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A theoretical examination of tax evasion among the self-employed

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Abstract. *Informal activities are looked upon by most governments as a loss in potential revenue. An extension of the Ramsey model is presented that includes an income tax and a parameter that allows for the evasion of part or all of those taxes. The model shows the decrease in government revenue and long term levels of consumption and capital. However, the growth rate of capital and consumption remains unaffected by informal activities. The model does not include any assumptions about how individuals will choose to spend the money they save by evading taxes.*

Keywords: Tax Evasion, Self-Employment, Long-run growth, Ramsey-Cass-Koopman, Optimal Growth, Entrepreneurship

JEL Classification: L26, H26, E26.

Introduction

Self-employed individuals have many difficult decisions to make as they decide to start their own venture and the decision making continues as they begin operating the firm. This paper focuses on one of those decisions, which is, do I participate in the formal or the informal sector of the economy? A self-employed person can participate in informal activities in a variety of manners, for example, hiring informal labor, buying informal inputs, selling in informal markets and evading taxes. Governments have tried over time to discourage these types of activities, even though there may be a degree of informal activity that contributes significantly to economic growth.

Take the model presented here as a marginal addition to the theoretical investigation of tax evasion, specifically as it relates to the self-employed, and how the effects are felt throughout the economy. This model employs the basic Ramsey-Cass-Koopman optimal growth model with government involvement as presented in Blanchard and Fischer (1989). The government involvement in this model is modeled by an income tax and the difference in the model presented in this paper is the addition of a parameter which allows self-employed individuals to evade any percentage of the income tax. The model shows that tax evasion among the self-employed decreases government revenue, levels of capital and consumption but does not affect the long term growth rate in the economy.

A major argument as to why individuals decide to become self-employed is because of the ease at which they can avoid paying taxes. Falsifying income and botching deductions are just a couple of the ways in which it may be easier to evade taxes as a self-employed individual. Often times, small businesses may receive payments in cash and this income is difficult to trace, therefore it is difficult to prove that tax evasion is taking place.

One possible motivation for choosing entrepreneurship, or self-employment, over wage-earning employment is the ease of evading taxes, as noted by Andreoni et al. (1998). A self-employed, sole proprietor can underreport income and overstate deductions more easily than someone employed as a wage-earner. If the perceived probability of being caught is low and the penalty for underreporting is low then the self-employed may choose to risk underreporting if they can avoid paying the taxes on the income. If the self-employed behaved in this manner then one would believe that lower taxes could increase self-employment levels. Fölster utilized data from OECD countries and found that national tax burden and self-employment as a percentage of GDP were negatively related. It is difficult to determine if this actually supports the case where entrepreneurs choose to become so to avoid taxes.

Parker and Robson (2004) also examined OECD data, specifically from 1972 to 1996, to determine what explains international differences in rates of self-employments. The cross country analysis provided an interesting comparison between countries and the panel dataset allowed the researchers to examine the countries over time. The authors showed how multiple explanatory variables cointegrated with the self-employment variable. The results suggested that average income tax rates and self-employment rates are positively and significantly related. These findings supported an earlier study by Robson and Wren (1999). Taken at face value, the implications of such studies are that as individuals face higher tax rates they are more likely to enter into self-employment. This study offers more specifics about which taxes may be related to self-employment when compare to Fölster's study. However, the cross country macro level data sets, such as the OECD have many weaknesses. For example, reporting methods are not standardized throughout the member countries. Therefore, an individual that is categorized as self-employed in one country may not be categorized as such in another. Torrini (2005) also used OECD data to take a closer look at the relationship between public policy and self-employment. One of the results is that unemployment benefits are negatively related to self-employment, which suggests that unemployed workers with high benefit rates have little incentive to start their own business. However, these results were sensitive to model specifications.

Donald Bruce (2000) investigated the dynamics of the U.S. tax system and individuals' choice of self-employment. The Panel Study of Income Dynamics provided a good panel of U.S. data and his data set covered 1970 through 1991. The author was interested in determining the benefit that a self-employed person gains from being non-compliant. Differential taxes, specifically between wage-earning and the self-employed, were a focus of the study. Bruce computed the tax differentials for the transition from wage-earning into self-employment. The findings suggest that higher tax differentials led to a reduction in entry into self-employment. However, Bruce does not suggest that entrepreneurs choose to do so to avoid paying higher taxes. One implication of the study is that higher marginal tax rates for the self-employed could be associated with more deductions for filing as a business. Therefore, the higher marginal tax rates increase the benefits for the self-employed.

