

Lurking in the Shadows: The informal sector and government policy *

Jane Ihrig
Board of Governors

Karine S. Moe
Macalester College

June 2001

Abstract

This paper develops a dynamic model that sheds light on the evolution of the informal sector. We show how tax rates and enforcement policies influence the size of this sector, as well as how the sector naturally shrinks as an economy transitions towards steady state. We find that a reduction in the tax rate is the best policy for decreasing the size of the informal sector. This policy not only reduces informal employment, but also increases the standard of living. The distortion resulting from the existence of an informal sector, in terms of the reduction in steady state capital, however, is small, and steady state utility actually rises when an informal sector is introduced to an economy with taxes. Given this result, policymakers may want to view the informal sector as an integral part of the economy.

JEL:O17,O53,H26 Keywords: enforcement, informal employment, taxation

*Ihrig: Division of International Finance, 20th and C Streets NW, Washington DC 20551, ph:(202)452-3372, fax: (202)736-5638, email: ihrig@frb.gov, Moe: Department of Economics, 1600 Grand Avenue, Saint Paul, MN 55105, ph:(651)696-6793, fax:(651)696-6746, email: moe@macalester.edu. We would like to thank Gerhard Glomm, Ed Green, Ellen McGrattan, Marcelo Veracierto, and Kei-Mu Yi for comments on an earlier draft. All errors are our own. The views in this paper are solely the responsibilities of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of other members of its staff.

1 Introduction

The informal sector, which produces legal goods but does not comply with government regulations, is a functioning part of all economies. It is estimated that in developing countries the informal sector employs up to 60 percent of the workforce and produces nearly 40 percent of GDP, while in the OECD countries the informal sector employs approximately 17 percent of the workforce and produces 14 percent of GDP.¹ These numbers provide anecdotal evidence that the informal sector makes a sizeable contribution to national income, even as an economy becomes developed.

Throughout time, governments and international organizations have taken actions that affect the size of this sector. Burkina Faso recently created a tax bracket geared towards those who have never paid taxes before, hoping to collect a minimal two percent of income from these individuals and shift them from the informal to formal sector. The World Bank supports the goal of taxing laborers and sends mobile tax units to countries for the collection of tax revenue. These actions lead us to question whether governments should try to control the size of this sector. Those who want to reduce informal employment point out that agents in the informal sector undermine tax collection and drive a wedge between the returns to factors across sectors. This affects the government's ability to provide public goods and creates an inefficiency or welfare cost. Those supporting informal employment say the informal sector provides a relatively easy way to create and expand employment, and provides a source of subsistence income during recessions.

To shed light on some of the issues in this debate, one must understand the dynamics of the informal sector and how government tax policy affects the size of this sector. We develop a simple dynamic model where an agent has the option to work in the informal sector. In the informal sector, an agent avoids taxes unless caught, but works with less capital intense

¹A comprehensive overview of estimates of the informal sector can be found in Schneider and Enste (2000).

production methods.² In the formal sector, an agent pays taxes and has access to the capital market. The tradeoff for the agent is between higher productivity per unit of labor input in the formal sector and lower productivity but possible avoidance of taxes in the informal sector.

Recent theoretical research has modeled the connections between the informal sector and macroeconomy using AK growth models (Loayza, 1996 and Sarte, 2000).³ The AK framework, however, does not generate the transitional dynamics of the informal sector observed in actual economies. Specifically, the proportional change in the size of the informal sector and output as restricted by an AK model is not borne out in the data. Instead, our dynamic model captures the empirical observation that as an economy grows from a low level of real GDP per capita, changes in informal employment are large. As economies near steady state, changes in informal employment are small.

Model simulations yield movement in output (both total and informal) and capital consistent with data from both developed and less-developed countries. The informal sector naturally declines as the economy grows (even with no change in tax policies) and the informal sector is a functioning part of an economy's steady state. Calibrating to Sri Lanka in 1990, we find a steady state where approximately two percent of time is devoted to informal production and where the informal sector produces less than one percent of total output. This, of course, is far from Sri Lanka's current situation where it is estimated that nearly 45 percent of time is devoted to informal employment and 40 percent of total output is produced by the informal sector.

Given that our model replicates the stylized facts of informal data, we proceed to analyze the effect of alternative tax policies on the informal sector and the remaining economy. Empirical work by Johnson et al. (1998) and Schneider and Enste (2000) find, for both

²The informal sector should not be confused with the criminal sector, which produces illegal goods and services such as drugs and prostitution. The informal sector produces the same goods as the formal sector, but tries to avoid government regulations.

