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THE POVERTY IMPLICATIONS OF ALTERNATIVE TAX REFORMS: RESULTS FROM A NUMERICAL APPLICATION TO PAKISTAN

By

Andrew Feltenstein (Georgia State University, afeltenstein@gsu.edu)[1]
Carolina Mejia (World Bank)
David Newhouse (World Bank)
Gohar Sedrakyan (Georgia State University)

Abstract

This paper presents results from four simulations of the impact of potential tax reforms in Pakistan on poverty, shared prosperity, and inequality. The simulations are carried out in the context of a dynamic computational general equilibrium (CGE) model that incorporates endogenous tax evasion. The simulations link the CGE model to household survey data that is incorporated in a micro simulation model. The combined models suggest that equal yield increases in sales and corporate tax rates differ mildly in their impacts on consumption and poverty. Endogenously modeled tax evasion plays an important role in the results.

I.   Introduction

Many countries, particularly in the developing world, suffer from volatile revenue sources, which make it difficult to finance essential projects. They also have large numbers of poor people and there are concerns that revenue increases will negatively impact those people. Accordingly, attempts are often made to increase public revenues, while at the same time trying to minimize the impact of these revenue increases on the poor. The general intuition is often that increases in regressive taxes, such as the sales tax, will have a more negative impact upon the poor than will increases in progressive taxes, such as the corporate income tax. In this paper we will analyze the problem of how to increase tax revenues while trying to minimize the impact of this revenue increase on the poorest segment of society. We will use a numerical analysis

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[1] This paper was written as part of a World Bank project on fiscal policy and poverty alleviation in Pakistan.   The views expressed here are our own.

calibrated and applied to Pakistan, a country that faces both problems of poverty, as well as very poor public revenue performance. Our results will indicate that the standard intuition, at least in this case, may often be incorrect.[2]

Pakistan is in a delicate fiscal situation, with a budget deficit of around 5.8 percent of GDP for 2014 and with tax revenues amounting to only 10.3 percent of GDP. Tax reform is therefore high on the political agenda.[3] Although reforms may seek to raise revenue or improve efficiency, in particular by reducing tax evasion, changes in the tax code will also affect the income distribution and the welfare of households. The objective of this paper is to shed light on the potential distributional effects of tax reforms in Pakistan, by linking the output of a Computational General Equilibrium (CGE) models to a nationally representative household survey (the Pakistan Standard of Living Measurement Survey, PSLM). A top-down approach is utilized, in which the macro and sectoral outputs of the CGE model are used as inputs into micro-simulations.[4] A particular characteristic of the CGE model is that it incorporates tax evasion as an endogenous outcome of optimizing behavior by the corporate sector. Given Pakistan's relatively low rate of overall tax collection, as well as high statutory tax rates, it is important to be able to include the impact of evasion.

Our paper will be structured as follows. The next section will be a review of the relevant literature on tax evasion in the context of general equilibrium models, while Section III will give

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[2] Many authors have examined the relationships between tax regimes and poverty. See, for example Tanzi and Zee (2001, 2000), and Keen and Simone (2004) for a number of general insights, and Lustig (1998) for an application to the case of Mexico. Bird (2005) looks at the re-distributive role of the personal income tax in developing countries.

[3] Fiscal data obtained from the World Bank's Spring 2014 South Asia Economic Focus *Time to Refocus*.

[4] This is a commonly used approach in trying to analyze the impact of fiscal policy such as taxes and tariffs on heterogeneous consumer groups (See Feltenstein, Lopes, Porras-Mendoza, and Wallace, 2014 for a survey).

the intuition behind the treatment of tax evasion in our model. Section IV will develop the dynamic computational general equilibrium (CGE) model that we use to analyze tax changes at the macro level. The next section will give the numerical results of the simulations of alternative tax policies in the CGE model. Section 6 will discuss the micro simulation model that links the CGE macro results to poverty analysis, and will present the poverty outcomes of alternative tax regimes. The final section will be a conclusion.

II.   Literature Review

A number of studies consider the sustainability of poverty reduction in Pakistan. Thus, the World Bank report from 2013 analyzes the trends of poverty reduction by regions in Pakistan. It concludes that, for the period 2001-2008, Pakistan had a positive performance in linking economic growth with poverty reduction. The study addresses both urban and rural households with different levels of income. However, it also notes that the main issue for Pakistan has been to ensure sustainable economic growth, as the country has had only one period of four consecutive years of growth (Newman J. (2013)). A more recent World Bank report prioritizes the steps for strengthening Pakistan's public finance. This improvement is linked with a continued enhancement of tax collection, helping to maintain the sustainability of the government's growth-oriented agenda (World Bank, 2016). The same source suggests, as a proposed measure in the improvement of revenue mobilization, an increased reliance on direct taxes and less on the general sales tax (GST). Notably, the rebalancing of revenue collection responsibilities between federal and provincial governments is an additional step in the agenda towards improvement of tax efficiency efforts, as provinces contribute significant amounts to the budget deficit of Pakistan (IMF, 2016).

There have been a number of papers that consider the most appropriate tax structures for specific developing economies, with the aim of providing the highest possible tax revenues with the lowest negative impact on poverty. Among these, during the recent decade, are Tanzi, 2000, Tanzi and Zee, 2001, Keen et al., 2004, Martinez-Vazquez et al., 2011, and Feltenstein and Cyan, 2013. Different authors have taken alternative approaches to estimating an optimal tax level. Thus, for comparison, the tax level as a share of GDP in major industrialized countries (members of the OECD) is about 38%, compared with a sample of developing countries with an average of 18% (Tanzi and Zee. 2001). Authors have also mentioned the necessity of dealing with a tradeoff between economic growth and income inequality while designing a tax structure (Atkinson and Stiglitz, 1976; Gentry and Ladd, 1994; Arnold, 2008; Liu and Martinez-Vazquez, 2015).

Some authors have analyzed tax structures in low-income countries with weak tax mobilization. They have concluded that the weaknesses were a consequience of the fact that the formal sector of economy represented a relatively small share of employment and business activities. Therefore, the effect of reforms associated with those taxes levied personal or corporate income have had quite limited impact on government revenues. (Tanzi, 1987, 2000; Gemmel and Morrissey, 2003). Given the limited public administration tools in many developing countries, the empirical evidence suggests that perhaps the best policies are through introduction of indirect taxation mechanisms to finance necessary government expenditures (Heady, 2004, Bird and Zolt, 2005). As "in many developing countries, the effects of even the most progressive income tax on distributional outcomes are likely to be small compared to the effects of taxes on consumption…" (Bird and Zolt, 2005).

The general equilibrium analysis of tax systems has added interesting dimensions missing in studies with partial equilibrium models. These complex interdependencies are included in the analysis of public policies and its linkage to economic output . See, for example, Thissen, M. (1998), Devarajan and Hossein (1998), and Ke-young Chu et al., (2000). Additionally, the social accounting matricies (SAM) used in the CGE studies have become more user-friendly for programming. See Keuning et al (1988), Robinson (1989), Round (2003), Ahmed, V. and O'Donoque, C. (2007).

Computational general equilibrium tools have been used in studies of the fiscal system of Pakistan by both domestic and international economists (Shah and Walley (1991), Feltenstein and Cyan, (2013), Feltenstein et al. (2014)). Studies of tariffs, with application to Pakistan, have led to the general notion of reducing tariffs. See, for example, Kemal M. A. et al. (2001), Martinez-Vazquez J. (2006), and Guilherme and Taglioni (2013). Some recent studies have addressed the possibilities of widening the tax base and rationalizing tax rates. These papers favor the GST as relatively easier to collect and more amenable to tax reforms than changes to direct taxation. Among such studies are Refaqat, S. (2003), Ahmed, V. and O'Donoque, C. (2007), and Ahmed, S. et al (2010).

III.   **Modeling Tax Evasion**

Pakistan 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 percent of GDP in 2003 to around 9 percent of GDP in 2012. Widespread evasion is reported; for example, only 2 percent of working age population pays personal income taxes (Kleven and Waseem, 2013). Additionally, a study in 2011 found

that out of the 46000 registered firms, only around 24000 filed corporate income tax returns.[5]

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.[6]

We confine our analysis of tax evasion to business's evasion of the corporate income tax.

There are, of course, many other forms of tax evasion. There might be evasion of the personal

income tax, as well as under-invoicing of the sales tax. We will emphasize the corporate income

tax since is generally the most problematic source of tax revenue. The personal income tax is

typically withheld at the source, making it relatively difficult to evade. Sales taxes are also not

simple to evade, since doing so requires falsification of receipts, as well as corresponding

manipulation of income statements. If, in fact, a firm did evade sales tax, then this would tend to

increase the profitability of the firm and so at least some of this increase profit would be captured

by the corporate income tax. Accordingly, our omission of sales tax evasion probably leads to

an underestimation of the increased profitability of the evading firm, as well as its corresponding

rate of investment.

We model the cost of operating in the underground economy 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

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[5] 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.

[6] We should be clear that we cannot prove that the low tax effort in Pakistan is the result of evasion, or of an inefficient collection mechanism. However in this paper we are implicitly assuming that evasion is responsible for a major part of the revenue shortfall.

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.

Our approach also assumes that firms can evade taxes without any real risk of detection or punishment. Shleifer and Vishny (1993) point out that where public pressure on corruption or the enforcement ability of the government is relatively weak - as is the case in many developing countries - this is in fact a fitting assumption. Of course the specific case of Pakistan may well deviate from this general assumption, as variable enforcement of tax collection in different sectors of the economy may occur. Such differential levels of enforcement could impact revenue collections across sectors, independently of access to credit issues. However we lack information on differential tax enforcement, and hence have not attempted to incorporate it in our stylized model.

IV.   A General Equilibrium Specification

In this section we develop the formal structure of a dynamic general equilibrium model that endogenously generates an underground economy. Much of the structure of our model is

designed to permit numerical implementation for Pakistan. Our model has n discrete time periods. All agents optimize in each period over a 2 period time horizon. That is, in period t they optimize given prices for periods t and $t+1$ and expectations for prices for the future after $t+1$. When period $t+2$ arrives, agents re-optimize for period $t+2$ and $t+3$, based on new information about period $t+2$.

