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Tax Structures in Developing Countries: Many Puzzles and a Possible Explanation

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The past academic literature on tax policy has focused almost entirely on the analysis of tax structures in the richest countries, particularly the U.S. Overall the optimal tax models explain reasonably well the observed tax policies in these countries. As summarized in Gordon (2000), for example, past theoretical work suggests that taxes on consumption or labor income should dominate use of capital income taxes in open economies under plausible assumptions. Consistent with this, value-added taxes, personal income taxation of labor income, and payroll taxes are the most important sources of revenue in many countries. Even under the income tax, a large fraction of personal savings in practice is tax exempt.[1]

Of course there are some deviations between the forecasts from models of optimal policy and observed government policies even in the richest countries. For example, Friedman (1969) argued that the optimal inflation rate should be negative (to bring nominal interest rates down to zero), whereas observed inflation rates have been positive even if relatively low.[2] Optimal tariffs should be close to zero, given that countries rarely have much market power in particular commodities beyond what individual firms have. Tariffs in

[1] The largest investments for most people are their house, consumer durables, and pension. The return on these forms of saving is largely exempt from tax in most countries. Gordon, Kalambokidis, and Slemrod (forthcoming -a, forthcoming -b) report evidence that the U.S. collects little or no net revenue from taxes on capital income, and imposes much lower distortions on investment and savings decisions than it at first appears given the statutes.

[2] Feldstein (1997) calculated a large efficiency gain from lowering the inflation rate towards zero, even from a low positive initial level, due to the lack of correction for inflation in the measurement of taxable income.

the past have been large, but with GATT and now the WTO, tariffs at least among developed countries are indeed very low.

Tax policies in developing countries are much more puzzling, however. These differences are laid out in more detail in section 1. To begin with, poorer countries collect on average only two-thirds or less of the amount of tax revenue that richer countries do, as a fraction of GDP. Yet, given the severe needs for investments in say infrastructure and education in these countries, is it plausible that the lack of revenue simply represents differing tastes for public vs. private goods in poor vs. rich countries? While the personal income tax is the dominant source of tax revenue among richer countries, it is only a minor source of revenue among the poorest countries. Instead, the corporate income tax is a much more important source of tax revenue in poorer countries, as are tariffs and seignorage. Yet the existing optimal tax theories argue that tariffs and seignorage are particularly poor sources of tax revenue, while distortions to savings and investment incentives created by a corporate tax should also be avoided.

A natural starting point in explaining these differences in tax policy is greater tax enforcement problems in poorer countries. In this paper, we explore the implications of a specific hypothesis about the source of such enforcement problems, and show that adding this hypothesis to an otherwise standard optimal tax model can easily explain each of the above differences in policies between poor and rich countries, along with a variety of other differences in observed policies.

The key assumption in the paper is that firms can avoid tax payments in any country by shifting entirely to cash transactions and not using the financial sector, thereby avoiding leaving any paper trail.[3] When firms make use of the financial sector, in contrast, the government can gain access to their bank records and use this information in enforcing the tax law.[4] Firms then have to choose whether the economic benefits from use of the

[3] Cash transactions are extremely hard to monitor even in the richest countries. Likely for this reason, illegal activity seems to rely heavily on cash transactions.

[4] Among the richest countries, governments can rely on firms to provide information about individual wage and dividend incomes, and accounting reports and tax audits both to double-check these reports by firms on

financial sector are greater or less than the resulting tax liabilities. Poorer countries differ from richer countries under our hypothesis simply because the value firms receive from using the financial sector is much more modest.

When the value from using the financial sector is low, the government needs to worry about possible disintermediation and the resulting loss of its tax base when choosing its tax structure. This threat of disintermediation not only can keep tax rates low, but can also have important effects on the design of the tax structure, and on government policies more generally.

We presume, for example, that large capital-intensive firms are more dependent on the financial sector, allowing the government to impose higher taxes on them without inducing disintermediation. In poorer countries, taxes do seem to be paid far more heavily by large and capital-intensive firms than by the rest of the economy. Relying more heavily on corporate income taxes is one means of focusing tax collection on the firms that are most dependent on the financial sector.

With the resulting much higher effective tax rates on large and capital-intensive firms, one would expect to see few large and capital-intensive firms. This is not at all apparent given the data, suggesting that there are policies in place to protect these firms, and thereby protect the government's tax base. An example would be tariff protection for industries dominated by large and capital-intensive firms. Another policy that implicitly favors these firms is inflation. Firms that use the financial sector are largely protected from inflation, whereas those firms that rely on cash transactions so as to evade tax are thereby vulnerable to inflation. Policies may sensibly encourage or hinder investments by multinationals, depending on the government's ability to tax multinationals vs. competing domestic firms. There may even be an efficiency gain from introducing red tape hindering activity in the untaxed sector.

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individual earnings and to document each firm's own earnings. Accounting firms and tax audits, in turn, rely heavily on the records of a firm's transactions through the financial sector, making these records a key underlying source of information supporting most forms of taxes.

Section 2 develops the basic model for the choice of tax structure, given the threat of disintermediation. Section 3 explores a variety of supplementary policies a government can use to protect its tax base.

Section 4 then provides a brief discussion of a related puzzle why state-owned banks are so common among poorer countries. What compensates for the presumed resulting efficiency loss from public ownership? Since the government needs to rely on banks to gather information about firms, it needs some controls to assure access to this information. Direct ownership is one approach. In addition, direct ownership may be valuable in order to discourage lending to untaxed firms, and perhaps to induce lending to taxed firms even when the bank loses money, given the gains to the government from the resulting tax revenue on the new investment.

Finally, section 5 provides a brief summary and discussion.

1. Data on tax policies in poor vs. rich countries

Table 1 compares the sources of tax revenue among countries of different income levels. To begin with, as seen in the Table, the poorest countries collect two-thirds or less of the revenue collected in the richer countries, as a fraction of GDP.