³An AK model is a constant saving rate version of the simplest endogenous growth model.

transitional and developed economies, that higher burdens of tax policy are correlated with larger informal sectors. Their measures of tax burden, however, combine the administration of the tax policies and the tax rates themselves, and the analysis focuses on cross-sectional data. Here we consider the effects of these policies, either individually or jointly, on the transition of an economy.

Either a reduction in the tax rate or an increase in enforcement increases the level of total output and decreases the size of the informal sector in the steady state. We find, however, that the effect of these two policies on the informal sector do differ. While small changes in the tax rate cause measurable changes in the size of the informal sector, modest changes in the enforcement variable (i.e., increases in the probability of detection without substantial penalties) have negligible effects. In order for enforcement to have a measurable effect on the size of the informal sector, the government must impose quantitatively large penalties along with increased policing. This suggests that governments interested in reducing the size of the informal sector should reduce the tax rate and/or increase the tax penalty of informal agents who are caught. If the economy wants to maintain tax revenues as a percent of GDP (for, possibly, public good provisions), the model suggests lowering the tax rate and increasing enforcement simultaneously. Therefore, when the World Bank sends mobile tax units to countries for tax collection, this increase in enforcement has minimal effects on the standard of living. Alternatively, if the objective is to increase the country's standard of living, the World Bank should encourage governments to lower tax rates along with increasing tax collection efforts.

We conclude the analysis by measuring the welfare loss associated with the existence of an informal sector. Specifically, we compare steady state capital stocks and utility in three cases: (a) with no taxes and no informal sector, (b) with taxes but no informal sector, and (c) with taxes and an informal sector. Moving from an economy with no taxes and no informal sector to one with taxes (a to b), we find a large loss in the steady state capital stock. While the introduction of an informal sector to an economy with output taxes (moving from b to

c) further depresses capital and output in steady state, utility actually rises. Since informal workers can produce output without capital, the depressed steady state savings rate allows for higher consumption. These findings provide support for those who believe the informal sector should remain a functioning part of the economy.

We now turn to Section 2 where we describe some stylized facts associated with informal employment. The theoretical economy is presented in Section 3. In Section 4 we discuss the selection of parameter values. Model simulations and policy experiments are reported in Section 5. Concluding remarks are found in Section 6.

2 Stylized Facts

In this section, we describe two stylized facts associated with the informal sector. These statistics are the ones most frequently noted in other empirical work on informal employment.

1. There is a negative and convex relationship between real GDP per worker and the percent of output produced in the informal sector, where informal workers produce a legal product but avoid taxation and other government regulations.
2. Higher tax burdens (combining the tax rate with enforcement) significantly increase the size of the informal sector.

Before discussing these stylized facts in more detail, we define our measure of informal output. We use a physical input measure of the informal economy as reported by Schneider and Enste (2000). The physical input method estimates the size of the informal sector based on electricity usage, wherein the difference between growth of the official GDP and the growth of electricity usage is attributed to the growth of the informal economy. Other methods for estimating the informal economy include direct estimation methods, such as surveys conducted by the International Labour Organization, as well as other indirect methods, such as currency demand estimation. While the nominal value of the size of the informal

sector varies across measures, the stylized facts highlighted in this section remain invariant to the measure of informal labor.

Figure 1 plots the relationship between real GDP per worker and informal output as a fraction of total output for a cross-section of countries in 1990. There exists a negative and convex relationship between the series. This relationship holds if one alternatively looks at manufacturing sector data or time devoted to the informal sector as a fraction of total labor hours. The direction of causality in this relationship, however, is unclear. It may be that a decrease in the size of the informal sector increases GDP per worker as workers shift from informal employment to formal employment. Alternatively, as GDP per worker rises, capital rises and this shifts workers from the informal to the formal, more productive, sector. We believe there is two-way causality and capture this in the model below.

The second stylized fact is the empirical link between tax policy and the size of the informal sector. Many studies suggest an increase in the tax rate is one of the main causes of increases in the size of the informal economy. We know, however, that the level of the tax rate cannot be a true indicator of the tax burden since many countries have high levels of corruption. As mentioned above, Johnson et al. (1998) provide empirical evidence, from a cross-section of countries in Latin America, the OECD, and the former Soviet bloc, that the informal economy is large when the burden of tax policy is large. Specifically, this burden is measured by both the administration of the tax policies and the tax rates themselves. Ihrig and Moe (2000) estimate the effect of changes in the tax rate and enforcement on the size of the informal sector in Asian countries. They find each policy significantly influences Asian countries' informal sectors.

We now develop a theoretical model that allows us to examine the relationships among informal employment, real GDP per worker, and taxation policies. The model, with appropriate parameter values, matches these stylized facts.

