An analysis of the VAT in a Small Open Economy

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Abstract

The purpose of this paper is to evaluate the optimality of the consumption value-added tax (VAT) in a small open economy with a formal and an informal sector. The VAT is found in over 135 countries and often raises a significant portion of government revenue, especially in developing countries where reliance on other types of taxes is limited by a large underground economy. In the case of Latin America, the adoption and trajectory of the VAT has had as much to do with these structural factors as with economic phenomena such as high debt, periods of high inflation, and trade liberalization. The resulting upward trend in the rate observed over time raises the question of the optimality of this form of taxation as a centerpiece in fiscal reform. While it is difficult to isolate the effects of high taxes on growth, we can explore the effects of a decrease on output, employment, and inflation. The preliminary results of this analysis indicate that a decrease in the VAT leads to an increase in employment that ultimately increases output solely in the formal sector, the sector from which the government collects tax revenue. Thus, under plausible conditions decreasing the VAT can lead to higher output, and lower inflation in the steady state.

1. Introduction

The quick spread in the adoption of the value-added tax in the developing world has been the result of the relative ease in the collection of taxes at the cash registry compared to the self-motivation and honesty required from agents to pay income taxes. The value-added tax is an effective tool to raise revenue when the credit chain system functions as designed. The special feature of this tax is its property of distorting only the price of final goods given that the seller is refunded for his VAT expense incurred in purchasing inputs. This feature makes the value-added tax a less distortionary tax compared to a sales tax, whose burden often falls on businesses causing production inefficiencies (Ring, 1999). Moreover, to the extent that the seller wants to get refunded for his VAT expenses, he will charge, collect and report his sales thereby reducing the monitoring costs necessary for the government to make the system work.

Ivory Coast and Brazil were the first developing countries to adopt the
VAT in the late sixties\(^1\). Now there are over 20 countries in Latin America and 30 countries in Africa that rely on its collection. International financial institutions have played a significant role in the rise of the popularity of this form of taxation. (Keen, Lockwood, JDE 2010). The IMF and the World Bank often include the introduction of the VAT as part of reform programs to address subpar tax collections. The Gambia is the most recent example of a nation urged by the IMF to implement a tax reform centered on the adoption of the VAT by 2013.

The rising popularity of this type of fiscal reforms has prompted researchers to examine its performance. Gordon and Nielsen (JPE 1996) find that the tax, in the presence of a small informal sector (3.4 percent of GDP), reduces evasion costs despite the increase in cross-border shopping. More recently, however, the focus has turned to the case of developing countries where the large informal economies and imperfections in the credit chain challenge the theory behind the VAT. Piggot and Whalley (AER 2001) account for the effect that the VAT has on agents’ decisions to operate in the informal sector and found that welfare is reduced when its base is expanded. In the model of Emran and Stiglitz (JPE 2005) that combines a change in trade taxes with a compensating change in the base or rate of the VAT, the authors find that welfare can be reduced even in the absence of an informal sector. Supporters of these reforms point out that the VAT has proved to be a robust source of revenue in the majority of developing countries and as a result it has improved the efficiency of the tax system.\(^2\)

The increase in the tax rates is evidence of the strength of the value-added as an effective revenue-raising tax instrument. In Latin America, the average VAT has increased from an average of 10.9 percent at its introduction to 14.7 percent as of 2004-2005 (from several sources but mostly IMF FAD. Time and geographic coverage to be expanded). Figure 1 depicts the path of the VAT for all countries in Latin America for the years 1992, 1994, 1996, 1998, 2000 and 2004. Each dot may represent more than one country whenever different countries have the same tax rate.

As Tanzi (2000) points out, economic development in the region have played an important role in shaping the current tax system of Latin America. The debt crisis of the 1980s limited governments’ ability to borrow from

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\(^1\)France was the first country to adopt a VAT in 1954

\(^2\)Keen, Lockwood JDE 1999 find that adoption of the value-added tax increases revenue-to-GDP by 4.5 percent in the long-run
abroad, inducing countries to increase taxation to service the debt. Excessive money growth led to periods of high inflation pushing government toward tax instruments with short collection lags to protect the value of tax revenue. Finally, trade liberalization spread and with it the need to find alternative sources of revenue.

