	-30.605	-42.055*	-56.706*
	(23.038)	(29.633)	(37.403)	(21.204)	(24.343)	(30.095)
reprt_sales	0.332**	0.471***	0.679***	0.238	0.199	0.265
	(0.168)	(0.166)	(0.205)	(0.174)	(0.219)	(0.270)
tax_inform	0.088	0.096	0.188	0.234	0.289	0.381
	(0.223)	(0.267)	(0.340)	(0.243)	(0.262)	(0.327)
audit_prod21	-0.957***	-0.741**	-0.790**	-1.147**	-1.084**	-1.249**
	(0.354)	(0.289)	(0.344)	(0.453)	(0.452)	(0.565)
lnpop				-4.061**	-4.084*	-4.916*
				(1.784)	(2.195)	(2.854)
educind				12.575	16.172	23.148
				(14.046)	(18.214)	(25.121)
urbanshare				9.233	27.249	34.144
				(20.534)	(23.421)	(32.013)
exper				0.329	0.543	0.624
				(0.451)	(0.536)	(0.711)
developed				-11.056	-7.930	-3.005
				(8.217)	(11.291)	(15.601)
Constant	48.672	65.965	86.849*	104.346**	116.198***	143.531***
	(36.925)	(42.060)	(52.529)	(41.636)	(39.802)	(48.731)
Observations	67	64	64	65	62	62
R-squared	0.232	0.225	0.225	0.264	0.300	0.323

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tables 2.10 and 2.11 repeat the analysis from Tables 5 and 6, but include year fixed effects as well. The WES specifications again show complexity as a statistically

important determinant of the tax gap, while audit productivity also remains significant for c-efficiency and general collection efficiency in the fully controlled model. The WDI specifications also show results comparable with previous specifications, though tax administration factors are generally statistically significant, while tax payer factors are not.

In a majority of the estimation sets without controls, the measure of tax evasion is statistically significant. However, with the inclusion of control variables, this significance disappears. Specifically, the inclusion of the educational index is the primary driver behind this change. Though this measure of education may encompass a number of effects, this result suggests a strong negative correlation between education levels and tax evasion. As societies become more educated, tax evasion seems to fall. This could be due to increasing costs to illicit activities as education becomes more prevalent. Educated taxpayers are able to earn more legitimately and have more to lose if caught evading taxes. Study of this relationship could prove a fruitful avenue for future research.

Table 2.10: WES Data Results with Year Fixed Effecs

VARIABLES	ve	ceff	gc	ve	ceff	gc
complexity	-5.773*	-8.700**	-13.052**	-1.876	-4.976	-8.209*
	(2.930)	(3.640)	(5.182)	(2.859)	(3.344)	(4.840)
reprt_sales	0.106	0.235	0.343	-0.095	-0.158	-0.165
	(0.159)	(0.182)	(0.225)	(0.181)	(0.211)	(0.266)
tax_inform	-0.200	-0.299*	-0.390*	-0.281**	-0.251*	-0.307*
	(0.145)	(0.168)	(0.219)	(0.123)	(0.131)	(0.165)
audit_prod21	-0.171	0.152	0.176	-0.429	-0.671	-0.802
	(0.450)	(0.568)	(0.715)	(0.476)	(0.565)	(0.738)
Year 2004	27.503**			62.540***		
	(13.174)			(13.513)		
Year 2005	32.389***	8.112	9.844	45.683***	-2.099	3.219
	(9.683)	(13.475)	(16.027)	(7.840)	(14.619)	(20.129)
Year 2006	20.629**	-5.016	-9.882	27.785***	-20.896	-21.062
	(8.663)	(15.206)	(18.181)	(8.164)	(16.455)	(22.018)
Year 2007	28.423**	-2.028	-9.096	51.336***	0.462	1.982
	(10.792)	(14.903)	(18.109)	(10.317)	(17.581)	(25.162)
Year 2008		-29.119	-37.936*		-41.757**	-46.259**
		(18.125)	(21.725)		(16.282)	(21.717)
Year 2009	12.156	-18.048	-25.959	23.732*	-24.551	-25.185
	(15.528)	(22.932)	(27.335)	(12.615)	(19.378)	(24.752)
lnpop				-6.914***	-6.902***	-8.292***
				(1.663)	(2.081)	(2.795)
educind				30.389	31.289	37.865
				(18.654)	(21.739)	(30.172)
urbanshare				-1.205	22.698	31.589
				(18.648)	(22.749)	(31.572)
exper				0.103	0.219	0.197
				(0.276)	(0.330)	(0.450)
developed				-18.726**	-11.222	-5.902
				(8.286)	(11.750)	(17.442)
Constant	27.886**	59.110***	73.848***	102.894***	153.035***	179.798***
	(10.973)	(22.137)	(26.625)	(25.684)	(39.468)	(51.418)
Observations	67	64	64	65	62	62
R-squared	0.324	0.371	0.418	0.519	0.562	0.578

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.11: WDI Data Results with Year Fixed Effects

VARIABLES	ve	ceff	gc	ve	ceff	gc
taxprep	-0.009	0.003	0.007	-0.001	0.008	0.016
	(0.010)	(0.010)	(0.013)	(0.008)	(0.009)	(0.012)
taxevade	-0.135	-0.156	-0.251	0.003	0.065	0.038
	(0.131)	(0.139)	(0.180)	(0.111)	(0.110)	(0.141)
taxbribe	-0.326***	-0.456***	-0.607***	-0.170	-0.269**	-0.386**
	(0.111)	(0.125)	(0.161)	(0.108)	(0.114)	(0.150)
taxmeet	-0.612	-1.042	-1.253	-1.967	-2.204*	-2.730*
	(1.144)	(1.224)	(1.490)	(1.392)	(1.276)	(1.518)
Year 2005	7.923	17.003***	31.718***	2.316	-21.167**	-17.227
	(5.824)	(6.415)	(8.552)	(13.053)	(8.026)	(10.445)
Year 2006	-8.453	-5.549	-0.257	-3.548	-29.953***	-30.223***
	(6.087)	(6.524)	(8.113)	(11.208)	(6.519)	(8.348)
Year 2007	0.662	6.610	13.035	14.934	-6.116	-2.792
	(6.587)	(5.784)	(8.086)	(11.487)	(4.397)	(6.288)
Year 2008				25.046**		
				(11.246)		
Year 2009	-11.094	-6.400	-1.579		-27.969**	-27.864
	(13.504)	(17.231)	(20.820)		(13.852)	(16.818)
lnpop				-6.021***	-5.619**	-7.244**
				(1.732)	(2.277)	(2.891)
educind				29.179*	35.897**	44.707**
				(15.267)	(16.719)	(21.248)
urbanshare				14.429	25.607	30.928
				(19.382)	(19.305)	(24.371)
exper				-0.343	-0.344	-0.561*
				(0.243)	(0.241)	(0.309)
developed				-4.059	2.422	9.904
				(6.483)	(7.496)	(10.220)
Constant	69.655***	75.320***	86.788***	118.466***	132.839***	163.240***
	(8.906)	(9.438)	(11.957)	(25.593)	(36.962)	(46.543)
Observations	83	79	79	81	77	77
R-squared	0.178	0.254	0.290	0.440	0.504	0.528

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Discussion

These results suggest a number of avenues by which authorities can address the tax gap. An important trend in tax reform has been a shift from an enforcement paradigm to a service paradigm. The enforcement paradigm places emphasis on the criminal aspects of tax evasion, represented in this analysis by the willful tax evasion measure. This emphasis assumes the tax gap is primarily driven by evasive behavior and addresses the gap through increased enforcement measures and stiffer penalties for evasion.

However, the models underlying this paradigm, first proposed by Allingham and Sandmo (1972), do not adequately account for the levels of compliance seen in reality. As a result, a large body of literature has developed focusing fully explaining tax compliance. One result of this line of inquiry is the growing importance of a service paradigm for tax authorities (Alm and Martinez-Vazquez 2003). Under the service paradigm tax authorities focus on helping the taxpayer accurately file their taxes by providing information and other services when needed. Though studies focusing on these changes in tax administration are still sparse, early results suggest that the service paradigm does increase compliance (Alm, Cherry, Jones and McKee 2010).

The results from this analysis seem to support a service paradigm for tax authorities as well. The distinction between enforcement and service paradigms directly suggests the two types of evasion identified for this analysis. Willful evasion is a proactive undertaking in which the taxpayer purposefully does not pay taxes. No amount

of tax preparation help from tax authorities will affect the willful evader's decisions. Only the threat of discovery and punishment will deter this evasion, therefore an enforcement paradigm is appropriate.

However, the enforcement paradigm does little to deter unintentional evasion. Unintentional evaders intend to comply with the tax code, but are unable because of tax code uncertainty and complexity. A service oriented tax administration mitigates the difficulties arising from that complexity, thereby increasing compliance rates.

Generally when tax evasion is addressed, the distinction between willful and unintentional evasion is not made. All failures to pay taxes are considered to be evasion, with no consideration of the motivations or difficulties behind those failures. By distinguishing these two types of evasion, this analysis gives some evidence as to why the service paradigm has enjoyed so much prominence in recent tax administration reforms. In terms of individual's compliance, the main driver of the tax gap is the unintentional evasion that the service paradigm is designed to address. These results suggest that greater gains in tax compliance are to be made focusing on making it easier for taxpayers to pay taxes.

In addition to establishing more helpful tax administrations, this analysis suggests tax code simplification could also reduce the tax gap. Compliance costs, encompassing time and resources necessary to prepare and pay taxes, can be substantial, particularly for small firms when the VAT is considered. This analysis suggests that reducing complexity and the corresponding compliance costs will not only lighten the load on firms, but also

result in happier, and thus more willing, taxpayers. With reduced compliance costs, firms have the necessary capacity to fully comply, and the tax gap shrinks correspondingly.

Simplifying and streamlining the tax paying process addresses shortcomings in revenue due to taxpayer factors. Equally important is adequately funding and staffing the tax authorities. The arguments for the importance of good tax administration are well developed. (Bird and Gendron 2007). Even with the "self-enforcing" features of the VAT, the need for highly skilled and honest tax officials is evident (Bird 2004). Further, the success of either the service or enforcement paradigm in increasing overall compliance depends on having capable tax authorities furnished with the necessary tools to complete their jobs. Even the best designed tax system can be rendered irrelevant if it is not implemented properly.

Though the arguments for good tax administration cover a range of issues, this analysis focuses only on the role of tax administration in increasing tax revenues. Competent tax authorities are able to quickly identify and collect taxes that are due. This analysis shows that as competence declines, as measured by the number of visits needed to perform an audit, the tax gap increases. While a broad measure of tax administration quality, this result gives some empirical evidence for the importance of high quality tax administration.

Further, the results of this analysis show that corruption is detrimental to revenue collection. Good governance is widely recognized to be essential to a number of positive economic outcomes (Jenkins 1992). Corruption at the level of the tax official, as

indicated by firms expected to give tax bribes, is shown to reduce tax collections. Additionally, society wide corruption levels are also shown to have implications for the tax gap. While the corruption perception index is a countrywide measure, it is reasonable to expect the level of corruption to trickle down to the tax administration, particularly if corruption has been established as a societal norm.

While this study provides evidence for the determinants of the tax gap, the results are not conclusive. Though the base, firm-level data from which the measures are derived is large, the aggregation to the country level greatly reduces sample size. The necessary reliance of these types of macro-level studies on such small cross-sectional samples can be problematic and necessary consideration is needed in drawing conclusions. Additionally, the firm level data on which these measures are based are subject to reporting biases, particularly due to the sensitive nature of the topic. While this is an important issue, the lack of higher quality data forces compromise.

Conclusion

Tax revenue shortfall is a significant problem, particularly for developing countries. Without adequate tax revenues, governments can not provide the necessary public services to foster growth. Further, shortfalls push governments to levy ever more distortionary taxes in attempts to raise funds. These additional taxes places an undue burden on economies, and likely hinder growth.

Though the tax gap is an important policy issue, little empirical work has focused

on determining what drives the gap. The general approach in previous literature attributes the tax gap to some combination of tax evasion and tax administration/design. However, this approach does not distinguish between types of evasion or administration issues. When undertaking tax reforms, governments must be aware of the source of revenue shortfall in order to enact appropriate reforms that will address that shortfall.

This study identifies four potential causes of the tax gap, each with different policy implications. Two causes arise from the taxpayer. Unintentional evasion, arising from complexities in the tax code, should be addressed through measures such as tax code simplification and taxpayer education. Willful evasion, a criminal behavior, requires tougher penalties for evasion and better enforcement of the laws. Similarly, tax administration have analogous causes. Administration issues arising from inadequate resources devoted to collecting taxes can be solved by adequately funding and staffing the tax authority. Corruption of the tax authorities, the final cause, requires its own solutions.

This study gives some insight into which causes are the primary factors driving the tax gap. Firm-level data collected from a variety of countries shows the most significant drivers of the tax gap are unintentional evasion and poor tax administration, followed by tax administration corruption. As such, the most effective reforms to increase tax revenue will focus on establishing a competent, service oriented tax administration that enables taxpayers to comply with the law instead of just punishing them after they've unwittingly broken the law.

Table 2.12: Correlation Coefficients for All Variables

	obst_taxreg	law_govreg	complexity	reprt_sales	tax_inform
obst_taxreg	1.0000				
law_govreg	0.2145	1.0000			
complexity	0.9563	0.3399	1.0000		
reprt_sales	0.0543	-0.0179	0.0417	1.0000	
tax_inform	0.3861	-0.3210	0.3055	0.1695	1.0000
audit_prod21	0.0319	-0.2460	0.0049	0.2754	0.6194
taxmeet	0.1478	-0.1073	0.1163	-0.0710	0.5443
taxbribe	0.3605	-0.2880	0.2886	0.2152	0.9897
taxevade	0.1339	0.0447	0.1216	-0.8497	0.0087
taxprep	0.1150	0.1428	0.0995	0.1309	0.1101
corruption	-0.3484	-0.1384	-0.3291	0.2262	-0.4735
lnpop	0.1716	0.1957	0.1218	-0.0779	-0.0442
educind	-0.0616	-0.0539	-0.1065	0.6037	0.1317
urbanshare	-0.0762	0.1658	-0.0917	0.3222	-0.1732
exper	0.2312	0.2603	0.2331	0.0084	-0.3155
developed	-0.0829	-0.2755	-0.1267	0.2698	-0.0681

	audit_prod21	taxmeet	taxbribe	taxevade	taxprep
audit_prod21	1.0000				
taxmeet	0.6653	1.0000			
taxbribe	0.6098	0.5400	1.0000		
taxevade	-0.1311	0.1600	-0.0393	1.0000	
taxprep	0.1819	0.1067	0.1328	-0.1652	1.0000
corruption	-0.2131	-0.3666	-0.4559	-0.2219	-0.1945
lnpop	-0.1030	-0.0379	-0.0682	0.0825	0.2111
educind	0.3250	-0.0734	0.1683	-0.4688	0.2217
urbanshare	0.0615	-0.1999	-0.1610	-0.2993	0.2841
exper	-0.1958	-0.2542	-0.3433	-0.0224	0.2045
developed	-0.0149	-0.2456	-0.0744	-0.1900	-0.0260

	corruption	lnpop	educind	urbanshare	exper
corruption	1.0000				
lnpop	-0.2056	1.0000			
educind	0.3334	-0.1214	1.0000		
urbanshare	0.4335	0.0516	0.6845	1.0000	
exper	0.1769	0.1801	0.0876	0.3491	1.0000
developed	0.5272	-0.1069	0.2311	0.0662	0.1791

Chapter 3: Macroeconomic Effects of VAT Evasion and Enforcement

Introduction

Tax evasion is often considered a significant problem in most countries and significant resources may be spent trying to address this problem. This view of tax evasion stems from a focus on shortfalls in government revenues resulting from tax evasion, and the resulting inability of governments to fund public goods and services, which may contribute to economic growth. However, this is not the only perspective with which to approach evasion. An alternative view to focusing on revenue shortfall is to consider the direct effects of evasion on economic growth. Should evasion create a drag on economic growth, then the resources used to deal with evasion may be well spent. However, if evasion results in greater economic growth, then a more benign attitude toward evasion may be warranted. This could be possible if, for example, evasion were to leave more resources in the private sector for investment that otherwise could be wasted, via corruption or inefficiency, in the public sector.[1]

Theoretically, the effects of evasion on growth are mixed. With respect to savings and capital accumulation, tax evasion increases disposable income. A portion of this income is then saved, increasing the economy's capital stock and thereby driving higher economic growth. Alternatively, the evaded funds could be invested abroad, reducing the economy's capital stock.

[1] Public resources from taxation may also be used simply for public consumption without any direct implications for economic growth. That will depend on the type of public consumption.; for example retirement benefits vis-à-vis education

Higher evasion also results in lower government revenue. Lower revenue places greater constraints on government spending on public goods and infrastructure. If spending on public goods is sub-optimal due to this constraint, economic growth will suffer accordingly. The resulting lower revenue may induce the government to raise tax rates or increase resources devoted to enforcement to increase revenue levels. Higher tax rates will create more distortions in the economy and higher resource allocation to enforcement reduces resources available for more productive purposes. Both actions will have the effect of reducing economic growth.

In addition to the effects on government revenues and public finance, tax evasion also has an associated excess burden which reduces welfare (Martinez-Vazquez 1993). One source of excess burden are "anxiety costs" stemming from the gamble the tax evader takes when hiding income. Additionally, evasion could result in misallocation of resources as the illicit revenues are shifted even less efficient activities in the underground sector or the government closes its revenue gap without raising taxes. Evasion also imposes an externality on non-evading taxpayers as they must compensate for the lost revenue from their own income.

The difference between anticipated tax revenue and actual tax revenue, the tax gap, can be quite significant, particularly for developing economies. For example, at $4.8 billion, Pakistan's tax gap for all federal taxes was over 30% of potential revenue in 2005 (Ahmed and Rider 2008). Contrasted with total Pakistani FDI in 2004-2005 of $1.5 billion (Azam and Rehman, 2009), it becomes clear that, particularly in developing

economies, the revenue lost to tax evasion can be quite significant. Developed countries can be little better off, with OECD tax gaps ranging from 4%-17.5% (Slemrod, 2007). While the question of public expenditures' effect on growth has not been fully settled, a number of empirical studies have found positive effects (Cashin 1995, Clements, Bhattacharya and Nguyen 2003, Devarajan, Swaroop and Zou 1996, Gupta, Clements, Baldacci and Mulas-Granados 2005).