Production

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

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

The five types of capital correspond to five aggregate nonagricultural productive sectors. These sectors are:

SECTOR 1=LIGHT MANUFACTURING
SECTOR 2=HEAVY INDUSTRY
SECTOR 3=ELECTRICITY,WATER, SEWAGE
SECTOR 4=TRANSPORT
SECTOR 5=HOTELS, HOUSING, HEALTH SERVICES

An input-output matrix, A_t, is used to determine intermediate and final production in period t. The matrix is 50 x 50, and is taken from *Samwalk* 2010, the most recent social accounting matrix for Pakistan. The first 50 rows and columns of the input-output matrix correspond to domestic production. The final row and column represents imports of intermediate and final goods, which are treated as a single aggregate commodity. Corresponding to each sector in the input-output matrix, sector-specific value added is produced using capital and urban labor for the nonagricultural sectors, and land and rural labor in agriculture.

The specific formulation of the firm's problem is as follows. Let y_{Ki}^j, y_{Li}^j be the inputs of capital and urban labor to the jth nonagricultural sector in period i. Let Y_{Gi} be the outstanding stock of government infrastructure in period i. The production of value added in sector j in period i is then given by:

$$va_{ji} = va_{ji}(y_{Ki}^j, y_{Li}^j, Y_{Gi}) \tag{1}$$

where we suppose that public infrastructure may act as a productivity increment to private production.

Sector j pays income taxes on inputs of capital and labor, given by t_{Kij}, t_{Lij} respectively, in period i. The interpretation of these taxes is that the capital tax is a tax on firm profits, while the labor tax is a personal income tax that is withheld at source. There are no pure profits here, since production functions are constant returns to scale, and hence the corporate income tax is treated as a tax on returns to capital.

We suppose that each type of sectoral capital is produced via a sector-specific investment technology that uses inputs of capital and labor to produce new capital. Investment is carried out by the private sector and is entirely financed by domestic borrowing

Let us define the following notation:

C_{Hi} = The cost of producing the quantity H of capital of a particular type in period i.
r_i = The interest rate in period i.
P_{Ki} = The return to capital in period i.
P_{Mi} = The price of money in period i.
δ_i = The rate of depreciation of capital.

Suppose, then, that the rental price of capital in period 1 is P_1. If C_{H1} is the cost-minimizing

cost of producing the quantity of capital, H_1, then the cost of borrowing must equal the present

value of the return on new capital. Hence:

$$C_{H1} = \sum_{i=2}^{n} \left[\frac{P_{Ki}(1-\delta)^{i-2} H_1}{\prod_{j=1}^{i-1}(1+r_j)} \right] \tag{2}$$

where r_j is the interest rate in period j, given by:

$$r_j = 1/P_{Bj}$$

where r_j is the price of a bond in period j. The tax on capital is implicitly included in the

investment problem, as capital taxes are paid on capital as an input to production.

The decision to invest depends not only on the variables in the above equation, but also upon

the decision the firm makes as to whether it should pay taxes. This decision determines the

firm's entry into the underground economy.[7] We assume that the firm's decision is based upon a

comparison of the tax rate on capital with the rate of return on new capital. Formally, suppose

that we were in a two period world. Suppose that:

$$\frac{P_{K2}}{1+r_1} \geq t_{K1}$$

that is, the present value of the return on one unit of new capital is greater than the current tax

rate on capital. In this case we assume the investor pays the full tax rate on capital inputs.

Suppose, on the other hand, that:

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[7] We should again emphasize the limitations in our modeling of tax evasion. The firm here will
be evading only the corporate income tax, based upon a comparison between the tax rate and the
return to investment.

$$\frac{P_{K2}}{1+r_1} \leq t_{K1}$$

Here the discounted rate of return is less than the tax rate. The extent to which the firm goes into the underground economy is determined by the gap between the tax rate and the rate of return to investment. That is, the firm pays a tax rate of $\bar{t}_{K1}$ where:

$$\bar{t}_{K1} = t_{K1}\left[1 - \left(\frac{t_{K1} - \frac{P_{K2}}{1+r_2}}{t_{K1}}\right)^{\alpha}\right] \tag{3}$$

Here $0 \leq \alpha$ and higher values of α lead to lower values of taxes actually paid. That is, the ratio $\frac{\bar{t}_{K1}}{t_{K1}}$ reflects the share of the sector that operates in the above ground economy. Hence α represents a firm-specific behavioral variable. An "honest" firm would set $\alpha = 0$, while a firm that is prone to evasion would have a high value for α. Thus $\propto$ may reflect not only inherent honesty of the firm, but also perceptions of the risk of getting caught. We have not modeled endogenous risk or punishment, so the use of $\propto$ is admittedly ad hoc. We should also note that the tax evasion mechanism of eq. 3 is not fully consistent with the present value calculation of eq. 2. Ideally, the tax paying firm would decide upon the rate of tax evasion, in advance, for each time period. Recall that our model is 2 period perfect foresight, with adaptive expectations thereafter. Hence it is not possible to derive optimum rates of tax evasion for each forthcoming period since the firm does not know all future prices. Accordingly, we have the again ad hoc specification of eq. 3 which is a simplified version of 2 period optimization, combined with the behavioral assumption represented by $\propto$.

Banking

We will suppose that there is one bank for each nonagricultural sector of the economy. There are 5 such sectors, and hence 5 banks, corresponding to each of the aggregate capital stocks. Each bank lends primarily to the sector with which it is associated. The banks are, however, not fully specialized in the sector they correspond to. We make the simplifying assumption that each bank holds a fixed share of the outstanding debt of its particular sector. It then holds additional fixed shares of the debt of each of the remaining sectors. We make this assumption of diversification of assets in order to allow for a situation in which a firm that evades taxes, and thereby enters the underground economy, might receive varying degrees of credit rationing from the different banks to which it applies for loans.

We assume the borrower is required to show the bank his tax returns in order to obtain aloan. There is a single, flat corporate tax rate that the borrowing firm faces. Hence, suppose that T_{K1} represents taxes actually paid by the borrower in period 1. This is known to the bank, as the potential borrower is required to present his tax returns. Thus if the borrower fully complied with his tax obligation, and hence carried out no underground activity, the value of his capital, $\hat{K}_1$, would be given by:

$$\hat{K}_1 = \frac{T_{K1}}{t_{K1}}$$

In this case the bank lends an amount L_1, where $L_1 < C_{H1}$, as the bank would not be able to seize the full value of the loan in the case of a default. The situation we have described would, in the case of perfect certainty, have credit rationing when the estimated value of the firm's capital is less than its loan request. If the firm's capital is greater than its loan request, there would be no credit rationing.

In a more realistic case of uncertainty about both the true value of the firm, as well as about the bank's own ability to seize the firm, one might expect the lending process to be somewhat different. Accordingly, we will suppose that a simple functional form determines bank lending as a function of the amount requested as well as the estimated value of the firm's capital. We define the amount the bank lends, L_1, as:

$$L_1 = C_{H1} \left[\frac{\dfrac{\widehat{K}_1}{C_{H1}}}{1 + \dfrac{\widehat{K}_1}{C_{H1}}} \right]^{\gamma} = C_{H1} \left[\frac{\widehat{K}_1}{C_{H1} + \widehat{K}_1} \right]^{\gamma} \tag{4}$$

Here γ represents a measure of risk aversion by the bank. If $\gamma = 0$, there are no credit restrictions, and the bank ignores estimates of the borrower's estimated net worth. As γ rises, the bank increasingly restricts lending if the term in brackets is less than 1. Thus if a firm operates entirely in the underground economy it will not be able to borrow to finance investment. If banks are highly risk averse, they will never lend more than a firm's estimated net worth, which is based on its tax return. This tax return therefore represents all the information the bank needs in order to determine its response to a request for a loan.

Consumption

There are 18 different consumer categories, each of which has either urban or rural labor, initial allocations of the 5 capital types, and land. They also have initial allocations of financial assets; money, bonds, and foreign exchange. The 18 categories are taken from the SAM for Pakistan (SAMWALK 2010). They are given by:

1. Urban quintile 1
2. Urban quintile 2

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

The consumer classes have differing Cobb-Douglas demand functions with weights derived from the SAM consumption data. Endowments are similarly taken from the SAM. The consumers maximize intertemporal utility functions, which have as arguments the levels of consumption and leisure in each of the two periods. See Appendix 3 for the complete consumer's optimization problem.

The Government

The government collects personal income, corporate profit, and value-added taxes, as well as import duties. It pays for the production of public goods, as well as for subsidies. In addition, the government must cover both domestic and foreign interest obligations on public debt. The resulting deficit is financed by a combination of monetary expansion, as well as domestic and foreign borrowing

The Foreign Sector

The foreign sector is represented by a simple export equation in which aggregate demand for exports is determined by domestic and foreign price indices, as well as world income. The specific form of the export equation is:

$$\Delta X_{n0} = \sigma_1 \left[\frac{\pi_1}{\Delta e_i + \pi_{Fi}} \right] + \sigma_2 \Delta y_{wi}$$

where the left-hand side of the equation represents the change in the dollar value of exports in period i, π_i is inflation in the domestic price index, Δe_i is the percentage change in the exchange rate, and π_{Fi} is the foreign rate of inflation. Also, Δy_{wi} represents the percentage change in world income, denominated in dollars. Finally, σ_1 and σ_2 are corresponding elasticities.

Imports are treated as a single aggregate good produced by the foreign sector. Consumption demand for imports is determined as part of the consumer's demand given by equation (5) in Appendix 3, in which consumers have an elasticity of demand for imported goods. Imports are also the final row and column of the input-output matrix. Thus imports are both intermediate and final goods, with intermediate demand being generated by the input-output matrix and final demand coming from consumer optimization. Accordingly, both intermediate and final demand for imports are dependent upon the exchange rate.

