



UNIVERSIDAD CARLOS III DE MADRID

working
papers

Working Paper 07-85
Economic Series 51
December 2007

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Tax Rates, Governance, and the Informal Economy in High-Income Countries*

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First Version: April 2007
This Version: December 2007

Abstract

This paper studies the mechanisms behind the informal economy in high-income countries. About 16.3% of output in high-income OECD countries was produced informally in 2001-02. In a recent paper Davis and Henrekson [2004] show that there exists a positive relationship between tax rates and the informal economy for high-income OECD countries. Existing models of the informal economy mostly focus on developing countries. To account for the informal economy in high-income countries, build a model economy, following Lucas [1978], in which agents of different managerial abilities decide to become workers, managers of informal firms, or managers of formal firms. In contrast to formal managers, managers of informal firms do not pay taxes but run the risk of getting caught, taxed, and fined. A calibrated version of the model economy is able to generate the observed differences in informal economy of 21 high-income countries. Although tax rates are crucial for explaining the observed differences in informal economy, the quality of governance, the extent to which these tax rates are enforced, also plays an important role. Policy experiments show that by improving the enforcement of their tax policies countries can reduce informality. A smaller informal economy is accompanied by larger firms and higher productivity.

JEL Classification: O17, J22, H2

Keywords: Informal economies, High-Income Countries, Tax Rates, Governance

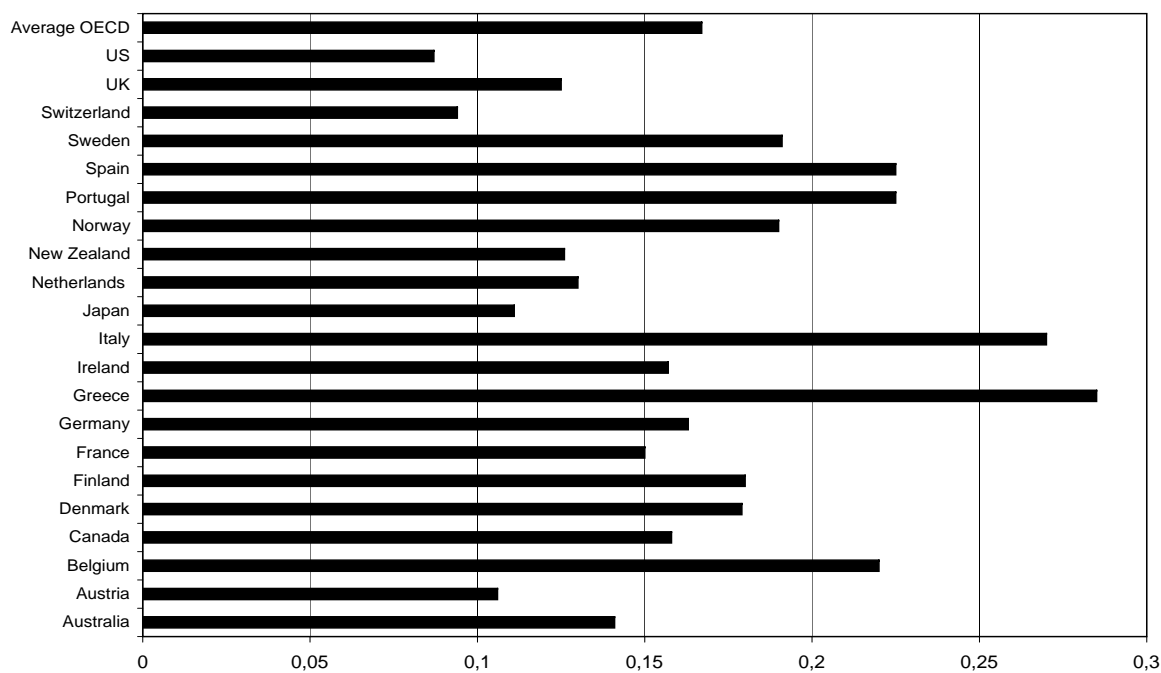
* I would like to thank my supervisor, Nezh Guner, for his invaluable advice and support. I am very grateful to all participants of the XII Vigo Macro Workshop 2007 and the Fourth Annual Vienna Macroeconomic Workshop on Current Topics in Macroeconomic Theory and Policy (2007), in particular to Franck Portier and Max Gillman, for their comments and suggestions. I would also like to thank Gregorio Mednik for continuous questions and ideas.

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1 Introduction

Informal economic activity was long thought to be a feature of developing countries. Formalization of business was supposed to go hand in hand with economic development. But despite worldwide economic growth employment has increasingly become informal as recently stated by the United Nations [2006]. Indeed, even among high-income countries a large part of economic activity is informal.

Figure 1.1: Informal Economy 2001-02 as % of official GDP



Data: Schneider [2002]

Estimates by Schneider [2002], reproduced in Figure 1.1, show that on average 16.3% of GDP in high-income OECD countries was produced informally in 2001-02.¹ In Greece the informal economy amounted to 28.5% of GDP, whereas in the US an equivalent of 8.7% of GDP was estimated to have been produced informally.² Put differently, legally

¹In this paper 'OECD' or 'high-income OECD countries' excludes the following OECD countries: Czech Republic, Hungary, Iceland, Korea, Luxemburg, Mexico, Poland, Slovak Republic, and Turkey.

² Frey and Weck [1983] cite various alternative estimates for informality. More recent estimates are hard to come by. One exception is Alañón and Gómez [2004] for Spain. According to them, the

produced goods and services worth \$892 billion (about \$3090 per capita), went illegally untaxed in the US, while in Greece production of goods and services worth \$49 billion (about \$4380 per capita) escaped taxation.³

But forgone tax revenues are just one of the costs the informal economy brings along. Farrell [2004] points out that informal firms, bound to stay small in order to hide, impede economic growth and that their illegal cost advantage distorts competition. The author cites research by the McKinsey Global Institute showing that: “the substantial cost advantage that informal companies gain by avoiding taxes and regulations more than offsets their low productivity and small scale. Competition is therefore distorted because inefficient informal players stay in business and prevent more productive formal companies from gaining market share. Any short-term employment benefits of informality are greatly outweighed by its long-term negative impact on economic growth and job creation.” (Farrell [2004] p.28) As a policy recommendation Farrell [2004] advises countries to strengthen enforcement by improving their audit capabilities in order to ensure compliance with policies and to reduce informality.

Furthermore, the informal economy has been growing over time. Between 1989 and 2002 informal economic activity has risen by an average of 3 percentage points in all high-income OECD countries and by as much as 7 percentage points in Denmark and Portugal. Far from moving in opposite ways, economic development and informality seem to have developed parallel. Rather than having become obsolete the informal economy in high-income countries is large and growing. However, there are sizable differences in the informal economy, even across high-income countries. What can explain these differences? What are the driving forces behind informal economic activity? And in particular: Why does the informal economy continue to exist even in high-income countries?

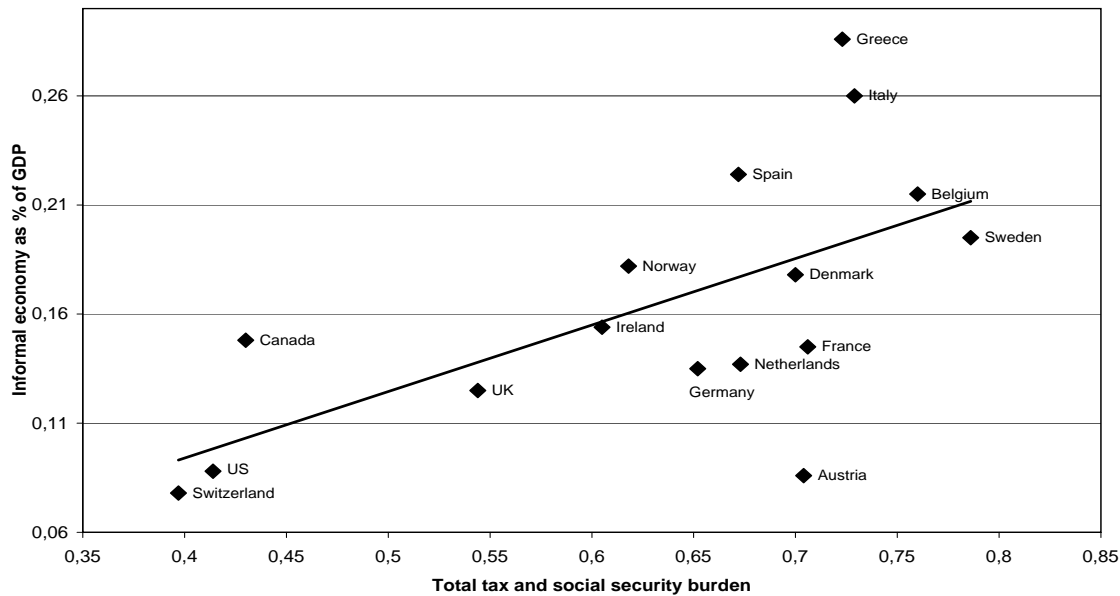
A recent paper by Davis and Henrekson [2004] provides one possible answer to the last question. Across 16 high-income OECD countries the authors find a positive and significant relation between tax rates and the informal economy. Figure 1.2, which relates tax rates on income and consumption and social security contributions to the size of the informal economy, is a replication of their result. However, for countries with equally high tax rates, informal economy estimates are strikingly different. In 1995-96 Austria and Italy had similar total tax rates on income and consumption and social security contributions of

Spanish informal economy amounts to 20.9% of GDP (2000), compared to 22.5% (2001-02) estimated by Schneider [2002].

³Schneider [2002] defines the informal economy as all “unreported income from the production of legal goods and services [...] which would generally be taxable were they reported to the [...] authorities.” (p.4).

around 70% and 75%, but whereas Austria's informal economy was estimated to amount to 8.6% of GDP, the estimate for Italy was 26%. Apart from tax rates additional forces seem to drive the informal economy in high income countries.

Figure 1.2: Tax Rates and the Informal Economy 95-96

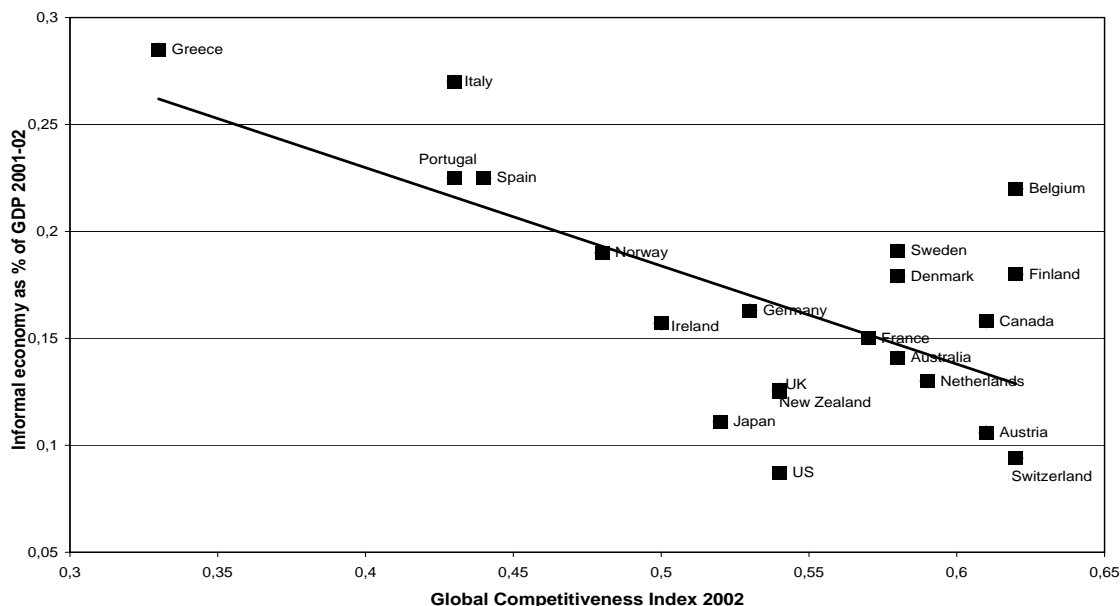


Data: Schneider [2002]

Lack of institutional quality and corruption are possible suspects. Their importance for explaining differences in informal economy has been illustrated by various empirical studies. Friedman et al [2000], Chong and Gradstein [2007], and Johnson et al [1998] all find a positive relation between lack of institutional quality, a large regulatory burden, corruption and the informal economy. The link between institutional quality and the informal economy also holds for high-income countries. Figure 1.3 displays the negative relation across 21 high-income OECD countries between a measure of institutional quality, the Global Competitiveness Index published by the World Economic Forum [2006], and estimates of the informal economy. This negative relationship is robust to various alternative measures of institutional quality by the World Bank (Kaufmann et al [2006]).⁴

⁴The negative relationship is also robust to the exclusion of the two poorest among the 21 high-income OECD countries: Greece and Portugal. The anti-corruption index published by Transparency

Figure 1.3: Global Competitiveness Index and Informal Economy



Data: Schneider [2002] and World Economic Forum [2006]

The current paper proposes a model that links differences in the size of the informal economy and tax evasion to differences in tax rates and enforcement of tax policy across high-income countries. In the model economy, there is a representative household and a government. The household has a continuum of members who differ in their managerial ability, as in Lucas [1978]. Given their ability, household members can become workers, set up an informal firm and evade taxes, or set up a formal firm and pay taxes. Formal and informal managers have access to the same technology that uses labor, capital, and their managerial ability as inputs. The representative household makes decisions about optimal consumption, investment, and occupation of each of its members.