Among the richest countries, the main sources of revenue are the personal income tax (42.7% = 54.3%(1-.178) of revenue) and various types of consumption taxes (32.9% of revenue). Consumption taxes are even more important among the poorest countries (51.2% of their lower tax revenue), but the personal income tax is of minor importance, collecting only 14.3% of tax revenue. Instead, the corporate income tax is much more important (19.3% of revenue, compared with 9.7% in richer countries), and tariffs are also important (16.4% of revenue, compared with a trivial fraction in richer countries). As seen in the Table, seignorage represents a major nontax source of revenue among the

poorest countries (21.8% of tax revenue, compared with 1.7% in richer countries). As a result, inflation rates among the poorest countries on average tend to be much higher.

These sharp differences in sources of tax revenue do not seem to correspond to sharp differences in statutory tax rates between poor and rich countries, however. Among a limited set of countries where we have been able to acquire data, listed in Table 2, the average maximum statutory tax rates under the VAT are very close among poor vs. rich countries (14.7% vs. 16.2%). The average maximum corporate tax rates are also very close (26.7% vs. 29.6%), while the maximum personal tax rates are not that different (34.7% vs. 42.8%).

The *effective* tax rates, though, must be very different given the lower fraction of GDP collected by these taxes among poorer countries, presumably due to their much larger informal economies. As seen in Table 1, estimates of the size of the informal economy are on average more than twice as large in poorer countries than in richer countries. As a simple summary description of how tax revenue relates to these tax rates, we regressed the fraction of tax revenue collected against the maximum VAT rate and the minimum of the top personal and corporate tax rates,[5] focusing separately on data from poorer and richer countries. If countries are otherwise the same, but simply differ in their tax rates, then the coefficient on each tax rates should roughly reflect the size of the tax base, as a fraction of GDP, multiplied by the ratio of the average to the maximum tax rate.

Using data from the richer countries (18 observations), results seem quite sensible:

$$\text{Revenue/GDP} = .06 + .46\ \min(t,\tau) + .58\ s, \qquad R^2=0.42$$
$$(.07)\ \ (.20) \qquad\qquad (.19)$$

[5] Our motivation for focusing on the minimum income tax rate is the apparent ease of shifting income between the corporate and personal tax bases, as documented for example in Gordon and Slemrod (2000). If this income shifting is sufficiently costless, then only the minimum rate matters. When we add the maximum tax rate, it has a tiny and insignificant coefficient. When we include both corporate and personal tax rates separately, the qualitative results are the same, but the fit is not as good.

Here, t is the maximum personal tax rate, τ is the maximum corporate tax rate, while s is the maximum consumption tax rate. Consider, for example, the coefficient of .58 on s. If the consumption tax base on average were roughly 2/3's of GDP, then the implied effective tax rate is (.58/.67)s = .87 s. Given the common use of lower tax rates on services and necessities such as food, this result seems quite reasonable. The coefficient of .46 on the minimum income tax rate also seems plausible, given the frequent use of a progressive rate structure under the personal income tax, leading to an average tax rate much below the maximum rate.

With data from poor countries (25 observations), in contrast, results are dramatically different:

$$\text{Revenue/GDP} = .22 - .23\ \min(t,\tau) + .22\ s, \qquad R^2=0.38$$
$$\qquad\qquad\quad (.03)\ \ (.07) \qquad\qquad (.09)$$

One possible explanation for the lower coefficient on s is that the average VAT rate is much below the maximum statutory tax rate, perhaps because the underground economy is often very large in poorer countries. The negative coefficient on the income tax rate, however, suggests reverse causation: when revenue is very low due to a large underground economy, statutory tax rates become higher to collect more from the few firms that remain part of the taxed sector. These are certainly the interpretations we will suggest based on the theory described next.

2. Tax policy when information is limited

Existing models deriving optimal tax policy typically assume that the government can observe the income earned by all factors and by all firms, even if underlying ability is not observable. How do forecasts for the optimal tax policy change if the difficulty of observing income flows is taken into account explicitly?

Consider the following highly stylized setting. The economy consists of a collection of industries. Firms in industry *j* have a Cobb-Douglas production function $f_j \equiv K_j^{b_j} L_j^{1-b_j}$, where f_j denotes industry output, K_j denotes the industry's capital stock, and L_j its labor inputs.

There is free entry to each industry, so that each firm earns zero net-of-tax profits in equilibrium. If a firm does not make use of the financial sector,[6] using cash for all transactions, it leaves no paper trail. As a result, we assume that the government does not observe anything about the firm, including its existence, so cannot impose any direct taxes on it. Profits for such a firm then equal $p_j^* f_j - rK_j - wL_j$, where p_j^* is the output price in industry *j,* set on the world market,[7] *r* is the local interest rate, and *w* is the local wage rate.

If a firm in industry *j* does use a financial intermediary, doing so increases its output by the fraction a_j,[8] so that output becomes $(1+a_j)f_j$, and pretax profits become $(1+a_j)p_j^* f_j - rK_j - wL_j$. If firms in the industry do choose to use banks, then the government can observe all its transactions through auditing the banks' records. It can then impose taxes based on this information. Consider first the optimal use of sales taxes at rate s_j on each industry j.

If the sales tax is collected whether output is sold abroad or on the domestic market, as we assume, we infer that $(1+s_j)p_j = p_j^*$, where p_j is the price domestic firms now receive, net of the sales tax payment. The resulting tax revenue equals

[6] We simplify the analysis by assuming that firms in an industry use banks for either all or none of their transactions.
[7] Assume the country is small, so is a price taker in world markets.
[8] In principle, a_j can be negative. This could occur when firms fear that the banks will abscond with their funds, or at least limit their ability to withdraw cash when needed.

$\sum_{j \in T} s_j p_j f_j = \sum_{j \in T} s_j^* p_j^* f_j$, where $s_j^* = s_j/(1+s_j)$ and where T describes the set of industries that make use of banks, so are taxable.

If all firms use banks, then we are back to the standard framework in which the government can observe and tax all sales. Let β_j=1 if the firms in industry j use banks, with $\beta_j = 0$ otherwise.

Given these assumptions, each firm acts to maximize expected net-of-tax profits, so chooses factor inputs and β_j based on:

$$\max_{\beta_j, L_j, K_j} \left((1-\beta_j) p_j^* f_j + \beta_j p_j^* (1-s_j^*)(1+a_j) f_j - rK_j - wL_j \right)$$

Firms that use banks choose capital inputs so that $p_j^* \partial f_j / \partial K_j = r/[(1-s_j^*)(1+a_j)]$, while $p_j^* \partial f / \partial K_j = r$ otherwise, with comparable equations determining labor inputs.