V.   **Simulations of the Pakistan General Equilibrium Model**

Benchmark Simulation

After having calibrated our model to historical Pakistan macro data, we carry out an out of sample simulation based upon 2012. That is, we assume that all fiscal policy parameters (tax rates, real public core spending, and deficit financing rules) remain constant for the 8 years of the simulation. We assume that the country runs a managed exchange rate, and arbitrarily assume that the exchange rate is devalued by 6 percent per year. At the same time we assume that the

world inflation rate is 4 percent annually and world growth is 2 percent per year. We chose the exchange rate devaluation rate so as to approximate the gap between world and Pakistan inflation over recent years. The world inflation and growth projections were taken from the World Economic Outlook (WEO) of the International Monetary Fund. The model is then run forward for 8 periods and generates a set of macro-economic variables. In addition, year by year real incomes are calculated for each of the 18 household categories. The results for this simulation are given in Appendix Table 1.

As our simulations generate a large of endogenous outcomes for different economic parameters, there is a question of how best to compare different policy simulations. We have, in general, chosen to make comparisons in terms of 8 period averages of key variables. In some instances we will also use averages rates of change in particular variables to make comparisons. Such averages and overall rates of change are, of course, broad measures. The interested reader can use the Appendix tables to compare individual years.

We see in Appendix Table 1 that annual real growth averages 3.2 percent. The average inflation rate is 9.9 percent over the same 8 year forward looking time horizon. Thus the forward looking growth rate is roughly in line with the current Pakistan growth rate, while the future inflation rate is somewhat higher than the current rate.

Tax revenues stabilize at about 19 percent of GDP, which is higher than their actual share in GDP. This discrepancy is the result of our previously discussed modeling of tax evasion. Since we only incorporate evasion of the corporate tax, we implicitly assume that the statutory rates are the effective rates for the sales, personal income, and tariff rates. Of course there is evasion of all of these taxes and tariffs and, in particular, there is evidence of a considerable amount of smuggling. Our simulated tax revenues are thus higher than the historical numbers

which incorporate broader evasion.   We have increased current expenditure by an amount equal to the over-shooting of the tax revenues. We have done so in order to replicate the budget deficit, which is a primary determinant of interest rates, which in turn influences investment and growth. We see that the budget deficit stabilizes at approximately 7.5 percent of GDP, after starting out quite high.[8] This is somewhat higher than the current budget deficit, as might be expected since we assume no change in tax or expenditure patterns. Finally, the trade deficit starts off at 5.2 percent of GDP, in line with its current value, and then gradually improves to become a small surplus by the end of the simulation. This outcome is a result of our assumed rate of future devaluation combined with the assumptions for world growth and inflation.

If we turn to the next part of the table, showing real income by household group, we see that almost all sectors exhibit growth over the 8 periods, although there are exceptions. Thus, for example, the category "urban other" suffers income losses over the simulation, as does the category "waged rural landless farmers Punjab".   The overall average growth rate of real income is 2.5 percent, and the urban sector experiences a very slight decline in real income, while the rural sector's real income grows by 4.3 percent annually. We should not attribute any absolute significance to these numbers. Rather, they should be used in comparison to the counterfactual examples which will come next.

17 Percent Sales Tax

As our first counterfactual simulation we will suppose that the sales tax is increased from 16 percent in the base case to 17 percent as part of an attempt to improve tax collection. This particular increase is chosen because, at the time, the government proposed changing the tax rate to 17 percent. Hence our changes will reflect both reality as well as the marginal performance of

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[8] This is probably due to our attributing some of the stock of private debt to the public sector, as these debts are sometimes difficult to differentiate in the data.

sales tax increases. Our later goal will be to determine how large a corporate tax increase needs

to be, in the absence of any administrative changes, to generate the same revenue increase. We

should note that this exercise does not reflect the many possible measures that could be

undertaken to increase revenues in Pakistan. For example, the country could introduce property

taxes, transaction taxes, and excise taxes. In addition, one might try to examine the effects of

improved tax administration upon revenue efficiency. We have, however, chosen to stay with

this set of rather simple exercises since they reflect proposals that are currently under

consideration. In fact, the sales tax increase has been proposed by the World Bank as well as the

Pakistan government. The search for revenue neutral changes in other tax rates would then be a

standard exercise. We do not know how other tax regime changes would be implemented, so

that their introduction would be purely hypothetical. Similarly, improved tax administration is

clearly an important issue, but very difficult to model within our general equilibrium model

context. We are thus implicitly assuming that tax evasion behavior, as well as tax

administration, remain constant for our exercise. This assumption of constant tax administration

does not imply that improved tax administration is not important. Rather, it requires a new study

that is beyond our scope.

The results are given in Appendix Table 2. We see that the average share of revenues to

GDP rises from 20.4 percent to 21.1 percent. At the same time, real GDP declines initially, but

by period 7 is slightly higher than in the base case. Also inflation also declines slightly. It is

interesting to note that there is a decline in tax compliance, as compared to the base case, as the

increased sales tax has lowered the profitability of investment. Aggregate annual real income

across all households over the 8 periods of the simulations remains virtually unchanged from the

base case (0.04 percent higher). The urban sector sees a 0.03 percent increase in real income, while the rural sector sees a 0.04 percent increase in real income.

45 Percent Corporate Income Tax Rate

As a further experiment, suppose we ask what would happen if we try to use a corporate income tax rate increase to achieve the same increase in tax revenue as was brought about by the 17 percent sales tax. Accordingly, we will derive a corporate tax rate that depends endogenously upon the sales tax increase. Such an equivalent increase cannot be derived analytically, but must be determined by repeated simulations with different capital tax rates. As shown in Table 3, an increase in the corporate income tax from 35 to 45 percent leads to an average tax to GDP ratio of 21.1 percent, which is precisely what was generated by the 17 percent sales tax rate. At the same time, as might be expected, there is a significant deterioration in tax compliance, as the tax increase reduces the return to capital. Final period capital stocks are also lower across all sectors, leading to a reduced marginal product of labor.

The negative impact of the corporate tax increase causes aggregate real household income to be 1.0 percent lower, than it was in the base. Rural consumption growth suffers disproportionately, declining by 1.1 percent, while urban consumption declines considerably less, by 0.7 percent. This is largely due to the fact that the decline in capital has impacted the rural sector more severely than the urban sector. Additionally, the urban sector holds a preponderance of the stock of public and private debt and hence realizes an income increase from the capital gains on their bond holdings, as interest rates have decreased.   We may thus conclude that, from a macro and household income point of view, the 17 percent sales tax rate is superior to the 45 percent corporate income tax rate in generating the same 21.1percent tax to GDP ratio.

19 Percent Tariff

As a final example, we will experiment with a 5 percentage point increase in the tariff rate on imports, increasing it from 14 to 19 percent. The results of this simulation are given in Table 4.   The average tax to GDP ratio, 21.0 percent, is virtually the same as with either the 17 percent sales tax or the 45 percent corporate income tax.[9] At the same time, the aggregate household real income is essentially unchanged (0.06 percent higher than in the base case). It is interesting to note that the tariff increase benefits the urban sector slightly more than the rural sector. Finally, the tariff increase has relatively little impact on the rates of tax evasion. This is intuitively clear, as imports are not domestically produced, so the increased tariff rate has little impact upon the rate of return to capital.

It would thus appear that for the macro economy the 17 percent sales tax has the best overall outcome of the various counter-factual policies. The 45 percent corporate income tax rate, which generates the same overall tax to GDP ratio as does the 17 percent sales tax, produces lower real GDP in all periods than does the sales tax increase. In addition, average real household income growth is lower with the corporate income tax increase than it is with the sales tax increase. Thus a modest sales tax increase would appear to be our choice among revenue equivalent tax changes, if we consider only macro aggregates. If we turn to poverty indicators, we find certain additional results. This will be the subject of the next section.

VI. Poverty Calculations

As noted in the previous section, three particular changes to the tax code are considered:, a one percentage point increase in the General Sales Tax, a ten percentage point increase in the corporate tax rate,   and a five percentage point increase in the tariff rate. Changing the corporate

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[9] In order to achieve a precise 21.1 percent tax to GDP ratio, we need to set the tariff rate at 19.2 percent. Since this would seem to be an unrealistic rate for a real-world tariff rate, we set the rate at 19 percent, which brings us to total tax revenues of 21.0 of GDP, which we would claim is close enough for our comparison.

tax rate from 35 to 45 percent, and changing the GST from 16 to 17 percent are revenue

equivalent policies, increasing revenue by 0.7 percentage points of GNP (from 20.4 percent in

the baseline to 21.1 percent of GNP). Raising the tariff to 19 percent, from 14 percent, increases

revenue by only 0.6 percentage points of GNP, while having a less favorable macro outcome

than does the sales tax increase.

In this section we allow the endogenous outputs of the CGE model, in particular the

series of real consumption indices reported in Appendix Tables 1-4, to be entered as data inputs

to our micro-simulation model of Pakistan households. We report the simulated effects of the

tax reforms on two outcomes: 1) the average change in real consumption for each quintile

(incidence), as well as the share of the benefits or burden accruing to each quintile of the

consumption distribution (targeting performance), 2) the poverty rate, as compared to the

baseline case. In order to calculate these outcomes, we apply the CGE generated growth rates in

real household income uniformly within the corresponding household groups in the 2010-11

Pakistani Social and Living Standards Measurement Survey (PSLM) to simulate the effect of the

four reforms.[10] In each case, we compare the effects under the reform to the baseline scenario to

assess the effects on household welfare, following a "top down" procedure in which the

endogenous outcomes generated by the CGE model are fed into a micro-simulation model

(MSM). This approach has been used extensively as a way of connecting the more aggregate

outputs of CGE models with the detailed household data available in MSM models. A survey of

such models is given in Feltenstein, Lopes, Porras-Mendoza, and Wallace (2014).

Incidence and Targeting

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[10] The growth rate we use is the average growth rate of the simulated real income produced by
the model in periods one through eight.