Firms producing informally face a probability of getting caught, taxed, and fined. If a firm is not able to pay the fine the government seizes its total available profits. The probability of getting caught is increasing in firm size. This makes it impossible for very large firms to evade taxes. If a firm is caught, its activities are revealed and its production is counted

International [2002] also relates negatively to estimates of the informal economy across high-income countries. In addition percentages of affirmative answers to “if cheating on taxes is justified” and “if almost all compatriots cheat on taxes”, are clearly positively related to estimates of the informal economy. (World Value Survey [2000]).

as formal. Hence informal economy is defined as the ratio of output by hidden informal firms to the production of formal firms and informal firms that are caught. In this model the government's role is passive. It simply taxes formal firms and those informal firms that are caught. In addition the government collects fines and seizes profits of tax evaders.

The occupational choices in this economy are characterized by two thresholds for managerial ability. The first threshold defines who becomes a worker and who will be an informal manager. The second threshold divides informal and formal managers. These two thresholds determine the size of the informal economy, and they depend on tax rates and the probability of getting caught. Higher tax rates increase informality. However, two economies with equally high tax rates may differ in their informal economy due to different degrees of enforcement of tax policy. Different parameterizations of the probability of getting caught reflect these different degrees of enforcement.

I calibrate the model economy to capture the size of the informal economy, average establishment size, capital-output ratio, capital share, and employment and establishment shares of small and large establishments of one particular country. I take the tax rates observed in the data and select the parametrization of the function for the probability of getting caught for each country separately to generate the observed differences in the informal economy of 21 high-income countries. This procedure provides a model-based measure of institutional quality for each country. Given tax rates, in order to match the size of the informal economy, the model requires countries to have significant differences in the degree of enforcement technology. The parameters that govern this enforcement technology can then be compared with the available evidence on institutional quality. The results show that there is a positive and significant relation between the model-based measure of institutional quality and several empirical measures of institutional quality. In addition, results from policy experiments indicate that by improving the enforcement of their tax policies countries can reduce informality. This reduction does not only assure tax revenues to be in line with tax rates but it is also accompanied by an increase in a country's average firm size and various productivity measures.

In contrast to the current paper, the existing literature on the informal economy has almost exclusively looked towards developing countries when trying to answer the question: "What are the driving forces behind informal economic activity?". Most models propose mechanisms that link informality to labor-intensive, low productivity economic activities.

In an influential paper, Harris and Todaro [1970] model the informal economy as a parallel sector resulting from an urban migration that exceeds employment in the formal

sector. Every immigrant who is too unproductive for the formal economy is absorbed by an unregulated informal sector. In a similar spirit, Rauch [1991] considers the particular device of minimum wage regulations and how they create a dual informal-formal labor market, where less productive informal workers work for a wage below the minimum rate in order to avoid unemployment. Given the lack of empirical evidence for entry barriers to the formal sector however, recent models abstain from the traditional dualistic view and try to model an endogenously emerging informal economy.⁵

Among these more recent models, the ones that are closely related to the current paper are Amaral and Quintin [2006], Antunes and Cavalcanti [2007], and Prado [2007].⁶ Amaral and Quintin [2006] try to account for characteristics of the labor market in developing countries, where despite free entry to the formal sector informal workers tend to be less educated and are paid less than formal workers. In their model, the informal economy arises from imperfections in the capital market due to a lack of commitment to financial contracts. Formal entrepreneurs pay taxes and obtain external credit while managers of informal firms without access to outside financing substitute capital by low-skilled labor. Antunes and Cavalcanti [2007] use a similar framework where employment tax, entry costs into the formal sector, and access to credit lead to a more capital-intensive production by formal firms. The authors examine the separate and joint influence of regulation costs and enforcement costs of financial contracts on the informal economy. They perform a quantitative test to assess the importance of both types of costs for explaining differences in the informal economy between the US and Mediterranean Europe as well as the US and Peru. They find differences in the first case to be exclusively due to regulation costs, but conclude differences in the informal economy between the US and Peru to rely to the same extent on both types of costs. Prado [2007] builds a model of monopolistic competition where firms can decide to operate formally by paying taxes and an entry cost or to operate informally paying an enforcement cost. The author quantifies the influence of government policy, consisting of tax rates, entry costs to the formal sector, and levels of enforcements, on the informal economy by backing out unobserved levels of enforcement for all OECD countries and Brazil.

However, none of these recent models addresses the particular question this paper attempts to answer, "Why does the informal economy exist even in high-income countries?"⁷

⁵Maloney [1999] for example cannot find any empirical evidence for entry barriers into the Mexican formal sector.

⁶Another important strand of literature looks at the effect the informal economy has on economic growth; see for example Loayza [1997] and Sarte [2000].

⁷Busato and Chiarini [2004] is one of the few works that looks at the informal economy in a high-income country. However, it does not address the question of why the informal economy exists, instead

The answer to this particular question is important for two reasons. To start with, there exists little empirical work on the environment of the informal economy in developed countries. The sparse findings however, differ strongly from the description of the informal economy environment in developing countries.⁸ Schneider and Badekow [2006] find that in Germany of those working informally 43% have a full employment in the formal economy compared to only 6.5% who are unemployed.⁹ This stands in contrast to the informal economy in developing countries characterized as broadly “consisting of units engaged in the production of goods and services with the primary objective of generating employment and income to the persons concerned.” (The International Conference of Labour Statisticians (ICLS) [1993]; Paragraph 5).

Secondly, whereas the costs of establishing a formal business seem to play an important role for developing countries, for high-income countries no robust relation between the “Ease-of-Starting-Business-Index” (Djankov et al. [2002]) and informality can be established.¹⁰ Therefore, a focus on the fixed costs for establishing a business formally does not seem adequate for the study of the informal economy in high-income countries. Instead, an emphasis on the role of tax rates as made in this paper seems more appropriate for the proposed analysis, because across high-income countries tax rates are clearly positively related to the size of the informal economy. For a broader group of countries, however, there is no consensus about the relation between taxes and the informal economy.¹¹

The remaining of this paper is organized as follows. The next section presents the model in greater detail. I then describe my calibration strategies. Section 4 presents the results of the paper. In section 5 I perform some policy experiments. Section 6 concludes.

it studies the business cycle dynamics of the Italian economy assuming an exogenously less productive informal sector.

⁸Williams and Windebank [1998] compare local studies of the informal economy in high-income countries. They do not observe any clear patterns on earnings, type of workers, or their motivations.

⁹7% work part-time formally, 8% are pensioners, and 8.2% are house-wives.

¹⁰The initially positive relationship loses any significance when excluding Greece and Portugal from the sample of 21 high-income OECD countries.

¹¹For 49 countries Johnson et al [1998] establish a positive relation between high taxes and informal economy, whereas Friedman et al [2000] looking at 69 countries argue that higher taxes are related to better functioning public administrations and hence to less informal economy.

2 The Model

The set-up follows Lucas' [1978] span-of-control model. There is a single representative household and a government in this economy. The household is made up of a continuum of members with different managerial abilities. According to their managerial ability, household members either become workers or managers. Managers produce a homogenous good by using labor, capital, and their ability as inputs. Managers can operate a formal establishment and pay taxes to the government, or they can choose to operate an informal establishment and evade taxes. Tax evaders run the risk of getting caught, taxed, and fined by the government. The larger their establishment, the greater is the risk they face. Given incomes of all household members, the household decides jointly about consumption and savings.

Household The household is composed of a continuum of members. Its total size is normalized to unity. The household lives forever and maximizes the infinite sum of discounted utilities given by

$$\sum_{t=0}^{\infty} \beta^t \log(C_t), \quad (2.1)$$

where C_t denotes total household consumption at time t , and $\beta \in (0, 1)$ is the discount factor.

Endowments Each household member has one unit of productive time that he supplies inelastically. Household members differ in their managerial ability (z). For each individual this ability is time invariant. It is distributed in $Z = [0, \bar{z}]$ with cdf $F(z)$ and density $f(z)$. The household assigns occupations to its members depending on their ability. They can become workers, set up an informal establishment, or operate as formal entrepreneurs.

Production Both formal and informal managers have access to the same technology. They hire workers, rent capital, and produce a single output, which is used for consumption and investment, according to

$$Y_t = F(z, n_t, k_t) = z^{1-\gamma} (k_t^\nu n_t^{1-\nu})^\gamma, \quad (2.2)$$

where $\gamma \in (0, 1)$ is the span-of-control parameter.

Formal managers Formal managers pay a proportional tax (τ) on profits. They choose the optimal amount of labor and capital in order to maximize their profits net of taxes.

Given a wage rate (w_t) and a rental rate for capital (R_t), their problem is

$$\max_{\{n_t, k_t\}} \pi_t^f = (1 - \tau)\pi_t = (1 - \tau)[z^{1-\gamma}(k_t^\nu n_t^{1-\nu})^\gamma - w_t n_t - R_t k_t].$$

Combining the two first order conditions of this maximization problem, the optimal capital-labor ratio for formal managers is given by,

$$\frac{k_t}{n_t} = \frac{\nu}{1 - \nu} \frac{w_t}{R_t}, \quad (2.3)$$

which is independent of the tax rate (τ). This implies that optimal profits of formal managers are given by

$$\pi_t^f(z, w_t, R_t) = (1 - \tau)(1 - \gamma)^{\frac{1}{1-\gamma}} z \left(\frac{\gamma(1 - \nu)}{w_t} \right)^{\frac{\gamma}{1-\gamma}} \left(\frac{\nu}{1 - \nu} \frac{w_t}{R_t} \right)^{\frac{\nu\gamma}{1-\gamma}}. \quad (2.4)$$

Higher wages (w_t) and interest rates (R_t) reduce formal managers' profits, as do higher tax rates (τ) and a larger span-of-control parameter (γ). More managerial talent (z), on the other hand, increases profits of the formal manager.

Informal managers Informal managers do not pay taxes. They run, however, the risk of getting caught by the government. If they are caught, they are taxed just as their formal counterparts. In addition they have to pay a fine M . If their profits are too low to cover the fine, the government seizes their total available profits.