3 A Simple Model

This section develops a dynamic model of an agent's decision to accumulate capital and to work in the formal and informal sectors. The economy is characterized by a representative agent, who is endowed with an initial capital stock and a fixed amount of productive time per period. The agent chooses to allocate time between the formal and informal sectors. One key difference between these sectors is that formal production is taxed by the government, while informal production is only taxed when caught by the authorities.⁴ We assume the tax revenues are used by the government to produce nonproductive services.

Informal and formal output are modeled as producing a homogenous good, which suggests the model may more accurately depict a developing country whose production focuses on low-end manufacturing and agricultural output. A distinguishing feature of the two sectors is their production methods. Formal firms employ labor and capital, while informal firms employ solely labor. This implicitly assumes informal production has a fixed stock of capital. Typically, one finds informal agents do not have access to formal capital markets and production methods are much more labor intense than the formal sector (Celestin, 1989 and Thomas, 1992).⁵

The timing of the model is such that the agent begins the period with a capital stock, k , the tax rate in the formal sector, τ , and expectations of the tax rate faced in the informal sector, $\rho * \tau$ (which depends on the tax rate, τ , and the level of enforcement ρ which

⁴Rauch (1991) and Loayza (1996) argue that the minimum wage is a key government policy affecting informal employment. Thus, we should see a negative relationship between the real minimum wage and the size of the informal sector. We do not observe this relationship in the data. In many countries the real minimum wage has saw-toothed over time and the size of the informal sector does not adjust accordingly.

⁵Lall (1989) studies the informal sector in seven sub-regions of the National Capital Region of India and finds less than 0.3 percent of informal capital is obtained from commercial banks. DeSoto (1989) cites Instituto Libertad y Democracia estimates of monthly interest rates (outside of the formal credit market) for informal businesses close to 22 percent in Lima during June 1985. At the same time, a formal business could obtain a maximum rate of 4.9 percent at a bank.

captures policing and a possible penalty). The agent chooses next period's capital stock, k' , consumption, c , and time spent working in the formal, t_f , and informal, t_i , sectors to maximize

$$V(k) = \max E(\log(c) + \beta V(k')) \quad (1)$$

subject to

$$c + k' - (1 - \delta)k \leq (1 - \tau)\theta_f k^\alpha t_f^{1-\alpha} + (1 - \rho * \tau)\theta_i t_i^\gamma \quad (2)$$

$$t_f + t_i \leq T \quad (3)$$

where δ is the depreciation rate of capital, and T is the total amount of time allocated to the agent. Equation 2 is the budget constraint: consumption plus investment in capital must be less than or equal to after-tax formal plus expected after-tax informal output. Equation 3 is the time use constraint: time spent working in the formal and informal sectors must sum to less than or equal to the time endowment, T .

We interpret $\rho * \tau$ in one of two ways. We can think of the informal agent facing a probability ρ of being caught, and that when caught, the agent must pay taxes on output at the rate of τ . In this scenario, the value of $\rho * \tau$ ranges from 0 to τ . Alternatively, the government may impose a penalty on the informal agent, in addition to the tax payment. If this penalty is a percent of output, then the value of $\rho * \tau$ incorporates both the tax rate faced by the formal sector, τ , and the penalty. In this case, the upper bound on the value of $\rho * \tau$ is greater than the tax rate in the formal sector.

The model focuses on the agent's decisions to accumulate capital and to devote time to working in the formal and informal sectors of the economy. The size of the informal sector is related to the production techniques in each sector and to government taxation policies. The formal sector employs both capital and labor to produce output and then pays

taxes on the output. An informal firm hires labor, but does not have access to capital. In addition, the informal firm avoids paying taxes unless caught. This illustrates two tradeoffs for the agent. First, the agent must allocate time between the formal sector, which has higher productivity but is subject to taxation, and the informal sector, which has lower productivity but can possibly avoid taxes. Second, the agent must decide how to allocate output between consumption and capital accumulation, given that higher capital in future years will increase productivity in the formal sector, and thus generate higher future consumption.

The model also captures the two-way causality between changes in the size of the informal sector and economic growth.⁶ As a country grows, capital accumulates and makes the agent more productive in the formal sector. Hence, as a country evolves toward steady state, we expect a natural shift of employment from the informal to the formal sector. Additionally, a decline in informal employment means workers move to the more productive formal sector. This shift increases total output in the economy.⁷

Unlike previous dynamic models of informal employment, we simplify the analysis by excluding additional problems associated with the existence of informal employment such as lack of access to public goods and bureaucratic behavior. Our results indicate that the key activities of the informal sector can be explained without the added complications addressed by these other models. Given that our framework is consistent with the dynamics of the informal sector, this model can be used as a building block to address how these other issues affect the transition of informal employment and output.

