



A computational general equilibrium approach to sectoral analysis for tax potential: An application to Pakistan[☆]



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ABSTRACT

This study develops a dynamic general equilibrium model, applied to Pakistani data, in which optimizing agents evade taxes by operating in the underground economy. The cost to firms of evading taxes is that they find themselves subject to credit rationing from banks. Our model simulations show that in the absence of budgetary flexibility to adjust expenditures, raising tax rates too high drives firms into the underground economy, thereby reducing the tax base. Aggregate investment in the economy is lowered because of credit rationing. Taxes that are too low eliminate the underground economy, but result in unsustainable budget and trade deficits. Thus, the optimal rate of taxation, from a macroeconomic point of view, may lead to some underground activity. We note, in particular, that incorporating a VAT without any other tax reductions greatly reduces the tax compliance of the service sector.

We have applied our model to Pakistan, and have calibrated our model to an 8 year period from 2004 to 2011. We note that it gives a reasonable approximation of Pakistani macro data. We then use a sectoral breakdown of tax data generated by the model to estimate tax gaps on a sector by sector basis. We note that certain sectors are currently paying taxes below their potential, while others may be above their tax potential. These sectoral gap estimates may be used as indicators of where greater tax enforcement efforts should be directed.

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1. Introduction

In many developing and transition countries, economic activity in the underground economy is estimated in excess of 40% of GDP (Friedman et al., 2000; Schneider & Enste, 2000).¹ This diversion into unofficial activity undermines the tax base and can significantly affect public finances and the quality of public administration (Dessy & Pallage, 2003; Johnson et al., 1997; Loayza, 1996). The illegal nature of underground activity also constrains private investment and growth. One important cost imposed by the inability to enforce legal contracts is the limited access to formal credit markets.

We develop a simple intertemporal general equilibrium model with heterogeneous agents, multiple production activities and credit rationing to explain the prevalence of a large underground economy and corresponding gap between potential

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¹ As in Braun and Loayza (1993), "the underground economy is defined as a set of economic units which do not comply with one or more government imposed taxes and regulations, but whose production is considered legal". We do not explicitly model regulations, assuming they are uniform across sectors.

and actual taxes collected. Our model is then applied to Pakistan. In particular, we explore the link between tax rates, access to credit, and the extent of tax evasion, and examine the consequences of the underground economy for public finances and aggregate economic performance.² Entry and exit into the underground economy is derived as part of optimizing behavior that depends on taxes and interest rates. Firms operating in the underground economy are subject to credit rationing by banks, which reduces loans in relation to the firm's nonpayment of taxes.

Since the size of the underground economy in the paper depends upon both endogenous and exogenous variables, our framework has scope for analyzing policy changes. In particular, we address the issue of policy responses in response to tax-avoiding activity, and we emphasize the ambiguous effects of taxation by means of numerical simulations of a computational general equilibrium (CGE) model for Pakistan. Economic reform will depend upon policies that reduce the various forms of tax evasion.

Pakistan is a useful example of a country that has severe problems with tax evasion. In particular, apart from having a poor tax collection effort, Pakistan has had a steadily declining tax to GDP ratio. In recent years, tax collection has come down from 10.9% of GDP in 2003 to around 9% of GDP in 2012 (Cyan & Martinez-Vazquez, *in press*). Widespread evasion is reported; for example, only 2% of working age population pays personal income taxes (Kleven & Waseem, 2013). Additionally, a study in 2011 found that out of the 46,000 registered firms, only around 24,000 filed corporate income tax returns.³ Thus Pakistan provides a case study of a country in which there are both high degrees of tax evasion, as well as a steadily declining tax effort. As we shall see in Section 4, certain available Pakistani data is quite old.⁴ Hence our analysis should be viewed as both an example of how this modeling approach can be applied to any country suffering from tax evasion. Additionally the study provides certain useful insights on Pakistan despite the age of some of the underlying data. We would thus claim that our results, in particular the tax gap analysis, offers qualitative insights for Pakistan, although we would be hesitant to claim that the simulation outcomes represent "correct" absolute values.

Section 2 provides a brief overview of our modeling of the underground economy. Section 3 presents our dynamic CGE model. Section 4 discusses the parameterization of the model and presents an initial calibration exercise. Section 5 discusses extensions to further disaggregation of the tax gap analysis.

2. Macroeconomic background

The cost of operating in the underground economy is modeled in terms of the inability to borrow from the official banking system. Banks in the model are assumed not to have perfect information about the firm's true ownership of assets and its associated true tax obligation. We assume that due to collateral requirements, credit is provided only in relation to the firm's implied ownership of assets, which is determined from its actual tax payment. The idea here is that in the face of default, banks can only seize those assets that have been officially declared by the firm. Hence, the higher the extent of tax evasion, the lower the implied value of firm assets, and the lower the amount of credit provided by the banking system. Our approach has some similarity to Kiyotaki and Moore (1997) who model credit limits on loans. These limits are determined by estimates of collateral which, in turn, are determined by estimates of durable asset holdings by borrowers. Here, tax payments are used to estimate the value of the durable asset of the borrower, as the asset cannot be directly observed.

We assume that firms can operate partially in the formal and partially in the underground economy. That part of their operation that takes place in the legal economy pays taxes and can borrow from the banking system. That part that is underground does not pay taxes and cannot borrow. Admittedly this distinction is artificial, but captures some of the benefits and costs of operating in the underground economy discussed in the literature. In reality, the underground firm may still be able to finance its investment needs by relying on trade credits or borrowing from secondary lenders who charge higher than market interest rates and are willing to incur high risks.⁵ More specifically, there is an alternative source of financing in Pakistan, as well as many other developing countries, that may be viewed as being between borrowing from the formal banking sector and entering the underground economy. This source is micro-financing in which micro-lenders offer lower rates than undocumented money lenders, but higher than the rates offered by the formal banking system.⁶ A more complete version of our model might have investors borrowing from the micro-lenders and paying higher rates, but avoiding the credit rationing they face from formal banks who examine their tax returns. This incorporation of diverse lenders is, however, beyond the scope of our research at this point.

² Access to credit could also be provided by microcredit institutions. However, these operations remain very small and do not offer a substitute to small firms at the threshold of informal sector. The microcredit operations target the poor households who do not own assets and accept social collateral in place of physical collateral. For example, in 2003 there were 240,000 active borrowers; the number increased to 1.27 million in 2007 under government policy but the gross loan portfolio increased from Rs. 2.3 billion in 2004 to 12.7 billion in 2007, with loan size increasing from Rs. 6629 in 2004 to Rs. 10,000 in 2007 (Rauf & Mahmoud, 2009; p.100). The average loan size of around \$100 does not offer a substitute financing option to the firms on the margin.

³ This study was carried out by the International Center for Public Policy, Andrew Young School of Policy Studies in 2011 to develop a micro-simulation model for the Federal Board of Revenue, Pakistan.

⁴ In particular, the available input–output matrix is almost 30 years old.

⁵ Huq and Sultan (1991) note that in Bangladesh, while borrowing rates from commercial banks were around 12%, firms dependent on noninstitutional sources to meet their financing needs paid rates between 48 and 100%.

⁶ See, for example, Haq and Safavian (2012) for an examination of how micro-credit in Pakistan expands borrowing opportunities for many people who would otherwise be excluded from the formal banking system, yet still excludes large numbers of eligible women borrowers.

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