Let $p(z)$ denote the probability of getting caught for a manager of talent z . I assume that this probability increases with firm size and that the largest firms are not able to hide at all.¹² In particular, suppose that there exists a labor demand $\tilde{n} = n(\tilde{z}_t)$, smaller than or equal to the labor demand of the best manager $n(\bar{z})$, such that the probability of getting caught is equal to one.¹³ For $z < \tilde{z}$, $p(z)$ is given by

$$p(z) = \begin{cases} \left(\frac{z}{\tilde{z}}\right)^\theta & \text{for } z < \tilde{z}, \text{ with } \theta > 0 \\ 1 & \text{for } z \geq \tilde{z}. \end{cases} \quad (2.5)$$

¹²This approach is similar to Fortin et al [1997] who assume costs of evading taxes and regulations to increase with firm size. Notice that I also assume that very small firms can hide perfectly. This has only technical implications as agents with such little managerial talent will always become workers.

¹³Note that there is a one-to-one mapping between labor demand and managerial talent z , since $n(z, R_t, w_t) = z\Upsilon R_t^{\frac{-\nu\gamma}{1-\gamma}} w_t^{\frac{\nu\gamma-1}{1-\gamma}}$ where Υ is a constant.

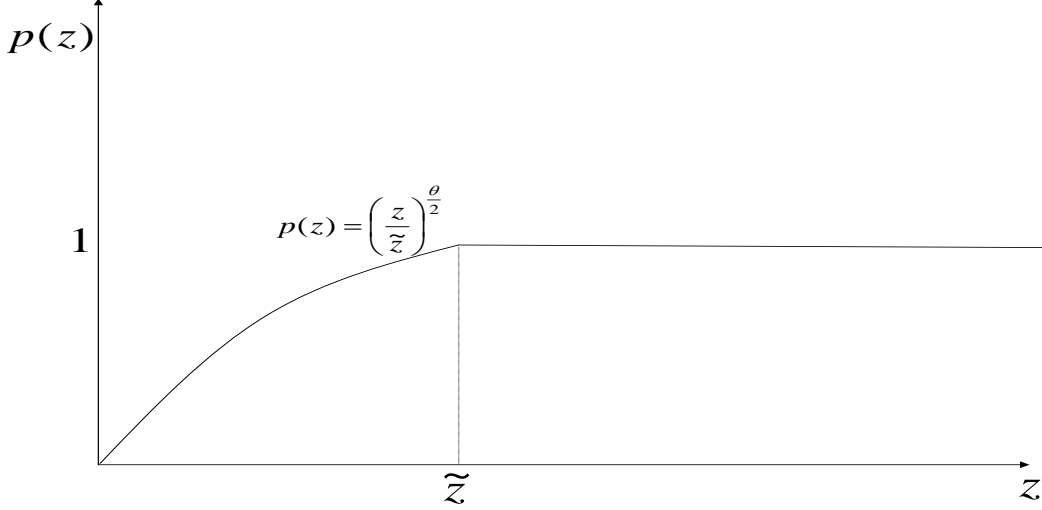


Figure 2.1: The probability of getting caught as a function of z

Figure 2.1 shows the function $p(z)$. For a given $z < \tilde{z}$, $p(z)$ is decreasing in θ , i.e. a higher θ is associated to a lower probability of getting caught.

Then informal managers face the following profit maximization problem

$$\max_{\{n_t, k_t\}} \pi_t^i = (1 - p(z))\pi_t + p(z) \max\{0, (1 - \tau)\pi_t - M\}.$$

Given that taxes are paid on profits, input choices are not distorted and informal managers' optimal decision rules for labor and capital inputs are identical to the ones for formal managers. Therefore, the optimal capital-labor ratio for informal managers is also given by equation (2.3).¹⁴

Informal managers' *expected* optimal profits are given by:

$$\pi_t^i(z, w_t, R_t) = \begin{cases} \frac{(1-p(z))}{(1-\tau)} \pi_t^f(z, w_t, R_t) & \text{for } M \geq \pi_t^f(z, w_t, R_t) \\ \frac{(1-p(z)\tau)}{(1-\tau)} \pi_t^f(z, w_t, R_t) - p(z)M & \text{for } M < \pi_t^f(z, w_t, R_t). \end{cases} \quad (2.6)$$

Informal managers whose profits net of taxes are smaller than the fine for evading taxes, loose all their profits if caught. They expect to make profits only if they successfully evade

¹⁴In contrast to Guner et al [2007] and Restuccia and Rogerson [2007] who consider how policies distort input decisions, this paper looks at firm specific reactions, to pay or to evade taxes, given a common tax policy.

taxes. In this case, their expected profits are equal to the ones of formal managers before taxes. More talented informal managers know that their profits net of taxes will suffice to pay the fine if caught. They thus expect their profits to be a convex combination of before tax profits and profits net of taxes minus the fine. National accounting in this economy counts production of informal firms that are caught as belonging to the formal economy.

Given the functional forms of $\pi_t^f(z, w_t, R_t)$ and $\pi_t^i(z, w_t, R_t)$, there exist two unique thresholds z_t^* and \hat{z}_t . Household members with managerial ability below z_t^* will become workers. As workers their managerial ability (z) is given the value 1. Hence, the income level of all workers is identical and equal to the wage rate (w_t). Those with abilities z such that $z_t^* < z < \hat{z}_t$ will become informal managers. Finally, members of the household with $z > \hat{z}_t$ set up formal businesses. Figure 2.2 captures this idea.

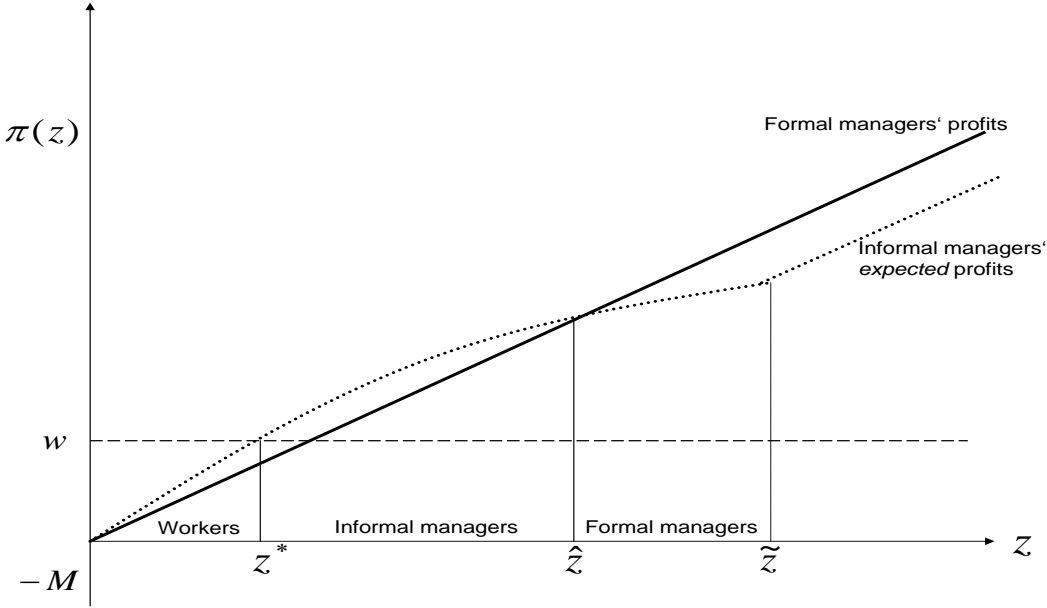


Figure 2.2: Thresholds for occupational choices

For $z < \tilde{z}$, informal managers' expected profits are a convex combination of before tax profits and taxed profits minus the fine. Managers of talent $z < \hat{z}$ face a low probability of getting caught. That is why they expect to make more profits as informal managers than as formal managers. As z approaches \tilde{z} , the probability of getting caught increase

and the two profit functions cross. With $p(z) \rightarrow 1$, informal managers' profits become a linear function of taxed profits minus the fine.

The Household's problem The household chooses sequences of consumption and savings, and the optimal occupation for each household member. If a household member becomes a worker, his managerial ability (z) is given the value 1 and his income level is w_t . If he becomes a manager, he has to decide whether to operate his establishment formally or informally. The contribution of every formal manager to the household is his profits net of taxes (equation 2.4).

Informal managers' contributions depend on whether they are caught or not. In case they are not caught their contributions are their before tax profits. If they get caught evading taxes, informal managers contribute to the household the after-tax profits of their firms less the fine (M) they have to pay. In case they are not able to pay the fine, all their profits are seized by the government and their contributions to the household income are nil.

Formally the household chooses $\{C_t, K_{t+1}, z_t^*, \hat{z}_t\}$ in order to maximize (2.1) subject to

$$C_t + K_{t+1} = R_t K_t + (1 - \delta)K_t + w_t F(z_t^*) + \int_{z_t^*}^{\hat{z}_t} \pi_t^i(z, w, R) f(z) dz + \int_{\hat{z}_t}^{\bar{z}} \pi_t^f(z, w, R) f(z) dz$$

and

$$K_0 > 0.$$

The solution to the household's problem is characterized by the following three first order conditions

$$\frac{1}{C_t} = \beta(1 + R_{t+1} - \delta) \frac{1}{C_{t+1}}, \quad (2.7)$$

$$w_t = (1 - p(z_t^*)\tau)\pi_t(z_t^*, w_t, R_t) - p(z_t^*)M, \quad (2.8)$$

and

$$p(\hat{z}_t)M = (1 - p(\hat{z}_t))\tau\pi_t(\hat{z}_t, w_t, R_t). \quad (2.9)$$

Condition (2.7) is the standard Euler equation for optimal capital accumulation. Condition (2.8) is similar to Lucas' [1978] condition for the 'marginal' manager. A household member with managerial ability z_t^* is indifferent between working or setting up an informal establishment. His wage has to equal the profits he expects to make as an informal manager.

The additional condition (2.9) determines the second threshold for the occupational choice. Any household member who has not become a worker, i.e those with managerial ability $z > z^*$, faces a second choice. He compares his income as a formal manager to his expected income as an informal manager. Whenever $\pi_t^f(z, w_t, R_t) \geq \pi_t^i(z, w_t, R_t)$ he goes formal. Condition (2.9) compares costs and benefits of being an informal manager. A household member with managerial ability \hat{z} is indifferent between keeping his establishment informal or going formal. His costs of being informal equal his benefits of informality, where costs are the fine weighted by the probability of getting caught and benefits are the tax burden weighted by the probability of not getting caught.

Government The government collects taxes on profits from formal firms and from those informal firms that are caught. In addition it collects the fines from these same informal firms. In case these firms are not able to pay the fine the government seizes their total available profits. Government revenues are used for pure government consumption only. Each period the government has to fulfill the following constraint:

$$G_t = \int_{\hat{z}_t}^{\bar{z}} \tau \pi_t(z, ;) f(z) dz + \int_{z_t^*}^{\hat{z}_t} p(z) \tau \pi_t(z, ;) f(z) dz + \int_{z_t^*}^{\hat{z}_t} p(z) \min((1-\tau)\pi_t(z, ;), M) f(z) dz \quad (2.10)$$

Equilibrium In equilibrium all three markets, i.e. for goods, capital, and labor, must clear. Denote by $n(z, w_t, R_t)$ and $k(z, w_t, R_t)$ demands for labor and capital services by a manager of ability z .¹⁵ Then for the labor market to clear we require

$$N_t = \int_{z_t^*}^{\hat{z}_t} n(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\bar{z}} n(z, w_t, R_t) f(z) dz. \quad (2.11)$$

Aggregate labor supply $N_t = F(z_t^*)$ has to equal the sum of the labor demands of informal and formal managers. For the capital market to clear we need

$$K_t = \int_{z_t^*}^{\hat{z}_t} k(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\bar{z}} k(z, w_t, R_t) f(z) dz. \quad (2.12)$$

With $y(z, w_t, R_t)$ being the supply of goods by any manager of ability z , for market clearing in the goods market we require

$$\int_{z_t^*}^{\hat{z}_t} y(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\bar{z}} y(z, w_t, R_t) f(z) dz = C_t + K_{t+1} - K_t + \delta K_t + G_t. \quad (2.13)$$

¹⁵Recall that factor demands for informal and formal managers do not differ.