Firms will choose to use banks if and only if doing so raises their net profits, so if and only if $(1+a_j)(1-s_j^*) > 1$, in which case

(1) $$s_j^* < \frac{a_j}{1+a_j}.$$

Put simply, firms use banks when the economic gain from use of the financial sector outweighs the resulting loss from being subject to the sales tax, even given that these economic gains are themselves subject to the sales tax. If the sales tax rate in industry j violates this inequality, then it would induce disintermediation in this industry, and collect no revenue.

This result has immediate implications for the variation of sales tax rates within a country, and also for variation in average sales tax rates across countries. Regarding the latter, countries in which the a_j's are systematically larger, so in which the financial sector provides greater value-added to firms, can feasibly impose higher sales tax rates without inducing disintermediation and a loss of its tax base. While the inequality conditions in equation (1) should easily be satisfied in richer countries, so have no effects on tax policy, we hypothesize that these conditions are a key factor limiting feasible tax rates and the amount of tax revenue that can be collected in poorer countries. If tax rates have been raised to their maximum feasible level, then a country will be unable to raise further revenue regardless of the social value of additional government expenditures. The key determinant of government revenue is simply the a_j.

If tax rates can differ by industry, then rates would be chosen so that all industries make use of banks, so remain part of the tax base.[9] Feasible sales tax rates vary by industry based on equation (1), so depend on the value of a_j in each industry. We assume that a_j is an increasing function of b_j, the weight on capital in the production function. Maintaining accounts with a bank allows the bank to monitor the firm's performance, giving the bank information about the firm as well as potential collateral. Both facilitate future lending to the firm. Loans are relatively more valuable to a firm the greater the amount of capital it needs to finance. Firms with a higher value of b_j, by demanding a higher capital/labor ratio, therefore gain more from use of banks. Use of banks is also presumably more valuable the greater the physical distance at which a firm engages in market transactions, since banks are designed to facilitate financial transactions at a distance. For simplicity, we assume that more capital-intensive firms are also those firms more likely to trade at a distance, perhaps because the minimum efficient size of a firm is larger the greater its capital intensity.

[9] If the tax rate in any industry is raised high enough to induce disintermediation, then there is a discrete drop in tax revenue with no gain to firms in the industry.

The feasible tax rates, as a fraction of factor incomes, are then higher for capital-intensive industries, which have a higher value of a_j. Even if a uniform sales tax rate would be optimal ignoring the constraints in equation (1), tax rates need to be reduced for less capital-intensive industries when equation (1) becomes binding, and then raised for more capital-intensive industries to compensate for the resulting loss in tax revenue.

Industries, as defined in practice under the tax law, are inevitably heterogeneous, however. Any increase in a sales tax rate for a broad group of industries will then cause some disintermediation, adding a new source of excess burden beyond those commonly considered. The more elastic the extent of disintermediation at the margin, the higher the marginal excess burden from a rate increase, everything else equal.

Factor income taxes can then help lessen the degree of disintermediation, even if factor tax rates cannot vary by industry. To see this, start from the above setting with positive sales tax rates in all industries. Within a given industry *j* with heterogeneous firms, for any given initial sales tax rate s_j^*, there should be some b_j^* at which a firm is just indifferent to using banks. Any firm *k* in this industry with $b_{jk} > b_j^*$ will use banks, and conversely. Consider introducing a marginal tax rate, t_K, on expenditures on capital, with a compensating marginal cut in s_j^* just sufficient to leave net profits unchanged for firms with $b = b_j^*$. Given the Cobb-Douglas assumption, this implies that $\partial s_j^* / \partial t_K = -b_j^*(1 - s_j^*)$. With these combined tax changes, firms with $b = b_j^*$ by construction remain indifferent to using banks.

Starting from a setting with $t_K = 0$, tax revenue from firms with $b = b_j^*$ is also unchanged. Tax payments by any firm *k* with $b_{jk} > b_j^*$ go up, however, due to these combined tax changes. Starting from $t_K = 0$, the marginal change in tax payments equals

$$rK_{jk} + p_j^*(1+a_j)[f_{jk}\frac{\partial s_j^*}{\partial t_K} + s_j^*\frac{\partial f_{jk}}{\partial t_K}] = p_j(1+a_j)[(b_{jk}-b_j^*)(1-s_j^*)f_{jk} + s_j^*\frac{\partial f_{jk}}{\partial t_K}],$$

given that $rK_{jk} = b_{jk}(1-s_j^*)p_j^*(1+a_j)f_{jk}$ with a Cobb-Douglas production function. Since by construction $b_{jk} > b_j^*$, the first term is positive. This outweighs the second term as long as the effective tax rate on firm *k* is below the rate at the top of the Laffer curve.[10] Intuitively, since these other firms are more capital intensive, the cut in the sales tax rate is not sufficient to offset the increase in the tax on capital expenditures. This marginal tax change will not induce any disintermediation, since these firms discretely gained from use of banks. There is no marginal excess burden from distortions to capital/labor ratios, since the tax change is imposed at a point where this choice is efficient.

Further increases in t_K in principle could eventually induce disintermediation among some of the more capital-intensive firms within the industry. To judge whether this might occur, let $r^* \equiv r(1+t_K)/[(1+a_j)(1-s_j^*)]$ and $w^* = w/[(1+a_j)(1-s_j^*)]$ represent the effective factor prices. Then with a Cobb-Douglas production function, the unit cost equals $b^{-b}(1-b)^{-(1-b)}(r^*)^b(w^*)^{1-b}$. Using banks continues to be attractive for any firm with $b > b_j^*$ if and only if

$$\frac{(1+t_K)^b}{(1+a_j(b))(1-s_j^*)} < 1$$

for all $b > b_j^*$, given that by definition this equation is just satisfied for firms with $b = b_j^*$. This condition is equivalent to the condition

$$\frac{1+a_j(b)}{1+a_j(b_j^*)} > (1+t_K)^{(b-b_j^*)} \qquad (2)$$

[10] Throughout, we assume that the tax rate remains below the rate at the peak of the Laffer curve.

holding for all $b > b_j^*$.[11]

If equation (2) holds in all industries, then tax revenue unambiguously increases as t_K increases, with compensating cuts in each of the s_j^* to avoid any resulting disintermediation. Presumably, however, each of the s_j^*'s must remain nonnegative.[12] Increases in t_K can then be offset by compensating cuts in each of the s_j^* to prevent any disintermediation only so long as all industries still have $s_j^* > 0$. Further increases would still raise additional revenue in the industries that have $s_j^* > 0$. In the remaining industries it would raise additional revenue from those firms that do remain in the tax base but cause a rise in b_j^* and a loss in revenue from those firms that leave the tax base.