A further step in being able to tailor policies which create disincentives for tax evasion by the self-employed is to understand which of the self-employed are more likely to evade taxes. This information gives policymakers power to create specific policies that will focus on the sector of the population that are intended to be affected by the policy. Schuetze (2002) conducted a study that mainly focused on the demographic differences among the self-employed and which were more likely to be non-compliant. The data was collected from the Canadian Family Expenditure Surveys and covered the time span of 1969 to 1992. One major finding of the study is that those who were self-employed in the construction industry were more likely to be non-compliant, which may be due to the ease of underreporting in such industries. The construction industry was followed closely by service industries. Another interesting finding is that the level of non-compliance decreases with age. Also households that were headed by two self-employed individuals (as opposed to one) concealed less income.

Model

The model below is an extension of the Ramsey-Cass-Koopman optimal growth model by including an income tax and the ability for the self-employed to evade this tax. The ability to more easily evade taxes is an often cited reason that individuals choose to become self-employed. Also, with regards to access to certain markets, the self-employed are treated differently than small business owners. For our discussion and for the implications of this model, we are only referring to the self-employed and not those who own small businesses. Therefore, the self-employed are agents in this model and not firms. This model specifically focuses how an income and tax evasion is felt throughout the economy. The model includes the self-employed and firms interacting in a marketplace.

First, the self-employed maximize the constant relative risk aversion utility function below. For simplicity, utility is only a function of consumption. c_t is total consumption by a representative agent at time *t*.

$$u(c_t) = \frac{{c_t}^{1-\theta} - 1}{1-\theta} \tag{1}$$

To maximize utility, a self-employed individual solves the maximization problem below.

$$\max_{c_t} \int_0^{\infty} \frac{{c_t}^{1-\theta} - 1}{1-\theta} e^{-(\rho-n)t} dt \tag{2}$$

Subject to the following constraints

$$\dot{a}_t = (1 - \phi\tau)[w_t + r_t a_t] - c_t - n a_t$$

$$a_0 = a_0$$

$$a_t \geq -B \ \forall t$$

$$c_t \geq 0 \ \forall t$$

The first constraint shows how the self-employed's assets, a_t, accumulate over time. ρ is the discount rate w_t is the wages the self-employed earns from labor. r_t is the interest earned on assets. na_t is the dilution of assets due to population growth. Therefore, $[w_t + r_t a_t]$ is the income of a representative self-employed agent. τ is the income tax rate faced by all of the self-employed in the model. ϕ is the amount of taxes which they evade, $0 > \phi > 1$. A lower value for this parameter represents a higher level of tax evasion. As ϕ approaches one, the self-employed is paying more of the tax rate and as it approaches zero the self-employed agent is paying less. This shows that a high level of tax evasion leads to more income for the agent. ϕ can be directly affected by government policy. For example, as penalties for being caught evading taxes increases an agent is more likely to evade a lower amount of taxes. If the probability of being caught increases then the self-employed agent is again more likely to evade a lower amount of taxes.

The second constraint shows that the self-employed agent starts with a given asset level at time zero. The third condition constrains the self-employed agent from running a Ponzi scheme. This condition maintains that at a given point in time an agent can no longer borrow. The final constraint restricts consumption levels to be positive at all times. To solve the maximization problem, the Hamiltonian equation below is used.

$$H_t = \frac{{c_t}^{1-\theta} - 1}{1-\theta} e^{-\rho t} + \mu_t[(1 - \phi\tau)[w_t + r_t a_t] - c_t - n a_t] \tag{3}$$

μ_t is the marginal value of an agent's assets at time *t*. An agent's utility would increase by μ_t if they had one more unit of assets. The Hamiltonian, H_t, is the utility level, received from income, of a given agent at time *t*. The agent receives utility from their consumption in the present and receives future utility from their current savings. After first differentiating the Hamiltonian, the first order conditions (FOCs) below become evident.

$$\partial H_t / \partial c_t = 0 = c_t{}^{-\theta} e^{-\rho t} - \mu_t \Rightarrow \mu_t = c_t{}^{-\theta} e^{-(\rho - n)t} \tag{4}$$

$$\partial H_t / \partial a_t = -\dot{\mu}_t = \mu_t[(1 - \phi\tau)r_t] - n) \tag{5}$$

$$\partial H_t / \partial \mu_t = \dot{a}_t = (1 - \phi\tau)[w_t + r_t a_t] - c_t - n a_t \tag{6}$$

$$TVC\text{: } \lim_{t \to \infty} \mu_t a_t = 0 \tag{7}$$

The transversality condition (*TVC)* keeps the system stable and forces that as times approaches infinity either the marginal value of assets or the level assets (or both) must be equal to zero. Now, equations (4) and (5) can be used to derive the "Euler Equation." After logging and differentiating (4), equation (8) is the result.