While examining the effect of evasion on economic growth is important, from a policy perspective, governments have limited control over a firm's actual decision to evade taxes on income the taxpayer is responsible for reporting. Instead, the level of tax evasion an individual chooses to engage in is based on a number of factors, some of which are controlled by the government. Compliance factors like the audit rate and penalties levied on evaders are set by the government and influence evasion rates. A wide body of literature has demonstrated the response of evasion rates to these factors (Alm 2012, Alm and Jacobson 2007). The changes in evasion rates resulting from changes in these compliance factors will then translate into changes in economic growth.

If a government's goal is to maximize economic growth, it is important for policy makers to understand how the decisions they make in setting compliance factors will affect growth. In understanding these effects, policy makers can make better informed decisions regarding compliance factors and any potential tradeoffs with economic growth. By understanding this tradeoff, the government can understand if it suffers from a principle-agent problem with the tax collection authority.

For example, while increasing the audit rate may result in higher tax collections, and thus suit the tax authorities of getting the most revenue possible, if higher audit rates result in lower economic growth, policy makers may wish to forgo higher collections the higher audit rates bring. Alternatively, if the proceeds of evasion are not being put to productive use by the private sector, but instead being consumed or shifted abroad, the government can chose to increase collection efforts in an attempt to use that revenue for more productive public good uses.

Despite the potential impacts of tax enforcement on growth, little empirical work has focused on it. This study presents two analysis to examine the effect of tax enforcement and tax revenue shortfall in general on economic growth. The first uses firm level data to generate measures of audit rates and corruption in the tax administration, which are then applied in a cross-sectional analysis of enforcement measures. The second uses tax collection efficiencies at the country level to extend the first analysis to a panel setting. The ensuing results are consistent with a theoretical endogenous growth model of tax evasion and enforcement, suggesting that while some direct effects of lax enforcement can be beneficial, the overall effect of lower tax revenue is detrimental to growth.

Literature Review

A well developed body of literature has been developed on optimal tax enforcement. Early theoretical work by Allingham and Sandmo (1972) uses the rational

crime framework of tax evasion subject and government budget constraints to derive optimal enforcement levels. Allingham and Sandmo's solution sets the optimal enforcement parameters where the "marginal cost [is] greater than marginal tax revenue", a result that gives greater enforcement than the traditional cost benefit analysis.

Following this result and using a similar welfare maximization model as Sandmo, Slemrod and Yitzhaki (1987) develop a theoretical result which yields an optimal level of enforcement equal to the savings in excess burden from reducing evasion. In this model, the excess burden arises from the uncertainty associated with evasion gamble and increasing the probability of detection serves to reduce this excess burden as it reduces uncertainty. Thus optimal tax enforcement levels occur where the marginal cost of additional enforcement is equal to the marginal reduction in excess burden obtained from making the evasion gamble more certain. The level of revenue generated from the increased enforcement does not enter into this optimality decision because the model views it as a simple transfer between agents. However, this model only gives a partial equilibrium answer as the revenue gained is not limited to being just a transfer, but can be used productively as investments or public goods.

Mayshar (1991) emphasizes tax administration "technology" in a generalized framework to examine the optimal tax administration efforts and shows that the social costs of increasing enforcement to increase revenue may outweigh the social costs of increasing tax rates. Similarly, Kaplow (1990) and Cremer and Gahvari (1993) introduce tax administration and enforcement in a commodity tax setting, showing there is a

tradeoff between the tax rate and enforcement measures and the optimal tax often depends on the presence of evasion and enforcement costs. These models have been extended to include income taxes with heterogenous individuals in terms of income and enforcement rules, resulting in implications for tax progressivity (Cremer and Gahvari 1994, Cremer and Gahvari 1996). Other work has introduced different tax bases and penalty structures as well (Borck 2004, Richter and Boadway 2005). This line of literature focuses on the appropriate balance between using tax enforcement measures versus other methods, such as higher rates or broader bases, to raise revenue.

Chander and Wilde (1998) approach the problem of income taxation enforcement with a principle-agent framework. Drawing Mirrlees' (1971) optimal tax policy work, the theoretical question the authors investigate is how progressive taxation should be. In terms of tax enforcement, this model gives a regressive result for optimal audit probabilities; audit costs (and thus probabilities) are low only when high income taxpayers pay less than low income tax payers.

While this branch of the literature relies on a traditional approach of setting the level of tax enforcement as an optimization problem, other studies have examined the optimal methods of enforcement. Graetz, et al. (1986) and Sansing (1993) allow for interaction between taxpayer and tax enforcement officials. Meanwhile, Alm, and Mckee (2004) use an experimental setup to show that, while the tax authority can effectively use information from taxpayers due to coordination failures between the payers, switching between audit rules can increase enforcement. Additionally, when tax payer

characteristics are known to the tax authority, they can be incorporated into the audit decision, yielding more efficient monitoring strategies (Bigio and Zilberman 2011).

The significant body of work on optimal tax enforcement focuses on increasing compliance rates in light of costs associated with the necessary audits to do so. In this respect, the literature focuses on a partial equilibrium framework and what action is optimal for the taxpayer and tax collector with the goals of maximizing utility and collections respectively. Little attention has been paid to how these optimality decisions affect economic growth in a dynamic setting.

Efforts to study economic growth also have deep roots. Endogenous growth models began appearing in the 1980s to account for economic growth with choices made inside the economy (Romer 1994). Instead of growth being the result of some exogenous change from outside forces, this line of inquiry focuses on public and private choices that cause growth to fluctuate. A number of different factors have been examined, including the effect of taxes and government spending on growth (Bleaney, Gemmell and Kneller 2001, Cashin 1995, Johansson, Heady, Arnold, Brys and Vartia 2008). However, while some theoretical work addressing tax evasion has been developed, almost no empirical work has been conducted testing the impact of tax evasion on economic growth. The few empirical studies that do exist tend to focus on single countries or employ crude methods.

The effects of tax evasion and compliance measures on growth have been the subject of several theoretical studies. Caballé and Panadés (1997) introduce an overlapping generations model incorporating the rational crime framework that

characterizes the partial equilibrium work on tax evasion. Focusing on compliance policy, this study finds the audit and fine rates have ambiguous effects on growth. These effects depend on the relative productivity between public and private capital. In scenarios in which private capital is more productive, increases in compliance measures will reduce growth, while when public capital is more productive, increased compliance will increase growth.

In contrast, Gahramamov (2009) employs an overlapping generation model with small enforcement parameters, particularly a low fine rate. As with other theoretical models, the result is an increase in evasion and capital accumulation. However, in this model, capital accumulation exceeds the golden rule level, resulting in a sub-optimal growth path. In this respect, increasing enforcement to reduce savings results in more balanced growth.

Also using an overlapping generations model, Wrede (1995) emphasizes productive public resources in the relationship between evasion and growth. In cases in which public spending is productive and adds to the capital stock, evasion will reduce the long run growth rate. However, when government spending is consumptive in nature, the effects of evasion become ambiguous, depending on the intertemporal elasticity of substitution.

Approaching the problem using stochastic optimal control, Eichhorn (2004) gives similar results. Finding households increase savings, which in turn boost economic growth, when engaging in tax evasion, this study conforms with other theoretical work.

However, this model assumes a purely consumptive public good, thus under-provision has no effect on the growth rate. Further, the government can adjust the tax policy to compensate, thus creating a neutral result on economic growth.

Lin and Yan (2001), adopting a similar assumption of consumptive public goods, use a dynamic portfolio choice model to examine the effect of tax rates on growth. Here the authors find that evasion rates respond negatively to higher tax rates and the resulting increases in evasion are beneficial for economic growth. However, in addition to omitting public investments, the model does not allow for the cost of evasion, which the authors concede could alter the results.

While the theoretical literature on tax evasion and growth has received some attention recently, the empirical literature is much sparser. Some studies of the effects of tax reform, particularly with respect to VAT reforms as this tax is generally assumed to make evasion more difficult, on an economy may capture some of the effects, however these are too intertwined with other factors to draw conclusions (Bolton and Dollery 2005, Emran and Stiglitz 2005, Hines 2004, Spiro 1993). Meanwhile, other studies have employed simulations to test theoretical models (Chen 2003).

However, to date there are no significant empirical studies that have specifically addressed the macroeconomic effects of tax evasion on a wide scale. While the relationship between taxes and growth in general has generated a good deal of literature (see Lee and Gordon (2005), Romer and Romer (2010), and Barro and Redlick (2011) for examples), tax evasion is different from overall tax policy due to its illicit nature and

commission by a certain subset of the population which could create differential effects between payers and non-payers. Because of this difference from general tax policy, this study seeks to fill the gap in empirical literature on evasion and growth.

Theory and methods

Modeling the relationship between tax enforcement factors and economic growth begins with Barro's (1990) standard AK model of endogenous growth with pubic expenditure as modified by Chen (2003) to incorporate taxes and tax evasion. In this model of growth representative households maximize discounted lifetime utility of:

$$\int_0^{\infty} e^{-\rho t} \frac{c^{1-\sigma}(t)-1}{1-\sigma} dt \qquad (1)$$

where ρ is the time-preference rate, σ is the reciprocal of the intertemporal elasticity of substitution and c(t) is the private consumption expenditure[2]. The firm's production function is given by:

$$y(t) = Ak^{\eta}(t) g^{1-\eta}(t) \qquad (2)$$

where $0<\eta<1$, y(t) is output per capita, A is the technology level, k(t) is capital input per capita, and g(t) is the productive government services in time t, such as infrastructure or property rights enforcement. Government services are provided freely to producers and funded through a tax on income. Disposable income available to households thus takes

[2] This model can be extended to include government consumption expenditure in the consumer's utility function. While this inclusion does affect the optimal level of income reporting, β*, it ultimately does not affect the comparative statics of the changes of increased enforcement on the optimal consumption path. An increase (or decrease) in tax revenue will result in an increase (decrease) of either government consumption expenditure or government investment (or both), both of which have a positive (negative) impact on consumption growth. In this case, the inclusion of government consumption expenditure is omitted to simplify the analysis.

the form of:

$$y_d = (1-p)[(1-\tau\beta)-h_0(1-\beta)^2]y + p[(1-\tau\beta)-h_0(1-\beta)^2-\pi\tau(1-\beta)]y \equiv (1-\tau_E)y \quad (3)$$

where $\tau_E \equiv \tau[1-(1-\beta)(1-p\pi)]+h_0(1-\beta)^2$ is the economy's effective tax rate. As with partial equilibrium models of tax evasion, households have the choice to report a portion of their income, given by β, on which they must pay taxes of τ. Alternatively, the household can chose to evade taxes, with the risk of being caught of p and subject to a penalty of π on the evaded portion of income, (1- β). The term h_0 is a composite term that captures the costs and the opportunities for evasion and can be written as $h_0=C/O$. The parameter *C* captures a number of costs associated with evasion, such as the necessity of employing resources in the actual hiding of income. Following Bayer (2004), *O* represents the opportunities for evasion that differ between tax payers. For example, employees subject to withholding have less opportunity to evade than the self-employed that voluntarily report their earnings. The marginal cost and opportunity to evade are increasing and decreasing, respectively, in the amount of evasion, resulting in a decreasing returns to evasion[3].

The capital stock increases with savings, given by the difference between disposable income and consumption:

[3] This disposable income model is based on the standard Allingham and Sandmo model of tax evasion (1972). However, actual evasion levels fall well short of theoretical predictions (Alm, McClelland and Schulze 1992; Graetz and Wilde 1985), and a number of attempts have been made to reconcile the theoretical predictions with the empirical results (see Hashimzade, Myles, et al. 2010 for a review). Despite this shortcoming, the theoretical predictions for the enforcement parameters hold, with higher audit rates and cost of evasion resulting in lower levels of evasion (Dubin, Graetz, et al. 1990; Alm 2012; Alm and Jacobson 2007). Since these are the parameters of concern for this study, the naive model evasion will suffice in giving the appropriate theoretical predictions without additional complications.

$$\dot{k} = (1-\tau_E)y - c \qquad (4)$$

To complete the model, the government's budget constraint is given by:

$$\tau[\beta + p\pi(1-\beta)]y \equiv T = f_0 py + g \qquad (5)$$

where f_0 is an audit cost parameter, giving total tax enforcement costs of $f_0 py$.

To find the optimal values for the parameters under government control, the household's optimization problem must first be solved. The household maximizes lifetime utility (1) subject to its disposable income and savings (2)-(4). The resulting Hamiltonian equation is given by:

$$\max_{c\beta} J = \frac{c^{1-\sigma}(t)-1}{1-\sigma} e^{-\rho t} + \lambda\{(1-\tau[\beta + p\pi(1-\beta)] - h_0(1-\beta)^2) Ak^{\eta} g^{1-\eta} - c\} \qquad (6)$$

and the first order conditions are:

$$\frac{\partial J}{\partial \beta} = \lambda(-\tau(1-p\pi)y + 2h_0(1-\beta)y) = 0$$

$$\tau(1-p\pi) = 2h_0(1-\beta) \qquad (7)$$

$$\beta^* = 1 - \frac{(1-p\pi)\tau}{(2h_0)} \qquad (7.1)$$

$$\frac{\partial J}{\partial c} = e^{-\rho t} c^{-\sigma} - \lambda = 0$$

$$-\sigma \ln c - \rho t = \ln \lambda \qquad (8)$$

$$\lim_{t\to 0} k(t)\lambda(t) = 0 \qquad (9)$$

Denoting $\dot{c} \equiv dc/dt$ and $\dot{\lambda} \equiv d\lambda/dt$, and rearranging (8) gives the following:

$$\frac{\partial J}{\partial c \partial t} = -\sigma \frac{\dot{c}}{c} - \rho = \frac{\dot{\lambda}}{\lambda}$$

$$\frac{\dot{\lambda}}{\lambda} = -A\eta\left(\frac{g}{k}\right)^{1-\eta}(1-\tau_E)$$

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}\{A\eta\left(\frac{g}{k}\right)^{1-\eta}(1-\tau_E) - \rho\} \qquad (10)$$

Equation (7) gives the household's optimal degree of tax evasion at the point at which the marginal benefit of tax evasion equals the marginal cost of evasion, with the optimal level of evasion shown by (7.1). The optimal amount of evasion depends on the probability of audit, the fine rate, and the tax rate, all of which the government controls. Additionally, the costs associated with evading enters into the optimal evasion level. While the government does not directly control this, policy makers can influence this measure to some extent. Consistent with the partial equilibrium tax evasion literature, the amount of evasion is decreasing in the probability of audit, the cost of evasion and the fine rate and is ambiguous with respect to tax rates. Equation (9) is the transversality condition that ensures capital does not grow too fast. Finally, equation (10) is the growth rate of consumption determined by the difference between the marginal rate of return on capital and the time-preference rate. Similar to the tax evasion decision, the household adjusts consumption growth as well according to the parameters set by the government, with the tax enforcement parameters entering into the function through the effective tax rate, τ_E.

Given the household's response to the government controlled parameters, the government can now solve its maximization problem. Combining the government budget constraint (5) with the production function (2) and rearranging gives:

$$\frac{g}{k}=A^{1/\eta}[\tau_E-h_0(1-\beta)^2-f_{0p}]^{1/\eta} \qquad (11)$$

In this model, the government maximizes consumption, or economic, growth by choosing an optimal tax rate. Thus the objective function is:

$$\underset{\tau}{Max}\frac{\dot{c}}{c}=\frac{1}{\sigma}\{A^{1/\eta}\eta[\tau_E-h_0(1-\beta)^2-f_0 p]^{(1-\eta)/\eta}(1-\tau_E)-\rho\} \qquad (12)$$

Maximizing and taking into account the best response tax evasion function of the households (7) yields:

$$\frac{1-\eta}{\eta}(1-\frac{1-p\pi}{h_0}\tau^*)(1-\tau^*+\frac{1-p\pi}{4h_0}\tau^{*2})=(\tau^*-\frac{1-p\pi}{2h_0}\tau^{*2}-f_{0p})(1-\frac{1-p\pi}{2h_0}\tau^*) \qquad (13)$$

The government sets τ^* to a value where the left hand side of equation (13), the marginal benefit of taxation due to increases in g equals the right hand side, the marginal cost of taxation due to lower disposable income and capital growth. Equation (13) has three roots:

$$\tau_1^*=\frac{h_0}{(1-p\pi)^2} \quad , \quad \tau_2^*=\frac{2[h_0-\sqrt{x}]}{(1-p\pi)^2(1+\eta)} \quad , \quad \tau_3^*=\frac{2[h_0+\sqrt{x}]}{(1-p\pi)^2(1+\eta)}$$

where $x=h_0^2-h_0(1-\eta+f_0 p\eta)(1-p\pi)^2(1+\eta)$. Of these three roots, τ_2^* results in the highest growth rate, thus globally maximizing the government's objective function. With these results, the equilibrium can be defined, with the optimal tax rate τ_2^*, the equilibrium rate of tax evasions is:

$$\beta^*=1-\frac{1-\sqrt{1-(1-\eta+f_0 p\eta)(1-p\pi)^2(1+\eta)/h_0}}{(1-p\pi)^2(1+\eta)} \qquad (14)$$

with an equilibrium tax rate of:

$$\tau_E^* = \frac{\eta}{1+\eta}\frac{2[h_0 - \sqrt{h_0^2 - h_0(1-\eta+f_0 p\eta)(1-p\pi)^2(1+\eta)}]}{(1-p\pi)^2(1+\eta)} + \frac{(1-\eta+f_0 p\eta)}{1+\eta} \qquad (15)$$

and an equilibrium growth rate of:

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}\{A^{1/\eta}\eta[(\tau_E^* - \frac{(1-p\pi)^2}{4h_0}(\tau_2^*) - f_0 p)^{(1-\eta)/\eta}(1-\tau_E^*)] - \rho\} \qquad (16)$$

The effects of changes in parameters under government control on growth and tax evasion levels can be derived from this equilibrium growth rate. Specifically, this study examines the changes in the costs of evasion h_0, as well as the enforcement parameter p, the probability of audit.