First, we examine the implications of the model in terms of the incidence and targeting implications of the three proposed tax increases. Appendix Table 5, as well as the subsequent graphs, shows the average change in real consumption for each expenditure quintile under the alternative scenarios, in comparison to the baseline. The base case generates highest overall growth rate in real consumption. Of the alternative tax policies, raising the sales tax gives the highest aggregate level of real consumption. Thus the real consumption is higher for each quintal with the 17 percent sales tax than it is with the 45 percent corporate income tax. Similarly, the sales tax increase generates higher aggregate real consumption than does the tariff increase, although all of the counterfactual scenarios have lower aggregate consumption levels than the base case. It is useful to look at the relative impacts of these alternative tax policies on different income categories. It is interesting to note that the lowest quintal suffers a greater consumption loss under the corporate tax increase than it does under either the sales tax or tariff increases, contradicting standard intuition. Similarly, it is useful to note that the highest quintal is impacted relatively more by the sales and tariff changes than any of the four lower quintals, but is not affected by the corporate tax increase as much as is the third quintal. The negative impact of the corporate tax upon the lowest quintal is explained by the fact that the end of period sectoral capital stocks are considerably lower with the corporate income tax than with either of the other simulations (Appendix Tables 1-4), so that the marginal product of labor is also lower. This reduced marginal product, and hence wage, tends to impact the poorest households most severely since most of their income comes from labor. Thus there seems to be strong support for the conclusion that the sales tax increase is welfare superior to the equal tax yield corporate tax increase, at least from the point of view of impact upon consumption.

Finally, it should be noted that the tariff increase leads to nearly as large an overall reduction in consumption as does the sales tax increase. This outcomes occurs because although the sales tax impact a broader set of consumption goods than does the import tariff, the tariff also directly affects the cost of production for many sectors of the economy. The resulting prices increases are passed on to consumption.

Poverty Rates

Over the past 15 years, Pakistan has made important progress in reducing poverty. According to the latest available household survey data, the incidence of poverty decreased from 64.3 percent in 2001 to 29.5 percent in 2013 (See Figure 1). Despite a temporary setback between 2010 and 2011, poverty resumed its rapid decline thereafter. Poverty has declined in both urban and rural areas, although the headcount rate remains twice as high in the latter as in the former (36.9 percent vs. 18.2 percent).[11]

Pakistan's poverty is determined using a standard methodology. The official poverty line used was defined in 2001 based on a food energy intake approach (minimum caloric intake of 2350 calories per adult equivalent per day), using 1999 data. The poverty line is currently updated using the inflation rate from the Consumer Price Index (CPI), and the consumption data comes from the integrated household study known as the Pakistan Social and Living Standards Measurement (PSLM) Survey. This survey is collected by the Pakistan Bureau of Statistics over an entire year, every three years.[12]

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[11] Our estimates follow closely the official methodology, even though slight discrepancies may arise due to differences in data cleaning protocols.

[12] The first integrated household survey was implemented in 1998-99. Since then, consumption data was collected in 2001-02, 2004-05, 2005-06, 2007-08, 2010-11, and 2014-2015, and the consumption module has experienced minor changes.

Despite the use of standard methods, poverty measurement in Pakistan is the subject of an ongoing controversy. The latest official estimate of poverty found that 29.5 percent of the total population was poor in 2013. There are several concerns among experts regarding the limitation of the current methodology. First, questions are raised about the appropriateness of using the CPI to deflate the poverty line, because the reference basket is based on a typical urban household, which spends a lower share of its budget on food than poor households in the PSLM. Since food prices have been increasing more than non-food prices, using the CPI underestimates the actual price increases faced by the poor, which leads poverty to be understated about 3 percentage points (Newman 2013). Second, the most recent population census was carried out in 1998, and the lack of a more recent sampling frame makes recent rounds of the PSLM less representative of the national population. In addition, it is particularly difficult to collect data in the province of Baluchistan because it is a vast territory with a highly dispersed population.[13] These are important methodological issues that should be addressed, but initial indications suggest that they will have a limited effect on both the decline in measured poverty and the simulated effects of changes to the tax code on poverty.[14] Finally, we should note that for our simulations we choose a time period that is based upon the year after this most recent survey. Also, we have used an 8 period out of sample simulation, since adding more periods would not seem to add additional information. Finally, our results are based upon the single household

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[13] Additional concerns of lesser importance are the exclusion of durable goods from the poverty line and the fact that spatial deflation is based purely on food prices.

[14] Although the sample frame is old, it is only used to sample villages in the first stage. Thus the PSLM samples are only failing to capture new villages, largely in peri-urban areas. With respect to Baluchistan, the recent wild fluctuations in poverty rates have had a limited impact on national poverty trends because Baluchistan only contains roughly 5 percent of the nation's population. Finally, while the poverty line is old, the measured reduction in poverty is robust to a wide variety of poverty lines, including the $1.25 per day used by the World Bank.

study discussed earlier. It would, of course, be better if we had access to other household surveys, so as to test the robustness of our results. However we are limited this single survey.

How do the simulated tax reforms affect poverty in the model? For each of the four tax reform scenarios Appendix Table 6 presents estimates of the percentage point change in poverty headcount relative to the baseline. In the baseline simulation the share of poverty in the economy slowly increases over the first 4 years of the simulation and then declines to approximately its original level, the sharp decline in the final year is a result of the closure rule in the model and is not relevant. Rises in the sales tax rate and the tariff rate have similar, and very slight negative impacts upon the shares of poverty, as compared to the baseline case. When the higher corporate tax is imposed, the share of the population in poverty is, on average, 1.15 percent higher than in the base case. The reasons for these differential impacts upon poverty are essentially the same as those that explain the consumption changes. The increase in the corporate tax rate severely lowers the rate of capital formation, thereby reducing the marginal product of labor and thereby causing all sectors of society, but especially the poor, to realize a negative income effect. Hence poverty increases relative to the base case.   Thus, based upon the impact on poverty, we would again rank the sales tax rate increase as superior to the equal yield corporate tax increase, since it generates a slightly greater, if very small, improvement in poverty rates, while generating higher tax revenues.

As a final measure of the relative benefits of the different tax reforms, we have also estimated inequality, as measure by the Gini coefficient. Table 7 gives the Gini coefficients for the baseline case, as well as each of the policy reform scenarios. If we consider the part of the table that shows changes in the Gini coefficient relative to the baseline, we see that the coefficient declines in both the case of the sales tax increase, as well as that of the tariff increase,

although the changes are quite small. These decreases would indicate that inequality declines in both cases. The corporate tax simulation, on the other hand, causes the Gini coefficients to increase on average, indicating a worsening in the measure of inequality. Thus the corporate income tax increase appears to be worse in terms of poverty impacts than do either of the other two tax changes.

Figure 1. Poverty Headcount Rate, 2001 - 2013
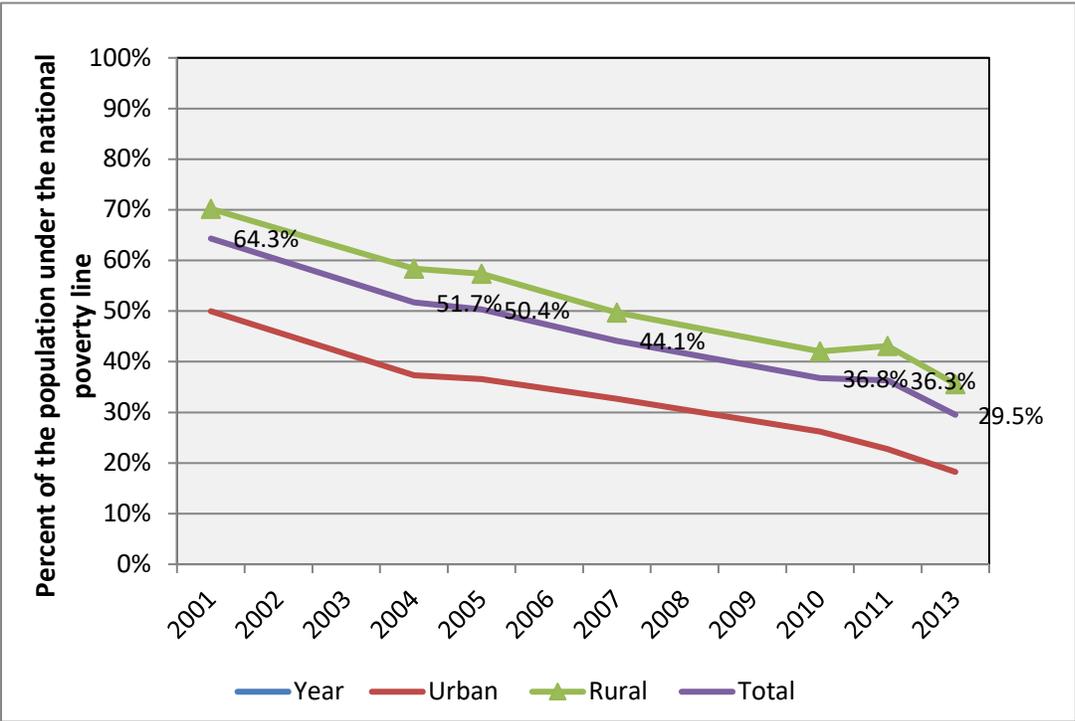
Note: Author's calculation using PSLM 2001, 2004, 2007 and 2010.

Conclusions

This paper examines the potential effects of changes to the tax code on income distribution and welfare in Pakistan. It relies on a top-down approach, where the outputs of a dynamic CGE model are used as inputs into a micro-simulation model based on household data. In particular, the estimated effects on the income of 18 household groups taken from the model were applied uniformly to the per capita consumption of each group in the 2011 Pakistan Living Standards Measurement Survey. This approach imposes strong assumptions and is constrained by the nature of the Social Accounting Matrix that underpins the numerical implementation of the CGE model, as well by the structure of the CGE model itself. However, it provides a useful and logically consistent framework for considering how tax reforms may affect the poor.