We can now define a competitive equilibrium for the model economy. Given a government policy $\{\tau, M, p(z)\}$ and a sequence of prices for labor and capital $\{w_t, R_t\}_0^\infty$, a competitive equilibrium is a collection of sequences $\{C_t, K_{t+1}, z_t^*, \hat{z}_t\}_0^\infty$ such that:

1. $\{C_t, K_{t+1}, z_t^*, \hat{z}_t\}_0^\infty$ solves the household's problem;
2. all three markets, for goods, capital, and labor clear for all t , i.e. equations (2.11)-(2.13) hold;
3. the government budget constraint is fulfilled, i.e. equation (2.10) holds.

Absent any exogenous growth, there will be a steady state with all variables remaining constant.

2.1 Comparative Statics

As I discussed in the Introduction (see Figures 1.2 and 1.3), two factors, tax rates and the quality of institutions, are clearly related to the size of the informal economy across high-income countries. Comparative statics show that these factors also play a key role in the model and that the model has the potential to deliver the relations observed in the data.

Tax rates In the current setup, higher tax rates lead to a larger informal economy. An increase in τ reduces profits of formal managers more strongly than expected profits of informal managers. Formal managers' tax burden increase to the full extent of the higher tax rate, whereas the increase in the informal managers' tax burden is downscaled by the probability of getting caught. As a result, the slope of the formal manager's profit function decreases by more than the slope of the informal manager's expected profit function and \hat{z} , the ability of the marginal formal manager, rises (see Figure 2.3).

With higher tax rates there are thus more informal and less formal managers. The average talent of the informal manager and hence the average size of his establishment increase. A larger fraction of informal managers, however, will get caught, because the probability of getting caught is increasing in establishment size. But facing higher tax rates, previously formal managers are willing to take the risk of getting caught and they try to evade taxes. If they get caught their output is counted as formal production. Only if they succeed to hide from the government is the production of the newly informal managers counted as informal. As a result of the increase in τ , overall formal output, produced by formal

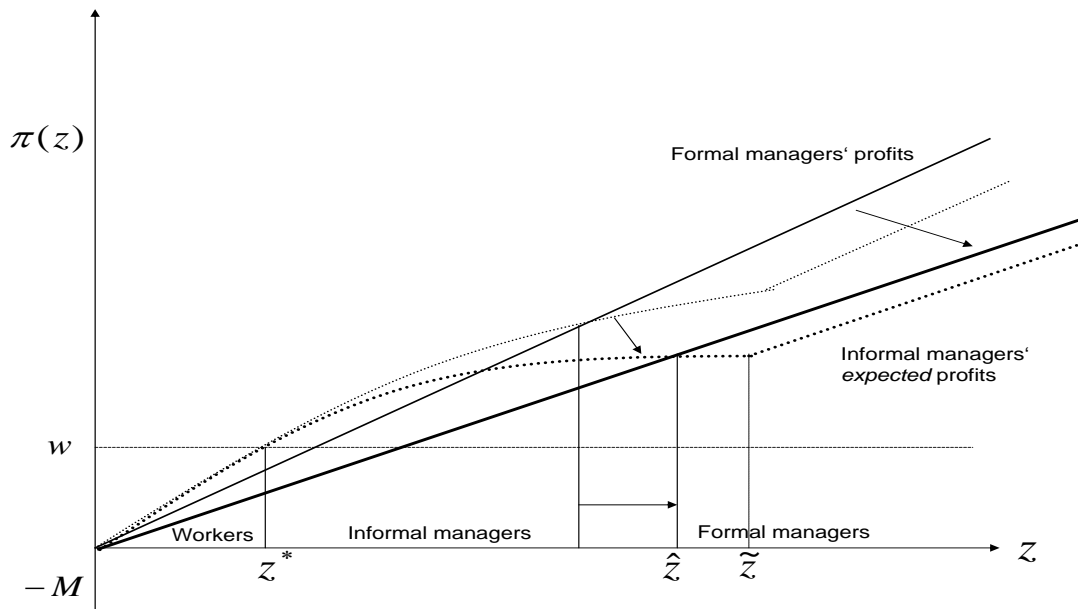


Figure 2.3: Effects of increase in tax rate (τ) on \hat{z}

managers and informal managers who are caught, decreases.

Higher tax rates will also alter the first threshold z^* , the ability of the marginal informal manager. But this is only of secondary order.¹⁶ As wages are not directly affected by tax rates but profits of the informal manager are reduced, being a worker becomes relatively more attractive as opposed to being an informal manager. Agents with relatively low managerial ability switch from being an informal manager to being a worker, which leads to a larger value of z^* . More individuals wanting to become workers increases labor supply and lowers labor demand and will thus induce a fall in wages. As a result, the initial switch in occupational choice and thus the rise in z^* is dampened. Additionally, lower wages increase each manager's labor demand. As the minimum size at which informal establishments get caught with certainty is fixed, the overall increase in number of employees, causes \tilde{z} , the ability of the marginal manager caught with certainty, to decrease.

The overall effect of higher tax rates on the informal economy is positive. Facing higher tax rates, least able informal managers prefer to be workers and least able formal managers

¹⁶For clarity purposes the secondary effects of parameter changes on z^* and \tilde{z} are omitted in Figures 2.3, 2.4, and 2.5.

switch to informality. This leads to a higher average ability of the informal manager, and thus a larger average size of the informal firm. Formal production, the sum of production by formal managers and informal managers who get caught decreases and output by informal managers who succeed to hide from the government increases. Hence, as a response to a higher tax rate, informality measured as the ratio of hidden informal output to formal output also increases.

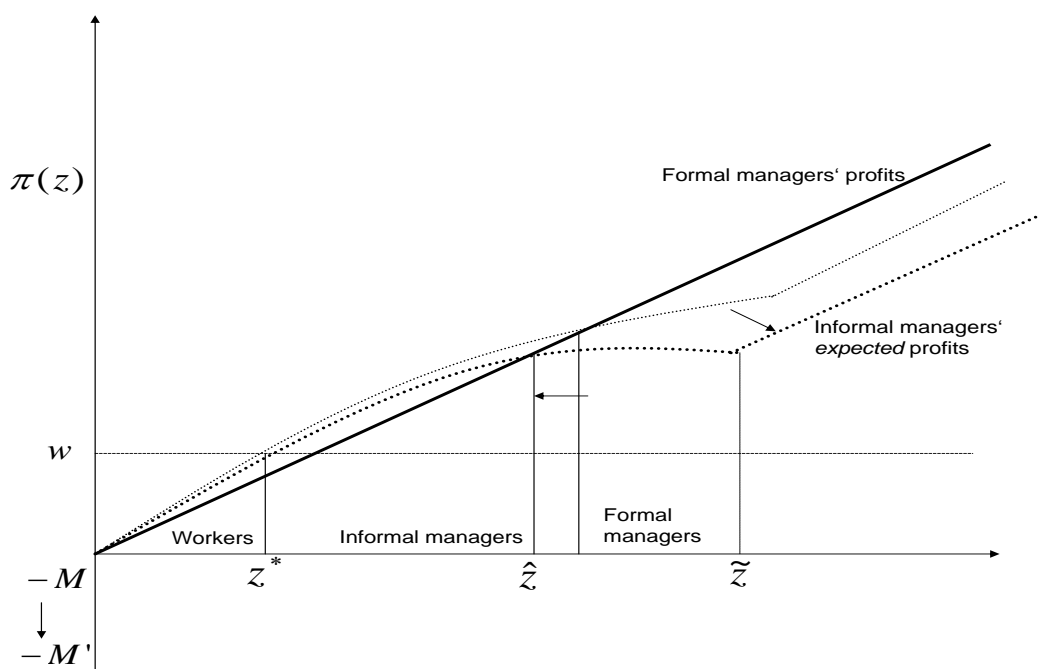


Figure 2.4: Effects of increase in fine for evading taxes (M) on \hat{z}

Fine for evading taxes An increase in the fine for evading taxes (M), solely affects expected profits of informal managers. Informal managers who get caught are left with lower profits after paying tax debt and fine, and they take this into account when calculating their expected profits. The reduction in expected profits reduces the curvature of the informal managers' expected profit function. As a result of the increase in M , \hat{z} decreases (see Figure 2.4). Previous tax evaders switch to being formal. Due to a lower \hat{z} , the average size of informal firms and thus also informal managers' probability of getting caught decrease. Hence, a smaller fraction of informal managers will get caught.

Wages are not directly affected by an increase in the fine. But reduced profits of informal managers make being a worker relatively more attractive. More individuals preferring to be workers instead of managers leads to a larger value for z^* . General equilibrium

effects reduce the wage which limits the rise in z^* but also increases each managers' labor demand. As with higher taxes, the increase in each manager's labor demand causes \tilde{z} , the ability of the marginal manager caught with certainty when evading taxes, to fall.

Higher fines for evading taxes reduce the number of informal managers. Low ability informal managers prefer to be workers and the most talented informal managers go formal. The informal economy, measured as the ratio of hidden production to formal output decreases as the fine for evading taxes increases.

Probability of getting caught evading taxes An increase in θ , the curvature of the probability of getting caught function (equation 2.5), reduces the risk of getting caught evading taxes. A reduced probability of getting caught decreases the weight of after tax profits minus fine and increases the weight of before tax profits in the informal managers' expected profit function (equation 2.6). As a result of the increase in θ , informal managers' expected profits increase, resulting in a steeper slope of the informal managers' profit function. The ability of the marginal formal manager, \hat{z} rises (see Figure 2.5). As evading taxes becomes a more attractive option fewer managers pay taxes and only a fraction of previously formal production; i.e. of those informal managers who are caught, is counted as formal.

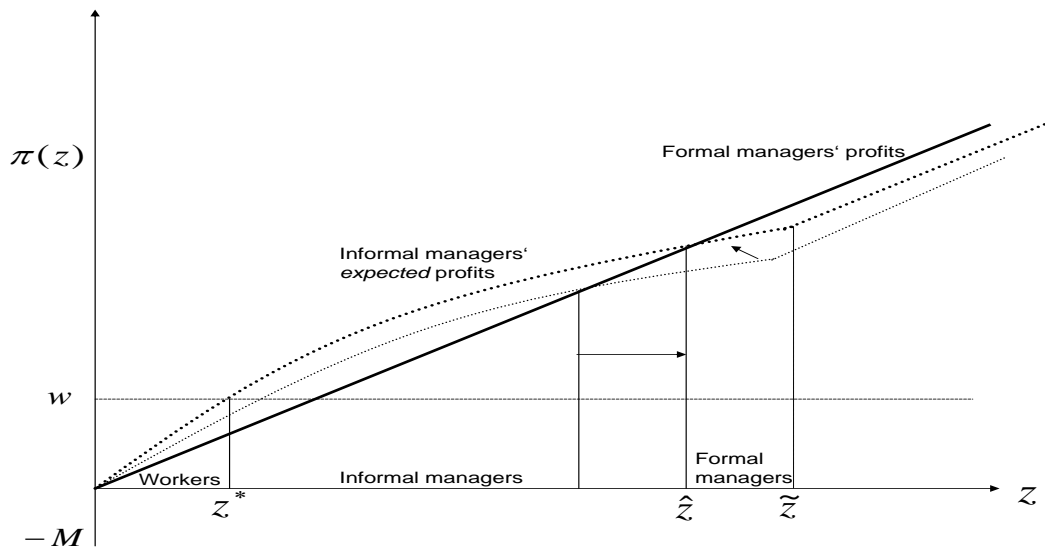


Figure 2.5: Effects of increase in (θ) ; i.e decrease in probability of getting caught on \hat{z}

The increase in informal managers' expected profits leads to more individuals wanting

to be informal managers instead of workers. As being a worker becomes relatively less attractive, z^* , the ability of the marginal informal manager decreases. Labor supply falls and labor demand rises, resulting in higher wages, that dampen the fall in z^* and decrease each manager’s labor demand. The ability of the marginal manager caught with certainty, \tilde{z} increases. With higher θ , a lower probability of getting caught evading taxes, there will be more informal economy.