Before proceeding to the model simulations and policy experiments, we discuss the parameterization of the model.

⁶Economic growth is measured as a change in the sum of formal output plus informal output.

⁷The increase in output occurs because total output is the sum of formal and informal output, and the marginal product of t_f is greater than the marginal product of t_i so long as $\rho < 1.0$.

4 Data and Calibration

We calibrate the model to match the observations on the capital stock, k , real GDP per worker, $y = \theta_f k^\alpha t_f^{1-\alpha} + \theta_i t_i^\gamma$, and the percent of output produced in the informal sector, $\frac{\theta_i t_i^\gamma}{y}$, in Sri Lanka in 1990. We calibrate to Sri Lanka because it is a low-income country with a relatively big informal sector (estimated to be 40 percent of total output in 1990). Real GDP per worker and the capital stock are taken from the Penn World Tables (Summers and Heston, 1991).⁸ As outlined in Section 2, we use the physical input measure of informal employment as reported in Schneider and Enste (2000).

The capital share parameter, α , the discount rate, β , and the capital depreciation rate, δ , are set to literature standards of 0.33, 0.96, and 0.08, respectively (see, e.g., Parente and Prescott (1992)). We normalize the total amount of time, T , to 100. The time use parameters, therefore, can be interpreted as the percent of total time devoted to production in the formal, t_f , and informal, t_i , sectors.

Tax policy parameters are set such that the tax rate, τ , is set to 0.093 and enforcement is set to zero, $\rho = 0$. We use the lowest marginal statutory tax rate reported for Sri Lanka in 1990 (Easterly and Rebelo, 1993). Setting a value of enforcement is the most challenging of all parameters since there are no direct measures of enforcement.⁹ Since we show the results are not sensitive to small changes in the value of enforcement, we set $\rho = 0$ in the initial simulation and consider sensitivity analysis of this tax policy in Section 5.

We use the first order conditions of the model and the definition of output to match factor productivities, θ_f and θ_i , and the labor share of output in the informal sector, γ , to the observed values of capital, total output and the share of informal output. The parameter

⁸Real GDP per worker as reported in the Penn World Tables includes the output of the economically active population, thus it includes estimates of informal output (as measured in household surveys).

⁹Some proxies for enforcement include seignorage and the amount of resources devoted to tax collection, but the values of these variables do not indicate a value for ρ .

values are listed in Table 1.¹⁰ Notice that θ_i is significantly larger than θ_f . We interpret this large value of θ_i to be incorporating total factor productivity and the sector-specific capital used in informal production.¹¹

5 Results

The workhorse of this section is the calibrated model. We begin by demonstrating that the model fits stylized fact 1 - informal output as a fraction of total output has a convex relationship with a countrys standard of living. Then we adjust the model parameters to allow for alternative taxation policies. The model's response to these alternative policies indicate the model is also consistent with stylized fact 2 - tax burdens significantly affect the size of the informal sector. The model also highlights that tax rates and enforcement of *penalties* on informal activity are more critical in reducing the size of this sector than is increasing the *policing* of the sector.

5.1 Simulation

Using value function iteration to solve the model, we find the optimal capital investment and time devoted to the informal sector for a given level of capital stock. Figure 2 displays the relationship between some key variables of the model. Panel A plots the capital stock on the y axis and total output on the x axis. As is standard in any model, as the capital stock rises, output rises. Steady state in this model is a capital stock of 60,803 (which is nearly 7

¹⁰In the calibration and simulations we annualize labor hours since capital and output are annual numbers (T=100*52). We always report t_i and t_f , however, in units so that T=100 and we can easily interpret t_i and t_f as percentages.

¹¹The parameterized model implies the fixed stock of capital in the informal sector, k^i , is one percent of the formal capital stock in Sri Lanka in 1990, assuming $\theta_i = \theta_f * (k^i)^{1-\gamma}$.

times the size of Sri Lanka's 1990 capital stock) and output per worker of 23,993 (which is over 9 times Sri Lanka's 1990 output per worker).

Panel B illustrates the relationship between the informal sector and total output. The convex relationship between the informal sector, measured as informal output as a fraction of total output, and total output is consistent with empirical studies and Figure 1. The simulated model captures the two-way causality between increases in total output and declines in informal output. Intuitively, as capital builds in the economy (and total output rises), the formal sector becomes more productive, thus encouraging workers to switch out of the informal sector. Then, the switch from the informal to the formal sector causes total output (and, therefore, the capital stock) to rise, which in turn, encourages more workers to switch out of the informal sector.