![Figure 1: Evolution of the VAT in Latin America](image_url)


The quality of the tax system, administration and expenditure policies in a large number of developing countries calls for rethinking the purpose of fiscal reform. While the introduction of the VAT has improved the fiscal position of developing economies, the reliance on high value-added taxation in the presence of poor institutions is questionable. Once the VAT has been introduced, increases in the rate come at relatively low cost and high benefits for the government. Announcement of a cut in federal work pay, for example, is commonly faced with fervent opposition but increases in the value-added

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3

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tax go relatively silent. Hence, it is not surprising to see the size of the VAT trending upward across developing countries amid increasing debt service, high inflation or mounting pressure for reducing or eliminating trade duties.

Should the value-added tax be at the center of fiscal reform in less developed countries given the quality of government policy and the challenge to create an environment where other forms of taxation are viable? What are the costs associated with a high VAT? Has the VAT perpetuated the inability or unwillingness of the government to improve its budgetary position in alternative ways? Under what conditions is a lower consumption tax conducive to growth? This paper employs a model of a small open economy and brings together households, firms, and the government to explore the effects of a decrease in the value-added tax rate on output, employment, and inflation. We abstract from compensating adjustments in other taxes, commonly found in the literature, because we want to evaluate the optimality of the VAT for its effects on decisions by the consumer and the impact of these decisions on the fundamentals of the economy, and not for its effect on government revenue flows.

2. The Model

This is a currency substitution model of a small open economy with a floating exchange rate. Firms produce two traded goods, one in the formal sector and another one in the informal sector. The good in the formal sector is produced using capital and labor whereas the good in the informal sector is produced using capital, labor and land. This distinction is made to differentiate their production technologies to allow for the existence of the two sectors in equilibrium and it’s motivated by the importance of the agricultural sector in developing countries. The household stores wealth in the form of domestic money, foreign money, and an indexed nontraded bond issued by the government. The government balances its budget by issuing domestic money and bonds. All variables are in aggregate terms so $M$ denotes total nominal money supply, for example. Variables in real terms are denoted by small caps so $m$ is total real money holdings.
2.1 Preferences

The household has CES preferences over consumption and leisure. Total consumption expenditures, denoted by \( E \), are divided between consumption in the formal sector, \( C^1 \), and consumption in the informal sector, \( C^2 \). Throughout the model, variables related to the formal sector are indexed by 1 and those related to the informal sector by 2. The value-added tax, \( x \), is assessed only on formal sector consumption.

\[
E = c(1 + x)C(C^1, C^2) \quad (1)
\]

Consumption expenditure can also be written in terms of the demand for both goods. This definition will be used in subsequent sections.

\[
E = (1 + x)D^1 + D^2 \quad (2)
\]

The household chooses the level of consumption expenditure, \( E \), needed to achieve utility \( u \), the level of labor supply, \( L \), real domestic and foreign money holdings, \( m \), and \( F \), respectively; as well as the level of investment in each sector, \( I_1 \) and \( I_2 \). In solving the optimization problem we obtain the solution for the price level \( P = ec(1 + x) \), where \( e \) is both the exchange rate and the price of the traded good in the informal sector given the absence of a nontradable sector. Currency depreciation is denoted by \( \epsilon \), where \( \epsilon = \frac{\dot{e}}{e} \). A dot over a variable denotes its time derivative.

The representative consumer solves

\[
U = \int_{0}^{\infty} \left[ \left( \frac{E}{c(1+x)} - a \frac{L}{1+\frac{1}{\psi}} \right)^{1-\frac{1}{\tau}} + \phi \left( \frac{m}{c(1+x)}, \frac{F}{c(1+x)} \right) \right] e^{-\rho t} dt \quad (3)
\]

The function \( \phi \) captures the utility derived from the liquidity services that both forms of money offer, \( \tau \) and \( \rho \) are elasticities of substitution and \( \rho \) is the time preference rate. To reiterate, the function \( c(1+x) \) divides domestic and foreign money holdings given the need to pay for the VAT using liquidity.
We add the constraint that total wealth equals money and bold holdings

\[ A = m + b + F \] (4)

Total private asset accumulation is determined by savings

\[ \dot{A} = (1 - h)(r_1 K_1 + w_1 L_1) + r_2 K_2 + w_2 L_2 + sT + r\left(A - m - F\right) - \epsilon m + g - E - I^1 - \frac{v}{2}(I^1 - \delta)^2 K^1 - I^2 - \frac{v}{2}(I^2 - \delta)^2 K^2 \]

where \( g \) refers to a lump-sum transfer the household receives from the government, \( I_j \) and \( \frac{v}{2}(I_j - \delta)^2 K^j \), for \( j = 1 \) and 2, refers to the investment level and the adjustment cost associated with increasing capital. This adjustment cost specification implies that that total and marginal adjustment costs go to zero as investment goes to zero.