The most striking result is that an equal yield increase in the corporate and sales tax rates have quite different impacts upon consumption and poverty in the model. Due to its significant negative impact upon capital formation, the increased corporate income tax, which has to be raised by 10 percentage points to generate an equivalent yield to a 1 percentage point increase in the sales tax, lowers the rate of capital formation.[15]   The lower marginal product of labor and corresponding negative income effect tend to increase poverty, relative to both the base case as well as to the case in which the sales tax rate is increased.   Increasing the tariff rate by 5 percentage points yields almost the same revenue increase as the two other hypothetical changes (21.0 percent of GDP on average versus 21.1 percent for the sales and corporate tax increases). Footnote 9 discusses the reason for why the tax to GDP ratios are not precisely the same   The

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[15] This result is partially due to the fact that the general equilibrium model incorporates endogenous evasion of the corporate income tax as optimizing behavior. This tax evasion causes corporate profit taxes to be relatively less effective in raising revenues than are sales taxes. As noted earlier in the paper, we do not incorporate evasion of the sales, personal income, or trade taxes. Accordingly our results should be taken with caution because of this omission.

tariff increase has a similar welfare effect, both in terms of consumption and poverty, to the sales tax increase. However the tariff increase generates a lower average rate of real GDP growth, as well as final period real GDP, than does the sales tax increase. None of the alternative tax scenarios generates significant income redistribution, a result that is consistent with the theoretical argument that very little income redistribution is possible through indirect taxation (Sah 1983). Ultimately, we conclude that, given Pakistan's goal of increasing tax revenue, a uniform sales tax increase is the superior tax instrument, assuming that the government also wishes to reduce negative impacts on poverty.

APPENDIX 1: GENERAL EQUILIBRIUM SIMULATIONS

Table 1: BASE CASE (BASED ON 2010)

YEAR	1	2	3	4	5	6	7	8
REAL GDP	100	100	98.7	102.4	109.7	114.2	119.8	124.6
NOMINAL GDP	100	120.4	129.6	146.4	175.9	192.3	233.3	241
PRICE LEVEL	100	120.4	131.3	143	160.3	168.4	194.7	193.4
INFLATION	0	20.4	9	8.9	12.1	5	15.6	-0.7
TAX REVENUES/GDP	22.3	21.5	21	20.3	20.2	19.5	19.8	19
GOV. EXPENDITURES/GDP	36.6	33.6	30.4	28.9	27.8	27	26.5	26.7
GOVERNMENT DEFICIT	-14.3	-12.1	-9.4	-8.6	-7.6	-7.5	-6.7	-7.7
INTEREST RATE	21.6	6.3	5.6	3.9	4.1	2.6	2.7	1.6
EXPORTS/GDP	15.7	16.1	17.2	18.7	18.4	20.8	20.1	24.3
IMPORTS/GDP	21	20.7	20.7	19.9	19.2	18.5	18	17.2
TRADE DEFICIT/GDP	-5.2	-4.5	-3.5	-1.2	-0.8	2.4	2.2	7.1

SHARE OF SECTOR PAYING TAXES (normalized)

PERIOD	2	4	6	8	
SECTOR 1	100	100	100	100	SECTOR 1=LIGHT MANUFACTURING
SECTOR 2	100	100	100	100	SECTOR 2=HEAVY INDUSTRY
SECTOR 3	100	100	100	100	SECTOR 3=ELECTRICITY,WATER, SEWAGE
SECTOR 4	100	100	100	100	SECTOR 4=TRANSPORT
SECTOR 5	100	100	100	100	SECTOR 5=HOTELS, HOUSING, HEALTH SERVICES

REAL INCOME (PERIOD) 1/	1	2	3	4	5	6	7	8
Urban quintile 1	3.68	3.58	3.91	3.93	4.42	4.52	4.69	4.92
Urban quintile 2	5.71	5.25	5.39	5.44	5.71	5.88	5.87	6.19
Urban other	31.72	29.5	25.06	25.33	26.11	26.94	26.59	28.06
Med farm Sindh	3.45	3.91	5.32	5.41	6.87	6.98	8.38	8.46
Med farm Punjab	16.73	16.77	17.53	18	19.1	19.66	21.37	21.85
Med farm OthPak	4.07	3.6	3.69	3.8	3.89	4.02	4.26	4.37
Small farm Sindh	3.18	2.88	2.95	3.03	3.18	3.28	3.52	3.61
Small farm Punjab	5.56	5.93	5.82	5.94	6.63	6.79	7.49	7.67
Small farm OthPak	3.42	3.37	3.58	3.65	4.17	4.26	4.75	4.86
Landless Farmer Sindh	1.2	1.2	1.36	1.39	1.64	1.67	1.92	1.95
Landless Farmer Punjab	1.07	1.29	1.52	1.55	1.87	1.91	2.2	2.24
Landless Farmer OthPak	0.46	0.48	0.55	0.55	0.67	0.68	0.78	0.8
Waged rural landless farmers Sindh	2.58	2.34	2.28	2.32	2.36	2.44	2.45	2.56
Waged rural landless farmers Punjab	3.32	2.91	2.65	2.7	2.58	2.67	2.55	2.69
Waged rural landless farmers OthPak	2.43	2.81	2.93	2.98	3.09	3.19	3.24	3.38
Rural non-farm quintile 1	3.01	2.93	2.91	2.93	3.22	3.31	3.4	3.57
Rural non-farm quintile 2	3.65	3.63	3.68	3.81	4.14	4.38	4.4	4.79
Rural non-farm other	7.33	7.31	6.6	7.17	7.87	8.44	9.14	9.9
TOTAL	102.57	99.7	97.73	99.91	107.53	111.03	117.01	121.88

1/ These should be interpreted as index numbers that have relative significance, but are not connected to current monetary values.

SECTORAL CAPITAL PERIOD 8 1/
(Stock; relative to base case)

SECTOR 1	100	SECTOR 3	100	SECTOR 5	100
SECTOR 2	100	SECTOR 4	100		

Table 2: Sales Tax = 17%

YEAR	1	2	3	4	5	6	7	8
REAL GNP	99.6	99.8	98.7	102.2	109.2	113.8	120.2	126.7
Nominal GDP	97.9	117.8	126.1	142.7	169.8	185.9	225.1	235.6
PRICE LEVEL	98.3	118.1	127.9	139.6	155.6	163.4	187.3	185.9
INFLATION	0.0	20.1	8.3	9.2	11.4	5.1	14.6	-0.7
TAX REVENUES/GDP	23.0	22.3	21.7	20.9	20.9	20.1	20.4	19.6
GOV. EXPENDITURES/GDP	37.2	34.1	30.7	29.1	28.1	27.2	26.6	26.4
GOVERNMENT DEFICIT	-14.2	-11.8	-9.0	-8.2	-7.2	-7.0	-6.2	-6.8
INTEREST RATE	21.3	6.4	5.5	3.8	3.6	2.4	2.4	1.4
EXPORTS/GDP	16.1	16.5	17.6	19.2	18.9	21.4	20.6	24.5
IMPORTS/GDP	21.2	20.9	21.0	20.1	19.5	18.7	18.3	17.5
TRADE DEFICIT/GDP	-5.2	-4.5	-3.4	-1.0	-0.5	2.7	2.4	7.0

CHANGE IN TAX COMPLIANCE FROM BASE CASE (PERCENT)

PERIOD	2	4	6	8	
SECTOR 1	0	0	0	0	SECTOR 1=LIGHT MANUFACTURING
SECTOR 2	-4.3	-4.5	-3.7	-6.9	SECTOR 2=HEAVY INDUSTRY
SECTOR 3	0	-4.9	-6.5	-8.7	SECTOR 3=ELECTRICITY,WATER, SEWAGE
SECTOR 4	-1.5	-2.4	-1.7	-2.2	SECTOR 4=TRANSPORT
SECTOR 5	1.5	-5.2	-4.8	-5.7	SECTOR 5=HOTELS, HOUSING, HEALTH SERVICES

REAL INCOME (PERIOD)	1	2	3	4	5	6	7	8
Urban quintile 1	3.68	3.57	3.91	3.93	4.42	4.51	4.7	4.97
Urban quintile 2	5.72	5.25	5.4	5.46	5.72	5.87	5.89	6.25
Urban other	31.62	29.37	25.01	25.34	26.12	26.85	26.64	28.33
Med farm Sindh	3.45	3.9	5.29	5.4	6.84	6.91	8.33	8.45
Med farm Punjab	16.86	16.87	17.57	18.09	19.09	19.57	21.3	21.91
Med farm OthPak	4.11	3.63	3.71	3.82	3.89	4	4.25	4.39
Small farm Sindh	3.21	2.9	2.96	3.05	3.18	3.26	3.51	3.62
Small farm Punjab	5.56	5.93	5.81	5.95	6.61	6.75	7.47	7.69
Small farm OthPak	3.43	3.37	3.57	3.65	4.16	4.23	4.73	4.87
Landless Farmer Sindh	1.21	1.2	1.36	1.39	1.63	1.66	1.91	1.95
Landless Farmer Punjab	1.07	1.28	1.52	1.54	1.87	1.89	2.19	2.25
Landless Farmer OthPak	0.46	0.48	0.54	0.55	0.67	0.68	0.78	0.8
Waged rural landless farmers Sindh	2.6	2.35	2.28	2.33	2.37	2.43	2.46	2.59
Waged rural landless farmers Punjab	3.34	2.92	2.66	2.72	2.58	2.67	2.56	2.72
Waged rural landless farmers OthPak	2.44	2.82	2.94	3	3.1	3.18	3.25	3.41
Rural non-farm quintile 1	3.01	2.92	2.91	2.93	3.22	3.29	3.4	3.6
Rural non-farm quintile 2	3.65	3.62	3.68	3.81	4.14	4.37	4.41	4.83
Rural non-farm other	7.32	7.3	6.59	7.17	7.85	8.4	9.11	9.96
TOTAL	102.72	99.69	97.71	100.12	107.44	110.53	116.91	122.6

SECTORAL CAPITAL (relative to base case)