In Panel B we see Sri Lanka 1990 as the first observation, $y = 5700$ and $y_i/y = .40$. The evolution of the economy, *ceteris paribus*, will bring Sri Lanka to a steady state where informal output is less than one percent of total output. Here, the steady state level of time devoted to informal employment is roughly two percent of total hours. One point this simulation highlights is that, even in the absence of government intervention ($\rho = 0$), Sri Lanka will naturally evolve toward a steady state with a relatively small informal sector.

5.2 Policy Experiments

This subsection addresses the effect of tax rates and enforcement on key variables of the model. We specifically focus on how tax policies affect the steady state level of the capital stock, total output, and the size of the informal sector.

We begin by varying the tax rate, holding enforcement at the calibrated level. Table 2A presents the percent deviation in the steady state levels of the key variables (rows) from their levels in the calibrated model for various tax rates (columns). A quick glance at the table reveals that the tax rate has a significant impact on the economy. Just raising the tax

rate from 9.3 percent to 10 percent generates more than a 1.5 percent rise in informal output relative to total output in steady state and creates a half percent decline in the economy's standard of living in steady state. Larger changes in the tax rate have even more noticeable effects on steady state levels of the informal sector and total output. Hence one can easily reduce the size of the informal sector by reducing the tax rate, but keep in mind two key points: (1) the informal sector is already relatively small in steady state (for the model as calibrated to Sri Lanka, it represents less than one percent of total output), and (2) by reducing the tax rate government revenue may fall below the level necessary for production of public goods (this point is discussed in more detail below).

Turning to enforcement, we consider how the informal sector reacts to the possibility of being caught by the authorities. Enforcement can be interpreted in different ways. First, the authorities can change the level of policing of this sector, which alters the chance that an informal agent is caught. Second, the authorities can change the penalty associated with being caught in the informal sector, by imposing a tax (as a percent of output), in addition to the formal tax of τ , on agents that are caught. Both of these types of enforcement are captured in the value of ρ in the model. We let ρ vary between 0.0 (the calibrated value), 0.1, and 5.0. If we think of the tax policy as being one where the agent only pays taxes at the rate faced by formal agents when caught, then $\rho = 0.1$ means 1 out of 10 agents working in the informal sector is caught. If we believe a percent of output is taxed away when caught, then $\rho = 0.1$ implies that the odds an informal agent is detected by the government are less than 1 in 10, but when the agents are caught, the government imposes a penalty tax.

Table 2B illustrates how key variables are affected by enforcement of the tax law. Percent deviations from the calibrated model's steady state are shown for each of the variables (rows) for various enforcement levels (columns). Results indicate that a small change in enforcement from 0.0 to 0.01 or even 0.1 result in a negligible difference in steady state capital stock, a country's standard of living and the informal sector, whether measured in terms of output or labor. This suggests that in order for enforcement to have a measurable impact on an

economy, we need a relatively large increase in the value of ρ (e.g., by imposing a penalty on informal output when it is found). Large levels of enforcement, such as $\rho = 5.0$, reduce the steady state size of the informal sector while raising steady state capital and the country's standard of living. With the significant changes in the informal sector (a near 5 percent decrease in informal output as a percent of total output and a 9 percent fall in informal labor as a share of total labor), however, there is only a minor increase in the standard of living. Thus, a country whose goal is to reduce the informal sector through increased enforcement should consider implementing tax penalties not just increased policing. But the authorities should recognize that the reduction in the informal sector is not going to produce large changes in the capital stock or total output (and recall that this model assumes full employment so any shift of labor out of the informal sector is used to produce output in the formal sector).

From Tables 2A and 2B we see the tax rate, as opposed to enforcement policy, plays a more critical role in determining a country's standard of living. These results imply a country can increase its standard of living by reducing its tax rate. Governments, however, must balance increasing output with the provision of public goods. Although this issue is not addressed in the paper, we can consider keeping tax revenue as a percent of GDP constant to allow the government to produce a given level of public good. Then, any decrease in the tax rate must be offset by an increase in enforcement. Since the positive effect on real GDP per worker of lowering the tax rate dominates the negative effect of increasing enforcement, the overall effect on output is positive. This analysis suggests a joint policy of decreasing tax rates and increasing enforcement. Therefore, when the World Bank sends mobile tax units to countries for tax collection, it should also encourage governments to lower tax rates in order to generate a significant increase in the economy's standard of living.

5.3 Welfare Analysis

While taxes cause a distortion in the formal sector, the informal sector drives a wedge between the returns to labor across sectors and hence creates an additional inefficiency. We are interested in how much of the economy's total loss in welfare is attributed to the existence of an informal sector. Obviously a large welfare loss associated with the informal sector would support the proponents who want to reduce the size of the informal sector, while a relatively small welfare loss from informal production would give credence to the argument that the informal sector should remain a viable part of an economy.