The global optimum for t_K could in theory involve a very high tax rate with a very narrow tax base, depending on parameters. For example, if one set of firms would always use the banking system, then a very high t_K in principle can collect substantial revenue from these firms at the cost of collecting little or nothing from other firms. Lowering the tax rate by enough to pull more firms into the tax base, however, may lower overall tax revenue. Optimal tax rates can be very high, in spite of the threat of disintermediation.

Our forecast that capital tax rates will be used heavily is sharply contrary to the forecast from the standard model that capital income taxes will play little or no role in an optimal tax system, though this forecast is broadly consistent with the observed heavy use of corporate income taxes and limited use of labor income taxes among the poorest countries. Intuitively, the government is trying to collect more revenue from industries that use banks, while avoiding disintermediation to the extent it can. Since the firms just

[11] This imposes a minimum average exponential growth rate for the function $(1+a_j(b))$

[12] Negative sales taxes (sales subsidies) are presumably infeasible, given the potential for repeated trades of the same good.

indifferent to using banks are more labor intensive than those already using banks, the marginal firms are relatively more concerned about sales tax (and particularly labor income tax) rates, compared with capital tax rates, than the inframarginal firms. Cutting sales tax rates and raising capital tax rates therefore can raise revenue without inducing disintermediation.

So far, we have ignored the possibility of taxes on imports or exports. When would trade distortions be used, assuming as before that the country is a price-taker in the world market for all goods? With no constraints on sales tax rates on consumer goods, then the results in Diamond-Mirrlees (1971) forecast production efficiency, requiring that the relative prices faced by domestic producers equal those prevailing on the world market. When tax rates are constrained by the threat of disintermediation, though, forecasts change.

To consider these questions more formally, assume for simplicity that, ignoring tariffs, the country would produce nonzero amounts of two homogeneous goods.[13] Capital expenditures are taxed at some rate t_K, while conditional on t_K each industry faces a maximum sales tax rate $s_i^{\max}$, with $s_1^{\max} < s_2^{\max}$.[14] The country exports the first good, and imports the second good. The imported good is subject to a tariff at rate τ_2, while exports of the first good are untaxed.

Denote imports of the second good by M_2, and denote domestic consumption of the two goods by C_i. Domestic consumer prices then equal p_1^* and $p_2^*(1+\tau_2)$, while the prices faced by domestic producers equal $p_1^*(1-s_1^*)$ and $p_2^*(1+\tau_2)(1-s_2^*)$. To simplify notation, let $f_1^* \equiv f_1$ and $f_2^* \equiv (1+\tau_2) f_2$.

[13] This in fact is stronger than is needed. We only need to assume that both goods are produced at the equilibrium tariff rate.

[14] With only two homogeneous goods, a capital tax does not help in easing the pressures from possible disintermediation. It does change relative factor prices, however.

In setting tax and tariff rates, we follow convention and assume that the government is maximizing a standard representation of social welfare:

$$W = \max_{s_i^*, \tau_2} \left[V(p_1^*, p_2^*(1+\tau_2), w, r) + U(\sum_i s_i^* p_i^* f_i^* + t_K rK + \tau_2 p_2^* M_2) \right]$$

$$= \max_{s_i^*, \tau_2} \left[V(p_1^*, p_2^*(1+\tau_2), w, r) + U(\sum_i p_i^* (f_i - C_i)) \right].$$

Here, $V(.)$ is the indirect utility a representative resident receives from private sector activity, *U(.)* represents the utility from public expenditures, and K is the aggregate capital stock. Given the overall domestic budget constraint, government tax revenue equals the value of domestic output at world prices net of the value of domestic consumption: $\sum_i p_i^* (f_i - C_i)$. The government maximizes this subject to the constraint that $s_i^* < s_i^{\max}$, for any given t_K.

Focus first on the more conventional situation where the constraints on the s_i^*'s are not binding. For a given value of τ_2, consumer prices are fixed. Consider the set of coordinated changes in s_1^*, s_2^*, and t_K that leave unchanged the net factor prices faced by individuals (*r* and *w*), but affect the composition of production.[15]

With any such combined tax change, the factor and goods prices faced by consumers all remain unchanged, so that the C_i's remain unchanged. The composition of production changes, however. With government revenue equal to $\sum_i p_i^* (f_i - C_i)$, taxes within this set should then be chosen to maximize $\sum_i p_i^* f_i$. This occurs if the relative output prices faced by firms equal the relative international prices for these goods, requiring that $(1 - s_1^*) = (1 + \tau_2)(1 - s_2^*)$. Production would then be efficient: this is the Diamond-

[15] For example, with a given increase in the tax rate on the labor-intensive sector and a suitably larger increase in the tax rate on the capital-intensive sector, the market clearing wage rate can remain unchanged but the equilibrium value of $r(1+t_K)$ falls. The return to savings, r, can then be left unchanged through a suitable cut in t_K. However, these combined tax changes cause a shift in production towards the labor-intensive sector.

Mirrlees result. Relative consumer prices, though, are distorted away from the relative prices prevailing in world markets whenever $\tau_2 \neq 0$. Tariffs are used then only to the degree that the optimal tax structure includes distortions to relative consumer prices as well as factor income taxes.[16]

How does tariff policy change when the s_i^*'s and t_K are limited due to the threat of disintermediation? Given the limitations on direct taxes, individuals can be taxed indirectly through use of tariffs, raising the prices of at least some of the goods they consume. In addition, however, tariffs can be used to shift domestic production towards the more heavily taxed sector.