PERIOD 8

SECTOR 1	100	SECTOR 3	99.23	SECTOR 5	100.06
SECTOR 2	100	SECTOR 4	100.13		

Table 3: Corporate tax =45%

YEAR	1	2	3	4	5	6	7	8

REAL GNP	98.8	99.1	97.9	101.5	108.8	113.7	119.6	126.4
Nominal GDP	96.8	114.5	120.7	134.2	158.3	170.3	204.7	210
PRICE LEVEL	1	1.2	1.2	1.3	1.5	1.5	1.7	1.7
INFLATION	0	17.9	6.7	7.3	10.1	3	14.3	-2.9
TAX REVENUES/GDP	23.2	22.4	21.7	20.9	20.8	20	20.2	19.3
GOV. EXPENDITURES/GDP	37.5	34.8	30.6	29.3	27.7	27.1	26.3	26.5
GOVERNMENT DEFICIT	-14.3	-12.4	-8.8	-8.4	-6.9	-7.1	-6.1	-7.2
INTEREST RATE	20.2	5.6	4.7	3	3.1	1.9	2	1.1
EXPORTS/GDP	16.3	17	18.1	20.4	19.4	22.4	21.1	25.7
IMPORTS/GDP	21.3	21.1	21.3	20.2	19.6	19.1	18.7	18.1
TRADE DEFICIT/GDP	-5	-4.1	-3.1	0.2	-0.2	3.3	2.4	7.6

CHANGE IN TAX COMPLIANCE FROM BASE CASE (PERCENT)

PERIOD	2	4	6	8	
SECTOR 1	0	0	0	0	SECTOR 1=LIGHT MANUFACTURING
SECTOR 2	-44	-48.1	-50.8	-55.9	SECTOR 2=HEAVY INDUSTRY
SECTOR 3	-37.7	-39.6	-40.2	-42.7	SECTOR 3=ELECTRICITY,WATER, SEWAGE
SECTOR 4	-38.4	-41.3	-44	-45.8	SECTOR 4=TRANSPORT
SECTOR 5	-41.9	-46.8	-48.9	-52.1	SECTOR 5=HOTELS, HOUSING, HEALTH SERVICES

	1	2	3	4	5	6	7	8
REAL INCOME (PERIOD)								
Urban quintile 1	3.63	3.54	3.86	3.9	4.39	4.52	4.69	5
Urban quintile 2	5.67	5.23	5.34	5.44	5.69	5.9	5.89	6.31
Urban other	30.98	28.93	24.57	25.05	25.88	26.87	26.58	28.51
Med farm Sindh	3.46	3.89	5.22	5.3	6.68	6.76	8.12	8.24
Med farm Punjab	16.87	16.91	17.38	17.92	18.74	19.32	20.87	21.53
Med farm OthPak	4.12	3.65	3.67	3.79	3.83	3.96	4.17	4.32
Small farm Sindh	3.21	2.91	2.93	3.02	3.13	3.23	3.44	3.56
Small farm Punjab	5.51	5.9	5.72	5.85	6.48	6.65	7.32	7.56
Small farm OthPak	3.41	3.35	3.52	3.6	4.08	4.18	4.65	4.8
Landless Farmer Sindh	1.2	1.2	1.34	1.37	1.6	1.63	1.87	1.91
Landless Farmer Punjab	1.06	1.28	1.49	1.52	1.83	1.86	2.15	2.2
Landless Farmer OthPak	0.45	0.48	0.53	0.54	0.66	0.67	0.77	0.79
Waged rural landless farmers Sindh	2.58	2.34	2.26	2.31	2.34	2.43	2.44	2.59
Waged rural landless farmers Punjab	3.32	2.92	2.63	2.71	2.57	2.69	2.56	2.74
Waged rural landless farmers OthPak	2.42	2.82	2.91	2.98	3.07	3.18	3.23	3.41
Rural non-farm quintile 1	2.96	2.89	2.86	2.9	3.2	3.3	3.39	3.62
Rural non-farm quintile 2	3.6	3.58	3.63	3.78	4.11	4.38	4.4	4.87
Rural non-farm other	7.24	7.25	6.47	7.06	7.69	8.29	8.93	9.84
TOTAL	101.68	99.07	96.34	99.05	105.93	109.81	115.47	121.8

SECTORAL CAPITAL (relative to base case)

PERIOD 8

SECTOR 1	97.88	SECTOR 3	92.62	SECTOR 5	99.26
SECTOR 2	99.99	SECTOR 4	99.44		

Table 4: Tariff = 19 percent

YEAR	1	2	3	4	5	6	7	8
REAL GNP	99.9	100	98.9	102.4	109.6	114	120.4	126.6
Nominal GDP	99.8	119.7	128.7	145.1	173.9	189.6	230.8	240.3

PRICE LEVEL	1	1.2	1.3	1.4	1.6	1.7	1.9	1.9
INFLATION	0	19.9	8.7	8.9	12	4.9	15.3	-1
TAX REVENUES/GDP	22.8	22.1	21.5	20.8	20.7	20	20.3	19.5
GOV. EXPENDITURES/GDP	36.6	33.7	30.4	28.9	27.8	27	26.4	26.4
GOVERNMENT DEFICIT	-13.8	-11.6	-8.9	-8.1	-7.1	-7	-6.1	-6.9
INTEREST RATE	21.3	6.2	5.5	3.7	3.8	2.5	2.5	1.4
EXPORTS/GDP	14.9	15.3	16.2	17.7	17.4	19.8	19	22.7
IMPORTS/GDP	20.5	20.2	20.3	19.4	18.8	18.1	17.6	16.9
TRADE DEFICIT/GDP	-5.6	-4.9	-4	-1.7	-1.3	1.7	1.4	5.8

CHANGE IN TAX COMPLIANCE FROM BASE CASE (PERCENT)

PERIOD	2	4	6	8	
SECTOR 1	0	0	0	0	SECTOR 1=LIGHT MANUFACTURING
SECTOR 2	-4.2	0.5	2.6	-2.1	SECTOR 2=HEAVY INDUSTRY
SECTOR 3	0	-2.3	-3.2	-5	SECTOR 3=ELECTRICITY,WATER, SEWAGE
SECTOR 4	-0.7	-0.8	-0.5	-1.9	SECTOR 4=TRANSPORT
SECTOR 5	4.8	-1.9	-3.8	-2.5	SECTOR 5=HOTELS, HOUSING, HEALTH SERVICES

REAL INCOME (Period)	1	2	3	4	5	6	7	8
Urban quintile 1	3.69	3.58	3.91	3.94	4.41	4.52	4.69	4.96
Urban quintile 2	5.72	5.25	5.39	5.45	5.71	5.88	5.87	6.24
Urban other	31.74	29.49	25.04	25.38	26.08	26.92	26.58	28.29
Med farm Sindh	3.45	3.91	5.31	5.41	6.86	6.95	8.36	8.49
Med farm Punjab	16.74	16.8	17.52	18.04	19.08	19.62	21.32	21.95
Med farm OthPak	4.07	3.61	3.69	3.81	3.89	4.01	4.25	4.39
Small farm Sindh	3.18	2.89	2.95	3.04	3.18	3.27	3.51	3.62
Small farm Punjab	5.56	5.93	5.81	5.95	6.61	6.77	7.48	7.7
Small farm OthPak	3.42	3.37	3.58	3.65	4.16	4.25	4.74	4.88
Landless Farmer Sindh	1.2	1.21	1.36	1.39	1.64	1.67	1.91	1.96
Landless Farmer Punjab	1.07	1.29	1.52	1.55	1.87	1.9	2.2	2.25
Landless Farmer OthPak	0.46	0.48	0.54	0.55	0.67	0.68	0.78	0.8
Waged rural landless farmers Sindh	2.58	2.34	2.28	2.32	2.36	2.44	2.45	2.58
Waged rural landless farmers Punjab	3.32	2.91	2.65	2.71	2.57	2.67	2.55	2.72
Waged rural landless farmers OthPak	2.43	2.82	2.93	2.99	3.09	3.18	3.24	3.41
Rural non-farm quintile 1	3.02	2.93	2.91	2.93	3.22	3.3	3.4	3.59
Rural non-farm quintile 2	3.66	3.63	3.68	3.82	4.13	4.38	4.4	4.83
Rural non-farm other	7.32	7.31	6.59	7.17	7.86	8.42	9.12	9.96
TOTAL	102.65	99.76	97.67	100.08	107.37	110.84	116.86	122.63

SECTORAL CAPITAL (relative to base case)

PERIOD 8

SECTOR 1	99.9	SECTOR 3	99.5	SECTOR 5	100
SECTOR 2	100	SECTOR 4	100.1		

Table 5: Consumption under Alternative Tax Regimes 1/

Baseline

Quintile	2013	2014	2015	2016	2017	2018	2019	2020
1	2227.1	2174.4	2246.1	2274.1	2436.6	2495.0	2534.8	2632.7
2	3038.6	2901.8	2801.5	2830.3	2979.4	3058.4	3078.6	3221.3
3	3796.0	3655.1	3353.8	3387.0	3503.8	3585.3	3595.3	3733.3
4	4805.7	4655.8	4395.7	4427.3	4561.9	4638.3	4673.1	4807.3
5	8564.0	8417.9	8257.4	8297.1	8608.0	8697.7	8948.6	9092.1

Sales Tax Increase

Quintile	2013	2014	2015	2016	2017	2018	2019	2020
1	2225.0	2168.8	2243.4	2276.5	2436.8	2488.7	2537.9	2649.2
2	3040.6	2897.9	2799.6	2835.0	2980.8	3050.6	3084.0	3247.2
3	3789.0	3645.2	3349.6	3388.9	3503.8	3576.1	3598.8	3756.1
4	4798.4	4646.0	4391.0	4428.3	4560.5	4627.9	4675.7	4829.4
5	8557.3	8407.2	8250.4	8296.9	8600.5	8678.1	8945.1	9113.4

Corporate Tax Increase

Quintile	2013	2014	2015	2016	2017	2018	2019	2020
1	2203.4	2155.2	2218.7	2260.5	2420.5	2489.7	2531.9	2658.4
2	3015.0	2880.1	2765.2	2813.9	2960.7	3055.2	3078.6	3265.0
3	3742.7	3611.8	3310.9	3362.4	3479.6	3575.4	3589.4	3768.3
4	4745.4	4612.2	4354.0	4401.2	4534.8	4624.2	4661.1	4835.5
5	8496.1	8369.4	8206.1	8259.3	8551.0	8653.6	8892.5	9081.9

Tariff Increase

Quintile	2013	2014	2015	2016	2017	2018	2019	2020
1	2229.9	2175.2	2245.4	2277.8	2434.4	2493.1	2533.8	2647.2
2	3041.6	2902.7	2800.9	2835.8	2976.3	3056.2	3077.6	3243.3
3	3797.6	3654.6	3352.5	3391.6	3500.6	3582.7	3594.0	3753.3
4	4807.6	4655.8	4394.2	4431.2	4558.7	4635.4	4671.2	4827.5
5	8566.6	8418.9	8255.0	8300.6	8602.4	8691.2	8942.6	9117.0

1/ The units of measurement are billions of real 2013 Pakistan Rs. (National accounts Main Aggregates at current prices), Table 2, 2017.