In order to measure the welfare loss, we compare steady state values of output, capital, and the present discounted value of utility (PDV_u) under three scenarios: (A) a model with no informal sector and no taxes, (B) a model with taxes, but no informal sector, and (C) a model with an informal sector and taxes (the calibrated model). Table 3, column 1, indicates that moving from a distortion-free model to one with taxes generates large reductions in total output, capital, and the PDV_u. Once taxes are present, introducing an informal sector, column 2, further depresses capital and output in steady state but raises utility. The rise in utility occurs because the decline in the steady state savings rate exceeds the decline in steady state output, so steady state consumption rises. These results suggest that proponents of the informal sector have a valid argument. In terms of utility, the economy is better off by allowing an informal sector than by using resources to diminish the size of the sector. In terms of output and capital stock, the effects of an informal sector are very minor relative to the effects of taxation on the economy.

5.4 Extensions

Two possible extensions of the theory in this paper include the addition of human capital and/or technological change. The model could be extended to incorporate human capital by increasing the state space to include both human and physical capital. By allowing agents to

invest in human capital, one would expect to see a more rapid movement out of the informal sector, if human capital is more highly valued in the formal sector.¹²

Incorporating technological innovation in the model would not change the main points found in this paper. For instance, if one allows total factor productivity in both the formal and informal sectors, θ_f and θ_i , to grow at a constant rate then the simulations presented in Figure 2 would just hold for a given point in time (for a given capital stock). Increasing total factor productivity shifts the informal figure to the north and west in Panel B. For example, when we increase the total factor productivities in both sectors by four-fold, the model simulation includes a point that represents the United States' levels of output and informal employment in 1990. Alternatively, we could incorporate labor-augmenting technological growth. In this case we would redefine all the choice variables in terms of effective labor, where labor effectiveness grows at a constant rate. Such labor-augmenting technological growth, however, drives the informal sector to zero in the steady state. Given the empirical persistence of informal sectors, this outcome seems unlikely.

6 Conclusion

In this paper, we examine the dynamics of the informal sector and the role of government taxation policies on this sector. We develop a simple dynamic model that is consistent with the stylized facts associated with the informal sector and that captures the two-way causality between real GDP per worker and the size of the informal sector.

Simulations indicate that the model can replicate the movements in informal employment and output consistent with empirical observations. Tax and enforcement policy experiments suggest that lowering tax rates, as opposed to increasing the enforcement of tax policies, play a larger role in determining a country's standard of living. Of course, tax revenues are

¹²Another possible modeling technique for incorporating human capital is the span-of-control model as seen in Gollin (2000).

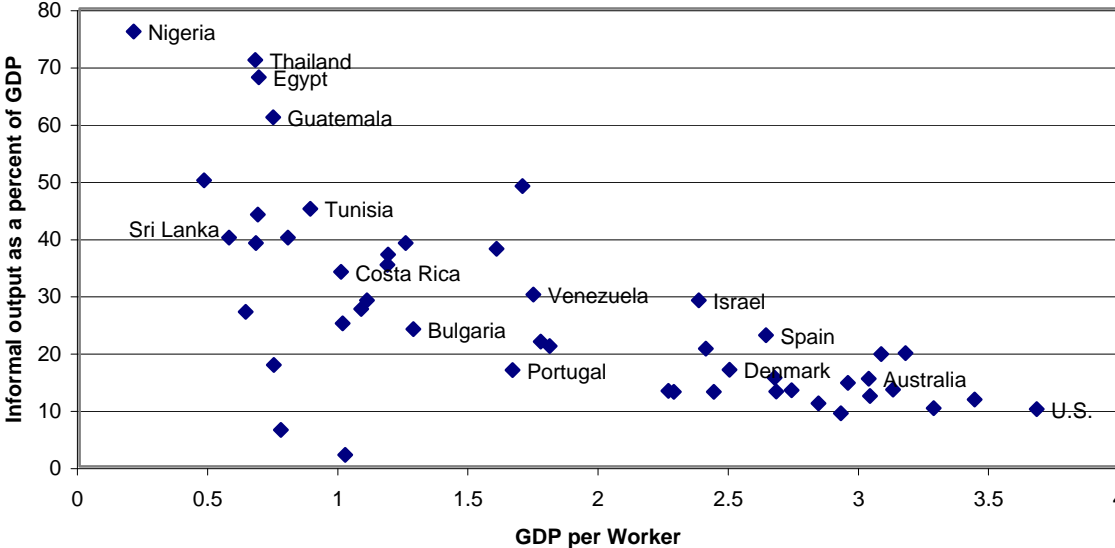
necessary for the provision of public goods. This research indicates that the World Bank should consider joint policies of tax rate reduction along with increased enforcement of tax laws.