The previous analysis shows that at a qualitative level the model can deliver the positive relation between tax rates and the informal economy, as well as the negative relation between informality and quality of institutions. The purpose of this paper, however, is to assess the quantitative importance of these driving forces behind the informal economy across high-income countries. In particular I would like to answer questions like: “How much does the informal economy increase when agents face a two percentage point increase in tax rates, given that institutional quality does not change?” or “what are the benefits of increasing audit probabilities for small firms by five percent in terms of reducing informal economic activity?” In order to address questions like these, one needs to pin down the elasticities of the informal economy with respect to tax rates and quality of institutions. The following sections undertake such a quantitative analysis.

3 Calibration Strategy

I start with fixing tax rates across countries based on a priori information. The remaining parameters are determined by matching certain key statistics for one specific OECD country. The tax rate (τ) in the model is fixed based on available data. As an indicator of the overall tax burden, I use what the OECD [2003] calls ‘tax wedge’. Data for this measure is available for all 21 countries and includes income tax, employee and employer social security contributions less cash benefits, applicable to a single individual without children and earnings equal to that of the average production worker. As I consider Schneider [2002]’s estimates of the informal economy for 2001-02, I take an average over the annual rates for both years. For the countries considered between 40 – 60% of all tax revenues stem from income taxes and social security contributions. Tax data used in Figure 1.2 is for 1996 and from Schneider [2002] and combines ‘tax wedge’ and value-added tax. Since, the positive relationship between tax rates and informal economy is robust over time as well as to the exclusion of value-added tax, in the current exercise I chose to use more recent data for 2001-02 and to leave aside value-added tax rates.¹⁷

¹⁷The positive relationship between tax rates and the informal economy across high-income countries is also robust to alternative measures of tax burden by Nickell and Nunziata [2001]. Given its collection mechanism, avoiding payments of value-added-tax requires net-works of informal firms as in de Paula

Next, I choose the technology parameters, the span-of-control-parameter (γ) and the share of capital (ν), and I pick the discount factor (β). I also specify the distribution of managerial ability $F(z)$. I assume that $F(z)$ is log-normally distributed with mean (m) and standard deviation (σ). These five parameters are determined by matching five targets; i.e. average firm size, employment and establishment shares for small firms, capital-output ratio, and capital share for one specific country. I choose to match these statics for France since average firm size in France is about median average firm size of all countries considered.¹⁸

Average firm size in the model includes formal and informal firms. Regarding the data one can take different stands. One possibility is to assume that all informal economy stems from clandestine operations. In this case, data would not reveal any information about informal firms. On the other hand informal firms might simply be firms that cheat on taxes and that appear just as their formal counterparts in national business registers. Under this assumption, one could rely on data from the European Commission [2003] for a measure of total average firm size.

A third approach, taken here, considers that 15 – 20% of official GDP in high-income countries is unlikely to be produced in the underground, but that these numbers measure tax evasion by registered firms. However, this approach takes into account that firms cheating on taxes may have an interest to lie about the number of their employees. Then measures of average firm size based on business registers as provided by the European Commission [2003] are not suitable as they may be downward biased.¹⁹ This problem can be avoided using the ratio of labor force to business owners as a measure of average firm size published by Entrepreneurs International (EIM) - Compendia [2002]. It turns out that average firm size data from both sources are very similar and there is no consistent bias that would result from a general underreporting of firm size in business registers. For half of all countries, for which data on average firm size is available by the European Commission [2003], average firm size is higher than when considering Entrepreneurs In-

and Scheinkman [2006]; with those avoiding taxes only buying from and selling to others avoiding taxes. Other major taxes are corporate taxes. However, across high-income countries there is no linear statistical relation between corporate tax rates and the informal economy.

¹⁸This holds for average firm size data from the European Commission [2003] as well as for data from Entrepreneurs International (EIM) - Compendia [2002].

¹⁹In case informal managers are not even registered as self-employed they will not figure as business owners in this data, but are captured as employees or as unemployed in the labor force, overestimating total average firm size. This would only reinforce results as countries with large informal economy and many unregistered informal managers would be those with even smaller total average firm size.

ternational (EIM) - Compendia [2002] data and for the other half numbers are lower.²⁰

According to Entrepreneurs International (EIM) - Compendia [2002] average firm size in France was 8 workers per firm, excluding establishments in agriculture, fishing, forestry and hunting.²¹ I set the span-of-control parameter in the production function (γ) to 0.708 to match this statistic. A drawback of the EIM- Compendia [2002] data set is that it does not provide any information on the size distribution of firms. The European Commission [2003] has data on detailed firm size distributions based on business registers. As discussed before, informal firms may lie about the numbers of their employees making the use of this data inadequate for the particular measure of firm size in the model. However, the firm size distribution is an outcome of the underlying distribution of managerial ability. In principle there is no reason to assume upfront that formal and informal managers differ in ability. Hence using this data to get an idea of the overall firm size distribution that includes both informal and formal firms seems admissible. In France, 37.1% of all workers are employed by firms that have 0 to 9 employees. These small firms make up 93% of all establishments (European Commission [2003]). In order to match employment and establishment shares of small and large firms in France I choose the mean log-managerial ability (m) to be 0 and set the standard deviation of log-managerial ability (σ) to 2.123.²²

The discount factor (β) is set to 0.9627 to match the capital-output ratio for France. As a target for the capital-output ratio, I use 2.3, an estimate provided by Maddison [1995]. In the model, $\gamma\nu$ is the share of capital income. Given γ , the parameter ν is set to 0.4506, to be able to generate a capital share of 0.319. The target for the capital share is taken from Gollin [2002] who finds a capital share for France of 0.319 when adjusting labor shares for self-employed income.²³ For the annual depreciation rate of capital (δ) I pick a value of 0.1, as in Prescott [1986]. Table 3.1 displays calibration targets, next to target values and the resulting statistics in the model.

Next, I determine M , the fine for tax evasion. According to standard procedures of tax administrations a subset of firms is audited each year. If they are found to evade taxes

²⁰ The correlation coefficient between both data sets is 0.63.

²¹ Average firm size data by the European Commission [2003] also excludes establishments in the primary sector of agriculture and fishing.

²² This simple functional form for the distribution of managerial talent has the shortcoming that one has difficulties matching employment shares and establishment shares simultaneously. This can be achieved assuming an extra tail for very talented managers as in Guner et al [2007]. However, as the focus of this paper is on small informal firms rather than on large firms, I decided to stick to a simple log-normal distribution for managerial talent.

²³ This adjustment makes labor shares relatively constant across countries.

Table 3.1: Calibration Targets and Model Values

Calibration Target	Values Target	Model
Average firm size in France	8	7.99
Employment share of small firms (0-9 employees) in France	37.1%	37.2%
Establishment share of small firms (0-9 employees) in France	93%	79%
Capital-output ratio in France	2.3	2.3
Capital Share in France	0.319	0.319

deliberately, they have to pay their tax debt and are fined in addition. I fix the fine for deliberate tax evasion (M) to a value of 2. There is a great variety of fines across the 21 countries considered. They range from surcharge on taxes evaded, to surcharge on profits, to fixed fines, or even imprisonment.²⁴ The most commonly imposed fine among the countries considered is a surcharge on taxes evaded.²⁵ Surcharges range from 40% to 300% of tax payable. For France, the fine chosen for calibration is equivalent to a surcharge on tax payable of 50%, which lies within the range of actual fines.²⁶

This leaves θ and \tilde{z} , the parameters for the probability function of getting caught to be determined. All of the 21 countries considered, except Switzerland, have so called Large Taxpayer Units (LTUs) that particularly control compliance with tax regulations for large taxpayers.²⁷ I assume that firms with more than 10 workers cannot hide from the government and are caught for sure if evading taxes; i.e. I set $n(\tilde{z}) > 10$.²⁸

The remaining parameter θ is chosen separately for each country to best match informal economy estimates for 2001-02 by Schneider [2002].²⁹ Hence, in the simulations τ and θ

²⁴See OECD's Centre for Tax Policy Administration [2006] for a detailed description on tax administration procedures in OECD countries, including fines imposed for deliberate tax evasion.

²⁵In this model imposing a surcharge on tax evaded instead of a fixed fine makes tax evasion independent of the tax rate and a function of the surcharge rate only.

²⁶With $M = 2$ and values for tax rate (τ) and before-tax profits (π) for France of $\tau \approx 0.5$ and $\pi \approx 8$, let s be the surcharge on tax payable, then $s = \frac{M}{\tau\pi} = 0.5$.

²⁷Baer [2002] explains the functioning of these LTUs in detail.

²⁸Establishments with 0 to 9 employees are defined as Micro-enterprises by the European Commission [2003] and the OECD [2002]. Note that even though $n(\tilde{z}) = 10$ is the same for all countries, general equilibrium effects require \tilde{z} to be adjusted accordingly.

²⁹There are various ways to estimate the informal economy. Schneider's estimates are based on the Currency Demand Method. Others like Friedman et al [2000] use estimates obtained by the so-called physical input or electricity method. Estimates of these two methods are different, but quite related with

vary across countries while all other parameters are the same. Table 3.2 summarizes the parameter values that remain constant across countries.

Table 3.2: Parameter Values

Parameter	Value
Depreciation rate (δ)	0.1
Importance of capital (ν)	0.4506
Span-of-Control (γ)	0.708
Mean log-managerial ability (μ)	0
Dispersion in log-managerial ability (σ)	2.123
Discount factor (β)	0.9627
Fine for evading taxes (M)	2
Firms detected with probability 1 ($n(\tilde{z})$)	> 10 workers

4 Results

Tax Rates, Enforcement, and Informal Economy Table 4.1 presents the model’s values for informal economic activity together with Schneider’s [2002] informal economy estimates for all 21 high-income OECD countries. The model matches Schneider’s [2002] estimates well. As a result, the positive relation between tax rates and informal economy as found by Davis and Henrekson [2004] is preserved in the model (see Figure 4.1). The elasticity of the informal economy with respect to tax rates is about 0.38; for rates between 20% and 55%, a five percentage point increase in tax rates is associated to an increase in informal economy of about two percentage points.

To provide some insight into the workings of the model it is helpful to take a closer look at a couple of countries. Consider for example Austria and Italy, two countries that differ strongly in terms of informal economic activity but that have similarly high tax rates of 47% and 46% respectively. The model estimates the informal economy to be around 11% in Austria and 27% in Italy. Given similar tax rates, agents in both countries are equally eager to be informal. However, the calibrated value of θ for Austria is 1.529; a lot smaller than the 2.2865 for Italy. In the model, a higher probability of getting caught in Austria restrains agents from evading taxes.

a correlation coefficient of 0.64.