Quintile 1: Comparison of Tax Regimes to the Baseline

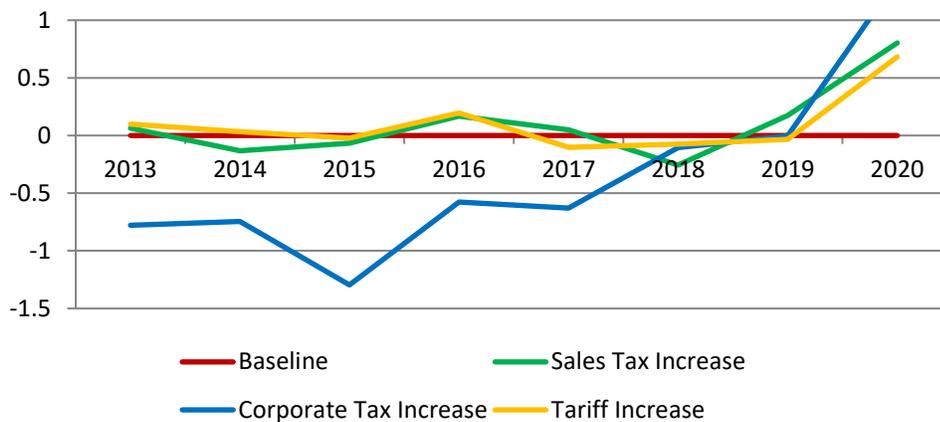| Quintile1	2013	2014	2015	2016	2017	2018	2019	2020
Baseline	0	0	0	0	0	0	0	0
Sales Tax Increase	-0.09	-0.26	-0.12	0.11	0.01	-0.25	0.12	0.63
Corporate Tax Increase	-1.07	-0.88	-1.22	-0.60	-0.66	-0.21	-0.12	0.98
Tariff Increase	0.12	0.03	-0.03	0.16	-0.09	-0.08	-0.04	0.55

Quintile 1: Comparison of tax regimes to the baseline
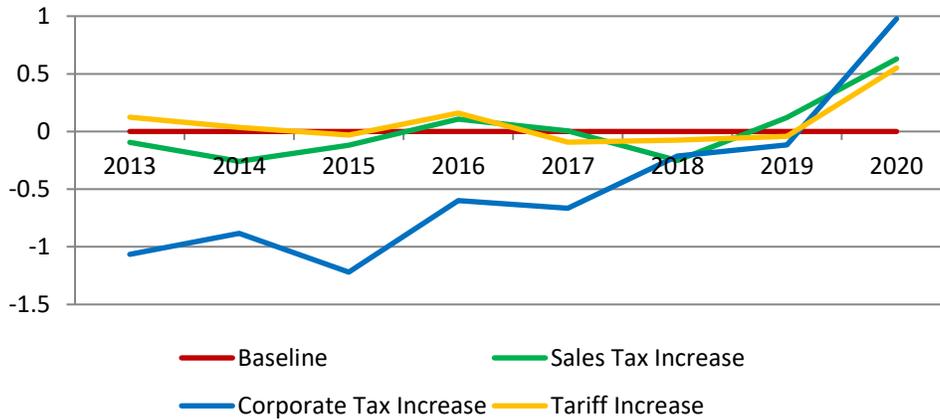
Quintile 2: Comparison of Tax Regimes to the Baseline

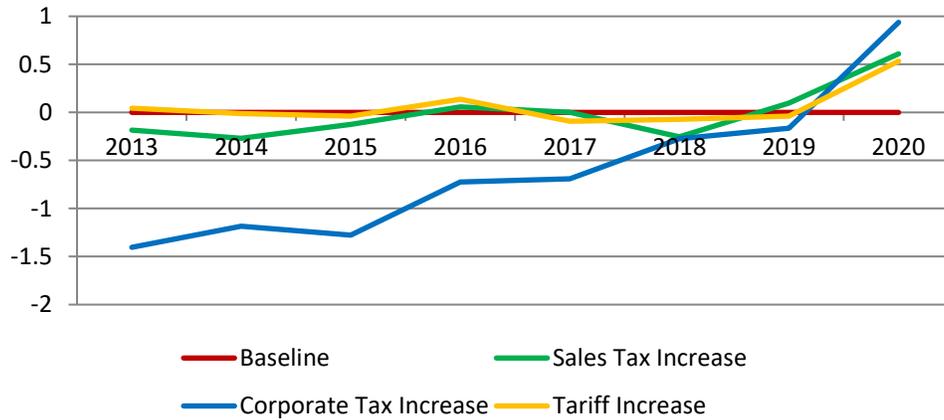| Quintile2	2013	2014	2015	2016	2017	2018	2019	2020
Baseline	0	0	0	0	0	0	0	0
Sales Tax Increase	0.06	-0.13	-0.07	0.17	0.05	-0.26	0.17	0.80
Corporate Tax Increase	-0.78	-0.75	-1.30	-0.58	-0.63	-0.10	0.00	1.36
Tariff Increase	0.10	0.03	-0.02	0.20	-0.10	-0.07	-0.03	0.68

Quintile 2: Comparison of tax regimes to the baseline

Quintile 3: Comparison of Tax Regimes to the Baseline

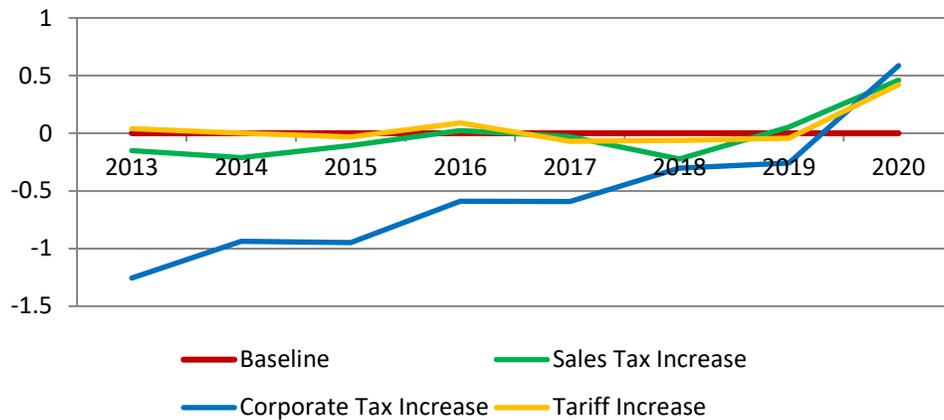| Quintile 3	2013	2014	2015	2016	2017	2018	2019	2020
Baseline	0	0	0	0	0	0	0	0
Sales Tax Increase	-0.18	-0.27	-0.13	0.06	0.00	-0.25	0.10	0.61
Corporate Tax Increase	-1.40	-1.18	-1.28	-0.72	-0.69	-0.27	-0.17	0.94
Tariff Increase	0.04	-0.01	-0.04	0.14	-0.09	-0.07	-0.04	0.53

Quintile 3: Comparison of tax regimes to the baseline

Quintile 4: Comparison of Tax Regimes to the Baseline

| Quintile 4	2013	2014	2015	2016	2017	2018	2019	2020
Baseline	0	0	0	0	0	0	0	0
Sales Tax Increase	-0.15	-0.21	-0.11	0.02	-0.03	-0.22	0.05	0.46
Corporate Tax Increase	-1.26	-0.94	-0.95	-0.59	-0.59	-0.30	-0.26	0.59
Tariff Increase	0.04	0.00	-0.03	0.09	-0.07	-0.06	-0.04	0.42

Quintile 4: Comparison of tax regimes to the baseline

Quintile 5: Comparison of Tax Regimes to the Baseline

| Quintile 5	2013	2014	2015	2016	2017	2018	2019	2020
Baseline	0	0	0	0	0	0	0	0
Sales Tax Increase	-0.08	-0.13	-0.08	0.00	-0.09	-0.23	-0.04	0.23
Corporate Tax Increase	-0.79	-0.58	-0.62	-0.46	-0.66	-0.51	-0.63	-0.11
Tariff Increase	0.03	0.01	-0.03	0.04	-0.07	-0.08	-0.07	0.27

Quintile 5: Comparison of tax regimes to the baseline
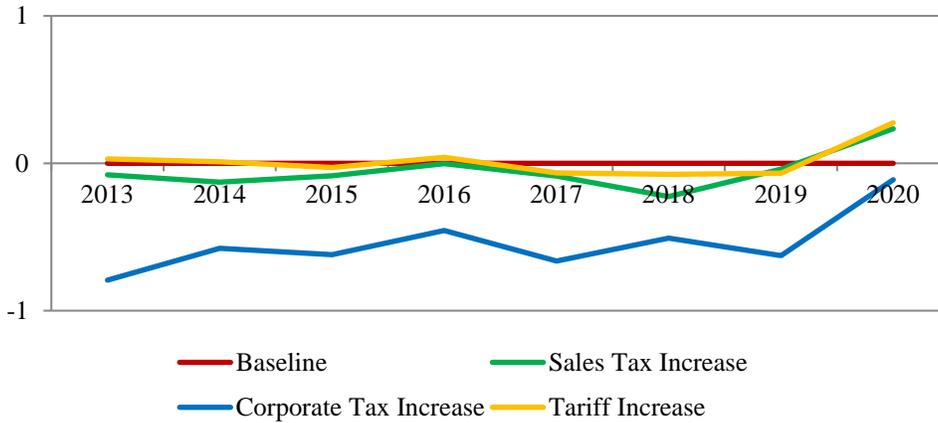
Change in Total from the Baseline

| Change in total from base	Baseline	Sales Tax Increase	Corporate Tax Increase	Tariff Increase
Quintile 1	0	-1.93	-2.39	-1.88
Quintile 2	0	-1.85	-2.27	-1.86
Quintile 3	0	-1.97	-2.54	-1.90
Quintile 4	0	-1.98	-2.48	-1.92
Quintile 5	0	-2.01	-2.49	-1.94