The government has some control over the costs, both pecuniary and non-pecuniary, of evasion borne by tax evaders. Government appeals to patriotism can increase tax morale, creating higher social costs for tax evasion (Konrad and Qari 2009). In low tax morale societies, tax evasion is more acceptable, thus households or firms can more easily engage the services of lawyers or accountants to aid in evasion. Similarly, a high level of corruption in the tax authorities is theoretically associated with higher evasion rates (Chander and Wilde 1992). Corrupt tax administrations lower the cost of tax evasion, making it easier to engage in evasion and increasing evasion rates. Even in highly corrupt societies, where the bribe rate becomes the de facto tax rate and the subsequent h_0 remains elevated due to high bribe rates, the cost of evasion is still less than or equal to that of a non-corrupt society.[4] Government reforms to reduce corruption

[4] If the bribe rate becomes the de facto tax rate, corrupt tax collectors would be viewed as the "government" and firms would seek to hide their income from them using the same methods used to hide revenue from non-corrupt officials. Thus, at a maximum, the costs of evasion in corrupt and non-corrupt societies are equal. Conversely, bribing tax officials could obviate the need for complicated

in the tax authority could serve to increase the cost of evasion. The overall effect of increasing evasion costs on economic growth can be divided into a direct and indirect effect. While the direct effect of increasing the cost of tax evasion on consumption growth is negative, the indirect effects are ambiguous, resulting in an ambiguous total effect. The theoretical effect of policies that increase evasion costs can be derived by (16) using $\tau_E \equiv \tau_2[1-(1-\beta)(1-p\pi)] + h_0(1-\beta)^2$ and rewriting:

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}\{A^{1/\eta}\eta[(\tau_2^*[1-(1-\beta^*)(1-p\pi)] - f_0 p)^{(1-\eta)/\eta}(1-\tau_2^*[1-(1-\beta^*)(1-p\pi)] + h_0(1-\beta^*)^2)] - \rho\} \quad (17)$$

Taking the derivative with respect to the cost of taxation, h_o, results in:

$$\underset{(?)}{\frac{d\frac{\dot{c}}{c}}{dh_0}} = \underset{(-)}{\frac{\partial\frac{\dot{c}}{c}}{\partial h_0}} + \underset{(?)}{\frac{\partial\frac{\dot{c}}{c}}{\partial(1-\beta^*)}} \underset{(-)}{\frac{d(1-\beta^*)}{dh_0}} + \underset{(?)}{\frac{\partial\frac{\dot{c}}{c}}{\partial\tau_2^*}} \underset{(-)}{\frac{d\tau_2^*}{dh_0}} \qquad (18)$$

The overall effect is ambiguous due to two indirect effects. First, while increasing evasion costs will decrease tax evasion rates, the effect of lower tax evasion on growth is ambiguous. Similarly, higher tax evasion costs reduce the optimal tax rate. More revenue collect from higher compliance rates associated with large evasion costs mitigates the need for the government to increase tax rates to generate more revenue. However, the effect of tax rates on economic growth is also ambiguous[5], making the total indirect effect uncertain.

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revenue hiding schemes, thus lowering the cost of evasion in corrupt societies.

[5] While the theoretical results of lower tax rates on growth are ambiguous in this model, the empirical literature indicates $\partial\dot{c}/c/\partial\tau$ is negative (Lee and Gordon 2005; Mullen and Williams 1994). This suggests that this indirect effect of higher evasion costs will result greater growth

Equation (17) can also be used to find the theoretical effect of tax enforcement audits on economic growth.

$$\frac{d\frac{\dot{c}}{c}}{\underset{(?)}{dp}} = \frac{\partial\frac{\dot{c}}{c}}{\underset{(?)}{\partial p}} + \frac{\partial\frac{\dot{c}}{c}}{\underset{(?)}{\partial(1-\beta^*)}}\frac{d(1-\beta^*)}{\underset{(? \text{ or } -)}{dp}} + \frac{\partial\frac{\dot{c}}{c}}{\underset{(?)}{\partial\tau_2^*}}\frac{d\tau_2^*}{\underset{(? \text{ or } -)}{dp}} \qquad (19)$$

The direct as well as the indirect effects of changes in tax enforcement have a theoretically ambiguous effect on economic growth. Increased probability of detection serves to reduce disposable income and increase government revenue as a greater number of evaders are caught and forced to pay back taxes and fines. While reduced disposable income lowers savings and investment, increased government revenue allows for more public goods to be provided. Thus the direct effect is ambiguous. As with the effect of the cost of tax evasion on growth, the effects of tax evasion and tax rates are ambiguous. When tax enforcement costs, $f_0 p$, are high, $d\tau_2^*/dp$ is ambiguous as is $d(1-\beta^*)/dp$. When enforcement costs are low, both terms are negative for reasons similar to the channels by which changes in tax evasion costs affect tax and evasion rates.

Given the ambiguous theoretical effect of tax evasion and of factors affecting tax evasion on economic growth, empirical testing can shed further light on the relationship. Using equations (18) and (19), this study tests the effects of audit probabilities and costs of evasion on economic growth.

The main econometric specifications for this study follow directly from (18) and (19):

$$\ln(GDPpercapita_i) = \beta_0 + \beta_1 p_i + \beta_2 h_i + \beta_3 evas_i + \beta_4 tax_i + \beta_n X_i + u \qquad (20)$$

where $GDPpercapita_i$ is the GDP per capita for country i, h_i and p_i are the variables of interest, the cost of evasion and the probability of audit, *evas* and *tax* are the evasion and tax rate, and X is a vector of control variables.

The estimates of β_3 and β_4 are also of interest to this analysis. While these are endogenously determined in the theoretical model, it is likely that there is some exogenous component to evasion and tax rates. In particular, tax rates, which are set by policy makers and subject to political economy considerations, may not conform to the optimal rates specified in the model. Further, from the theoretical model, the overall effect of changes in these variables on growth is ambiguous. As discussed earlier, understanding the effect of evasion on growth is important as that insight would guide policy decisions on reducing evasion if it negatively affects growth or perhaps engaging in benign neglect if evasion is shown to increase growth. Similarly, the effect of tax rates on growth is an important aspect of public policy decision and is the subject of a wide and mixed body of literature.

This specification gives rise to an identification issue with respect to the variables of interest, audit probability and evasion costs. Because tax evasion and the tax rate are endogenously determined by the costs of evasion and the probability of audit, the total effect of changes in audit probabilities or evasion costs is masked by the evasion and tax rate variables. With this specification, β_1 and β_2 will capture the direct effect of audits and evasion costs, but their indirect effects will be captured in β_3 and β_4. As a result the

estimates of the audit probability and evasion costs will be biased. In effect, this relationship can be represented by the following recursive system of equations:

$$evas_i = \alpha_0 + \alpha_1 p_i + \alpha_2 h_i + u_1 \qquad (21)$$

$$tax_i = \gamma_0 + \gamma_1 p_i + \gamma_2 h_i + u_2 \qquad (22)$$

$$\ln(GDPpercapita_i) = \beta_0 + \beta_1 p_i + \beta_2 h_i + \beta_3 evas_i + \beta_4 tax_i + u_3 \qquad (23)$$

Equations (21) and (22) are identified and can be estimated through OLS, however further exclusion restrictions are required for full identification of (23) (Green 2003). Specifically, when the $Cov(u_{1,2},u_3)=0$, then equation (23) is also fully identified and thus each equation in the system can be consistently estimated using OLS. Effectively, the log of per capita GDP becomes a linear function of *p*, *h*, u_1 and u_2 which are uncorrelated with u_3 resulting in a fully identified model.

The estimation procedure uses estimates of u_1 and u_2 as proxies for *evas* and *tax* respectively, thus (23) takes the form of:

$$\ln(GDPpercapita_i) = \beta_0 + \beta_1 p_i + \beta_2 h_i + \beta_3 u_1 + \beta_4 u_2 + \beta_n X_i + u_3 \qquad (24)$$

The residuals from equation (21) and (22) are the variation in tax evasion and tax rates once the effects of the probability of audit and evasion costs have been removed. With these residuals only capturing exogenous changes in evasion and tax rates, the indirect effects of changes in the audit rate or evasion costs is incorporated into β_1 and β_2 respectively, providing the unbiased total effect of those variables.

There is a great deal of literature finding a wide variety of factors partially related to economic growth (Sala-I-Martin 1997). Correspondingly, critics of these models have raised concern regarding the "fragility" of significant results (Levine and Renelt 1992).

The problem arises due to the chosen specification, particularly the vector of control variables used. Since the "true" model is not known, the inclusion of the appropriate control vectors is left to the discretion of the researcher. Consequently, a significant result for the variable of interest with one set of controls can become insignificant with another set of controls, even if the change in controls is only one variable.

To examine the issue of "fragility", Levine and Renault (1992) employ an extreme bound analysis to determine if the coefficient on the variable of interest is robust. Given the stringent nature of the extreme bound test, the variable of interest is rarely found to be robust. Sala-i-Martin (1997) argues that the extreme bound analysis may be too strong for any variable to pass, thus producing no robust variables. Instead, Sala-i-Martin proposes a test that finds the weighted average of all potential estimates and assigns a confidence interval to the variable in question.

This study will test the robustness of the results using the Sala-i-Martin method. This test consists of running regressions with every combination of control variable. The subsequent parameter estimates are then averaged to find the mean estimate of the parameter of interest, β_z, by:

$$\hat{\beta}_z = \sum_{j=1}^{M} w_{zj} \beta_{zj}$$

where the weights, w_{zj} are proportional to the likelihoods as models with high likelihoods are assumed to be closer to the "true" model. Thus the weights are:

$$w_{zj} = \frac{L_{zj}}{\sum_{i=1}^{M} L_{zi}}$$

likewise, the weighted average variance is constructed as:

$$\hat{\sigma}_z^2 = \sum_{j=1}^{M} w_{zj} \sigma_{zj}^2$$

Assuming the distribution of β is normal, once these measures are estimated, the cumulative distribution function (CDF) can be calculated and inferences made. Alternatively, if the distribution of β is not normal, then the inference testing can still be conducted by calculating the CDF for each estimate separately, then aggregating the individual CDFs with the appropriate weights (Sala-I-Martin 1997). While this method provides some defense against "fragility", care should still be taken with the results as the issue of omitted variable bias remains since every relevant control variable can not included.

Data

Tax evasion, corruption, and audit rate data for this study come from a compilation of survey data from the World Bank. Through the first decade of the millennium, the World Bank conducted the World Enterprise Survey (WES) and Business Environment and Enterprise Performance Survey (BEEPS), polls of individual firms regarding their business environment. The survey data covers 103 mostly developing countries and includes over 71,000 firms.

In addition to the firm level survey data, the World Bank also publishes World

Development Indicators (WDI) that provides additional measures of evasion, corruption and audit rates. While many of the countries in this data set overlap the countries surveyed in the WES, additional countries available in the WDI data provides added robustness.

Tax evasion in the WES is measured through an indirect question regarding what the firm thinks the typical firm in their industry reports as their taxable revenue to authorities. Due to the sensitive nature of the topic, indirect survey questions are preferred to direct questions of tax evasion as direct questions can lead to non-response or inaccurate responses (Gërxhani 2007). However, the respondent's answer to the indirect question is typically informed by their own experiences in the activity, and thus is indicative of their own behavior. Thus, in the absence of high quality audit data from the central government, the next best measure of tax evasion is through indirect survey questions. Further, because a third party, not the government, conducts the survey, participants should be more likely to be forthcoming as their confidentiality is assured.

As a measure of firm tax evasion, this variable is also dependent on the characteristics of firms being surveyed. To account for potential differences in reporting behavior in firms across countries, a first stage regression of reporting rates on firm characteristics and country specific fixed effects is performed to obtain the conditional mean reporting rates for each country. Once the coefficients for this regression are obtained, the estimates on the country specific fixed effects are the mean sales reporting rates conditional on firm characteristics. These country specific means are then used as

the measure of sales reported for tax purposes in the WES analysis. Alternatively, the WDI data measures tax evasion as the simply the percentage of firms that did not fully report their income for tax purposes.

Corruption in the WES data is measured through the firms' response to questions regarding bribery of tax officials, either solicited or unsolicited. As outlined previously, higher levels of corruption indicate a lower cost of tax evasion, thus leading to greater tax evasion. As such, high levels of bribery of tax officials represent low levels of h_i and can serve as a proxy of other tax evasion costs. Similarly, corruption in the WDI data is measured as the percentage of firms that have engaged in bribery to deal with taxes.

Finally, the WES data contains data if the respondent firm was audited in the previous year. This measure can be used to find a conditional probability of audit as the firm was selected for audit based on some attributes observable to the tax authorities. For example, firms with large revenues are routinely audited at higher rates than smaller firms. Because this conditional audit probability only applies to firms chosen for audit, it is not the unconditional audit probability faced by all firms in the economy. As such, finding an unconditional probability of audit can be likened to a selection problem as the audited firms are selected for audit. To find the economy wide audit probability, this study first estimates a selection equation of the form:

$$p = \delta X + \epsilon \qquad (25)$$

where p is if the firm was audited or not and X is a vector of observable firm characteristics that may influence the authority's decision to audit. These characteristics

include the firm's size, legal organization, age, industry and type of ownership. The conditional probability of audit is given by:

$$P(p=1|X)=\delta X \qquad (26)$$

while the full probability of audit is given by (25). To find the unconditional audit probability that all firms in the economy face (27) must be subtracted from (26) giving:

$$P(p=1)-P(p=1|X) \;=\; \delta X+\epsilon-\delta X \;=\; \epsilon \qquad (27)$$

Thus the estimated errors from the selection model can be used as the measurement of the base audit rate faced economy wide.

While the WDI data does not contain any direct information on audit rates, a measure of the average number of meetings firms must spend with tax officials provides information on audits. The higher the average number of meetings, the greater the audit probability. If each audited firm meets with tax officials once, then the average number of meetings across all firms will be the audit rate. Higher audit rates will results in more meetings with tax officials across the country which will be reflected in the WDI measure. This is not a perfect measure of audit rate as many firms will have more than one meeting with tax officials or tax officials may be placed in larger companies, obviating the need for audits. However, it does provide and additional way to examine the effects of audit probabilities.

From the firm level, the WES measurements of tax evasion, corruption and audit probability will be aggregated to the country level by taking the appropriately weighted average value for each variable. The resulting averages are subsequently combined with

data collected by Martinez-Vazquez and Bird (2011) to form a macroeconomic data set that includes GDP, tax rates and other country level controls. The WDI data, already aggregated to country-level, is also merged with the Martinez-Bird data for the analysis. Table 3.1 lists and describes all variables used for the WES/WDI analysis. Similarly, Table 3.2 reports summary statistics for all aggregated WES/WDI variables.

The Martinez-Vazquez and Bird data also provide additional variables by which to measure the effect of tax shortfalls on economic growth. This data set provides measures of the VAT tax gap for a panel of 86 countries over 19 years which provides an additional way to analyze the effect of tax collections on growth. Table 3.3 provides variable descriptions and Table 3.4 provides summary statistics for this data.

The VAT covers the same base, firm revenues, as the survey measure of evasion from the WES/BEEPS data. In addition to evasion, the tax gap can fluctuate with administrative effectiveness and other measurement issues discussed below. While the entire tax gap cannot be attributed to tax evasion, a large body of literature routinely uses the tax gap as a measure of evasion. Importantly, this measure also captures significant information about tax administration quality. Higher quality administrations will enforce tax laws more efficiently, thereby increasing the costs of evasion or the chances of being caught. The effect of higher evasion costs and detection probabilities will be to

Table 3.1: WES/WDI Variable Descriptions

Variable	Description
WES/WDI Analysis	
rgdpch	PPP Converted GDP per capita chained at 2005 constant prices
lnrgdpch	Natural log of rgdpch
inspect	Audit probability
tax_inform	Informal payment requested to deal with taxes
taxbribe	Percentage of firms that payed a bribe to deal with taxes
vatrate	Tax rate
reprt_sales	Percentage of sales reported for tax purposes
taxevade	Percentage of firms not reporting all sales
urbanshare	Share of population in urban centers
educind	Education Index
eu	Member of European Union
as	Member of the Americas
ce	Member of Central Europe
ap	Member of Asia/Pacific
af	Member of Africa
nmed	Member of Northern Africa/Middle East
capform	Capital Formation
inflation	Inflation
hlthexpend	Health Expenditures
save	Savings rate
fertility	Fertility rate
fdi	Foreign Direct Investment
beggpd	Natural Log of 1970 GDP
protestant	Percentage Protestant
catholic	Percentage Catholic
muslim	Percentage Muslim
goveff	Government effectiveness index
rlaw	Rule of law index
polstab	Political stability index

Table 3.2: WES/WDI Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
rgdpch	105	7034.32	7249.86	373.73	37032.43
lnrgdpch	105	8.28	1.17	5.92	10.52
inspect	76	0.09	0.46	-0.84	0.97
tax_inform	76	25.26	21.73	0.00	84.97
taxbribe	94	26.94	22.85	0.00	84.52
vatrate	94	16.20	3.87	5.00	23.00
reprt_sales	76	78.34	16.72	32.57	97.03
open	101	0.87	0.34	0.36	2.04
urbanshare	97	0.52	0.20	0.10	0.92
educind	97	0.70	0.24	0.15	0.99
eu	105	0.12	0.33	0.00	1.00
as	105	0.16	0.37	0.00	1.00
ce	105	0.21	0.41	0.00	1.00
ap	105	0.10	0.31	0.00	1.00
af	105	0.40	0.49	0.00	1.00
nmed	105	0.07	0.25	0.00	1.00
capform	99	24.11	6.45	10.14	41.53
inflation	101	6.75	5.05	0.04	34.70
hlthexpend	105	6.55	2.30	2.08	13.33
save	90	18.94	8.86	-2.14	42.80
fertility	105	3.16	1.66	1.08	7.26
fdi	105	5.61	7.40	-15.03	46.83
beggpd	67	21.14	1.65	17.77	24.84
protestant	103	12.50	16.58	0.01	68.00
catholic	102	31.27	33.14	0.01	97.00
muslim	104	25.38	33.72	0.00	99.90
goveff	105	0.28	0.73	-1.43	1.76
rlaw	105	0.33	0.74	-1.46	1.57
polstab	105	0.28	0.82	-2.40	1.30

Table 3.3: Tax Gap Analysis Variables and Descriptions

Variable	Variable Description
ve	VAT Collection Efficiency
ceff	C-Efficiency
gc	Gross Collection Efficiency
bureau	Bureaucracy Quality (0-4 points; 4 indicating strong bureaucracy)
durable	Regime Durability: Number of years since most recent regime change.
open	(Imports + Exports) / GDP
vatd	VAT System Dummy
petrolpc	Crude petrol per capita consumption (in 000 metric tons)
urbanshare	Share of population in urban centers
pop2	Population (in tens of millions)
gdp	GDP per capita in constant 2000 USD (Millions)
lngdp	Natural log of gdp
tmorale1	Tax Morale (percentage of individuals expressing cheating on taxes never justified)
agedep	Dependency Ratio
developed	Developed Country Dummy
neigh_collect	Weighted Average of Neighbor's Collection Efficiency

Table 3.4: Tax Gap Analysis Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ve	1096	35.853	14.297	0.166	96.183
ceff	1041	46.052	18.856	0.250	134.286
gc	1085	58.913	26.150	0.304	195.891
gdp2000usd	1947	290257	1054399	187.096	1.15E+007
lngdp	1947	10.294	2.262	5.232	16.258
vatd	2033	0.724	0.447	0	1
tmorale1	1273	0.718	0.148	0.266	1.17
agedep	1992	0.602	0.163	0.252	1.100
educind	1734	0.819	0.165	0	0.993
developed	2033	0.264	0.441	0	1
bureau	1599	2.540	1.101	0	4
durable	1833	28.145	34.761	0	199
open	1958	0.845	0.493	0	4.57
petrolpc	1490	0.002	0.005	0	0.038
urbanshare	2033	0.587	0.224	0.054	1
pop2	2009	4.736	15.711	0.00401	133

increase tax collections, resulting in higher collection efficiency ratios. As a result, these collection ratios can be used as an indicator of the effects of tax administration and tax evasion on growth.