In general, social welfare is maximized when[17]

(3) $0 =$

$$\left(\left(1-\frac{V_I}{U'}\right)p_2^* M_2 + \tau_2 p_2^* \frac{\partial M_2}{\partial \tau_2}\right) + \left(1-\frac{V_I}{U'}\right)s_2^* p_2^* f_2 + (1-s_2^*)\left(\frac{s_2^*}{1-s_2^*} - \frac{s_1^*}{1-s_1^*}\right)p_2^* \frac{\partial f_2^*}{\partial \tau_2} + t_K \frac{\partial rK}{\partial \tau_2}$$

Here, V_I/U' measures the relative value of an extra dollar of personal income compared with an extra dollar of government expenditures.[18] If the government simply focused on the direct effects of tariffs, then the first term in equation (3) would equal zero. The remaining terms are each positive however. By assumption $s_2^* > s_1^*$, while $\partial f_2 / \partial \tau_2 > 0$ since the relative producer price for good 2 goes up due to the tariff. Since this industry is more capital-intensive, *r* increases presumably causing savings and *K* to

[16] Labor income would be taxed here through a uniform increase in the s_i, with a suitable cut in t_K to leave r unchanged, while capital income is taxed through t_K.

[17] Note that the increase in the price received by domestic producers of good 2 generates extra income to residents, through the equilibrium adjustments in factor prices. In deriving this expression, we use the fact that factor inputs are allocated so as to maximize net of tax revenue from production, $\sum_i p_i(1-s_i^*)f_i^*$, so that $\sum_i p_i(1-s_i^*)\partial f_i^* / \partial \tau_i = 0$.

[18] When the constraints on feasible tax rates are binding, this ratio becomes smaller.

increase. As a result, the optimal tariff will be raised due to second-best considerations, in order to increase production in the more heavily taxed sector through use of the tariff.

Intuitively, due to the higher tax rate on production of the second good, the country produces too little of that good, everything else equal. By taxing imports of that good, so substituting domestic production for imports of that good and in equilibrium reducing exports of the first good, production shifts towards the more heavily taxed commodity, offsetting a preexisting distortion.

If the more heavily-taxed capital-intensive good is exported, however, so that $s_1^* > s_2^*$, then the last two terms in equation (3) are negative. If these terms are large enough, the optimal tariff on imports of good 2 can even be negative, lowering the market price of good 2 and shifting domestic resources into added production of the more heavily taxed good 1. Whether a country would be expected to encourage or discourage trade can then depend heavily on whether production of the exported good is taxed at a higher or lower tax rate than the imported good.

One issue with a tax on firm output is whether to limit the tax to final sales to (foreign or domestic) consumers, or to tax as well sales to other firms. If all firms are subject to tax, then the latter, e.g. a turnover tax, distorts the organization of production, encouraging firms to merge to avoid taxable transactions. Conventional optimal tax results, e.g. Diamond and Mirrlees (1971), show that such production distortions provide no compensating benefit, so should be avoided. In particular, taxing sales to an industry that is also part of the taxed sector is dominated by raising the sales tax rate on the purchasing industry – both raise the price to consumers but the first introduces additional distortions to production, lowering the value of output holding consumption fixed, so lowering government revenue.

This argument assumes that the purchasing industry k is itself subject to a sales tax that can flexibly be raised, if so desired. In our setting, however, the sales tax rate in industry k may be at the constraint implied by equation (1). (Industry k may not even be taxable.)

If this constraint is binding, so that the government would like to raise the tax rate on industry *k* but cannot do so directly due to the threat of disintermediation, then it can do so indirectly by taxing sales to this industry from some industry *j*.[19] Therefore a tax on sales to industry *k* raises the effective tax rate on the industry, as would be desired if the industry's tax rate is subject to a binding constraint.

Taxing sales to industry *k* may come at the expense of taxing sales to final customers, or sales to other industries, if industry *j* also faces a binding constraint from equation (1). With a binding constraint, only so much tax can be collected in total without inducing disintermediation. In that case, the issue is desired relative tax rates on different customers, and ultimately on different final goods. In industries paying a relatively high tax rate, it should be attractive to shift a considerable share of the industry's overall tax burden to taxes on sales to other industries so as to raise the effective tax rates on these other goods and in the process lowering the relative tax rate faced by final consumers of the taxed industry's goods. While there is no reason to think that the optimal tax rate on such firm-to-firm sales will be the same as on sales to final consumers, use of a turnover tax may still be a reasonable approximation to the optimal policy choice.

Similarly, if the government can observe when purchases by taxed firms come from untaxed firms, then it may want to impose a tax on these purchases.[20] Again, this imposes at least some tax on otherwise untaxed firms.

Our assumption that the government can fully observe sales and profits for firms that use banks is clearly heroic, particularly given the major problems even the U.S. government has in controlling tax avoidance by large corporations. A weaker assumption is that the government simply knows of the *existence* of a firm if it uses a bank. Inspectors can then visit the firm to learn more, in the process perhaps observing only K_j and the *number* of

[19] Note that taxes on sales to industry *k* do not directly affect the constraint in equation (1), since the tax is paid whether or not firms in the industry use the banking sector.
[20] Price scissors used in centrally planned economy are a good example.

workers, say N_j.[21] Since we argued above that the optimal tax structure would likely involve heavy taxation of K_j, even if f_j and L_j were also observable, the outcome can be close to those above. If only the number of workers is observed, though, and not L_j or f_j, this does undermine effective use of a sales tax.

Qualitative results also remain largely unchanged if we consider other stylized descriptions of the source of information for the government tax authorities. Consider for example the alternative assumption that the government observes a business only if it owns land (e.g. a mine or oil deposit) and/or operates out of a factory or office building, giving it a visible fixed location. To translate previous notation, let $\beta_j = 1$ if a firm owns a building or land, and assume that having such a fixed place of business raises output by the fraction a_j. If a business is "visible," assume again that the government can observe its entire capital stock, K_j, and its number of workers, N_j. Then the formal considerations affecting the choice of the tax structure remain exactly the same.

3. Implications for other policies

Many other puzzling policies can easily make sense once the government's problems obtaining information about economic activity are recognized. Consider the choice of an inflation rate. The taxed sector, given that it makes use of the banking sector, is presumably largely protected from an inflation "tax," since in equilibrium its bank deposits should earn a higher nominal interest rate, reflecting expected inflation. The untaxed sector, however, by construction relies heavily on cash transactions, making it particularly vulnerable to an inflation tax.