Change in total from the baseline
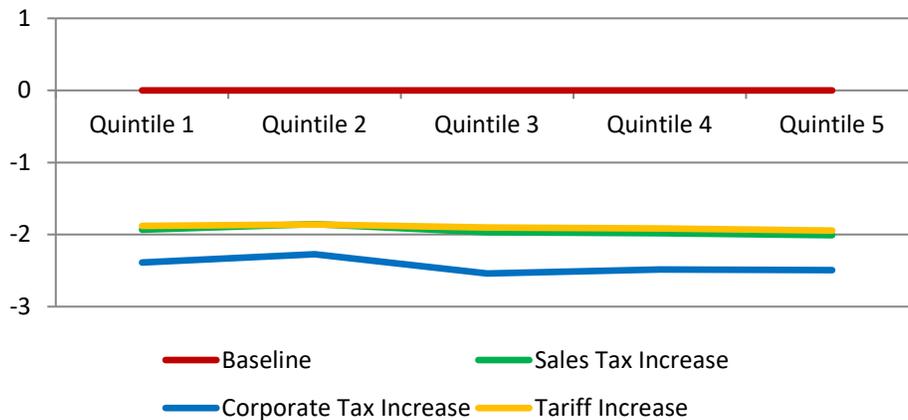
Average 8 period deviation of consumption of quintals under different regimes

Quintile	Baseline	Sales tax	Corporate tax	Tariff
1	0.00	0.03	-0.43	0.08
2	0.00	0.11	-0.32	0.10
3	0.00	-0.01	-0.59	0.06
4	0.00	-0.02	-0.53	0.04
5	0.00	-0.05	-0.54	0.02
Total	0.00	-0.01	-0.51	0.05

Average 8 period deviation of consumption of quintals under different regimes
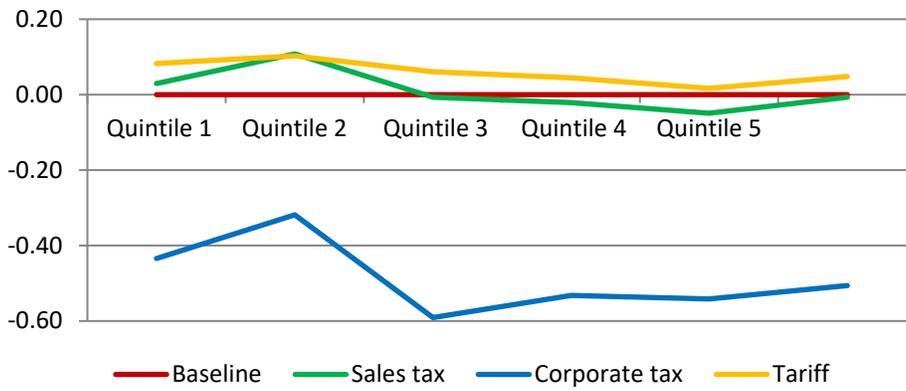
Table 6: Share of Overall Poverty in the Economy and Deviation of Counterfactual Cases from Baseline (In Percent)

Share					Deviation from Baseline				
Year	Baseline	Sales tax	Corporate tax	Tariff	Year	Baseline	Sales tax	Corporate tax	Tariff
2013	29.5	29.4	30.0	29.4	2013	0.0	-0.3	1.6	-0.3
2014	33.3	33.5	34.2	33.3	2014	0.0	0.7	2.8	0.0
2015	40.8	40.8	42.5	40.8	2015	0.0	0.1	4.3	0.2
2016	39.3	39.0	40.1	39.0	2016	0.0	-0.9	1.8	-0.8
2017	32.3	32.3	33.4	32.5	2017	0.0	-0.2	3.4	0.7
2018	27.9	28.4	28.1	28.0	2018	0.0	1.7	0.4	0.4
2019	26.9	26.6	26.9	27.0	2019	0.0	-1.2	0.0	0.3
2020	19.6	18.4	17.5	18.6	2020	0.0	-6.4	-10.8	-5.3
Average	31.2	31.0	31.6	31.1	Average	0.0	-0.5	1.2	-0.4

Table 7: Inequality as Measured by the Gini Coefficient

Gini Coefficient					Change relative to baseline (percent)				
Year	Baseline	Sales Tax	Corp Tax	Tariff	Year	Baseline	Sales tax	Corp tax	Tariff
2013	29.73	29.73	29.84	29.72	2013	0.0%	0.0%	0.3%	-0.1%
2014	30.27	30.30	30.38	30.27	2014	0.0%	0.1%	0.3%	0.0%
2015	30.52	30.53	30.72	30.52	2015	0.0%	0.0%	0.7%	0.0%
2016	30.25	30.22	30.33	30.22	2016	0.0%	-0.1%	0.2%	-0.1%
2017	29.63	29.61	29.68	29.64	2017	0.0%	-0.1%	0.2%	0.0%
2018	29.18	29.20	29.13	29.19	2018	0.0%	0.1%	-0.2%	0.0%
2019	29.53	29.48	29.43	29.52	2019	0.0%	-0.2%	-0.3%	0.0%
2020	28.81	28.69	28.51	28.72	2020	0.0%	-0.4%	-1.0%	-0.3%
Average	29.73	29.73	29.84	29.72	Average	0.0%	0.0%	0.3%	-0.1%

Appendix 2: Data Sources

Production

The input-output (IO) matrix is taken from the social accounting matrix (SAM) developed in Debowicz et al (2013), where we use the tab PSAM2C to derive the matrix representing 2010 technology. The IO matrix is 50x50, but in order to simplify computations we have aggregated the matrix to 27x27, where row and column 27 represent a single aggregate import. Sectoral value added functions are assumed to be Cobb-Douglas, with shares of the 5 different types of capital, urban and rural labor, and land giving the weights in the valued added function. These are also derived from PSAM2C. We have not directly estimated sectoral investment functions. Rather, we have assumed that the investment function, as in equation (2) is uniform across the 5 types of sectoral capital and is given by the value added function for the construction industry, taken from the SAM. Rates of investment will differ across capital types because of the differing rates of return to capital in different sectors. Finally, the coefficients α, γ representing the tax evasion and credit rationing in equations (3), (4) are taken to be uniform across sectors and are determined from calibration. For this exercise we have assumed that $\gamma = 0$, that is, no credit rationing.

Consumption

For the utility function described in equation (5), Appendix 3, we use weights derived from the SAM, tab EH. This gives shares of consumption for each household type, and we assume Cobb-Douglas utilities for each household. Factor allocations for each household category are taken from PSAM2C, which allocates various types of capital, labor and land across households. We aggregate land into a single type, and labor is aggregated into urban and rural.

We suppose that there is a uniform money demand function across all consumers, and we take the parameters of the equation from Qayyum, A. (2005).

Fiscal Parameters

Tax rates for the benchmark case are taken from KPMG (2012). Levels of public expenditure are taken from Pakistan <u>Statistical Yearbook</u> (various issues), Table 10. We assume that the public sector produces current expenditure with a Cobb-Douglas function whose shares of capital and labor are given by the aggregate shares of these factors in private production, where the shares are taken from the <u>Pakistan National Income Accounts</u>. The public investment function, which determines public capital spending, is taken to have the same parameters as the private investment functions.

Appendix 3: Consumer's optimization problem

Consumers maximise intertemporal utility functions, which have as arguments the levels of consumption, including imports, and leisure in each of the two periods. Formally, the consumer's problem is then given by equation 5.[16]

$$\text{Max } U(x), \quad x = (x_1, x_{Lu1}, x_{Lr1}, x_2, x_{Lu2}, x_{Lr2}) \qquad (5)$$

Such that:

$$(1+t_i)P_i x_i + P_{Lui}x_{Lui} + p_{Lri}x_{Lri} + P_{Mi}x_{Mi} + P_{Bi}x_{Bi} + e_i P_{Bfi}x_{Bfi} = C_i \qquad (5a)$$

$$P_{K1}K_0 + P_{A1}A_0 + P_{Lu1}L_{u1} + P_{Lr1}L_{r1} + P_{M1}M_0 + r_0 B_0 + P_{B1}B_0 + e_1 P_{BF1}B_{F0} + TR_1 = N_1$$

$$P_{K2}(1-\delta)K_0 + P_{A2}A_0 + P_{Lu2}L_{u2} + P_{Lr2}L_{r2} + P_{M2}x_{M1} + r_1 x_{B1} + e_2 P_{BF2}x_{BF1} + TR_2 = N_2$$

$$C_i = N_i$$

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[16] See Feltenstein and Shamloo (2013) for a discussion of this modelling approach.

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

<div align="right">(5b)</div>

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

<div align="right">(5c)</div>

$$\log P_{Mi} x_{Mi} = a + b \log(1 + t_i) P_i x_i$$

<div align="right">(5d)</div>

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

<div align="right">(5e)</div>

Where:

P_i = price vector of consumption goods in period i.

x_i = vector of consumption in period i. This includes final demand consumption of imports.

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

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

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

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

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

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

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

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

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

a_2 = elasticity of rural/urban migration.

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

K_0 = initial holding of capital.

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

A_0 = initial holding of land.

δ = rate of depreciation of capital.

P_{Mi} = price of money in period i. Money in period 1 is the numeraire.

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

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

π_i = domestic rate of inflation in period i.

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

x_{Bi} = quantity of bank deposits, that is, CDs in period i.

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

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

TR_i = transfer payments from the government in period i.

a, b, α, β = estimated constants.

d_i = constants estimated from model simulations.

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