This data set provides three measures of the tax gap: the VAT Efficiency ratio, the C-efficiency ratio, and the Gross Collection measure. While the base for each ratio is consumption, each measure is differentiated on how consumption is measured. The VAT Efficient ratio is based on GDP and is calculated as:

$$VE = \frac{R_v}{\tau_{vat} * GDP} \qquad (28)$$

where VE is the efficiency ratio, R_v is the total actual revenue collected from the VAT, and τ_{vat} is the tax rate for the VAT. Similarly, the C-efficiency ratio and the Gross Collection ratio are calculated as:

$$CE = \frac{R_v}{\tau_{vat} * Cons_T} \qquad (29)$$

$$GC = \frac{R_v}{\tau_{vat} * Cons_P} \qquad (30)$$

where $Cons_T$ and $Cons_P$ are total consumption expenditure and private consumption expenditure respectively. In each ratio, the denominator gives the total theoretical amount of VAT revenue. Due to a variety of factors, the actual revenue collected falls short of this theoretical total. In implementation, none of the tax bases used in these ratios are actual bases for functioning VATs. Exemptions and zero-ratings narrow the base and multiple tax rates change the actual denominator further. Because low

efficiency ratios can arise due to evasion or other factors like narrow bases, the relationship between tax evasion and the tax gap across countries is not consistent. The panel nature of the data mitigates this issue somewhat as a fixed effects estimator can be employed to estimate within country variation. While the other factors affecting the tax base are not necessarily time invariant, the changes in the tax base can be relatively infrequent resulting in most of the variation in within-country collection efficiency coming from collection issues.

Despite these measurement difficulties, these measures do contain information on the level of tax evasion as evasion leads to smaller numerators with respect to the denominator. Therefore, all else equal, economies with relatively larger levels of tax evasion will have ratios closer to zero, while countries with low levels of evasion will have ratios closer to one.

The tax collection efficiency ratio captures the full effect of tax enforcement and tax evasion, and therefore can be used to examine the combined effect of all factors. The WES/WDI analysis uses specific information on enforcement and evasion to disentangle the effects and measures only the direct effect of evasion costs and audit probabilities on growth. Combining (5) and a generalized version of (28) yields:

$$E = \frac{R}{\tau * GDP} = \frac{\tau[\beta + p\pi(1-\beta)]y}{\tau * y} = [\beta + p\pi(1-\beta)] \qquad (31)$$

Since optimal tax evasion, (1- β), is a function of tax rates, enforcement and evasion costs, the efficiency ratio is a function of these variables as well.

As with the WES/WDI analysis, the dependent variable for this tax gap analysis is the natural log of GDP and the specification takes the form of:

$$\ln(GDPpercapita_{it}) = \beta_0 + \beta_1 ER_{it} + \beta_n X_i + \gamma C + u \qquad (32)$$

where *ER* is the efficiency ratio of interest, *X* is a vector of control variables, and *C* is a vector of country fixed effects.

While the country fixed effects control for time invariant factors, the efficiency ratio is still endogenous as collections are determined by tax and evasion rates as well. An instrumental variable (IV) approach is used to account for this endogeneity. The variable used as an instrument for the efficiency ratio is the average collection efficiency of that ratio of other countries weighted by the inverse square root of the distance between capitals. High efficiency ratios in other countries should be associated with higher collections as tax administrations learn best practices from their neighbors. While sharing of knowledge between governments should be greater between neighboring countries due to proximity, distance does not preclude policy makers from learning best practices from further abroad. In essence, effective tax administration will spillover into other countries as policy makers share information. However, it is not likely that a neighbors effectiveness in tax collection will significantly affect economic growth. Further, as shown above the tax gap is endogenously determined by evasion costs and expected penalties. The use of an instrument variable will account for this endogeneity and identify the full effect of the tax gap on growth, not just the partial direct effect of audit probabilities and evasion costs as in the WES/WDI analysis. The enforcement

levels of a neighbor's tax administration is exogenously determined by factors in that country, but that country's experiences in implementation can be shared. As such, the weighted average of neighboring countries' collection efficiency satisfies both conditions of an instrumental variable for collection efficiency.

Results

The first results come from the regression to find unconditional audit probabilities at the firm level using the WES data. Table 3.5 reports the results from the first stage regressions. Column one details the logit regression of being audited on a variety of firm characteristics and industry indicators. Unsurprisingly, larger firms in terms of sales and employees are more likely to be audited as are domestically privately owned firms. Further, closed companies and partnerships are less likely to be audited than the omitted category of listed companies and more established companies are audited less. From these results, the residual unexplained probabilities of audit are obtained and, when aggregated to the country level, provide the country level audit probabilities.

Column two shows the results from the first stage regression of sales reported for tax purposes on firm characteristics and country fixed effects. Firms with high levels of sales report more, as do firms that are older and more established. Further, closed companies report more sales for tax purposes than the omitted category of listed firms.

Table 3.6 presents results from both the WES and WDI specifications. The results are weighted estimates of 1,793 regressions combining the four variables of interest and

1, 2, and 3 variable combinations of 22 controls. The WES regressions show that evasion costs, as measured by corruption of tax officials, is statistically significant at the 5% level. However, this result is tempered by a lack of significance in the WDI regressions. As predicted by (18), the direct effect of reduced evasion costs is positive growth. Higher tax official corruption rates reduces the costs of evasion, freeing resources to be used productively, thus increasing GDP. A one point increase in the percentage of tax officials requesting a bribe results in an increase of 0.012 percent in GDP.

While this result may seem contradictory to a well established literature showing corruption reduces growth and seems to indicate that private investment is more productive than public spending, the result here only measures the direct effect of a very specific type of corruption in reducing the costs of evasion. This result is therefore not necessarily inconsistent with the wider corruption and growth literature as this result does not speak to the full effects of economy wide corruption.

Like evasion costs, which is significant only in the WES regressions, audit probabilities are statistically significant in only the WES data. While imprecisely measured, the number of tax meetings does take the same sign as the audit probabilities from the WES data. While the theoretical direct effect of audit probability is ambiguous, higher audit probabilities, as measured by adjusted audit rates empirically have the direct effect of reducing GDP. In the WES regressions, a one percentage point increase in audit

Table 3.5: WES/WDI First Stage Results

VARIABLES	(1) tax_inspec	(2) report_sales
Ln(Sales)	0.0114***	1.289***
	(0.000522)	(0.173)
Number of Employees	5.61e-05***	-0.001
	(6.07e-06)	(0.000)
Years of Operation	-0.000274*	0.026*
	(0.000154)	(0.014)
Closed Company	-0.0690***	3.580**
	(0.0120)	(1.491)
Sole Proprietorship	-0.00902	-0.683
	(0.0128)	(1.617)
Partnership	-0.0439***	1.669
	(0.0137)	(1.780)
Public	0.0480	2.038
	(0.0411)	(3.511)
Other Legal Org.	-0.0304	1.485
	(0.0187)	(1.790)
Domestic Private Ownership	0.0814***	1.228
	(0.00782)	(0.739)
State Ownership	0.0414	3.222
	(0.0365)	(3.139)
Constant	0.487***	65.317***
	(0.0503)	(3.844)
Observations	39139	32292

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
(1) Industry Fixed Effects not reported.

probabilities results in a 1.015 percent decline in GDP. One possible channel for this result is that higher audit probabilities necessitate more government resources spent on enforcement, resources that can not be used for other productive services. Higher probabilities of audits and more audits also mean firms must spend additional resources on compliance instead of more productive uses.

Also significant in the WES regressions, but not in the WDI regressions, is tax evasion. Both estimates are consistent in sign as the WDI variable measures the percentage of firms engaged in tax evasion, while the WES variable measures the opposite of the average level of tax compliance. The WES measure of tax compliance is significant at the 10% level, with an increase in tax compliance resulting in greater GDP growth. Specifically, a one percentage point increase in sales reported by firms for tax purposes results in 0.014 percent increase in GDP. However, care should be taken with this result as evasion could be endogenous, with richer countries experiencing lower levels of evasion, instead of lower levels of evasion creating greater growth. Since the primary variables of interest in this study are evasion costs and enforcement probabilities, this potential endogeniety should not invalidate the analysis.

Table 3.6: WES/WDI Analysis Results

VARIABLES	WES lngdpch	WDI lngdpch
inspect/taxmeet	-1.015***	-0.05
	(0.308)	(0.071)
tax_inform/taxbribe	0.012**	-0.001
	(0.006)	(0.005)
reprt_sales/taxevade	0.014*	-0.006
	(0.007)	(0.005)
taxrate	-0.022	-0.011
	(0.028)	(0.024)
polstab	0.057***	0.053***
	(0.02)	(0.019)
rlaw	0.064***	0.08***
	(0.021)	(0.019)
goveff	0.111***	0.127***
	(0.02)	(0.017)
muslim	-0.001*	-0.001**
	(0.001)	(0)
catholic	0.0005	0.001**
	(0.0005)	(0.0005)
protestant	-0.001	-0.001
	(0.001)	(0.001)
beggpd	0.024***	0.023***
	(0.009)	(0.007)
fdi	-0.001	-0.001
	(0.003)	(0.002)
fertility	-0.048***	-0.048***
	(0.006)	(0.004)
save	0.003**	0.003*
	(0.001)	(0.002)
hlthexpend	0.009	0.013
	(0.012)	(0.01)
inflation	-0.003	-0.004
	(0.003)	(0.003)
capform	-0.001	0.001
	(0.003)	(0.002)

*** p<0.01, ** p<0.05, * p<0.1

Weighted Robust Standard Errors in Parentheses

Table 3.6 cnt.: WES/WDI Analysis Results

VARIABLES	WES lngdpch	WDI lngdpch
nmed	-0.008	0.026
	(0.095)	(0.058)
af	-0.13***	-0.156***
	(0.037)	(0.03)
ap	-0.066	-0.067
	(0.053)	(0.061)
ce	0.112***	0.108***
	(0.035)	(0.035)
as	0.019	0.041
	(0.04)	(0.037)
eu	0.113***	0.153***
	(0.031)	(0.031)
educind	0.325***	0.335***
	(0.055)	(0.034)
urbanshare	0.335***	0.361***
	(0.05)	(0.036)
open	0.071	0.068
	(0.043)	(0.042)

*** p<0.01, ** p<0.05, * p<0.1
Weighted Robust Standard Errors in Parentheses

In addition to these variables of interest showing statistical significance, a number of the control variables are also shown to be drivers of growth. Urban, and educated economies experience greater growth as do politically stable and well governed countries. Countries with larger Catholic populations experience greater growth, while larger Muslim populations is associated with slightly lower growth. In line with the literature, higher fertility rates generate lower growth. Beginning GDP is positive, which provides some evidence against convergence. Finally, African countries experience lower growth

while European Union and Central European countries have higher growth rates.

Table 3.7 gives the p-values for the WES/WDI analysis assuming a non-normal distribution of the estimates. Under this assumption, lower evasion costs and tax evasion levels are no longer significant in the WES specifications. However, the enforcement parameters of audit rates remains statistically significant at the 5% level.

Table 3.7: **P-Values for Non-normal *β* distribution – WES/WDI Analysis**

	WES	WDI
inspect/taxmeet	0.044	0.549
tax_inform/taxbribe	0.189	0.334
taxrate	0.408	0.477
reprt_sales/taxevade	0.230	0.331

To conclude the WES analysis, measures of collection efficiency are included as measures of tax evasion and results are reported in Table 3.8. Columns one, two, and three show results for the specifications with VAT efficiency, C-efficiency, and Gross Collection efficiency respectively. In all three specifications, higher audit rates result in lower GDP growth while higher bribe rates result in higher growth, all with similar magnitudes and statistical significance as the initial WES regression. Additionally, higher tax collections as measured by the C-efficiency and Gross Collection efficiency ratios have a positive impact on growth, with a one percentage point increase in collection efficiencies resulting in a 0.007-0.008 percent increase in GDP. Amongst the other

Table 3.8: WES Analysis with Collection Efficiency

	VAT Efficiency	C-Efficiency	Gross Collection Efficiency
VARIABLES	lngdpch	lngdpch	lngdpch
inspect	-0.929***	-0.895***	-0.905***
	(0.303)	(0.305)	(0.301)
tax_inform	0.011*	0.011*	0.011*
	(0.006)	(0.006)	(0.006)
Collection Efficiency	0.004	0.008*	0.007**
	(0.005)	(0.004)	(0.003)
taxrate	0.002	0.015	0.017
	(0.031)	(0.033)	(0.032)
polstab	0.062***	0.055***	0.052**
	(0.02)	(0.02)	(0.02)
rlaw	0.069***	0.062***	0.06***
	(0.02)	(0.021)	(0.021)
goveff	0.114***	0.11***	0.109***
	(0.017)	(0.018)	(0.019)
muslim	-0.001**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.001)
catholic	0.001	0.001	0.001
	(0.0005)	(0.0005)	(0.0005)
protestant	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
beggpd	0.025***	0.024**	0.024**
	(0.008)	(0.009)	(0.009)
fdi	-0.002	-0.003	-0.003
	(0.003)	(0.003)	(0.003)
fertility	-0.049***	-0.049***	-0.049***
	(0.005)	(0.006)	(0.006)
save	0.005***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)
hlthexpend	0.009	0.008	0.008
	(0.012)	(0.013)	(0.013)
inflation	-0.005**	-0.005**	-0.005**
	(0.002)	(0.002)	(0.002)
capform	0.001	-0.0002	-0.0004
	(0.003)	(0.003)	(0.003)

*** p<0.01, ** p<0.05, * p<0.1

Weighted Robust Standard Errors in Parentheses

Table 3.8 cnt.: WES Analysis with Collection Efficiency

	VAT Efficiency	C-Efficiency	Gross Collection Efficiency
VARIABLES	lngdpch	lngdpch	lngdpch
nmed	-0.026	-0.031	-0.032
	(0.082)	(0.073)	(0.076)
af	-0.139***	-0.125***	-0.121***
	(0.029)	(0.031)	(0.031)
ap	-0.022	-0.05	-0.048
	(0.052)	(0.044)	(0.044)
ce	0.135***	0.12**	0.105**
	(0.038)	(0.046)	(0.044)
as	0.028	0.033	0.041
	(0.042)	(0.044)	(0.044)
eu	0.123***	0.115***	0.111***
	(0.029)	(0.028)	(0.028)
educind	0.317***	0.307***	0.302***
	(0.046)	(0.049)	(0.049)
urbanshare	0.348***	0.339***	0.333***
	(0.047)	(0.049)	(0.048)
open	0.067	0.047	0.04
	(0.046)	(0.052)	(0.052)

*** p<0.01, ** p<0.05, * p<0.1

Weighted Robust Standard Errors in Parentheses

control variables, magnitudes and significance remain similar to Table 3.5 results, with the exception of inflation, which becomes significant in these specifications and is estimated to have a negative impact on growth.

While stricter enforcement measures and higher costs of evading seem to restrict growth by reducing resources available to the private sector, the inclusion of the collection efficiencies in the above specifications make it clear that focusing only on these two factors provides an incomplete explanation of tax enforcement and growth. To obtain a better picture of the overall effect of tax enforcement policies on growth, the wider measures of tax collection efficiency ratios are examined in a panel setting.

Table 3.9 presents the results of the first stage regressions from the fixed effects instrumental variable models. In each specification, the variable *neigh_collect* refers to the weighted average of collection efficiency in neighboring countries and is specific to the efficiency ratio being examined. The first column details the first stage regressions for the VAT efficiency ratio and shows that the weighted average of neighbor's VAT efficiency ratios is positively and significantly correlated with the domestic VAT efficiency ratio. Similarly, the weighted averages of neighbor's C-efficiency and Gross efficiency ratios, columns two and three, are both positively and significantly correlated with the corresponding domestic collection ratios.

The combined effect on growth of enforcement and evasion factors, as measured by overall tax collection efficiency ratios, are reported in Tables 3.10-3.12. Table 3.10 reports results using the VAT efficiency ratio. In all specifications, the efficiency ratio is

significant at the 5% level or better. The Instrument Variable Fixed Effects model is reported in column 3, with additional instrument validity statistics at the bottom. The first stage underidentification statistics strongly rejecting the null hypothesis of underidentification and the weak identification statistic exceeding the Stock-Yogo 10% maximal IV size critical value of 16.38, indicating *neigh_collect* is a strong instrument (Stock and Yogo 2002). All models produce positive estimates, showing that higher collection efficiency results in higher economic growth.