Since an inflation tax has a much larger impact on the unmonitored sector than on the taxed sector, it can well generate an efficiency gain offsetting the costs focused on by

[21] The value of output would be more difficult to observe.

Friedman (1969) and Feldstein (1997). To begin with, inflation raises the costs of business within the untaxed sector, causing these firms to shrink, leading capital and labor inputs to be reallocated to the taxed sector. Since there were too few such inputs in the taxed sector to begin with, due to the taxes, this reallocation at the margin is an efficiency gain. In addition, firms that would otherwise use cash transactions may instead shift to using banks as intermediaries, in order to avoid these costs. This shift is again an efficiency gain, due to both the value $a_j f_j$ provided by financial intermediation and the elimination of inflation distortions in this sector. These efficiency (and revenue) gains can easily be large enough to offset the standard losses from inflation, at least for low rates of inflation. The more responsive is the allocation of resources between the taxed vs. untaxed sectors to the inflation rate, the stronger the case for a higher inflation rate.

Equivalently in a U.S. context, an inflation tax would fall particularly on illegal activity, e.g. the drug trade, as well as tax evaders. Any resulting drop in illegal activity would represent a social gain, and one potentially large in size judged by the great efforts directly expended to reduce the amount of illegal activity. These gains must be traded off against the efficiency costs from an inflation tax in the rest of the economy.

Given the result from the stylized model above that taxes on capital can become large when the threat of disintermediation is important, too little capital will be invested in the taxed sector. As discussed in Gordon, Bai, and Li (1999), one extreme response to this tax-induced misallocation of capital is state ownership at least of the most capital-intensive firms, in order to induce these firms to take into account the benefits to the government from higher tax payments.[22] Another response, discussed in Gordon (2003), is government-subsidized credit to the taxed sector for the purchase of new capital. While the government loses directly from the subsidized loans to the taxed sector, it gains from the resulting extra taxes on the new investment, and new production. Even if the subsidy fully offsets the revenue collected in present value on the new capital investment, for example, the government can continue to collect revenue on existing capital (and

[22] Such state ownership in poorer countries of large capital-intensive firms is quite common.

output) while leaving undistorted the decision to purchase additional capital. These subsidies confined to firms in the taxed sector can also induce more firms to join the taxed sector.

The model also suggests particular types of restrictions on the activity of foreign multinationals within a country. Multinationals would certainly be part of the taxed sector, if only because a multinational's home country will require accounting firms to document the income and balance sheet of the local subsidiary, records that should be available to the host government. However, the multinational has many opportunities to shift real and financial activity across countries, depending on relative tax rates, e.g. through use of transfer pricing.[23] These income-shifting opportunities are not as readily available to domestic firms within the host country.[24]

The impact of multinationals on domestic tax revenue depends on the taxes they pay compared with the revenue lost from the resulting crowding out of domestic taxable activity. If multinationals sell goods to domestic residents otherwise produced by taxable domestic firms, then their effect on domestic tax revenue depends on the relative taxes paid by the multinationals compared to domestic firms as a fraction of sales. Due to their greater income-shifting opportunities, multinationals would commonly pay a lower effective tax rate. Given the loss of tax revenue from entry of multinationals, restrictions on entry of multinationals into sectors dominated by taxable domestic firms may be justified.[25] Alternatively, the government can compensate for the avoidance behavior of multinationals by trying to impose higher tax *rates* on these firms. If the result is at least comparable revenue from foreign-owned production to that lost from the crowding out of domestic production, then FDI could be welcome in these industries.

[23] See Gordon and Hines (2002) for a summary of the theoretical and empirical literature in this area.
[24] Even in the U.S., as documented by Grubert, Goodspeed, and Swenson (1993), foreign subsidiaries pay much less in taxes than seemingly equivalent domestic firms.
[25] Such restrictions may take the form of limits on the fraction of a firm that can be owned by a foreign multinational in particular industries, as long as minority ownership is not sufficient to induce such tax avoidance.

Governments would still gain revenue from the entry of multinationals into sectors otherwise dominated by *untaxed* firms. In this case, tax revenue increases by replacing untaxed domestic firms with multinationals that pay at least some tax. Even when multinationals produce in sectors dominated by taxed domestic firms, if the product produced by the multinational does not crowd out the domestic production, e.g. it is exported whereas domestic production is sold locally, then multinationals could still enter without a loss in government tax revenue.

One other mechanism to offset the tax distortion leading to too few firms in the taxed sector is to create nontax costs on those firms operating in the untaxed sector. For example, assume that the government can hire bureaucrats to monitor (hound) untaxed firms, and attempt to collect tax revenue from them. If the monitors cannot themselves be monitored, however, the government cannot collect revenue firm by firm based on what a bureaucrat learns. However, it can collect an ex ante amount, based on say the size of the sector over which the bureaucrat has authority, and then allow this ex ante payment to be set by market forces.

In equilibrium, competition among potential bureaucrats for the job would lead to an ex ante payment minus the bureaucrat's wage equal to the expected tax revenue collected minus the opportunity cost of the bureaucrat's time. If positive, this could be a form of tax farming. If negative, this could involve a very low official salary for such positions with no official revenue generation.

A bureaucrat in such a position would want to maximize the revenue collected. How much can be collected depends on what powers the bureaucrat has been given, e.g. what threats are available. With full powers, well defined property rights to extort the firms, and an unlimited time horizon, the bureaucrat would act like a Leviathan government. Firms should be able to escape from this bureaucratic extortion by becoming part of the monitored sector (in exchange of course for becoming subject to regular taxes). This option puts an upper bound on what the bureaucrat in equilibrium can collect equal to the taxes due in the taxed sector minus the efficiency gain from use of the banking sector. If

the bureaucrat becomes fully informed and has property rights to the firms evading taxes, then the extortion would be just low enough so that no firms would shift into the taxed sector.[26]

To what degree would a government choose to hire bureaucrats in this fashion? By our assumptions, the bureaucrat simply earns her opportunity cost, so is indifferent to being employed by the government. Assume in addition that the equilibrium salary of such a bureaucrat is positive, so that bureaucrats each collect less in revenue than their opportunity cost. The government then loses revenue directly from employing such bureaucrats. Given these considerations alone, bureaucrats are a pure social waste, harming the firms they extort while reducing the government revenue available to everyone else.