The law of motion for capital accumulation in each sector is given by

\[ \dot{K}_1 = I_1 - \delta K_1 \] (5)
\[ \dot{K}_2 = I_2 - \delta K_2 \] (6)

2.2 Production

Firms are perfectly competitive and produce output \( Q^1 \), and \( Q^2 \) by means of a CES production technology.

\[ Q^1 = F(K^1, L^1) \] (7)
\[ Q^2 = F(K^1, L^2, T) \] (8)

where \( K \) refers to capital, which is sector immobile; \( L \) refers to labor; and \( T \) refers to land.

We add the full employment condition in the labor market

\[ L = L_1 + L_2 \] (9)

Using Shephard’s lemma, this condition can be re-written as

\[ L = C^1_w Q^1 + C^2_w Q^2 \] (10)

\(^3\)The presence of capital adjustment costs ensures capital adjustment is gradual and smooth
The zero profit condition in each sector follow from the assumption of perfect competition and CRS technology

$$1 = C^1(w_1, r_1)$$ (11)

$$1 = C^2(w_2, r_2, s)$$ (12)

where $C^1$ and $C^2$ refer to the unit cost function in the formal and informal sector, respectively. The arguments of the cost function are the wages, $w_1$ and $w_2$; the capital rentals, $r_1$ and $r_2$; and the land rental in the informal sector, $s$.

2.3 The government

The government prints money and issues bonds to finance $g$ and debt service. Revenue is collected from a tax on production, consumption, and from the inflation tax.

$$\dot{m} + \dot{b} = g + rb - hQ^1 - xD^1 - \epsilon m$$ (13)

2.4 Net Foreign Asset Accumulation

Finally, the balance of payment identity derived from combining the household’s and government’s budget constraint states that foreign asset accumulation is financed by the current account surplus.

$$\dot{F} = Q^1 + Q^2 + xD^1 - E - A(I_1) - A(I_2)$$ (14)

2.5 Equilibrium

An equilibrium in this open economy is an allocation for the representative household $(E, L, m, F, I^1, I^2)$ along with $(K^1, K^2, b)$, an allocation for the firm in the formal sector $Q^1$, and for the firm in the informal sector $Q^2$, and prices $(w_1, w_2, r_1, r_2, s, \epsilon, r)$ such that (i) the household holds the maximization problem in (3), firms minimize their cost, the government satisfies the budget constraint in (13), and the requirement that foreign asset accumulation equals national savings.
3. Solving the Model

The first-order conditions are

\[
\left( \frac{E}{c(1+x)} - a \left( \frac{L^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}} \right) \right)^{-\frac{1}{\psi}} \frac{1}{c(1+x)} = \lambda_1 \tag{15}
\]

\[
\left( \frac{E}{c(1+x)} - a \left( \frac{L^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}} \right) \right)^{-\frac{1}{\psi}} (aL^{\frac{1}{\psi}}) = \lambda_1 w_2 \tag{16}
\]

\[
\lambda_1[(1-h)w_1 - w_2] = 0 \tag{17}
\]

\[
\frac{\phi_m(m, F)}{c(1+x)} = \lambda_1 (r + \epsilon) \tag{18}
\]

\[
\frac{\phi_F(m, F)}{c(1+x)} = \lambda_1 (r) \tag{19}
\]

\[
\lambda_1[1 + v(I_1 K_1 - \delta)] = \lambda_2 \tag{20}
\]

\[
\lambda_1[1 + v(I_2 K_2 - \delta)] = \lambda_3 \tag{21}
\]

along with the co-state equations

\[
\dot{\lambda}_1 = \lambda_1(\rho - r) \tag{22}
\]

\[
\dot{\lambda}_2 + \lambda_1[(1-h)r_1 - \frac{v}{2}(I_1 K_1 - \delta)^2 + v(I_1 K_1 - \delta) \frac{I_1}{K_1}] = \lambda_2(\rho - \delta) \tag{23}
\]

\[
\dot{\lambda}_3 + \lambda_1[(r_2 - \frac{v}{2}(I_2 K_2 - \delta)^2 + v(I_2 K_2 - \delta) \frac{I_2}{K_2}] = \lambda_3(\rho - \delta) \tag{24}
\]

where \( \lambda_1 \) is the time invariant multiplier attached to the wealth accumulation constraint, and \( \lambda_2 \) and \( \lambda_3 \) are the multipliers attached to the capital accumulation constrains in the formal and informal sector, respectively.
Combining the FOC for expenditures and labor supply, we obtain the following relationship

\[ aL^\frac{1}{\psi} = \frac{w_2}{c(1 + x)} \]  