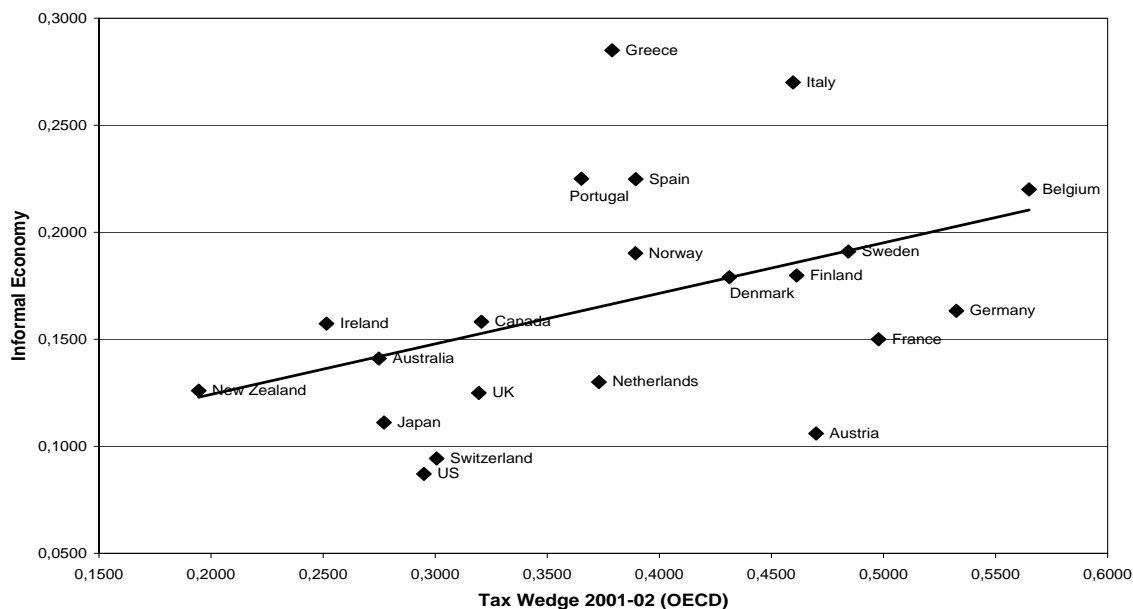
Table 4.1: Estimation Results for Informal Economy*

Country	τ	θ	Informal Economy	
			Model	Data from Schneider [2002]
Greece	0.3789	2.5025	0.2850	0.285
Italy	0.4597	2.2865	0.2700	0.270
Portugal	0.3652	2.1720	0.2250	0.225
Spain	0.3895	2.1260	0.2248	0.225
Belgium	0.5650	1.8843	0.2200	0.220
Sweden	0.4843	1.8073	0.1910	0.191
Norway	0.3893	1.9543	0.1902	0.190
Finland	0.4613	1.7931	0.1798	0.180
Denmark	0.4312	1.8370	0.1790	0.179
Germany	0.5325	1.6302	0.1633	0.163
Canada	0.3206	1.9984	0.1582	0.158
Ireland	0.2515	2.2378	0.1573	0.157
France	0.4978	1.6150	0.1500	0.150
Australia	0.2748	2.0975	0.1410	0.141
Netherlands	0.3730	1.7795	0.1300	0.130
New Zealand	0.1945	2.4164	0.1260	0.126
UK	0.3195	1.9040	0.1249	0.125
Japan	0.2771	2.0060	0.1111	0.111
Austria	0.4699	1.5290	0.1060	0.106
Switzerland	0.3006	1.8900	0.0943	0.094
US	0.2950	1.8929	0.0871	0.087

*Countries appear in decreasing order of informal economy.

On the other hand, there are countries with similarly sized informal economic activity but different tax rates, like Belgium and Spain. Both countries have an informal economy of about 22%. Tax rates in Belgium, at 57%, are the highest among all countries considered, whereas rates in Spain are somewhere in the mid-range with 39%. Therefore agents in Belgium have a stronger incentive to go informal than agents in Spain. To mitigate this incentive, the probability of getting caught evading taxes has to be higher in Belgium than in Spain. That is why for Belgium the calibrated value for θ is 1.8843, a lot smaller than the calibrated value of 2.1260 for Spain.

Figure 4.1: Informal Economy and Tax Rates in Model



Data: OECD [2003]

Establishments and Employment Empirically, countries with larger informal economy tend to have smaller average sized firms. Figure 4.2 shows that the negative relation between average firm size and informal economy also holds in the model. This relation between informality and average firm size shows up in several additional statistics. Countries with more informal economy turn out to have smaller firms and these smaller firms are more important in terms of employment and number of establishments. Many of these small firms are informal establishments.

Table 4.2 displays average firm size, employment and establishment shares for small firms (i.e. firms with less than 10 employees), fraction of informal establishments, and informal economy. Situated near the end of the table are Greece, Italy, and Portugal, all countries with large informal economy. A comparatively important fraction of the population in these countries are managers of relatively small sized establishments. These establishments play an important role for employment and in terms of numbers of establishments. More than half of all establishments in Greece, Italy, and Portugal successfully evade taxes. Austria, on the other hand, has relatively little informal economy. Average firm size is the largest among the 21 countries. Small firms play the least important role and only about 30% of Austrian establishments are informal.

Table 4.2: Estimation Results for Establishments and Employment*

Country	Average Firm Size	Small firms' (0-9 employees)		Fraction of informal establishments	Informal Economy
		Employment Share	Establishment Share		
Austria	8.2250	0.3660	0.7828	0.3061	0.1060
France	7.9901	0.3716	0.7901	0.3797	0.1500
Germany	7.9761	0.3726	0.7911	0.3965	0.1633
Netherlands	7.7196	0.3792	0.7993	0.3630	0.1300
Finland	7.7196	0.3792	0.7993	0.4293	0.1798
Sweden	7.6565	0.3806	0.8011	0.4430	0.1910
Denmark	7.6565	0.3806	0.8011	0.4320	0.1790
Belgium	7.5934	0.3824	0.8033	0.4753	0.2200
Switzerland	7.5386	0.3838	0.8051	0.3024	0.0943
US	7.5343	0.3838	0.8051	0.2864	0.0871
UK	7.5303	0.3838	0.8051	0.3615	0.1249
Norway	7.4672	0.3857	0.8073	0.4541	0.1902
Canada	7.4056	0.3871	0.8091	0.4180	0.1582
Japan	7.4042	0.3871	0.8091	0.3406	0.1111
Australia	7.3411	0.3889	0.8112	0.3966	0.1410
Spain	7.3175	0.3898	0.8121	0.4998	0.2248
Portugal	7.2781	0.3908	0.8133	0.5033	0.2250
Ireland	7.1890	0.3931	0.8161	0.4280	0.1573
Italy	7.1877	0.3931	0.8161	0.5470	0.2700
New Zealand	7.0891	0.3959	0.8193	0.3813	0.1260
Greece	7.0261	0.3973	0.8210	0.5720	0.2850

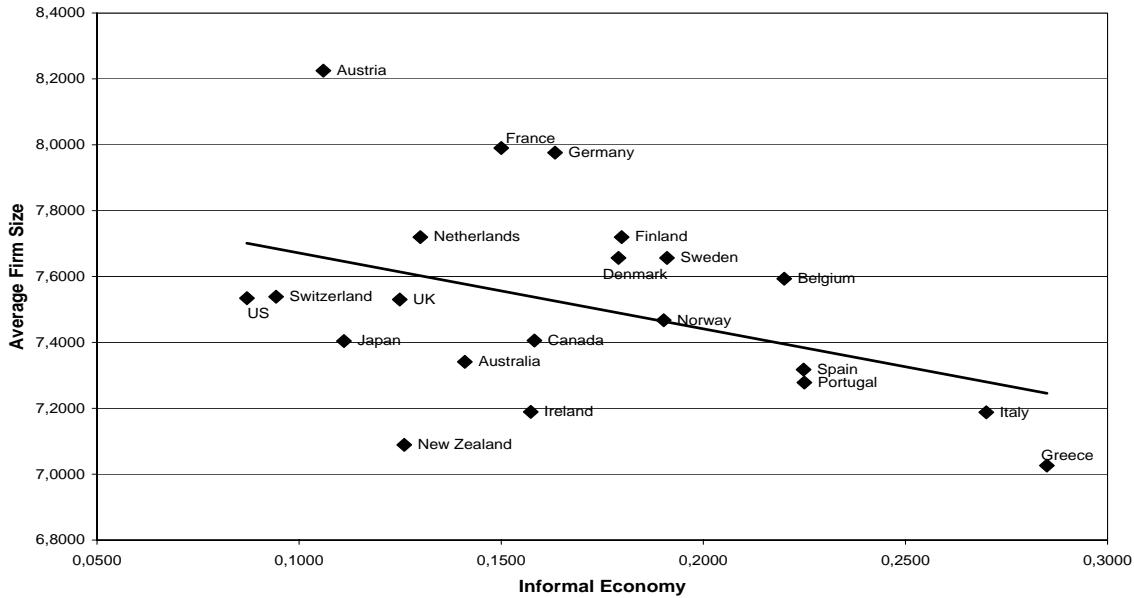
*Countries appear in descending order of average firm size.

The model has several implications consistent with data that go beyond the mere measure of informal economic activity. Countries with smaller average firms in the data turn out to be the ones with smaller average firms in the model.³⁰ However, there is less variability in average firm size across countries in the model than can be observed in the data, because variability in average firm size in the model is only due to differences in tax rates and degree of enforcement of tax policy. The model abstracts completely from other important factors that might explain why some countries have bigger average sized firms than others.³¹

³⁰The correlation coefficient between data on average firm size and estimates of average firm size in the model is 0.67.

³¹See Kumar et al [1999] for a recent study.

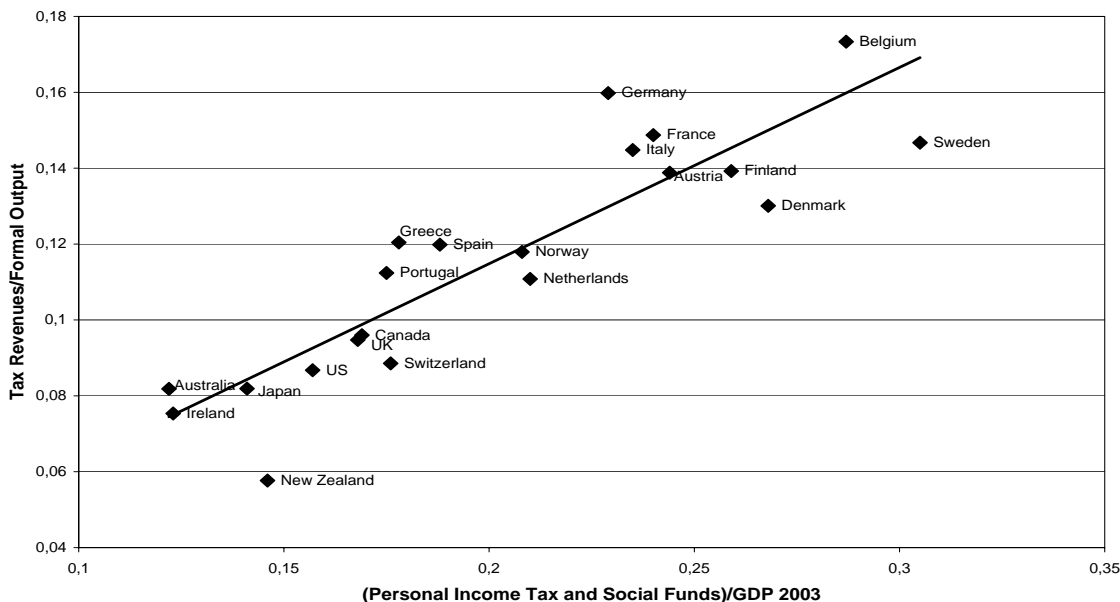
Figure 4.2: Informal Economy and Average Firm Size in Model



Government Revenue Finally, the model is also consistent with observed differences in tax revenues to GDP ratios across high-income countries. Figure 4.3 relates tax revenues in model and data. Consider Sweden, Denmark, and Belgium that all collect personal income tax and social funds of about 25 – 30% of GDP. These are the countries that also collect relatively more taxes in the model. On the other hand Australia, Ireland, New Zealand, and Japan collect all personal income taxes and social funds of less than 15% of GDP. These countries are also the ones with the lowest estimates of tax revenues to formal GDP in the model. Tax revenues to formal GDP in the model range from 5 – 20%. In the data, tax revenues to GDP stemming from personal income taxes and social funds range from 12 – 30%. This difference in range is not surprising as calibration did not target government revenues, and it also completely abstracted from different sources of government revenues.³²

³² Even though informality allows for tax revenues to differ from tax rates, countries with higher tax rates turn out to also be the ones with higher tax revenues. The ordering of countries is only slightly changed when considering tax rates and tax revenues or total government revenues (taxes, fines, and seized profits).