However, bureaucrats raise the cost of doing business in the "untaxed" sector, causing these firms at a minimum to employ fewer inputs. This in itself leads to an expansion of the taxed sector, and to that extent an efficiency gain. In addition, if the bureaucrat's information is imperfect, some firms will shift into the taxed sector, which again is an efficiency gain. These efficiency gains may well be large enough to more than offset the social waste that remains present.

Other forms of organization, e.g. making the bureaucrat's job temporary or employing multiple independent bureaucrats to hound the same pool of untaxed firms, may provide larger gains. With a temporary job, a bureaucrat has an incentive to seize what can be taken quickly, before the job terminates, to the point of confiscating anything of value. Similarly, as shown in Berkowitz and Li (2000), bureaucrats who compete on extracting rents from a common pool of untaxed firms together would impose a higher effective tax rate than would a Leviathan government. Anticipating this, otherwise untaxed firms would likely either not open or else open solely in the taxed sector. Such extreme rapaciousness then could induce most firms to join the taxed sector, or else not enter.

[26] If the information of the bureaucrat is not perfect, then the bureaucrat would charge enough that at least some firms do shift into the taxed sector.

This would be a more efficient outcome than allowing bureaucrats to collect monopoly rents from firms.

4. Implications for the treatment of the financial sector

In the above model, the financial sector plays a critical role in the functioning of the tax structure. The working assumption had been that the government has access to bank records on each firm, and can make use of this information in enforcing the tax law.

Why should banks be willing to provide this information? In particular, any bank that can reduce the taxes that its customers owe has a competitive advantage. In order to have access to bank records, the government cannot rely on market forces!

State ownership of the banks is one extreme policy that can in principle assure that banks make information available to the government. Another approach is use of bank regulations, whereby any bank that refuses to cooperate with the tax authorities loses its license to function as a bank. Market forces should still lead to the creation of an informal banking sector that circumvents these regulations, providing financial intermediation without exposing customers to tax liabilities. In order to preserve its revenue base, governments would be expected to oppose the development of such an informal financial sector. When it develops nonetheless, it will likely facilitate tax evasion.

Similarly, governments may impose capital controls making it difficult for firms to shift their deposits abroad, into foreign banks. These deposits are presumably outside the purview of the tax authorities, so use of foreign banks undermines the tax system.

Branches of foreign banks operating in the domestic economy may create the same problems. These banks again have a competitive advantage to the degree to which they can shift deposits abroad, where they cannot be monitored by the domestic tax

authorities. It is not surprising, given the model here, that governments are particularly concerned about the entry of branches of foreign banks into the country, since these banks can undermine the entire domestic tax system. Perhaps domestic-owned banks with foreign branches create the same risks unless the bank regulation is effective enough.

The tax treatment of banks also interacts critically with the tax system more broadly. Any taxes on banks in equilibrium reduce the gain, a_j, from using banks, lowering the feasible taxes that can be collected directly from firms. If all firms were identical, taxes on banks should crowd out other taxes on firms dollar for dollar. For example, if all new investments by taxed firms are financed by bank loans, then a tax on loans or income from loans is equivalent to a tax on capital, yet may be easier to administer. This would lead banks facing such a tax to report high spreads between loan and deposit interest rates, to compensate for the tax.[27] Everything else equal, therefore, the more that revenue is collected directly from banks the lower the feasible tax rates on capital expenditures, and on firms more broadly.

5. Summary and discussion

The key hypothesis of this paper is that governments need to rely on the information available from bank records in order to identify taxable entities and to measure the amount of their taxable activity. Use of banks then makes firms subject to the tax law. When tax rates are high enough, firms instead may forego the economic benefits from use of banks in order to avoid these taxes.

This threat of disintermediation may be of little import in the richest countries, where the value provided by financial intermediation is considerable. In poorer countries, however, this threat of disintermediation may be a key factor both limiting the government's ability to collect tax revenue and shaping government policy more generally.

[27] These large spreads, per se, then need not be an indicator of a poorly functioning financial sector.

In particular, based on this hypothesis about the role of banks in tax enforcement, we have derived the following forecasts for countries where banks provide only modest value added:

a) Tax revenue as a share of GDP will be low, constrained by the threat of disintermediation.

b) The tax base will be narrow, confined to larger and more capital-intensive firms that particularly value the use of financial intermediaries.

c) The optimal tax structure will put substantial weight on capital income taxes, in order to focus the tax burden on those firms least willing to forego use of the financial sector.

d) Tariffs will be used to protect the taxed sector.

e) Inflation will be used as an indirect means of taxing the untaxed (cash) economy.

f) Entry of foreign firms may be restricted in those sectors subject to tax, but be encouraged in otherwise untaxed sectors.

g) Entry of foreign banks will be particularly discouraged, given the ease with which foreign banks can facilitate tax evasion by domestic firms.

h) Red tape restricting activity in the untaxed sector is likely.

According to the model, all of these policies are optimal, given any standard Social Welfare Function, to the extent that the threat of disintermediation (and the resulting tax evasion) is important, raising questions about recommendations to avoid such policies.

Free-trade agreements, for example, are commonly defended as a means of eliminating costly distortions that limit the degree to which countries can take advantage of gains from trade. In our setting, however, the domestic tax system puts capital-intensive industries at an artificial disadvantage in international markets, so that further trade can easily reduce efficiency, and reduce the feasible amount of tax revenue that the government can collect.

Recent free-trade agreements have given particular weight to opening up markets for international trade in financial services. According to our model, entry of foreign banks can seriously undermine a country's domestic tax system, by making it easier for domestic firms to hide their activity from the government through shifting their financial accounts abroad.

Similarly, inflation can easily be argued to create substantial costs, e.g. through making long-term contracting very difficult. In our setting, inflation also creates offsetting benefits through raising the operating costs in the cash economy, a sector otherwise favored by being able to avoid domestic taxes.

Even reducing red tape can have costly side effects, according to the model, through making it easier for firms to operate in the "underground" economy.