Finally, we measure the welfare loss associated with the existence of an informal sector. We find a large distortion in an economy from the imposition of taxes, but the existence of an informal sector has minimal, if any, effect on the economy (depending on how one measures the distortion). These findings support those who view the informal sector as an important source of subsistence and as a relatively easy way to expand employment during recessions.

References

- Celestin, Jean-Bernard *Urban Informal Sector Information: Needs and Methods*. Geneva: International Labour Office, 1989.
- DeSoto, Hernando. *The Other Path: The Invisible Revolution in the Third World*. New York: Harper & Row, 1989.
- Easterly, William and Sergio Rebelo, "Marginal Income Tax Rates and Economic Growth." *European Economic Review* April 1993, 37(2-3), pp. 409–17.
- Gollin, Doug. "Nobodys Business but My Own: Self Employment and Small Enterprise in Economic Development." mimeo, January 2001.
- Ihrig, Jane and Moe, Karine. "Tax Policies and Informal Employment: The Asian Experience." mimeo, March, 2000.
- International Labour Organization. *Yearbook of Labour Statistics*, various years.
- Johnson, Simon, Kaufmann, Daniel, and Zoido-Lobaton. "Regulatory Discretion and the Unofficial Economy." *American Economic Review*, May 1998, 88(2), pp.387–392.
- Lall, Vinay D. *Informal Sector in the National Capital Region*. B.R. Publishing Corporation: Delhi, 1989.
- Loayza, Norman. "The Economics of the Informal Sector: A Simple Model and Some Empirical Evidence from Latin America." *Carnegie-Rochester Conference Series on Public Policy*, Dec 1996, 45(0), pp. 129-62.
- Parente, Stephen L. and Prescott, Edward C. "Technology Adoption and the Mechanics of Economic Development," in Alex Cukierman; Zvi Hercowitz, and Leonardo Leiderman, eds., *Political Economy, Growth, and Business Cycles*. Cambridge: MIT Press, 1992, pp. 197–224.
- Rauch, James E. "Modelling the informal sector formally" *Journal of Development Economics*, 1991, 35, pp. 33-47.
- Sarte, Pierre-Daniel. "Informality and Rent-Seeking Bureaucracies in a Model of Long-Run Growth." *Journal of Monetary Economics* August 2000 46(1), pp. 173–197.
- Schneider, Friedrich and Enste, Dominik. "Shadow Economies: Size, Causes, and Consequences." *Journal of Economic Literature* March 2000 38(1), pp. 77–114.
- Summers, Robert and Heston, Alan. "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988." *Quarterly Journal Of Economics*, May 1991, 106(9), pp.327–68.
- Thomas, J.J. *Informal Economic Activity*. Ann Arbor: University of Michigan Press, 1992.

Figure 1 - Informal output as a percent of total GDP vs. total GDP per worker, 1990



Source: Informal output measured by Schneider and Enste (2000).