Figure 4.3: Tax Revenues to GDP in Model and Data



Data: OECD's Centre for Tax Policy Administration [2006]

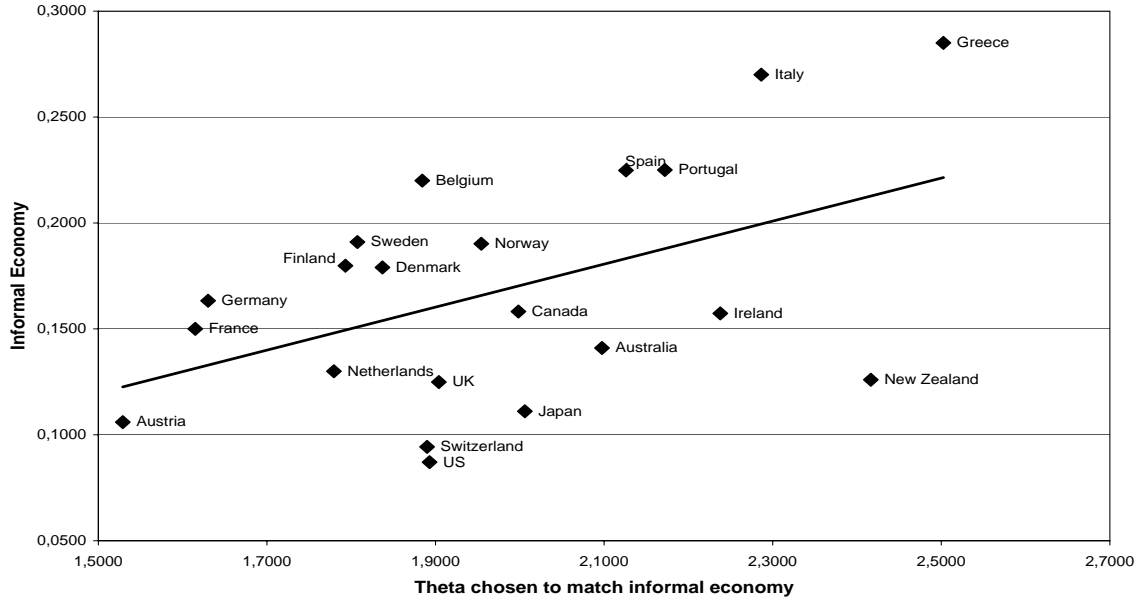
4.1 The Role of Enforcement

Different tax rates are only able to explain differences in informal economy to a certain extent. As discussed before, differences in the probability of getting caught evading taxes are also important. A high value of θ implies a low probability of getting caught. There is a clear positive relation between informal economy and calibrated values of θ (see Figure 4.4). Less informal economy is related to a high probability of getting caught, a low θ .

Agents facing high tax rates have a strong incentive to evade taxes. However, they will also take into account their country's enforcement of tax policy. If a country closely monitors its tax payers and controls their compliance with tax laws regularly, agents will prefer to pay their taxes upfront instead of later and together with a fine. Strictly enforcing its tax policy a country can counteract the positive effect of high tax rates on informality. In the model, this is achieved by a low value of θ which implies a high probability of getting caught evading taxes.

It comes as a natural question to ask what differences across high-income countries θ

Figure 4.4: θ chosen and Informal Economy in Model



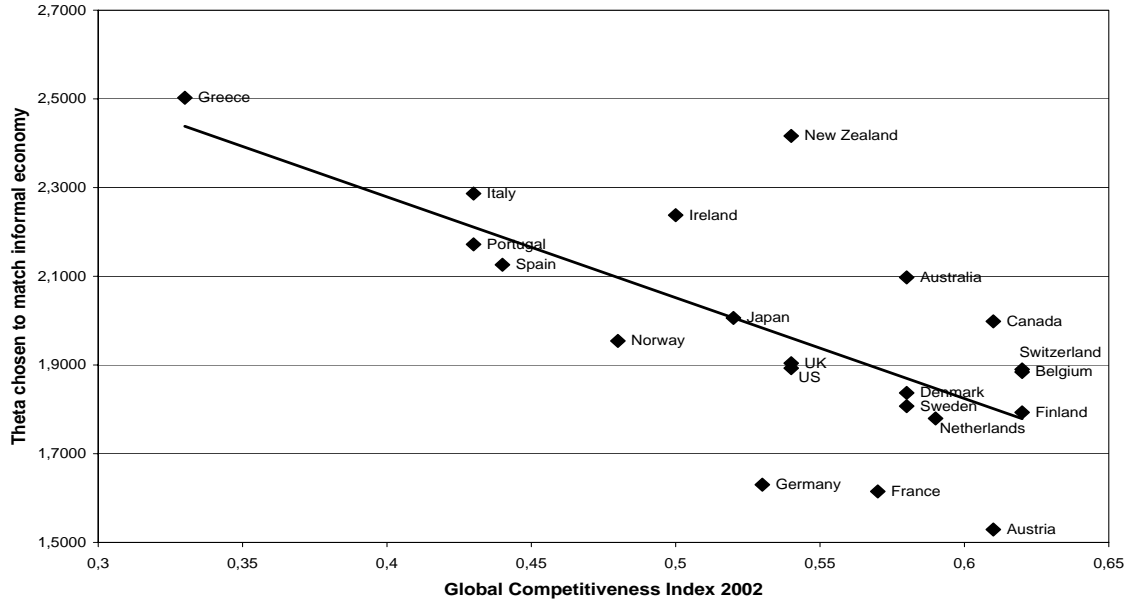
actually captures. A low θ , a high probability of catching tax evaders, can indicate that a country is coherently enforcing its policies. To do so, it needs good institutions and a high quality government. Corruption on the other hand poses an obstacle to the enforcement of policies. Figure 4.5 displays the relationship between the calibrated parameter values for θ and the Global Competitiveness Index across the 21 countries considered.³³ The Global Competitiveness Index can be used as an indicator of institutional quality. It is published annually by the World Economic Forum [2006], and asks business executives to rank their opinions on various public policy issues, among them the quality of government and institutions for the countries they are operating in. There is a strong negative relation between calibrated values of θ and scores of the Global Competitiveness Index. Countries with stricter enforcement of their tax policies in the model are also the ones that are judged to have better institutions and governments.

The negative relationship with the calibrated values of θ is robust to various measures of institutional quality by the World Bank as are the Government Effectiveness Index and the Rule of Law Index (Kaufmann et al [2006]).³⁴ Indices of Anti-Corruption by

³³The negative relationship is also robust to the exclusion of the two poorest among the 21 high-income OECD countries: Greece and Portugal.

³⁴ The Global Competitiveness Index is used as a subindex for the World Bank's Governance Indica-

Figure 4.5: θ chosen and Governance Quality



Data: Global Competitiveness Index (Kaufmann et al [2006])

Transparency International [2002] and the World Bank (Kaufmann et al [2006]) are also negatively related to the calibrated values of θ .³⁵ And percentages of affirmative answers to the question: “Are almost all compatriots cheating on taxes?” relate positively to the calibrated values of θ (World Value Survey [2000]).

The calibration of θ , the probability of getting caught evading taxes, reflects differences in quality of institutions across high-income countries. Consider again Austria and Italy. Given similar tax rates, differences in informal economic activity can only be explained by differences in enforcement of tax policy, in probabilities of getting caught. These different probabilities in the model have various empirical counterparts. According to cited indices of the World Bank (Kaufmann et al [2006]), in Austria there is a more effective government, a better rule of law, more competitiveness, and less corruption than in Italy where tax policies are enforced to a lesser extent. The probability of getting caught evading taxes is lower and the calibrated value of θ for Italy is higher and there is more informal economy.

tors [2006].

³⁵Dreher and Schneider [2006] find that when controlling for government quality corruption loses any relation to informality.

However, for some countries model-based measure and empirical measure of institutional quality differ strongly. Consider New Zealand and Germany. Both countries are evaluated similarly according to the Global Competitiveness Index, but their model-based measures of institutional quality are quite different.³⁶ Germany’s calibrated value for θ of 1.6302 indicates a higher probability of getting caught evading taxes and thus far better institutions than the calibrated value of 2.4194 for New Zealand.

These deviations suggest the following thought experiment. In this paper, values for θ were calibrated, given tax rates for each country, such that informal economy measures of the model coincide with Schneider’s [2002] estimates. Instead, one could have used empirical measures of institutional quality as inputs for θ to obtain a model-based measure of the informal economy. In this case, the probability of getting caught evading taxes would be the same in New Zealand and Germany; i.e. both countries would have the same value for θ . Differences in the informal economy in New Zealand and Germany could only be due to different tax rates. Given that tax rates in New Zealand and Germany are 20% and 53% respectively, assuming the same probability of getting caught evading taxes for a manager of ability z in both countries would result in very pronounced differences in model-based measures of informal economy. Analogously constructed model-based measures of informality for France and Australia as well as for Austria and Canada would also display more pronounced differences in informal economy across these countries than when considering Schneider [2002]’s estimates.

4.2 Allocation of Talent

Countries with stronger enforcement of tax policy have more productive firms. Various measures of productivity relate negatively to the calibrated values of θ . Table 4.3 displays values for average managerial talent, output per establishment, and size of smallest establishment together with the calibrated values for θ .³⁷

As enforcement decreases (and θ increases), all productivity measures decrease. Average managerial ability is lower and there is less output per establishment in countries with low enforcement of tax policies. Lack of enforcement is also related negatively to the size of the smallest establishment. In a recent paper, Laeven and Woodruff [2007] find that

³⁶Both countries also receive similar evaluations according to the Government Effectiveness Index, the Rule of Law Index and the Anti-Corruption Index by the World Bank (Kaufmann et al [2006]) and the Anti-Corruption Index by Transparency International [2002], with New Zealand doing slightly better on most of them.

³⁷ Average managerial ability is defined as: $\frac{\int_{z_t^*}^{\bar{z}_t} z f(z) dz}{\int_{z_t^*}^{\bar{z}_t} f(z) dz}$.

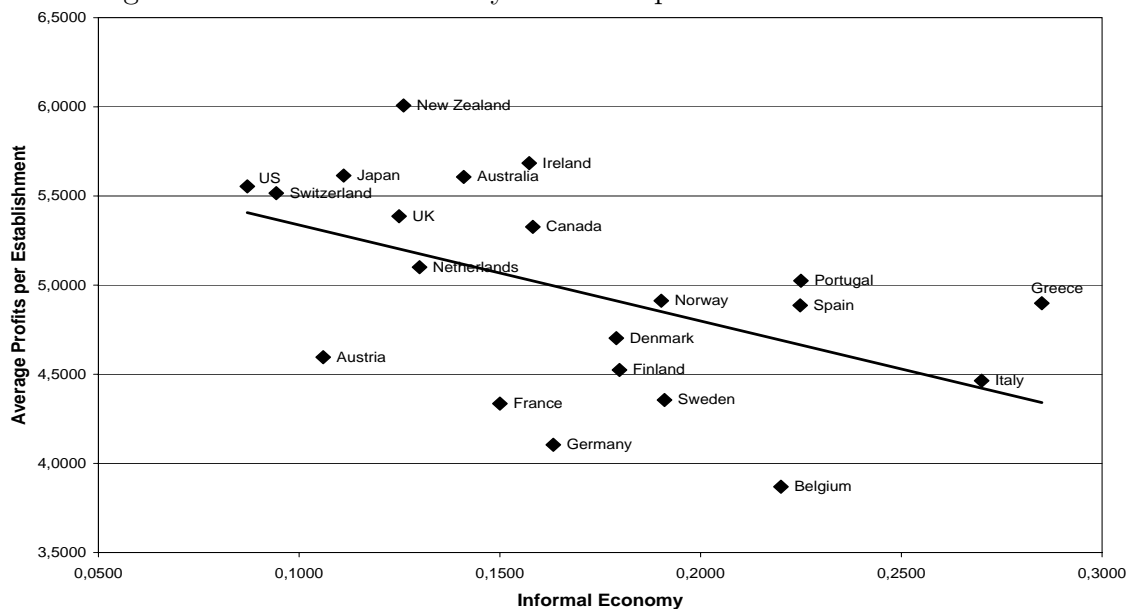
Table 4.3: Estimation Results for Productivity Measures*

Country	θ	Average Managerial Talent	Output per Establishment	Size of smallest Establishment $n(z^*)$
Austria	1.5290	61.9	28.87	1.8364
France	1.6150	60.7	28.15	1.7746
Germany	1.6302	60.6	28.10	1.7583
Netherlands	1.7795	59.2	27.32	1.6794
Finland	1.7931	59.2	27.32	1.6794
Sweden	1.8073	58.9	27.12	1.6600
Denmark	1.8370	58.9	27.12	1.6600
Belgium	1.8843	58.6	26.93	1.6407
Switzerland	1.8900	58.2	26.75	1.6232
US	1.8929	58.2	26.74	1.6222
UK	1.9040	58.2	26.74	1.6214
Norway	1.9543	57.9	26.54	1.6022
Canada	1.9984	57.6	26.35	1.5833
Japan	2.0060	57.6	26.35	1.5830
Australia	2.0975	57.2	26.15	1.5639
Spain	2.1260	57.1	26.08	1.5550
Portugal	2.1720	56.9	25.96	1.5448
Ireland	2.2378	56.4	25.68	1.5157
Italy	2.2865	56.4	25.68	1.5154
New Zealand	2.4164	55.8	25.37	1.4879
Greece	2.5025	55.5	25.17	1.4691

*Countries are ordered by decreasing degree of enforcement.