While estimates are significant and positive, the magnitude varies somewhat between the models. The IV-FE model indicates a one percent increase in collection efficiency results in a 0.69 percent increase in per capita GDP.

In addition collection efficiency, a few other variables are consistently significant across estimators. First political stability is a positive driver of economic growth, with more stable regimes having higher growth. A larger number of non-working population as indicated by a high age dependency ratio creates a drag on growth. Finally, more honest citizenry, as measured by higher tax morale, create greater growth.

Table 3.11 report similar results for the C-efficiency measure of tax collection. As with the VAT efficiency measure, C-efficiency is statistically significant across all specifications at the 5% level or better. The first stage statistics for the IV-FE model remain highly significant, showing the weighted average of neighbor's collections to still be a valid instrument. While the underidentification tests reject the null hypothesis of underidentification, the weak identification test statistic only exceeds the critical value of

Table 3.9: First Stage Regressions – IV-FE Estimations

Variables	VE	C-Eff	GC
neigh_collect	0.008***	0.005***	0.004***
	(0.002)	(0.002)	(0.001)
vatd	0.602***	0.737***	0.701***
	(0.111)	(0.131)	(0.131)
tmorale1	-0.158	-0.047	-0.096
	(0.113)	(0.12)	(0.122)
agedep	-1.022***	-1.693***	-1.827***
	(0.36)	(0.368)	(0.371)
educind	0.963**	0.748*	0.859**
	(0.394)	(0.392)	(0.385)
developed	-0.76***	-0.756***	-0.756***
	(0.108)	(0.115)	(0.114)
bureau	0.032	0.032	0.031
	(0.022)	(0.023)	(0.022)
durable	0.001	0.002*	0.003**
	(0.001)	(0.001)	(0.001)
open	-0.079	-0.02	-0.052
	(0.069)	(0.084)	(0.086)
petrolpc	21.507***	21.462***	20.855***
	(7.935)	(7.171)	(7.055)
urbanshare	-3.338***	-3.5***	-3.283***
	(0.899)	(0.885)	(0.883)
pop2	-0.032	-0.052*	-0.066**
	(0.03)	(0.031)	(0.029)

*** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors in Parentheses

8.96 for the 15% maximal IV size (Stock and Yogo 2002).

The results of the C-efficiency IV-FE specification are consistent with the VAT efficiency results. The same control variables show similar magnitudes and significance,

as does the variable of interest. Here, a one percent increase in the C-efficiency ratio results in a 0.55 percent increase in per capita GDP.

Finally, the results for the gross collection efficiency ratio are reported in Table 3.12. Like the two other collection efficiency measures, this measure is significant across specification and the instrument chosen is shown to be strongly correlated with the variable of interest. The results of each specification show similar magnitudes as those of the other measures of collection efficiency.

Discussion

Results from the WES/WDI analysis are consistent with the direct effects outlined in the theoretical model. The strongest result from these models suggests that higher enforcement rates, in the form of greater audit probabilities, results in lower growth. Firms facing a greater chance of audit must spend resources not only ensuring compliance in light of a potential audit, but also in dealing with the tax officials if they are selected for audit.

The empirical effect of evasion costs, as proxied by tax official corruption, is in line with the direct theoretical effect. More prevalent corruption not only reduces the costs of evasion, but is also indicative of a weak tax administration. Weak tax administrations are unable to enforce tax laws even when audit and penalty rates are high. The need to spend resources on hiding income and evading taxes is reduced when the tax administration is unlikely to find the evasion in the first place. The resources not needed to hide income can be used in productive pursuits, thus increasing GDP. While these

Table 3.10: Tax Gap Analysis Results – VAT Efficiency

VARIABLES	FE-No Controls lngdp	FE lngdp	IV-FE lngdp
lnve	0.163**	0.113***	0.69***
	(0.065)	(0.041)	(0.181)
vatd		0.307**	-0.031
		(0.130)	(0.145)
tmorale1		0.449***	0.478***
		(0.131)	(0.092)
agedep		-1.876***	-1.204***
		(0.414)	(0.317)
educind		0.275	-0.446
		(0.576)	(0.393)
developed		-0.037	0.378***
		(0.036)	(0.145)
bureau		0.003	-0.012
		(0.021)	(0.018)
durable		0.006**	0.005***
		(0.003)	(0.001)
open		0.219***	0.257***
		(0.056)	(0.056)
petrolpc		7.007**	-4.958
		(2.936)	(5.312)
urbanshare		2.269***	4.146***
		(0.572)	(0.783)
pop2		-0.061*	-0.041*
		(0.033)	(0.024)
Constant	-5.969***	-6.904***	
	(0.227)	(0.698)	
Observations	1067	645	645
R-squared	0.050	0.752	0.625
Number of id	86	52	52
First Stage Statistics			
F-Statistic			19.38***
Underidentification LM Statistic			17.50***
Underidentification Wald Statistic			19.78***
Weak Identification – Wald Statistic			19.383

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

direct effects seem to be clear, the overall effect on growth of these parameters is ambiguous. The indirect effects of these parameters on growth, as for example through their effect on public spending, can not be examined by these specifications. Instead, a broader measure of enforcement and collections must be used at the expense of precision in measuring evasion.

A clearer picture of the overall effect of these parameters can be gained from examining tax collection efficiency. Collection efficiency measures are less precise because they capture a number of other factors besides enforcement activity, such as tax structures peculiarities. Though not all variation in collection efficiency can be attributed to evasion, collection efficiency still encompasses most aspects of tax collection and evasion, and measures the end result of the interaction of all the parameters. When tax collections fall short, economic growth suffers, indicating that while the direct effect of audit probabilities and evasion costs are negative, these direct effects are overwhelmed by the indirect effects and interactions with other factors not present in the theoretical model.

The variables dealing with audit probabilities and evasion costs measure factors affecting intentional evasion. However, since intentional evasion is only a fraction of the tax shortfall, the effect of these factors on growth is correspondingly small. Other factors affecting tax collection efficiency are possibly more important to economic growth than simple tax evasion. While the theoretical model incorporating intentional evasion into growth theory is valid, it is incomplete. A more comprehensive model would account for other potential factors affecting tax shortfalls and their effect on growth.

Table 3.11: Tax Gap Analysis Results – C-Efficiency

VARIABLES	FE-No Controls lngdp	FE lngdp	IV-FE lngdp
lnce	0.207***	0.124***	0.555***
	(0.066)	(0.040)	(0.199)
vatd		0.285**	-0.021
		(0.128)	(0.159)
tmorale1		0.442***	0.441***
		(0.128)	(0.079)
agedep		-1.783***	-1.005**
		(0.420)	(0.41)
educind		0.306	-0.075
		(0.571)	(0.329)
developed		-0.029	0.281*
		(0.035)	(0.154)
bureau		0.002	-0.01
		(0.021)	(0.016)
durable		0.006**	0.005***
		(0.002)	(0.001)
open		0.214***	0.223***
		(0.056)	(0.052)
petrolpc		6.731**	-2.359
		(2.806)	(5.127)
urbanshare		2.335***	3.842***
		(0.570)	(0.81)
pop2		-0.059*	-0.037*
		(0.033)	(0.022)
Constant	-6.148***	-7.072***	
	(0.245)	(0.714)	
Observations	1023	645	645
R-squared	0.088	0.757	0.539
Number of id	82	52	52
First Stage Statistics			
F-Statistic			10.45***
Underidentification LM Statistic			10.41***
Underidentification Wald Statistic			10.66***
Weak Identification – Wald Statistic			10.445

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.12: Tax Gap Analysis Results – Gross Collection Efficiency

VARIABLES	FE-No Controls lngdp	FE lngdp	IV-FE lngdp
lngc	0.196***	0.117***	0.643***
	(0.061)	(0.039)	(0.199)
vatd		0.295**	-0.058
		(0.128)	(0.158)
tmorale1		0.445***	0.455***
		(0.130)	(0.088)
agedep		-1.782***	-0.768*
		(0.421)	(0.44)
educind		0.297	-0.236
		(0.568)	(0.347)
developed		-0.035	0.341**
		(0.035)	(0.156)
bureau		0.003	-0.01
		(0.021)	(0.017)
durable		0.006**	0.004***
		(0.002)	(0.001)
open		0.217***	0.243***
		(0.056)	(0.06)
urbanshare		2.277***	3.967***
		(0.565)	(0.808)
pop2		-0.058*	-0.023
		(0.033)	(0.023)
Constant	-6.180***	-7.046***	
	(0.240)	(0.710)	
Observations	1067	645	645
R-squared	0.088	0.755	0.3784
Number of id	86	52	52
First Stage Statistics			
F-Statistic			13.06***
Underidentification LM Statistic			12.726***
Underidentification Wald Statistic			13.33***
Weak Identification – Wald Statistic			13.056

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusions

Tax evasion and tax collection shortfalls are theoretically related to growth in a number of ways. However, the relationship between tax collections and growth is ambiguous. Resources that are not collected by the government through taxation can be used in productive private pursuits. However, the same resources that are not collected will not be used in productive public pursuits. The effect on growth is determined by which use, public or private, has the greatest return. While a great deal of work has been done on the determinants of economic growth, little of it has focused on tax collection levels.

To examine this issue, two separate approaches are used. The first uses aggregated firm level data on tax enforcement and evasion combined with country level data to test predictions generated by a theoretical growth model incorporating tax evasion. In general, the testable theoretical predictions were found to be valid, giving evidence that the model as a whole is valid. These results prove to be robust across a large number of regression specifications of a variety of control variables regularly associated with economic growth. Further, these results were replicable with an alternative data set that measured the same factors in different ways and covered a different sample of countries. However, the available data only offers a partial examination of the effects of evasion on growth.

The second approach involved using a panel of countries over a number of years to examine the overall interaction of factors from the theoretical model. Tax collection shortfalls are consistently found to reduce economic growth across a number of specifications and estimators. These results indicate that a variety of indirect effects or other factors outweigh the direct effects observed in the first approach using firm level data.

The results of these two analyses indicate that the return to public investment is likely higher in the sample countries. As a result, policy makers should attempt to fully maximize revenue collections. However, the manner in which this is accomplished is important as the results indicate that misplaced tax reform efforts could result in negative impacts on growth. Approaches that increase compliance levels while reducing the level of resources needed for tax compliance are preferred to approaches that seek increased compliance through methods that necessitate increased resources devoted to tax compliance.

While this study offers some evidence on the effect of tax compliance on economic growth, it is not definitive. The theoretical model of growth incorporating tax compliance has additional aspects and predictions that can not be tested with this data. Additional data and other measures of the model's parameters will provide a more accurate picture of the effects of compliance on growth. However, this study does indicate that this theoretical model is a valid starting point for this line of inquiry.

Chapter 4: Corruption and Tax Evasion

Introduction

Corruption and tax evasion are not new problems, and both are still significant problems facing today's economies. While these issues are distinct and can exist without each other, they can easily become intertwined, possibly exacerbating the effects of both problems. While a large body of work on each subject separately has been developed, the relationship between the two problems has remained a relatively unexplored area.

The theoretical effects of corruption on an economy are mixed. Some have taken the view that corruption "greases the wheels" of commerce, or that bribers grow into entrepreneurs who spur development (Bardhan 1997, Leys 1965). Conversely, the more intuitive view of corruption is that it creates serious inefficiencies in the economy, resulting in a wide range of adverse effects (Shleifer and Vishny 1993). The subsequent empirical work supports the latter view of corruption, confirming that it can result lower growth and investment (Goodspeed and Martinez-Vazquez 2011, Mauro 1995).

One potential channel for corruption's effect is through the reduction in government revenue from lower tax receipts. In corrupt societies, individuals wishing to evade taxes simply bribe their tax collector and the revenue goes at least partially uncollected. Particularly in cash-strapped developing nations, the resulting shortfall in revenue can seriously affect the government's ability to deliver public goods, such as education or health, that have been shown to increase growth.

The magnitude of these lost revenues can be substantial. From 1989 to 1999, the VAT tax gap in Chile averaged approximately 23%. With a Transparency International corruption perception index score of 7.2 (higher values indicate less corruption), Chile is viewed as a relatively uncorrupted country. In contrast, the VAT tax gap for Argentina, a country with a corruption perception index score of 2.9, has been estimated averaging over 55% of potential revenue during the same period. This shortfall in revenue represented nearly 3.5% of Argentine GDP (Bergman 2003). While it is clear that an uncorrupted government can still suffer tax evasion, higher corruption levels may exacerbate the problem.

Beyond the shortfall in government revenue and the subsequent underfunding of public goods, tax evasion also increases excess burden and reduces equity in the tax system. In the context of tax evasion, excess burden can be defined as the dollar value of the difference between the expected utility of paying taxes with certainty and the expected utility from facing the enforcement "lottery" (Yitzhaki 1987). Higher levels of evasion result in higher levels of excess burden due to risk aversion. Since enforcement requires real resources, there is an efficient level of evasion. However, in societies in which evasion is rampant, it seems likely that this efficient level is often exceeded.

Further, Hindriks et al. (1999) demonstrate that bribery to evade taxes is done by the middle of the income distribution, as the poor do not have enough to gain from evasion and the rich are insulated by their income levels. The bribe effectively becomes a surcharge added to the statutory tax schedule that decreases with income. As a result

more of the effective tax burden is then borne by lower incomes, reducing progressivity and increasing inequity.

Like the theoretical predictions for corruption in general, corruption with respect to tax evasion has been argued to have negative as well as positive effects. Corruption could increase tax revenue through the increased efforts of corrupt tax collectors (Mookherjee 1997). In order to maximize the number of bribes, inspectors have an incentive to work harder, increasing the probability a tax evader will be caught. Since the standard tax evasion decision model is decreasing in probability of being caught, fewer people will engage in evasion, resulting in higher revenues and more public goods than in a non-corrupt society.

While a good deal of theoretical work has focused on the relationship between corruption and tax evasion, empirical research on the firm's evasion decision is sparse. This study seeks to add to this literature by empirically investigating whether corruption leads to greater levels of tax evasion at the micro level. Using extensive firm level data gathered by the World Bank over several countries and years, this study will employ a propensity score matching technique in addition to standard econometric methods to provide a robust answer to the research question.

Literature Review

Chander and Wilde (1992) develop an early theoretical model of tax evasion that incorporates corruption. Following the work of Graetz et al. (1986), the authors adopt a

game-theoretic approach to tax evasion. From this framework, the authors find that, in the presence of corruption, increases in fine and tax rates can reduce government revenue through increased evasion.

More generally, theoretical work has addressed some aspects of the interplay between corruption and the tax system. These findings include additional evidence for a Laffer curve effect under a corrupt tax collection regime in which increased tax collection effort in the form of increased audits or tax rates serve to reduce government revenue (Sanyal, Gang and Goswami 2000); that the optimal tax structure in a corrupt society should be heavily tilted toward on consumption taxes (Barreto and Alm 2003); and that governments may be better off heavily monitoring corrupt collection agents (Besley and McLaren 1993) or even allowing a moderate degree of corruption (Flatters and Macleod 1995) than attempting to pay them an efficiency wage.

The more traditional expected utility framework of tax evasion first introduced by Allingham and Sandmo (1972) has also been extended to examine the relationship between corruption and evasion. Theoretical results from this line of work include findings that bribes, when sufficiently large, can act as deterrents to evasion, inducing the taxpayer to pay their taxes (Akdede 2006); that increases in the fine rate for corruption, while reducing corruption, can lead to increases in evasion, as taxpayers no longer face bribery costs of evasion (Acconcia, D'Amato and Martina 2003); and that increases in tax audit probabilities and fines are more effective than increasing investigations of corruption in reducing tax evasion (Bowles 1999).

Combining the Allingham and Sandmo model with a Ramsey growth model, Cerqueti and Coppier (2010) approach the relationship between corruption and evasion at a macroeconomic level. Further, the authors also allow for the interplay of tax morale with the corruption and evasion decision. While finding ambiguous effects on growth, the model produces unambiguous theoretical result that higher levels of corruption lead to lower tax revenues, particularly when tax morale is low.

While a good deal of the theoretical literature examines the effects of corruption on taxes and evasion, Goerke (2008) examines the firm's corruption decision in the presence of tax evasion. Focusing on the firm's corruption activities not related to evasion, Goerke finds that tax evasion has no direct bearing on the firm's bribery decision. However, changes in other exogenous factors, such as the bribe rate and tax rates, introduce ambiguity into the relationship such that corruption may have an impact on evasion.

The empirical work on the relationship between evasion and corruption is not as developed as the theoretical literature on the subject. Attilla (2008) examines the effects of corruption on growth through a tax revenue channel. This study finds that a combination of high levels of corruption and public revenue reduce growth, which is consistent with a detrimental effect of corruption on taxes. As corruption decreases tax revenue, governments can respond by increasing tax burdens to compensate, leading to more distortionary effects and lower growth.

Several other studies have focused on the increase in the underground economy

due to the presence of corruption. While this increase in the underground economy implies an increase in tax non-compliance, corruption, not the desire to evade, may be the driving force (Friedman, Johnson, Kaufmann and Zoido-Lobaton 1999). In other words, in highly corrupt economies, firms don't go underground to avoid higher statutory tax rates, but instead to avoid the higher effective tax that is associated with corruption and bribery.

Correspondingly, other studies have confirmed a positive association between corruption and the underground economy and a negative association between corruption and tax revenue (Brasoveanu and Obreja Brasoveanu 2009, Ghura 2002, Johnson and Kaufmann 1999, Tanzi and Davoodi 2001, Tanzi and Davoodi 1997). Other channels by which corruption reduces tax revenue is through its effect on tax morale. Corruption has been demonstrated to lower tax morale which is associated with lower tax compliance (Torgler 2004).

While these studies examine the effects of corruption on tax revenue at an aggregate level, much less work has focused on the actual relationship between corruption and the tax evasion decision. Some evidence has been presented of shared perceptions of corruption and evasion, which implies a close relationship, but does not directly address the interaction of the two (Torgler and Valev 2006).