For a small policy change, these effects on tax revenue also measure the effects of the policy change on economic efficiency.[28] That government revenue is keep very low due to the threat of disintermediation, however, suggests that the marginal welfare gain from

[28] By the envelope condition, private individuals and firms are indifferent at the margin to any changes in behavior induced by a policy change. Behavioral changes can have first-order effects on government revenue, however, so that these changes in revenue in fact measure the combined net benefits to all sectors of the economy. See Feldstein (1999) for further discussion.

extra government expenditures can be large, so that social welfare can be particularly sensitive to the impact of a policy change on government revenue.

There remain the standard gains from trade from cutting tariffs, and standard costs from inflation. In order to achieve these gains without creating more than offsetting efficiency and welfare losses through undercutting government tax revenue, the model suggests that the key policy focus instead should be on reform of the domestic financial sector. Any policies that raise the value of the services provided by financial intermediaries will increase the usage of the financial sector, raising efficiency and allowing the government to collect more revenue. Conversely, anything that undercuts the perceived value of the services provided by the financial sector, e.g. a bank failure, can undermine the fraction of GDP collected in tax revenue, in addition to any direct effects on GDP through loss of financial intermediation.

We have made no attempt here to estimate the quantitative size of the effects described in the paper. To do so, the key step is to estimate the effects of any given policy change on government tax revenue arising from behavioral responses. Our future research will aim at testing the forecasts from this model, and providing such quantitative estimates.

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Table 1
Sources of Government Revenue (1996-2001)

GDP per capita	Tax Revenue (% of GDP)	Income Taxes (% of Revenue)	Corporate Income Tax (% of income taxes)	Consumption and Production Taxes (% of Revenue)	Border Taxes (% of Revenue)	Inflation Rate	Seignorage Income (% of Revenue)	Informal Economy (% of GDP)
< $745	14.1	35.9	53.7	43.5	16.4	10.6	21.8	26.4
$746-2,975	16.7	31.5	49.1	51.8	9.3	15.7	24.9	29.5
$2,976-9,205	20.2	29.4	30.3	53.1	5.4	7.4	6.0	32.5
All developing	17.6	31.2	42.3	51.2	8.6	11.8	16.3	30.1
> $9,206	25.0	54.3	17.8	32.9	0.7	2.2	1.7	14.0

Notes: Authors' calculations based on available data between 1996 and 2001 from Government Finance Statistics (IMF, 2004a), International Finance Statistics (IMF, 2004b), and World Development Indicators (World Bank, 2003). The ranges for GDP per capita follow the World Bank 2003 classification of low income, lower middle income, middle income and high income countries. Seignorage is measured as the increase in reserve money and currency in circulation. Estimates of the size of the informal economy in 1999 in Column (9) are from Friedrich Schneider (2002), who uses the currency demand approach in estimation. Data within each cell are weighed averages. Tax revenue (% of GDP), inflation rate, and the size of the informal economy (% of GDP) are weighted by GDP of each country. Corporate income tax (% of income taxes) is weighed by the total income tax revenue of each country. All other data are weighted by the tax revenue of each country.

Table 2
Maximum Statutory Tax Rates, by Country

Country	Tax Revenue (% of GDP)	Corporate Tax Rate	Personal Tax Rate	VAT
Argentina	17.2%	35.0%	35.0%	17.0%
Bulgaria	21.4%	19.5%	29.0%	20.0%
Brazil	24.3%	34.0%	20.0%	0.0%
China	12.6%	33.0%	45.0%	17.0%
Czech Republic	21.7%	28.0%	32.0%	19.0%
Egypt, Arab Rep.	15.8%	40.0%	20.0%	0.0%
Estonia	23.2%	0.0%	26.0%	18.0%
Hungary	25.9%	16.0%	40.0%	25.0%
Indonesia	15.5%	30.0%	30.0%	10.0%
India	12.3%	36.8%	40.0%	0.0%
Lithuania	23.5%	15.0%	35.0%	18.0%
Latvia	22.3%	15.0%	25.0%	18.0%
Morocco	23.5%	35.0%	41.5%	20.0%
Mexico	14.5%	33.0%	35.0%	15.0%
Malta	21.9%	35.0%	35.0%	18.0%
Pakistan	12.9%	35.0%	35.0%	15.0%
Philippines	15.2%	32.0%	34.0%	10.0%
Poland	23.8%	19.0%	40.0%	22.0%
Romania	18.7%	25.0%	60.0%	19.0%
Russian Federation	23.9%	24.0%	13.0%	20.0%
Slovak Republic	21.2%	19.0%	19.0%	23.0%
Thailand	15.7%	30.0%	37.0%	7.0%
Turkey	20.3%	33.0%	40.0%	18.0%
Vietnam	17.0%	28.0%	60.0%	20.0%
South Africa	26.5%	30.0%	45.0%	14.0%
Zambia	17.9%	15.0%	30.0%	0.0%
All developing	19.6%	26.7%	34.7%	14.7%
Belgium	30.6%	34.0%	55.0%	21.0%
Canada	32.5%	36.6%	31.0%	7.0%
Cyprus	20.3%	15.0%	30.0%	15.0%
Germany	23.6%	25.0%	45.0%	16.0%
Denmark	47.6%	30.0%	60.0%	25.0%
Spain	21.9%	35.0%	56.0%	16.0%
Finland	33.6%	29.0%	35.0%	22.0%
France	28.3%	34.3%	54.0%	20.6%
United Kingdom	29.7%	30.0%	40.0%	17.5%
Greece	25.9%	35.0%	40.0%	18.0%
Ireland	21.1%	12.5%	42.0%	21.0%
Israel	33.2%	36.0%	49.0%	17.0%
Italy	30.1%	33.0%	45.0%	20.0%
Luxembourg	30.5%	30.0%	46.0%	15.0%
Netherlands	36.9%	34.5%	60.0%	17.5%
Norway	32.2%	28.0%	28.0%	23.0%
Portugal	24.3%	27.5%	40.0%	17.0%
Singapore	15.6%	22.0%	22.0%	0.0%
United States	21.5%	35.0%	35.0%	0.0%
All Developed	28.4%	29.6%	42.8%	16.2%

Note: Statutory tax rates are from http://www.worldwide-tax.com/index.asp#partthree. The rates do not include local taxes, if they exist.