(25)

A decrease in the consumption VAT will increase the real consumption wage and as a result, labor supply will increase.

\[ \hat{L} = \psi(\hat{w}_2 - \gamma x \hat{x}) \]  

(26)

We obtain factor demands using Shephards lemma and the zero profit conditions of both sectors

\[ \hat{L} = \left[ \gamma_2 \theta_1^2 (\sigma^2_{LL} - \sigma^2) - \gamma_1 \sigma^1 \right] \hat{w}_2 + \gamma_1 \hat{Q}^1 + \gamma_2 \hat{Q}^2 \]  

(27)

\[ \hat{K}_1 = \theta_1^1 (\sigma_1 - \sigma^1_{KK}) \hat{w}_1 + \hat{Q}_1 \]  

(28)

\[ \hat{K}_2 = \theta_2^2 (\sigma^2_{LL} - \sigma^2) \hat{r}^2 + \hat{Q}^2 \]  

(29)

4. Steady State Outcome

In steady state \( \rho = r, \dot{m}, \dot{b}, \dot{F}, \dot{E}, \dot{I}_1, \dot{I}_2, \dot{K}_1, \dot{K}_2 = 0 \) Applying these conditions to the FOCs for \( m \) and \( F \)

\[ \frac{\phi_m}{c(1 + x)} = \lambda_1(\rho + \epsilon) \]  

(30)

\[ \frac{\phi_F}{c(1 + x)} = \lambda_1(\rho) \]  

(31)

In steady state adjustment costs and investment is zero so \( \dot{\lambda}_2 \) and \( \dot{\lambda}_3 \) are zero so by the co-states for \( K_1 \) and \( K_2 \),

\[ (1 - h)r_1 = (\rho + \delta) \]  

(32)

\[ r_2 = \rho + \delta \]  

(33)

Now we can express the zero profit conditions using the steady state rental rates

\[ 1 = C^1 \left( \frac{w_2}{(1 + h)}, \frac{\rho + \delta}{(1 - h)} \right) \]  

(34)
\[ 1 = C^2 \left( w_2, \rho + \delta, s \right) \]  

(35)

Note that in steady none of the arguments of the cost function change. From the full employment condition in the labor market

\[ L = C_w^1 Q^1 + C_w^2 Q^2 \]

(36)

we observe that given a lower consumption VAT in steady state, labor supply is higher which seems to increase \( Q^1 \) and/or \( Q^2 \). But by Shephard’s lemma for the third factor, land

\[ T = C_s^2 Q^2 \]

(37)

\( T \) is fixed and \( C_s^2 \) is constant which implies that \( Q^2 \) is constant. Hence, the increase in labor in steady state results in higher output but solely in the formal sector.

\[ \hat{L} = l_1 \hat{Q}^1 \]

(38)

\[ \hat{Q}^1 = \frac{1}{l_1} \hat{L} \]

(39)

The increase in labor supply resulting from the cut in the consumption tax ends up increasing in steady state output in the formal sector only, the sector from which the government collects the labor tax. Similarly for capital in the formal sector we have

\[ K^1 = CrQ^1 \]

(40)

\[ \dot{K}_1 = \dot{Q}_1 \]

(41)

Since \( w_2 \) does not change in steady state, the FOC for \( L \) in steady state becomes

\[ \dot{L} = - \frac{\psi}{c(1 + x)} dx \]

(42)

The national income identity gives us

\[ E = Q^1 + Q^2 - xD^1 - \delta K_1 - \delta K_2 \]

(43)
The government budget constraint in steady state

\[ em = g + rb - hQ^1 - xD^1 \]  \hspace{1cm} (44)

5. Transitional Dynamics

The dynamic system is given by a 7 by 7 system of three state variables \( K_1, K_2, \) and \( F \), and four jump variables \( E, m, I_1, \) and \( I_2 \)

6. Calibration of the Model and Numerical Results
References


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