Most similar to this work, Uslaner (2007) uses a subset of the data used in this thesis to focus on the relationship between corruption and evasion in transition countries in 2002 and 2005. While Uslaner argues that evasion is primarily driven by the

perception of government effectiveness, he notes that one of the primary drivers of that perception is the level of corruption in a country. If taxpayers believe their payments will simply be appropriated by corrupt officials rather than used for public goods, they will not pay their taxes. Correspondingly, he finds corruption to be an important factor that negatively affects the decision to pay taxes.

The theoretical work on corruption and evasion mainly deals with efficient responses to evasion in the presence of corruption. However, the work dealing with the effects of corruption on evasion are somewhat mixed. Models using the rational crime model indicate that in some circumstances corruption depresses evasion. Models focusing on tax revenue and corruption show that revenues are adversely affected, indicating potentially larger amounts of evasion.

The empirical evidence is less ambiguous. In line with theoretical models of tax revenue, corruption has been consistently shown to reduce tax revenues through a variety of channels in aggregate models. While less work has been done at the micro level, the negative effects of corruption on tax compliance seems to persist at less aggregated levels, contrary to some implications of theoretical models of the tax compliance decision. This study address this discrepancy and extends the micro-level empirical work on corruption and evasion by developing a model of the taxpayer's evasion decision and testing that model with a more extensive set of data and methods than has been used previously.

Theoretical Approach

This theoretical model focuses on the firm's decision to pay or evade taxes. Firms earn a total income of Y, of which they either declare to the authorities, D, or attempt to hide, E.

$$Y = D + E \qquad (1)$$

In the traditional tax evasion model developed by Allingham and Sandmo (1972), agents face a risky gamble based on the probability of being audited by the authorities. If they are not audited, they receive and income of:

$$I_{NA} = Y - \tau D - h_0(Y - D)^2 \qquad (2)$$

where τ is the tax rate on income declared, and h_0 is the costs of evasion such as keeping two sets of book or hiring lawyers or accountants to help hide income. Costs are increasing exponentially in the amount of money being hidden as larger hidden sums require more resources; holding cash in Swiss bank accounts is far more expensive than hiding it under a mattress. In a non-corrupt society, if the firm is audited, then it is fined and the resulting income is:

$$I_{AS} = Y - \tau D - \pi\ \tau (Y - D) - h_0(Y - D)^2 \qquad (3)$$

where the firm must pay both taxes at the tax rate of τ, and a fine at the fine rate of π one the evaded income. Unfortunately for the firm, the resources used in hiding the income are still lost even in the event that the subterfuge is not successful.

In an economy with corruption, the firms face the probability of being audited by

a non-corrupt, or straight, official or by a corrupt official willing to take a bribe to enable their evasion. A corrupt official and bribery will result in a final income of:

$$I_{AC} = Y - \tau D - B - f(B) h_0 (Y - D)^2 \qquad (4)$$
$$\frac{\partial f(B)}{\partial B} < 0 \quad , f(B) \in [0,1]$$

Where B is the bribe paid to the official and f(B) is the factor by which bribing the official reduces costs of hiding income. This factor is decreasing in B, as larger bribes should buy bigger reductions in the costs of evasion. Defining B and f(B) and substituting into (4) gives:

$$B = \theta \pi \tau (Y - D) \qquad (5)$$
$$\theta \in [0,1]$$

$$f(B) = (1 - \theta)^{\alpha} \qquad (6)$$

$$I_{AC} = Y - \tau D - \theta \pi \tau (Y - D) - (1 - \theta)^{\alpha} h_0 (Y - D)^2 \qquad (4a)$$

Following Besley and McLaren (1993), θ is the fraction of the tax and fine liability paid as a bribe and represents the tax inspector's bargaining power. The benefit of bribery, f(B) is assumed to be dependent on this bargaining power and is adjusted by α, which represents the effectiveness of the corrupt official in reducing costs. This parameter can encompasses a wide range of factors including the level of enforcement of anti-corruption laws, the general level of corruption in a country, or even firm specific circumstances[1]. In a very corrupt country, the bribe may be sufficient to fully eliminate evasion costs; the

[1] For example, a U.S. multinational company operating in a corrupt environment may engage in bribery to avoid local taxes, but would still need to use additional resources to circumvent U.S. laws against corruption, such as the Foreign Corrupt Practices Act. In this case, the corrupt tax official's effectiveness in abetting evasion is limited to only what he can do in his country.

corrupt official takes the bribe and ignores the taxpayer. In a more honest or vigilant society, the corrupt official may be able to mitigate the evasion costs, but the taxpayer must still incur some costs in order to completely hide the evasion.

The three potential income levels can be placed in an expected utility framework:

$$E(U)=qpU(I_{AC})+(1-q)pU(I_{AS})+(1-p)U(I_{NA}) \quad (7)$$

where p is the probability of being audited and q is the probability of being audited by a corrupt tax inspector. The firm's problem is to maximize expected utility by deciding what amount of income to declare. Substituting the appropriate equations and maximizing (7) with respect to D results in:

$$\frac{\partial E(U)}{\partial D}=qp\frac{\partial U}{\partial I_{AC}}\frac{\partial I_{AC}}{\partial D}+(1-q)p\frac{\partial U}{\partial I_{AS}}\frac{\partial I_{AS}}{\partial D}+(1-p)\frac{\partial U}{\partial I_{NA}}\frac{\partial I_{NA}}{\partial D} \quad =$$

$$\varphi=qp\frac{\partial U}{\partial I_{AC}}[\pi\tau\theta-\tau+2h_0(Y-D)(1-\theta)^{\alpha}]+(1-q)p\frac{\partial U}{\partial I_{AS}}[\pi\tau-\tau+2h_0(Y-D)]$$

$$+(1-p)\frac{\partial U}{\partial I_{NA}}[2h_0(Y-D)-\tau]=0 \quad (8)$$

The second derivative of ϕ with respect to D is less than zero, indicating the F.O.C is a maximum.

$$\frac{\partial\varphi}{\partial D}=qp\frac{\partial^2 U}{\partial I_{AC}^2}[\pi\tau\theta-\tau+2h_0(Y-D)(1-\theta)^{\alpha}]^2+pq\frac{\partial U}{\partial I_{AC}}(-2h_0(1-\theta)^{\alpha})$$

$$+(1-q)p\frac{\partial^2 U}{\partial I_{As}^2}(\tau\pi\theta-\tau+2h_0(Y-D))^2+(1-q)p\frac{\partial U}{\partial I_{AS}}(-2h_0)$$

$$+(1-p)\frac{\partial^2 U}{\partial I_{NA}^2}[2h_0(Y-D)-\tau]^2+(1-p)\frac{\partial U}{\partial I_{NA}}(-2h_0)<0 \quad (9)$$

Correspondingly, the optimal amount of declared income can be defined as:

$$D^*=D(\tau,\pi,p,q,\theta,\alpha,h_0,Y) \quad (10)$$

Equation (8) also implicitly defines D as a function of the corruption variables q, α, and θ. By the implicit function theorem, the comparative statics of these variables can be calculated. Taking the derivative of φ with respect to each corruption variable gives:

$$\underset{(-)}{\frac{\partial \varphi}{\partial q}} = p\frac{\partial U}{\partial I_{AC}}[\pi\tau\theta - \tau + \underset{(-)}{2h_o}(Y-D)(1-\theta)^{\alpha}] - \underset{(+)}{p\frac{\partial U}{\partial I_{AS}}}[\pi\tau - \tau + 2h_0(Y-D)] \quad (11)$$

$$\underset{(?)}{\frac{\partial \varphi}{\partial \theta}} = pq(\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha})\underset{(?)}{\frac{\partial^2 U}{\partial I_{AC}^2}}(-\pi\tau(Y-D) + \alpha(1-\theta)^{\alpha-1}h_0(Y-D)^2)$$
$$+ qp\underset{(-)}{\frac{\partial U}{\partial I_{AC}}}(-\alpha 2h_0(Y-D)(1-\theta)^{\alpha-1}) \quad (12)$$

$$\underset{(?)}{\frac{\partial \varphi}{\partial \alpha}} = pq(\pi\tau\theta - \tau + 2h_0(Y-D)(1-\theta)^{\alpha})\underset{(+)}{\frac{\partial^2 U}{\partial I_{AC}^2}}(-h_0(Y-D)^2\ln(1-\theta)(1-\theta)^{\alpha})$$
$$+ pq\underset{(-)}{\frac{\partial U}{\partial I_{AC}}}(2h_0(Y-D)\ln(1-\theta)(1-\theta)^{\alpha}) \quad (13)$$

Given that the sign of the derivative of φ with respect to q is negative and ambiguous for the other two corruption variables, by the implicit function theorem, the effect of changes in corruption on the amount of declared income will also be negative with respect to the probability of being audited by a corrupt tax official and ambiguous with respect to the bribe level and effectiveness:

$$\frac{\partial D}{\partial q} = -\frac{\varphi_q}{\varphi_D} = -\frac{(-)}{(-)} \quad (14)$$

$$\frac{\partial D}{\partial \theta} = -\frac{\varphi_\theta}{\varphi_D} = -\frac{(?)}{(-)} \quad (15)$$

$$\frac{\partial D}{\partial \alpha} = -\frac{\varphi_\alpha}{\varphi_D} = -\frac{(?)}{(-)} \quad (16)$$

Income from a crooked audit will always exceed that of a straight audit. Should a corrupt tax inspector attempt to extort an amount greater than the tax and fines on the evaded amount, the taxpayer could simply approach a straight tax inspector and pay the full tax and fine owed. As a result, the bribe rate plus the reduced evasion costs associated with the bribe will always be less than the fine/tax rate on evaded income plus the full costs of evasion. In this respect, businesses will always prefer to be audited by a crooked auditor and decrease their reported income as the probability of audit by a corrupt auditor increases.

The auditor's bargaining power and bribery effectiveness have more ambiguous results on declared income. These two variables serve to change the price of tax evasion, with larger bribes and more effective bribes, as represented by higher values of θ and α respectively, reducing the costs of tax evasion. As the size of the bribe grows, the change in price of tax evasion has an income and substitution effect on the amount of income declared.

The income effect is represented by the first term of equation (12). As disposable income grows due to the lower costs of evasion from the larger bribe, declared income

will also increase. Declaring more income creates more certainty, thus declared income is a normal good. However, while the increase in income from falling costs of evasion are positive, the bribe must be paid to the corrupt authority. Paying the bribe offsets the income gains from the cost of evasion reduction and thereby reduces the amount of declared income. These two countervailing effects serve to create ambiguity with regard to the overall effect of the bribe rate on declared income.

The substitution effect from the relative price change between declared and undeclared income due to the bribe size is represented by the second term of equation (12). As the costs of evasion fall, the relative price of declaring income increases. This results in the substitution of evaded income for declared income as indicated by the negative sign of the substitution effect. Given the ambiguity of the income effect and the impossibility of determining which effect dominates, the total effect of changing the bribe size on declared income is theoretically ambiguous.

Similarly, changes in α also result in change in the costs of evasion, with higher values resulting in lower evasion costs. The more effective a corrupt official is at reducing the costs, the lower the costs will be. The resulting change in declared income is also subject to income and substitution effects. Unlike a change in the bribe size, increasing official effectiveness only creates a decrease in the costs of evasion, which results in higher income. Because the firm receives all the benefit from this income increase, the effect on declared income is unambiguously positive. As noted above, declared income is normal, thus the resulting increase in income will reduce tax evasion.

Counterbalancing this effect is a substitution effect that is similar to the substitution effect arising from an increase in the bribe. Like larger bribes, more effective corruption will reduce the costs of evasion. Correspondingly, the relative price of declaring income will increase and firms will substitute away from declared income to undeclared income. Again, it is impossible to determine which effect will dominate, so the overall effect of an increase in α on declared income is theoretically ambiguous.

Estimation Approach and Econometric Issues

Due to data limitations, not all parameters affecting the optimal level of income reporting in equation (10) can be explicitly included in the econometric specification. Measures of the tax rate, τ, and penalty rate, π, are not available. However, as these are constant at the country level, a vector of country fixed effects will control for them. Similarly, the data does not have good measures for evasion costs other than the corruption variables. Since corruption is the main focus of this analysis, they can not be used as a proxy for evasion costs. These shortcomings in this data set offers room for further research. The other factors affecting the firm's reporting decision are represented in the data set and are discussed below.

Following from equation (10), the main econometric specification for this study is:

$$rprt\_sales_i = \beta_0 + \beta_1 brib\_taxes_i + \beta_2 brsal\_per_i + \beta_3 brsal_i^2 + \beta_4 tax\_inspec_i + \beta_5 obst\_taxreg_i + \beta_6 obst\_hightax_i + \beta_7 \ln(sales)_i + \beta_n X_i + u \quad (17)$$

where *rprt_sales* is the percentage of sales a firm declares for tax purposes, *brib_taxes* is a dummy variable equal to one if the firm has made a bribe to deal with taxes, *brsal_per* is the firm's total bribery payments for tax and other purposes as a percentage of sales, $brsal^2$ is the square of *brsal_per*, *tax_inspec* is a dummy variable indicating that the firm has been audited within the past year, *obst_taxreg* and *obst_hightax* are categorical variables measuring how much the firm views tax regulations and rates as an obstacle to doing business and *ln(sales)* is the natural log of the firm's sales. The vector *X* contains control variables, including country fixed effects which also control for the tax and penalty rate faced by the firm as these are assumed to be invariant within a country.

The two estimates of interest are β_1, and β_2. The variable *brib_taxes* measures the firm's probability of facing a corrupt tax inspector, and thus represents the q variable from equation (10). While measuring a firm's entire bribery load, *brsal_per* and $brsal^2$ capture information on the amount of the bribe for tax evasion, and thus is a measure of θ. Finally, while the effectiveness of tax officials in reducing costs, α, is not specifically controlled for in this specification, the country level fixed effects included in the X vector will offer some control for this effect.

The effectiveness of officials in reducing evasion costs depends on how acceptable corruption is in the country. As corruption becomes more common and presumably more acceptable, it becomes more effective at reducing costs associated with evasion. For example, a firm engaged in evasion may keep two sets of books. Upon being audited by a corrupt auditor, the firm can then bribe the auditor to report the cooked

books to his superiors, thus enabling the evasion. In a society in which corruption is more common, the corrupt auditor's superiors could simply accept the auditor's word that the firm's books are straight, particularly if the superiors gain something from the transaction as well[2]. This obviates the need for two sets of books; the auditor's (corrupted) word stands in for the cooked books. Each country has its own level of corruption acceptance and the country fixed effects capture this acceptance level.

The amount of tax evasion in which a firm engages may affect the level of corruption in which they must also participate. Some theoretical work has focused on the incentives faced by the tax inspectors to accept bribes and notes that the tax evasion by firms and corruption by inspectors are complementary activities (Çule and Fulton 2005). While corruption may induce more firms to cheat on taxes, more cheating on taxes creates more opportunities for bribery of tax officials. This potential endogeneity may bias the estimates on the corruption variables and must be addressed.

This study first deals with the potential endogeneity by employing an instrumental variable approach. An appropriate instrument for the corruption variables is one that is correlated with corruption but uncorrelated with tax evasion. One such set of variables that meets these requirements is the information regarding the firm's other bribery activity. Such variables available include if a firm bribed authorities to get connected to infrastructure, to obtain a business license, and to obtain a government contract.

[2] A recent case in India illustrates the potential collusion between corrupt tax officials and their superiors. In his defense, a corrupt tax official claimed that the bribe "accepted by him was to be passed on to his senior Nahar and was not for his use only" (PTI 2013).

As corruption takes root in a society, these types of bribes will grow in conjunction with bribery of tax officials to evade taxes. A culture of bribery reduces the stigma and social costs involved with all forms of bribery. Further, if a firm is comfortable with bribing for other reasons, then it is unlikely to view tax bribery as unacceptable and refuse to engage in it. As a result, the other bribe variables meet the first condition for instrumental variables; they are correlated with bribery to deal with taxes.

Since the bribery activity captured by the instrumental variables does not affect the firm's relationship with the tax authorities, it is independent of the tax evasion decision (Goerke 2008). In a sense, these bribes can be viewed as a cost of doing business similar to the wage rate or cost of capital. While such costs affect total income and profits, they do not affect the amount of sales to report for tax purposes. As a result, these instruments also meet the second condition of instrumental variables. Further, given three instruments, bribery to deal with infrastructure, business licenses and government contracts, and only one endogenous variable, the equation is over-identified, which allows for testing of both instrumental variable conditions.

The dependent variable also presents estimation issues for least squares estimation. The percentage of sales reported for tax purposes is bounded between 0 and 100, with a large proportion (55%) of the sample reporting 100 percent of sales. The transformation from a continuous distribution, the actual amount of sales reported for tax purposes, to a limited distribution, the percentage of sales reported, creates issues for

conventional regression methods (Green 2003). In the context of this data, an instrumental variable Tobit model can be used to address this issue (Alm and McClellan 2012).

Endogeneity of the corruption variable can also be addressed through propensity score matching (DiPrete and Gangl 2004). Propensity score matching has the added benefit of not imposing a functional form on the data. The event of facing and bribing a corrupt tax collector can be viewed as a random treatment that the firm experiences, with the subsequent outcome being the amount of sales that are reported for tax purposes. The effect of corruption on tax evasion can be determined by finding the average treatment effect on the treated (ATT). The effect of the treatment on the outcome is observable on the treated firms and the effect of non-treatment on the outcome is visible for non-treated firms. Denoting declared income Y_1 for treated firms and Y_0 for non-treated firms the average treatment effect (ATE) can be written:

$$ATE = E(Y_1 | C=1 - Y_0 | C=0) \quad (18)$$

where E is the expectations operator and C is a dummy variable indicating if the firm faced corruption or not. However, due to potential endogeneities, the ATE will not be the same as the ATT. The ATT is determined by:

$$ATT = E(Y_1 | C=1 - Y_0 | C=1) = E(Y_1 - Y_0 | C=1) \quad (19)$$

Thus finding the ATT requires observation of the outcomes of the untreated when they are treated ($Y_0|C=1$), an observation that is impossible to make. Because the treatment is not necessarily completely random, it is necessary to employ propensity score matching

to establish a control group for comparison with the treated group. A well specified propensity score model will capture most of the issues arising from the non-random nature of the treatment. The propensity score model first identifies the characteristics that are highly associated with treatment. Based on those characteristics, firms that have a high probability to be treated but in actuality were not are established as a control group with which the treated group can be compared. From this group, the ATT can be measured, giving the effect of corruption on tax evasion.