Mexican states with better legal systems have larger firms. In Greece, where enforcement of tax policies is low, the smallest establishment employs less than 80% of the workforce employed by the smallest establishment in Austria, a country with good enforcement of tax policies and a small informal economy. The negative relation of enforcement of tax policies and informal economy translates into a negative relation of all productivity measures with the informal economy. An additional indicator of a firm's productivity is the entrepreneurial income it generates. Figure 4.6 relates entrepreneurial income to informal economic activity. In countries with less informal economy, the entrepreneurial income is larger. Given that in the model wages are slightly positively related to the size of the informal economy, the negative relation between entrepreneurial income and informal economy suggests a larger skill premium in countries with less informal economy.

Figure 4.6: Informal Economy and Entrepreneurial Income in Model



5 Policy Experiments

What would be the effect of reforms that improve the enforcement of a country’s tax policy? In order to answer this question I consider two different policy experiments. In the first experiment I raise the efficiency of tax enforcement in each country to the level of the most efficient country. In the second experiment I assume that there is perfect enforcement of tax policy in all countries.

Increasing Efficiency Tax evaders in Austria run the highest risk of getting caught. That is why its informal economy is small despite relatively high tax rates. Austria has the fifth highest tax rate and the third smallest informal economy among the 21 countries considered. What would happen if all other countries adopted policies increasing the probability of getting caught for tax evaders to Austrian standards?

If all countries were as efficient as Austria in catching tax evaders, they would all substantially reduce their informal economy as shown in Table 5.4. Under Austrian efficiency in fighting tax evasion, two countries Ireland, and New Zealand, would completely eliminate their informal economy. For all countries tax revenues would go up. Increases in tax revenues would range from 2.4% in Germany to 21% in Greece. And even though revenues

from fines and seized profits disappear for countries without informality, in all countries total government revenues would also increase by 1% to 12%.

Table 5.4: Changes in results when increasing efficiency to Austrian standards*

Increase in:						
Country	Informal Economy (%-point)	Government Revenues (%) relative to Output		Average Firm Size (absolute)	Average Managerial Talent (%)	Output per Establishment (%)
		Taxes	Total			
Greece	-0.2251	21.25	12.2	1.20	11.5	14.7
Portugal	-0.1717	16.19	7.3	0.95	8.9	11.2
Italy	-0.1713	15.61	10.2	1.04	9.8	12.4
Spain	-0.1593	14.85	7.1	0.91	8.4	10.7
Ireland	-0.1573	15.59	4.0	1.04	9.8	12.4
Australia	-0.1399	14.08	3.4	0.88	8.2	10.4
Canada	-0.1293	12.62	3.9	0.82	7.6	9.6
New Zealand	-0.1260	12.70	2.9	1.14	10.9	13.8
Norway	-0.1247	11.73	4.9	0.76	6.9	8.8
Japan	-0.1089	10.85	2.5	0.82	7.6	9.6
UK	-0.0969	9.53	2.8	0.69	6.3	8.0
Denmark	-0.0935	8.61	3.7	0.57	5.1	6.4
Finland	-0.0799	7.27	3.3	0.51	4.5	5.7
Switzerland	-0.0773	7.61	2.2	0.69	6.3	7.9
Sweden	-0.0764	6.91	3.8	0.57	5.1	6.4
Belgium	-0.0747	6.51	4.9	0.63	5.7	7.2
US	-0.0732	7.32	2.1	0.69	6.3	7.9
Netherlands	-0.0725	6.85	2.3	0.51	4.5	5.7
France	-0.0284	2.53	1.2	0.23	2.0	2.5
Germany	-0.0277	2.39	1.4	0.25	2.2	2.7
Austria	0	0	0	0	0	0

*Countries are ordered by decreasing gains in terms of less informality.

In addition all countries would increase their firms' productivity and the average size of their establishments. Columns four to six of Table 5.4 display absolute increases in firm size, and percentage increases in average managerial talent and output per establishment. If Italy had Austria's level of enforcement of tax policy, the average Italian firm would have one more employee and a manager with an ability 10% greater than under the Italian level of enforcement. Output per establishment would increase by 12% in Italy.

Perfect Enforcement Under perfect enforcement of tax policy the informal economy disappears no matter how high tax rates are. If getting caught is a certain outcome no one tries to evade taxes. Profits net of taxes are always preferred to profits net of taxes less a fine. Tax revenues and total government revenues increase even more than when imposing Austria’s efficiency, as can be seen in Table 5.5.

Table 5.5: Changes in results under perfect enforcement of tax policies*

Increase in:						
Country	Government Revenues (%) relative to Output		Average Firm Size (absolute)	Average Managerial Talent (%)	Output per Establishment (%)	Total Factor Productivity (%)
	Taxes	Total				
Greece	28.46	13.6	2.23	21.1	27.1	2.6
Italy	26.96	13.6	3.03	27.6	35.7	3.4
Spain	22.39	8.6	1.99	18.0	23.2	2.3
Portugal	22.39	8.3	1.82	16.7	21.4	2.1
Belgium	22.04	11.3	4.40	37.1	48.6	4.4
Sweden	19.12	7.6	2.88	24.7	31.9	3.1
Norway	19.09	6.4	1.80	16.1	20.6	2.1
Finland	17.95	6.6	2.50	21.4	27.5	2.7
Denmark	17.88	6.2	2.16	18.8	24.0	2.4
Germany	16.31	6.6	3.37	27.6	35.7	3.4
Canada	15.84	4.2	1.22	11.1	14.1	1.4
Ireland	15.59	4.0	0.93	9.1	11.3	1.1
France	15.03	5.4	2.71	22.4	28.8	2.8
Australia	14.08	3.4	0.97	8.9	11.3	1.2
Netherlands	12.97	3.4	1.38	12.1	15.3	1.6
New Zealand	12.70	2.9	0.59	5.7	7.1	0.8
UK	12.55	3.1	1.09	9.9	12.5	1.3
Japan	11.13	2.5	0.90	8.3	10.5	1.1
Austria	10.56	3.3	2.15	17.4	22.3	2.2
Switzerland	9.48	2.3	0.93	8.4	10.6	1.1
US	8.71	2.1	0.93	8.4	10.7	1.1

*Countries are ordered by decreasing gains in terms of tax revenues.

Increases in tax revenues range from a low 8.7% in the US to a high 28.5% in Greece. It is not surprising that these numbers are identical to informal economy estimates from the benchmark economy. When imposing perfect enforcement of their tax policies, countries

eliminate informal economy and hence tax evasion. As profits are proportional to output, the resulting increase in tax revenue has to be equal to what constituted forgone tax revenues in the benchmark economy.

In addition all countries increase their firms' productivity. Columns four to six of Table 5.5 show absolute increases in average firm size in terms of employees and percentage increases in average managerial talent and output per establishment. Belgium is the country that gains most from perfect enforcement of its tax policy. The average Belgian firm would employ 4 more workers and produce almost 50% more and the average manager in Belgium would be almost 40% more talented than before. Also Germany and Italy would increase their average firm size and corresponding productivity measures substantially under perfect enforcement of their tax policies. On the other hand, for countries like New Zealand and Ireland there are relatively little changes in productivity under perfect enforcement of their tax policies. In New Zealand, the average firm expands its workforce by less than one employee, and produces only about 7.1% more output than before. The country's average managerial talent increases only slightly by less than 6%.

But perfect enforcement of tax policy does not only increase productivity on the firm level. The reform would also affect a country's aggregate productivity. Column seven of Table 5.5 shows percentage increases in total factor productivity (TFP) after perfect enforcement of tax policy.³⁸ Again Belgium is the country that gains most from the reform, whereas changes for New Zealand are only minor. Belgian total factor productivity would increase by more than 4%, compared to a TFP increase of only 0.8% in New Zealand.

Gains from perfect enforcement are positively related to a country's tax rate. New Zealand and Ireland are the two countries with the lowest tax rates among the 21 countries considered. Their gains from improved enforcement of tax policy are only minor. On the other hand countries with higher tax rates have a greater interest in perfect enforcement as they face higher opportunity costs in terms of forgone tax revenues and productivity losses. Imposing high tax rates on establishments of all sizes provides an incentive for individuals of low ability to join the workforce instead of setting up their own establishment. The higher the tax rate, the greater the fraction of those who want to become managers but are discouraged to do so. Because the after-tax profits they could make as managers are lower than the wage rate they receive as workers. As a result, the average quality of managers and thus the average size of establishments is larger in countries

³⁸TFP is defined as $\frac{Y}{(\int_{z_t^*}^{z_t^*} f(z)dz + \int_{z_t^*}^{z_t^*} z f(z)dz)^{(1-\omega)} K^\omega}$, where $\omega = \frac{RK}{Y}$ is the share of factor payments to capital.

with higher tax rates. However, with imperfect enforcement of tax policy some of these low ability individuals will opt for taking the risk, setting up an informal business, and evading taxes. This allows for more small and less productive establishments to arise and reduces average firm size as well as the average quality of managers. And it is here that countries with high tax rates take greater losses from imperfect enforcement of their tax policies. In the exact same sense they achieve higher gains in terms of productivity when imposing perfect compliance with tax laws. High tax rates, perfectly enforced, serve as a selection mechanism for better managers and bigger firms as they force more low ability individuals into the workforce and discourage the set-up of small establishments.

6 Conclusion

The informal economy is large and growing in high-income countries. Most models of the informal economy focus on developing countries. However, the informal economy in high-income countries is different. Rather than linked to labor market issues as in developing countries, the informal economy in high-income countries is primarily linked to tax evasion. The positive relationship between tax rates and size of the informal economy and the negative relationship between informal economy and various indices of institutional quality across high-income countries constitute the building blocks for a model of the informal economy in high-income countries. In this paper I build a model economy where tax rates, tax evasion, and governance can account for differences in the informal economy across high-income countries.

A calibrated version of the model replicates well informal economic activity in high-income countries. Although tax rates are crucial for explaining the observed differences in informal economy, the quality of governance, the extent to which these tax rates are enforced, also plays an important role. Given data on tax rates and the informal economy, probabilities of getting caught evading taxes for each country are obtained. These model-based measures of institutional quality are positively related to various empirical measures of institutional quality.

Reducing the informal economy turns out to be more than just a question of fighting tax evasion. Policy experiments show that by improving the enforcement of their tax policies countries do not only reduce informality, but are also able to sustain larger and more productive firms and better managers. As a result countries with stronger enforcement of tax policy are more productive on the aggregate.

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