Figure 2 - Model Simulations

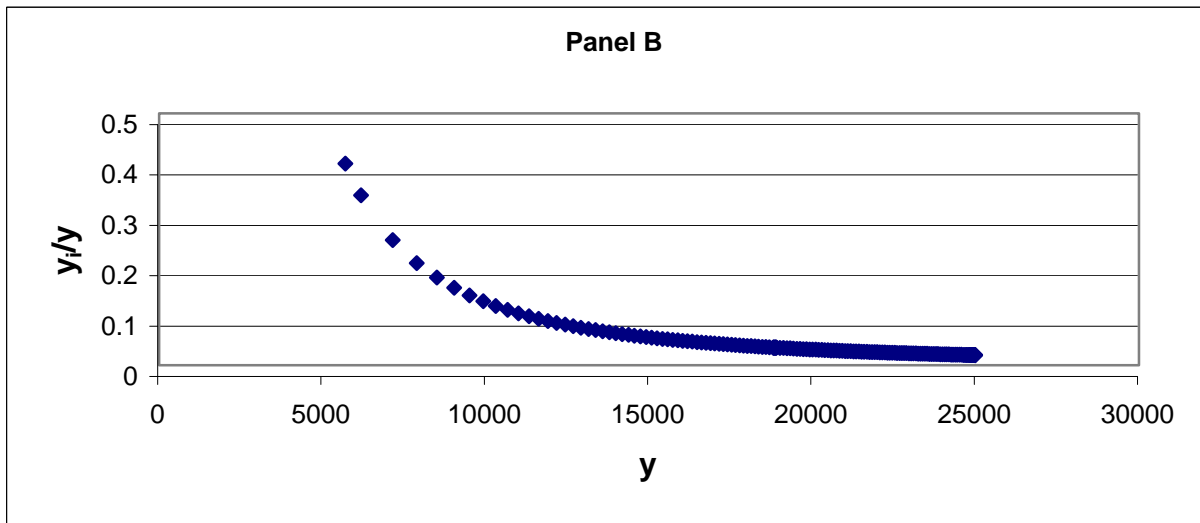
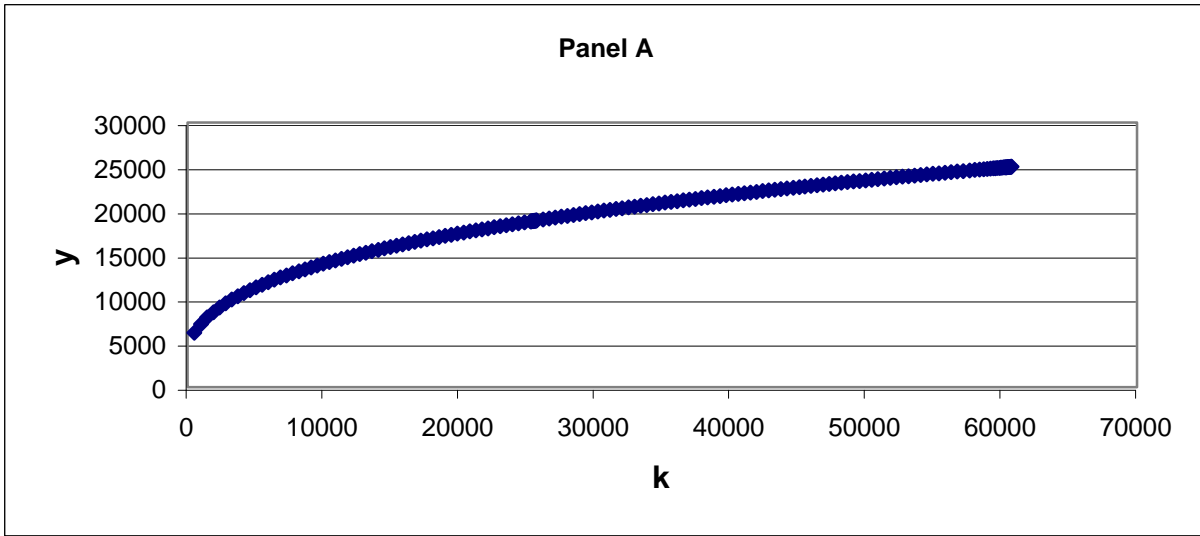


Table 1: Parameter Values

Parameter	Value
α	0.33
T	100
θ_f	2.10
θ_i	55.30
γ	0.495
τ	0.093
δ	0.08
β	0.96

Table 2A – Alternative Tax Rates ($\rho = 0$)
Percent change in steady state variable from calibrated model

Tax rate (τ)	0.00	0.093	0.10	0.20	0.30	0.40
Capital (k)	16.25	0.00	-1.19	-17.78	-33.50	-48.34
Real GDP (y)	5.83	0.00	-0.46	-7.35	-15.08	-24.11
Informal						
Output (y_i/y)	-18.13	0.00	1.61	29.79	72.33	141.85
Labor (t_i)	-25.16	0.00	2.33	45.16	115.78	241.01

Table 2B – Alternative Enforcement Policies ($\tau=0.93$)
Percent change in steady state variable from calibrated model

Enforcement (ρ)	0.00	0.01	0.10	0.20	0.30	5.00
Capital (k)	0.00	0.00	0.03	0.06	0.09	1.19
Real GDP (y)	0.00	0.01	0.05	0.10	0.15	2.17
Informal						
Output (y_i/y)	0.00	-0.18	-0.96	-1.92	-2.88	-71.02
Labor (t_i)	0.00	-0.10	-1.83	-3.65	-5.45	-46.981

Note: steady state of the calibrated model is
 $k=60802.8$, $y=23993.3$, $y_i/y=0.3\%$, $t_i=T=1.6\%$

Table 3 – Welfare Analysis

Model A = no informal and no tax

Model B = no informal but with tax

Model C = informal and tax (calibrated model)

Percent change in steady state variable from
calibrated model

	(1) A => B	(2) B => C	(3) A => C
y	-4.6	-1.60%	-8.4
k	-13.9	-1.6	-15.4
PDVu	-1.7	0.27	-1.3
c	-13.7	1.1	-12.8