Since the treatment is partially based on the firm's actions of engaging in bribery, it is important to control for a wide range of firm characteristics to account for this potential selection bias. For this analysis, a number of observable firm characteristics, including firm size in sales and employees, ownership and industry type, attitude toward taxes, and other bribery activities are used to identify the untreated firms that would have been likely to fall into the treated group in order to establish a control group. Since the firm's other bribery activity is an observable and captures the firm's attitudes toward corruption, the potential selection bias is mitigated. Once this is accounted for, the treatment contains a random element as bribing to deal with taxes can only occur if the firm has the chance to be audited by a corrupt official. The treatment is if a bribe was paid to deal with taxes and a probit regression gives the propensity that a firm engages in bribery based on the observable characteristics. After obtaining the fitted values from the probit regression, firms within the control group will be matched with firms in the treated group based on their propensity scores. The resulting average difference in outcomes is

the effect of bribing to deal with taxes on tax evasion.

In matching propensity scores, there is a tradeoff between efficiency and bias depending on what matching method is used for finite samples (Caliendo and Kopeinig 2008). To address this tradeoff, this study uses three matching techniques: Nearest Neighbor, Gaussian Kernel, and Epanechikov Kernel. Nearest Neighbor matching pairs observations based on which propensity scores are closest to one another. The similarity of the propensity scores between treated and non-treated observations reduce bias in the comparison, however the one-to-one comparison reduces the number of matches between groups which increases the variance. Kernel matching addresses this issue by using a weighted average of all control group observations to create a counterfactual for the treatment observation. Since all control group observations are used, the variance of the estimate is reduced. However, this method can introduce bias as bad matches may be used in the weighting scheme.

Data

The data for this study comes from a compilation of survey data from the World Bank. Through the first decade of the millennium, the World Bank conducted the World Enterprise Survey (WES) and Business Environment and Enterprise Performance Survey (BEEPS), polls of individual firms regarding their business environment. The survey questions of interest cover over 16,000 firms from 33 different countries. Due to missing data, sample sizes for richer specifications are closer to 8,000 observations. A description of variables used can be found in Table 4.1 and summary statistics in Table 4.2.

Table 4.1: Variable Descriptions

Variable	Description
rprt_sales	Percentage of sales reported for tax purposes
brib_taxes	Bribed to deal with taxes dummy
brsal_per	Total briberyas percentage of sales
brsal2	brib_tax^2
tax_inspec	Inspected by tax authorities in past year dummy
obst_taxreg	Tax regulations are an obstacle to business (0-No Obstacle, 3-Major Obstacle)
obst_hightax	Tax rates are an obstacle to business (0-No Obstacle, 3-Major Obstacle)
lnsales	Natural log of sales
obst_corrup	Corruption is an obstacle to business (0-No Obstacle, 3-Major Obstacle)
empfull	Full time permanent employment
Mining	Mining industry dummy
Construction	Construction industry dummy
Transport/communication	Transport/communication industry dummy
Trade	Trade industry dummy
Business services	Business services industry dummy
Hotels/restaurants	Hotels/restaurants industry dummy
Other service	Other service industry dummy
MF-Food	MF-Food industry dummy
MF-Textile	MF-Textile industry dummy
MF-Garments	MF-Garments industry dummy
MF-Chemicals	MF-Chemicals industry dummy
MF-Plastics and rubber	MF-Plastics and rubber industry dummy
MF-Non-metallic mineral p	MF-Non-metallic mineral products industry dummy
MF-Metals and metal prod	MF-Metals and metal products industry dummy
MF-Machinery and equip.	MF-Machinery and equip. industry dummy
MF-Electronics	MF-Electronics industry dummy
MF-n.e.c	MF-n.e.c industry dummy

Table 4.1 cnt.: Variable Descriptions

Variable	Description
Listed	Legal organization – Listed
Closed	Legal organization – Closed
Sole Prop.	Legal organization – Sole Proprietorship
Partnership	Legal organization – Partnership
Public Sector	Legal organization – Public Sector
Other	Legal organization – Other
Domestic Private	Ownership – Domestic Private
Foreign Private	Ownership - Foreign Private
State	Ownership - State
brib_infra	Bribed to deal with infrastructure dummy
brib_license	Bribed to deal with licenses dummy
brib_contr	Bribed to deal with contracts dummy

The dependent variable follows from a question asking firms what the typical firm in their area reports for tax purposes. Asking a firm directly about tax evasion is likely to result in evasive responses, as respondents are often wary of incriminating themselves or wish to present themselves in a positive light (Elffers, Weigel and Hessing 1987). Indirect survey questions seek to limit this misreporting by asking about the behavior of others. The respondent's answer is assumed to be informed by their own experiences and thus a reasonable proxy for their own behavior. While the indirect questions mitigate misreporting due to self-presentation reasons, it is still subject to misreporting due to firm's misapprehension of its own behavior. If the firm does not realize it is engaging in tax evasion, then it can not report its experience with tax evasion. However, the lack of formal high-quality audit data often makes this type of survey data the only way to

proceed in investigating tax evasion.

The dummy variable *taxinspect* controls for the audit probabilities faced by the firm. While this variable is most likely endogenous to tax evasion (Alm, Cronshaw and McKee 1993), since it is not the primary focus of investigation, the biases generated by this endogeneity do not affect the conclusions regarding the impact of corruption on tax evasion (Stock 2010). Indeed, by allowing the endogeneity, this variable potentially controls for other omitted variables that are correlated with both corruption and audit activities.

The two final factors in the theoretical model, firm income and costs of evasion, are represented in the empirical model by the natural log of sales and the firm's view of taxes being an obstacle to doing business. The firm's sales is a direct measure of Y in the theoretical model. While it does not measure evasion costs directly, the firm's view of taxes as an obstacle to business contains some information about these costs. First, the firm's evasion costs consists of pecuniary and non-pecuniary costs. Some pecuniary costs typically associated with evasion are the salaries to the CPAs and lawyers enabling evasion or the bank fees accompanying an account in which gains can be hidden.

Non-pecuniary, or psychological, costs arise from the social stigma of tax evasion or the possible embarrassment of being caught. Both these costs can contribute to a firm viewing taxes as an obstacle to business. When a firm faces low costs, it is easier to evade taxes. When taxes are easy and cheap to evade, they do not pose a large obstacle to doing business. A firm will simply evade the taxes it needs to evade and move on with

business[3]. However, when costs of evasion are high and evasion does not come as easily, taxes are not so lightly dismissed. In this respect, taxes increasingly become an obstacle to business as evasion costs increase.

Results

Table 4.3 reports first stage regressions for the IV analyses. Column one shows estimates from the least squares first stage regression. The instruments chosen are positively correlated with tax corruption and significant at the 1% level. A firm that bribes to deal with contracts, licenses, or infrastructure increases the likelihood a firm bribing to deal with taxes by between 18.8 and 28.5 percent. Column two gives the Tobit first stage estimates which do not significantly differ from the least squares results.

Throughout specifications and estimation methods, corruption on the part of tax officials enables tax evasion. Table 4.4 presents estimates from the main variables of the regression analysis, while Table 4.A1 gives results for country and year fixed effects. Column one of Table 4.4 gives results of a base model with no controls. Corruption and tax evasion are strongly linked as all measures of corruption are statistically significant at the 1% level. The addition of controls does not affect the statistical significance of these results. Column two presents results with controls consistent with the parameters of the theoretical model while column three estimates add firm characteristics controls.

[3] A similar effect has been shown to occur in the relationship between foreign direct investment (FDI) and taxation. High levels of corruption attenuate the relationship tax levels and FDI (Goodspeed, Martinez-Vazquez, and Zhang 2011)

Table 4.2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
rprt_sales	16231	88.164	19.918	1	100
brib_taxes	16231	0.405	0.491	0	1
brsal_per	16231	1.087	2.603	0	50
brsal2	16231	7.957	44.315	0	2500
tax_inspec	11009	0.529	0.499	0	1
obst_taxreg	15925	1.468	1.134	0	3
obst_hightax	16047	1.685	1.122	0	3
lnsales	12789	6.151	2.110	0	14.509
obst_corrup	15444	1.060	1.138	0	3
empfull	16213	114.422	440.698	2	9960
Mining	16231	0.010	0.101	0	1
Construction	16231	0.118	0.322	0	1
Transport/communication	16231	0.070	0.255	0	1
Trade	16231	0.230	0.421	0	1
Business services	16231	0.103	0.304	0	1
Hotels/restaurants	16231	0.066	0.249	0	1
Other service	16231	0.086	0.280	0	1
MF-Food	16231	0.082	0.275	0	1
MF-Textile	16231	0.019	0.136	0	1
MF-Garments	16231	0.035	0.183	0	1
MF-Chemicals	16231	0.012	0.111	0	1
MF-Plastics and rubber	16231	0.007	0.082	0	1
MF-Non-metallic mineral products	16231	0.013	0.114	0	1
MF-Metals and metal products	16231	0.045	0.207	0	1
MF-Machinery and equip.	16231	0.049	0.217	0	1
MF-Electronics	16231	0.005	0.069	0	1
MF-n.e.c	16231	0.051	0.219	0	1
Listed	16231	0.021	0.142	0	1
Closed	16231	0.256	0.436	0	1
Sole Prop.	16231	0.348	0.476	0	1
Partnership	16231	0.249	0.433	0	1
Public Sector	16231	0.087	0.282	0	1
Other	16231	0.039	0.193	0	1
Domestic Private	16231	0.793	0.405	0	1
Foreign Private	16231	0.121	0.326	0	1
State	16231	0.086	0.280	0	1
brib_infra	16044	0.250	0.433	0	1
brib_license	15981	0.441	0.496	0	1
brib_contr	15333	0.343	0.475	0	1

Table 4.3: First Stage Regression Results

Variables	IV First Stage brib_taxes	IV Tobit First Stage brib_taxes
brsal_per	0.013***	0.013***
	(0.003)	(0.003)
brsal2	-0.000**	-0.000**
	(0.000)	(0.000)
tax_inspec	0.036***	0.036***
	(0.010)	(0.010)
obst_taxreg	0.019***	0.019***
	(0.005)	(0.005)
obst_hightax	0.005	0.005
	(0.005)	(0.005)
lnsales	-0.004	-0.004
	(0.003)	(0.003)
yoper	-0.000	-0.000
	(0.000)	(0.000)
Closed	0.006	0.005
	(0.031)	(0.031)
Sole Prop.	0.013	0.013
	(0.032)	(0.032)
Partnership	-0.011	-0.011
	(0.032)	(0.032)
Public Sector	-0.080	-0.080
	(0.060)	(0.059)
Other	0.011	0.011
	(0.038)	(0.038)
Foreign Private	-0.001	-0.001
	(0.014)	(0.014)
State	0.052	0.052
	(0.054)	(0.054)
brib_infrastr	0.198***	0.195***
	(0.014)	(0.014)
brib_license	0.285***	0.287***
	(0.014)	(0.014)
brib_contract	0.188***	.188***
	(0.014)	(0.013)
Constant	0.016	-0.037
	(0.065)	(0.058)
Observations	7821	7821
R-Squared	0.487	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.4: Regression Analysis Results

VARIABLES	No Controls rprt_sales	Model Controls rprt_sales	Extended Controls rprt_sales	IV rprt_sales	IV-Tobit rprt_sales
brib_taxes	-7.360***	-4.536***	-3.895***	-6.758***	-22.464***
	(0.342)	(0.410)	(0.434)	(0.791)	(1.777)
brsal_per	-1.864***	-1.584***	-1.353***	-1.226***	-2.392***
	(0.177)	(0.216)	(0.188)	(0.179)	(0.312)
brsal2	0.045***	0.043**	0.035**	0.030***	0.058***
	(0.014)	(0.018)	(0.014)	(0.011)	(0.017)
tax_inspec		-0.288	-0.318	-0.385	-0.462
		(0.343)	(0.392)	(0.399)	(0.973)
obst_taxreg		-0.296	-0.435*	-0.266	-0.732
		(0.224)	(0.231)	(0.238)	(0.555)
obst_hightax		-0.789***	0.059	0.020	-0.412
		(0.216)	(0.223)	(0.227)	(0.540)
lnsales		0.853***	0.655***	0.651***	1.747***
		(0.075)	(0.103)	(0.115)	(0.303)
yoper			-0.000	-0.001	-0.008
			(0.009)	(0.008)	(0.026)
Closed			-1.643*	-1.839*	-9.532**
			(0.944)	(0.995)	(4.044)
Sole Prop.			-4.816***	-5.146***	-17.755***
			(1.013)	(1.051)	(4.090)
Partnership			-3.158***	-3.403***	-13.734***
			(1.001)	(1.042)	(4.086)
Public Sector			-6.926	0.364	124.402***
			(7.623)	(1.874)	(7.262)
Other			-0.575	-0.745	-5.900
			(1.236)	(1.310)	(4.809)
Foreign Private			1.264**	1.507***	5.674***
			(0.530)	(0.530)	(1.564)
State			6.240	-0.991	-125.834***
			(7.610)	(1.780)	(6.643)
Constant	92.816***	89.735***	90.244***	92.413***	137.397***
	(0.172)	(0.638)	(2.828)	(2.125)	(6.928)
Observations	16231	8601	8292	7821	7821
R-squared	0.084	0.083	0.169	0.169	NA

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Country, Year, and Industry dummy reported in appendix table due to space considerations.

In these specifications, tax bribery results in lower sales reporting for tax purposes. A bribe is estimated to reduce reported sales by 3.9-7.4 percentage points. Additionally, as the amount of bribery increases so does tax evasion. An increase of one percentage point in bribes as a percent of sales will decrease reported sales by between 1.4 and 1.9 percentage points. However, if bribery becomes too expensive, it becomes more advantageous to forgo bribery and pay taxes. Thus, the relationship between reported sales and bribe levels is parabolic. Once bribes reach between 18.42-20.71 percent of sales, firms begin to reduce their tax evasion.

Table 4.5: IV Validity Statistics

	First Stage brib_taxes
Underidentification test	
Kleibergen-Paap rk LM statistic	1394.12
P-value	0.0000
Kleibergen-Paap rk Wald statistic	2796.64
P-value	0.0000
Weak identification test	
Kleibergen-Paap rk Wald F statistic	924.228
Partial R-Squared	0.2985
Hansen J Statistic	1.307
Chi-sq (2) P-Value	0.5202

Additional instrument validity statistics can be found in Table 4.5. Underidentification is strongly rejected with LM and Wald statistics of 1394.12 and 2796.64 respectively. Similarly, tax bribery is strongly identified by the instruments, with the estimation giving a F-statistic of 924.23. These results indicate that the first instrumental variable condition of correlation between the instruments and the variable of interest is fulfilled.

Further, with three separate instruments, the equation is overidentified. This allows for testing of the orthogonality condition as well. These estimates produce a Hansen J statistic of 1.307, which fails to reject the null hypothesis of orthogonality. These results show that the chosen instruments are appropriate as they meet both conditions for valid instrumental variables.

The results of the least squares IV analysis can be found in the fourth column of Table 4.4. As with the non-IV regressions, corruption is shown to be a significant factor in tax evasion. Bribing to deal with taxes reduces amount of sales reported for tax purposes by 6.76 percentage points. Further, larger bribes result in reductions in reported sales until the bribe level reaches 20.43 percent of sales. The average VAT rate for the countries in the sample is 18 percent, and firms steadily increase the average level of bribery as a percentage of sales up until this point[4]. However, at this point the costs of bribery becomes too high and firms begin to reduce evasion. In effect, the tax rate

[4] The difference between the tax rate boundary of 18 percent and the actual boundary of 20.43 percent can be attributed to bribery arising from other activities as the measure of the bribery level includes all bribes, not just tax bribes.

creates an upper bound beyond which bribery is more expensive than simply paying the legitimate tax.

The IV Tobit estimation produce similar results to the least squares analysis. The three variables of interest, *brib_taxes*, *brsal_per*, and *brsal2*, are statistically significant at the 1% level. As in the other specifications, bribing to deal with taxes reduces the amount of sales reported. Paying more in bribes also reduces sales reported, but only to a certain point at which the bribe costs becomes too great and paying taxes becomes the optimal strategy.

Because the Tobit regression is a maximum likelihood procedure, the reported coefficients do not reflect the marginal effects like the coefficients for the least squares estimates. Therefore the size of the effect, particularly for *brib_taxes*, may seem much different from the least squares estimates. However, calculating the marginal effects for the Tobit procedure results in similar results to the least squares regressions. Bribing to deal with taxes reduces sales reported by 7.01 percentage points. Each additional percent of sales spent on bribery reduces reported sales by 0.696 percentage points. However, once the bribe rate exceeds 20.74 percent of sales, firms begin to report more sales for tax purposes.

The results of the regression analysis are broadly confirmed by the propensity score matching analysis. Table 4.6 presents summary statistics of firm characteristics by whether they bribed for tax purposes or not. Differences in means are fairly small, indicating a close relationship between the groups and a good likelihood of finding

appropriate matches between the groups for comparison. The unconditional difference in mean sales reporting is -7.06 percentage points, with firms that do not bribe reporting 93.26 percent of their sales and firms that do bribe reporting only 86.2 percent of their sales.

The smaller sample propensity score regression shows that the firm's probability of engaging in bribery is parabolic in the percentage of sales devoted to all bribes, with the probability first increasing and then decreasing after the bribe cost becomes too great. This result is in line with results from the IV analysis showing evasion dropping off due to high bribe costs. A greater bribe cost reduces or eliminates the gain from evasion and thus attenuates the need for bribery. Similarly, being audited and having the attitude that taxes are an obstacle to doing business (*tax_inpec* and *obst_taxreg/obst_hightax* respectively) are associated with a greater probability of engaging in bribery. Tax inspections provide more opportunities for bribery, while ambivalence toward taxes reduces the moral costs of tax bribery. More established and foreign private firms (as compared to the omitted category of domestic private firms) are less likely to bribe to deal with taxes.

Propensity score matching is successful only if appropriate matches can be made between treated and untreated observations. To achieve good matches, the propensity scores for both types of observations must share a common support. Figure 4.1 shows the common support between firms engaging in bribery and those which do not for the small sample matching. The distribution of the treatment group is nearly uniform across

Table 4.6: Summary Statistics by Bribery to Deal with Taxes

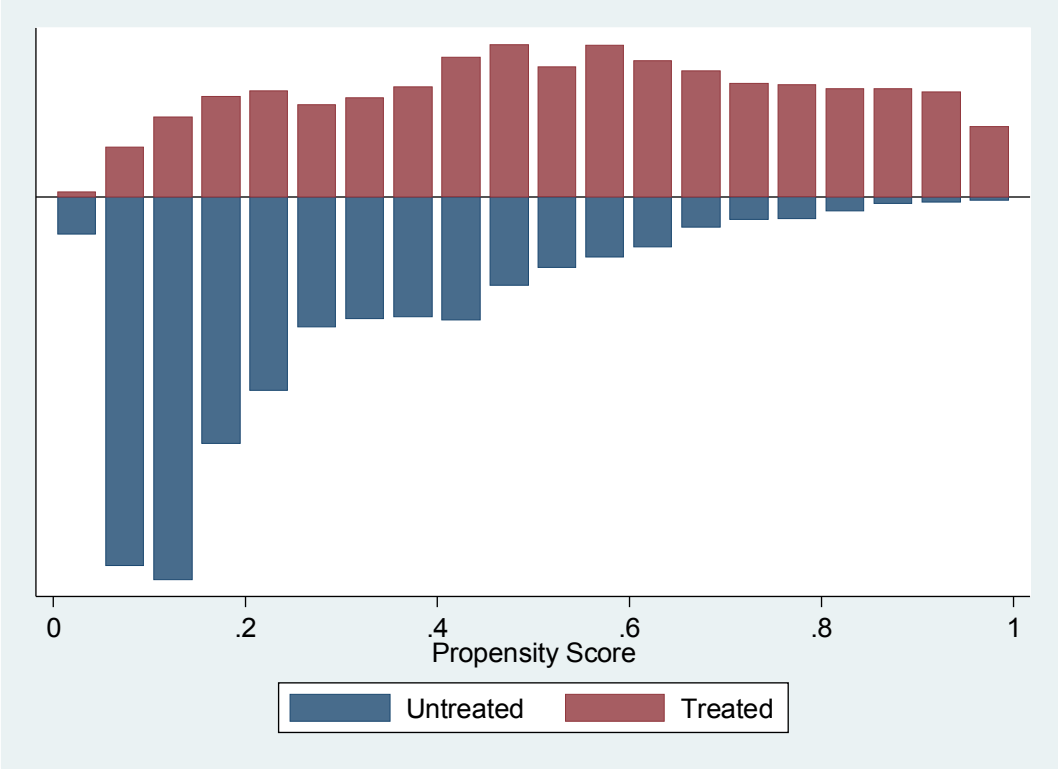
Bribed to deal with Taxes:		**No**			**Yes**		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Difference
Mining	5246	0.009	0.096	3046	0.010	0.097	0.000
Construction	5246	0.119	0.324	3046	0.125	0.330	-0.006
Transport/communication	5246	0.069	0.253	3046	0.063	0.242	0.006
Trade	5246	0.196	0.397	3046	0.223	0.416	-0.027
Business services	5246	0.122	0.327	3046	0.078	0.268	0.044
Hotels/restaurants	5246	0.065	0.246	3046	0.070	0.256	-0.005
Other service	5246	0.089	0.285	3046	0.072	0.259	0.017
MF-Food	5246	0.068	0.251	3046	0.118	0.322	-0.050
MF-Textile	5246	0.017	0.129	3046	0.018	0.132	-0.001
MF-Garments	5246	0.044	0.205	3046	0.045	0.207	-0.001
MF-Chemicals	5246	0.011	0.106	3046	0.012	0.111	-0.001
MF-Plastics and rubber	5246	0.006	0.074	3046	0.007	0.085	-0.002
MF-Non-metallic min. prod.	5246	0.013	0.112	3046	0.014	0.118	-0.001
MF-Metals and metal prod.	5246	0.052	0.223	3046	0.053	0.223	0.000
MF-Machinery and equip.	5246	0.056	0.231	3046	0.046	0.209	0.011
MF-Electronics	5246	0.006	0.079	3046	0.003	0.057	0.003
MF-n.e.c	5246	0.059	0.235	3046	0.045	0.207	0.014
Listed	5246	0.021	0.142	3046	0.015	0.123	0.005
Closed	5246	0.319	0.466	3046	0.244	0.430	0.075
Sole Prop.	5246	0.327	0.469	3046	0.398	0.490	-0.071
Partnership	5246	0.235	0.424	3046	0.265	0.441	-0.030
Public Sector	5246	0.067	0.251	3046	0.045	0.207	0.023
Other	5246	0.032	0.175	3046	0.033	0.179	-0.002
Domestic Private	5246	0.009	0.096	3046	0.857	0.350	-0.848
Foreign Private	5246	0.119	0.324	3046	0.098	0.298	0.020
State	5246	0.069	0.253	3046	0.044	0.206	0.025
brsal_per	5246	0.395	1.423	3046	1.474	2.717	-1.080
tax_inspec	5246	0.434	0.496	3046	0.647	0.478	-0.213
obst_taxreg	5246	1.213	1.137	3046	1.764	1.046	-0.551
obst_hightax	5246	1.483	1.161	3046	1.908	1.025	-0.425
empfull	5246	100.440	357.527	3046	81.734	284.266	18.706
lnsales	5246	6.700	2.100	3046	6.081	1.963	0.619
yoper	5246	18.355	18.801	3046	14.468	15.482	3.886
rprt_sales	5246	93.265	14.114	3046	86.201	18.985	7.064

Table 4.7: Propensity Score Regression Results

Variables	Small Sample brib_taxes	Large Sample brib_taxes
brsal_per	0.179***	
	(0.016)	
brsal2	-0.004***	
	(0.001)	
tax_inspec	0.188***	
	(0.036)	
obst_taxreg	0.199***	
	(0.020)	
obst_hightax	0.042**	
	(0.020)	
lnsales	0.007	
	(0.011)	
empfull	-0.000	
	(0.000)	
yoper	-0.005***	-0.007***
	(0.001)	(0.001)
Closed	0.056	-0.039
	(0.127)	(0.052)
Sole Prop.	0.088	0.173***
	(0.129)	(0.052)
Partnership	0.113	0.110**
	(0.129)	(0.052)
Public Sector	-0.368	-0.284
	(0.588)	(0.251)
Other	0.046	0.161**
	(0.152)	(0.064)
Foreign Privat	-0.097*	0.012
	(0.055)	(0.028)
State	0.219	0.144
	(0.581)	(0.249)
Constant	-1.563***	-0.121
	(0.245)	(0.101)
Observations	8292	20862

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 4.1: Propensity Score Matching Common Support



propensity scores, while untreated firms are positively skewed with a majority having low propensity scores. However, both distributions completely overlap, providing close matches between groups across the entire range of propensity scores.

Table 8 provides the results of the propensity score matching. Once again, this shows the entire sample of treated and untreated firms is on-support for both the large and small sample. The difference in average percentage of sales reported for taxes before matching, -7.06 for the small sample and -9.09 for the large sample, is statistically

significant at the 1 percent level. After matching, while the average difference falls, the difference is still significant across matching techniques and sample sizes. In the small sample, the matched mean difference in reported sales between the two groups is between -3.17 and -3.61 percentage points. The large sample shows similar results, with matched mean differences between -7.54 and -7.95 percentage points.

These results show that firms that engage in bribery will typically report fewer sales for tax purposes. Further, these results are similar in magnitude and significance to the regression analysis results which show bribery reduces the percentage of sales reported by between 3.9 and 6.76 percentage points.

Both the regression and matching analysis results are in line with the theoretical predictions showing firms decrease reporting of sales as the probability of facing a corrupt tax administrator increases. Additionally, the regression analysis shows the ambiguous theoretical result on bribe size is non-linear as well. Evasion first increases with bribe cost as firms can evade more if they pay more. However, once the costs of bribery become too great, firm will rather report their income than incur those bribery cost and evasion falls. While the theoretical result of bribe efficacy can not be addressed empirically with this data, this analysis has shown that the presented theoretical model does describe the relationship between bribery and tax evasion, at least in part.

Table 4.8: Propensity Score Matching Results

	Unmatched	Nearest Neighbor	Kernel – Gaussian	Kernel - Epanechnikov
Small Sample – Extended Matching Controls				
Treated	86.20	86.20	86.20	86.22
Controls	93.26	89.80	89.81	89.39
Difference	-7.06	-3.59	-3.61	-3.17
Std. Error	(0.366)	(0.752)	(0.512)	(0.555)
T-Stat	-19.29	-4.78	-7.05	-5.72
On-Support	8292	8292	8292	8279
Large Sample – Limited Matching Controls				
Treated	80.83	80.83	80.83	80.83
Controls	89.92	88.78	88.47	88.38
Difference	-9.086	-7.951	-7.637	-7.546
Std. Error	(0.299)	(0.499)	(0.341)	(0.353)
T-Stat	-30.35	-15.92	-22.38	-21.36
On-Support	20862	20862	20862	20862

Conclusion

Corruption and tax evasion are two distinct problems that affect all governments. While these problems can exist separately, they can easily become entangled. Corruption enables tax evasion by making it easier for taxpayers to hide their income. Tax evasion

can also contribute to corruption by creating additional opportunities for corruption to thrive. To address both issues, policymakers must understand the relationship between the problems. Using instrument regression analysis and propensity score matching, this study attempts to identifies the effect of corruption on tax evasion and provides evidence that corruption is a driver of evasion.

Corruption of tax officials is a statistically and economically significance determinant of tax evasion. Tax inspectors who request bribes result in reduction of sales reported for taxes of between 3 and 8 percentage points. Additionally, larger bribes result in higher levels of evasion. These results give support to the argument that tax compliance is dependent on the quality of the tax enforcers. Corruption effectively negate any reductions in evasion from establishing higher audit rates and penalties, the traditional enforcement measures used to increase compliance rates. The rules do not matter if no one bothers to enforce them. As a result, policymakers cannot attack tax evasion and expect results without addressing potential corruption issues first.

While corruption increases tax evasion, very high levels of corruption can create an atmosphere conducive to compliance. Unless the firm is being extorted by a corrupt tax official, once the costs of evading taxes grow greater than the costs of paying taxes the rational firm can simply comply with the law and avoid paying bribes. As a result, in situations in which the firm must pay a bribe rate to corrupt officials in excess of the tax rate, evasion rates begin to fall.

These results indicate that governments seeking to increase their tax revenues should first ensure their tax administration is honest. Corrupt tax administrations not only cause tax shortfalls through increased evasion on part of the tax payers, but they can also appropriate some portion the collected taxes due to the government. An honest tax administration enforces the existing tax laws effectively reducing evasion and remits all tax collections to the government. While this study only focuses on corruption's role in increasing evasion, addressing corruption serves to ameliorate both potential problems. Additionally, an honest tax administration allows policymakers to pursue a variety of other tax reforms designed to reduce evasion with the confidence that those reforms will be properly implemented.

Table 4.A1: Country and Year Fixed Effects Results

	OLS	IV	IV-Tobit
Albania	-8.538***	-14.498***	-25.009***
	(2.894)	(2.257)	(3.736)
Belarus	4.256	-1.726	-4.494
	(2.600)	(1.680)	(4.879)
Tajikistan	7.353***	2.374*	2.978
	(2.376)	(1.418)	(4.025)
Turkey	-13.426***	-19.413***	-36.999***
	(3.079)	(2.430)	(3.987)
Ukraine	3.044	-2.696*	-4.672
	(2.356)	(1.386)	(3.607)
Uzbekistan	11.924***	6.598***	25.266***
	(2.158)	(0.990)	(5.046)
Russia	-1.754	-6.871***	-13.560***
	(2.417)	(1.507)	(3.362)
Poland	3.712*	-2.418***	-12.333***
	(2.120)	(0.832)	(2.636)
Romania	5.021**	-1.126	-7.478**
	(2.209)	(0.962)	(3.134)
Serbia	-0.525	-5.038**	-12.763**
	(3.005)	(2.523)	(5.458)
Kazakhstan	8.679***	3.943***	10.796***
	(2.187)	(1.026)	(3.487)
Moldova	1.336	-4.193***	-14.809***
	(2.448)	(1.514)	(3.551)
Bosnia and Herzegovina	3.368	-2.853	-5.431
	(3.398)	(2.988)	(6.413)
FYR Macedonia	-7.427**	-13.390***	-26.932***
	(3.468)	(2.947)	(5.091)
Armenia	12.543***	7.223***	15.310***
	(2.130)	(0.943)	(3.355)
Kyrgyz Republic	3.114	-2.149	-3.127
	(2.702)	(1.927)	(4.117)
Estonia	6.305***	-0.233	-10.548***
	(2.160)	(0.850)	(3.659)
Czech Republic	-0.345	-6.699***	-19.354***
	(2.483)	(1.509)	(3.311)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.A1 – cnt.: Country and Year Fixed Effects Results

	OLS	IV	IV-Tobit
Hungary	1.148	-4.898***	-17.992***
	(2.282)	(1.171)	(3.089)
Latvia	6.258***	-0.276	-5.075
	(2.306)	(1.243)	(4.165)
Lithuania	2.131	-4.327**	-15.983***
	(2.575)	(1.695)	(4.008)
Slovak Republic	8.411***	2.531**	5.207
	(2.285)	(1.186)	(5.209)
Slovenia	2.295	-4.029***	-18.470***
	(2.344)	(1.249)	(3.506)
Bulgaria	0.002	-6.474***	-15.885***
	(2.583)	(1.862)	(3.932)
Croatia	2.978	-1.909	-10.127**
	(2.437)	(1.263)	(4.018)
Germany	2.215***	3.900***	-15.827***
	(0.780)	(0.698)	(2.297)
Portugal	2.062*	4.498***	-5.447*
	(1.059)	(1.039)	(3.121)
South Korea	-1.951**		-20.164***
	(0.931)		(2.537)
Ireland	4.973**	-1.385**	-11.560***
	(2.119)	(0.589)	(2.651)
Georgia		-4.919**	-14.593***
		(2.146)	(5.106)
Greece		2.498***	-12.973***
		(0.966)	(2.724)
Spain	6.079***		
	(2.122)		
Year 2004	2.956		
	(2.177)		
Year 2005		4.983***	
		(0.743)	
Constant	90.244***	92.413***	137.397***
	(2.828)	(2.125)	(6.928)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Chapter 5: Conclusion

The results of the previous three chapters suggest that policy makers should focus on tax reforms that first serve to increase the quality of the tax administration and next to simplify the tax code to make compliance as easy as possible. These chapters give evidence that poor or corrupt tax administrations can reduce government revenues, negatively affect growth, and enable tax evasion. Under the rational crime framework of tax evasion, increasing enforcement effort results in lower evasion and higher collections. However, this model has been shown to be incomplete and tax reforms proposed within this framework, consisting of only higher audits and penalties, are unlikely to fully address revenue shortfalls. Instead, efforts to increase tax collection efficiency should focus on administrative and tax code reforms within a service framework that emphasizes helping the taxpayer to comply (Alm and Martinez-Vazquez 2003).

In examining the determinants of the tax gap, this study finds that unintentional evasion, stemming from a complex tax code, and tax administration inefficiency and corruption reduce tax revenues. Service oriented reforms can address both these issues, providing a larger return on reform than an enforcement oriented approach that only addresses willful evasion. A competent and honest tax administration is able to efficiently enforce the existing tax code, reducing the need for additional measures that are not efficiency enhancing, such as higher tax rates. Importantly, a more efficient tax administration is able to increase revenues without putting more resources into tax

enforcement.

The second part of this study demonstrates why increasing collections without adding resources to enforcement can be desirable. Economic growth can be achieved through generating higher tax collection ratios. However, higher tax collection ratios generated by a focus on enforcement, increasing audit rates and penalties, may have a counterproductive outcome on growth. Resources used in evading and enforcing the tax code are unavailable for other productive uses. By treating the tax payer as a client and providing assistance in accurately paying taxes, officials can increase tax collections without resorting to enforcement measures which result in the use of productive resources in tax compliance.

The service paradigm, by making resources of the government available to taxpayers and streamlining the compliance procedures, also results in the freeing of private resources for productive uses. This achieves the same direct results on growth as reductions in evasion costs or lower audit rates. While the service paradigm maintains the compliance obligations, it allows the taxpayer to meet it at a lower cost and use the savings to invest in productive resources.

Further, these results are achieved without other negative side effects. Higher corruption levels may lower the costs of evasion and free resources, thus stimulating growth, but this is only a small and specific channel of the many through which corruption can operate. Corruption has many other costs and the general overall effect of corruption on growth is generally considered to be negative. A tax administration

implementing a service oriented approach to tax compliance avoids these types of negative effects.

Tax administration corruption is also positively associated with tax evasion which serves to reduce tax collections. While the positive correlation is an obvious result, this study shows that corruption causes elevated levels of evasion instead of tax evasion causing corruption. As a result, tax reforms focusing on effective and honest administration can serve to address both problems. By reducing corruption, policymakers also reduce evasion, thereby receiving better returns on reform than by focusing solely on evasion.

The importance of good tax administration is not a new result. Poor tax administration has adversely affected governments throughout history. Without good administration, governments must rely on ineffectual and heavy handed tactics to raise revenue, but even still run the risk of not raising enough. Effective tax administration that raises the appropriate revenues while minimizing the burdens on the population is not only beneficial to the government, but also to society as a whole.

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Vita

Chandler McClellan was born in Lagrange, Georgia, USA, on December 27th, 1979. He holds a BA in English and Economics and an MS in Agricultural and Applied Economics from the University of Georgia. Prior to pursuing his Ph.D. he worked in banking as a credit underwriter and lectured in Economics at Armstrong Atlantic State University in Savannah Georgia. His courses included Introductory Microeconomics, Introductory Macroeconomics, and The Economic Analysis of the Law.

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