$$\theta \frac{\dot{c}_t}{c_t} + \rho - n = -\frac{\dot{\mu}_t}{\mu_t} \tag{8}$$

And by rearranging (5), a different representation of $-\frac{\dot{\mu}_t}{\mu_t}$ is found and represented in equation (9).

$$\frac{\dot{\mu}_t}{\mu_t} = r_t - n \tag{9}$$

Setting (8) and (9) equal gives the "Euler Equation" seen in equation (10).

$$\frac{\dot{c}_t}{c_t} = \frac{1}{\theta}[(1 - \phi\tau)r_t - \rho] \tag{10}$$

There are two opposing forces on consumption for this self-employed agent. The agent is impatient and would rather consume today than save, however, the positive interest rate incentivizes the agent to save (invest) now to be able to consume even more in the future. Also, notice that if the interest rate exactly equals the discount rate then the agent will save just enough to keep consumption levels constant over time. If the interest rate is greater than the discount rate then the agent receives a higher reward for saving and therefore the agent consumes less today so they can consume more tomorrow. On the other hand, if the reward to saving is less then the agent will consume more today and consumption will decrease over time. The agent also has to choose whether to participate in informal activities by choosing how much tax to evade.

With equation (10) and our restraint on asset accumulation, there are two differential equations for consumption and assets, show in equations (11) and (12).

$$\dot{c}_t = \frac{c_t}{\theta}[(1-\phi\tau)r_t - \rho] \tag{11}$$

$$\dot{a}_t = (1-\phi\tau)[w_t + r_t a_t] - c_t - n a_t. \tag{12}$$

However, the phase diagrams cannot be drawn because wages and returns to investing in assets are determined in the marketplace and therefore the behavior of firms needs to be examined. Notice that when adding income tax rate and the ability to evade taxes to the model the agent now does not care about the interest rate on investments; he or she is more interested in the "after-tax" interest rate, which is the rate they will actually receive on their investments. This after-tax rate is dependent not only on the tax rate but also on the level of tax evasion.

The firms' solutions (equations (13) and (14)) and most of the market clearing conditions (equations (15) – (17)) are the same as in the original version of this model.

$$F_K(k_t, A_t) = R_t \tag{13}$$

$$F(k_t, A_t) - k_t F_K(k_t, A_t) = w_t \tag{14}$$

$$N_t = L_t \tag{15}$$

$$a_t = k_t \tag{16}$$

$$R_t = 1 - \phi\tau r_t + \delta \tag{17}$$

$$\phi\tau[w_t + r_t a_t] = \varphi_t. \tag{18}$$

Equation (15) restricts the labor market to equal population in the model. Equation (16) shows that the banks hold all of the agents' assets and rents the capital to entrepreneurs. δ is the depreciation rate of capital. Therefore, equation (17) shows that a competitive bank makes zero profits, assuming constant returns to scale. Equation (18) is the government's budget constraint and includes the parameter for tax evasion. It holds by definition. It just says that φ_t is the revenue the government will collect given this income tax rate. Notice that it is dependent on the level of tax evasion. If a representative agent evades a high level of taxes then the government has lower income. Therefore, the government, in this model, should work to deter agents from evading taxes. This could be done by higher penalties or a ensuring a higher probability of being caught.

Combining equations these equations gives us a price free representation of the steady-state levels of consumption and capital as seen in equations (19) and (20) respectively.

$$\dot{c}_t = \frac{c_t}{\theta}[(1-\phi\tau)(F_K(k_t, A_t) - \delta) - \rho] \tag{19}$$

$$\dot{k}_t = (1-\phi\tau)[F(k_t, A_t) - \delta k_t] - c_t. \tag{20}$$

Now that prices are gone, the equations are one step closer to being able to be displayed in a phase diagram. The only part of the equations that keep this from happening is the growth in productivity. This variable is changing over time; therefore the two sets of equations are not yet autonomous. To derive the necessary equations, new variables are defined below.

$$\dot{\hat{c}}_t = \frac{\dot{c}_t}{A_t} - g\hat{c}_t \tag{21}$$

$$\dot{\hat{k}}_t = \frac{\dot{k}_t}{A_t} - g\hat{k}_t \tag{22}$$

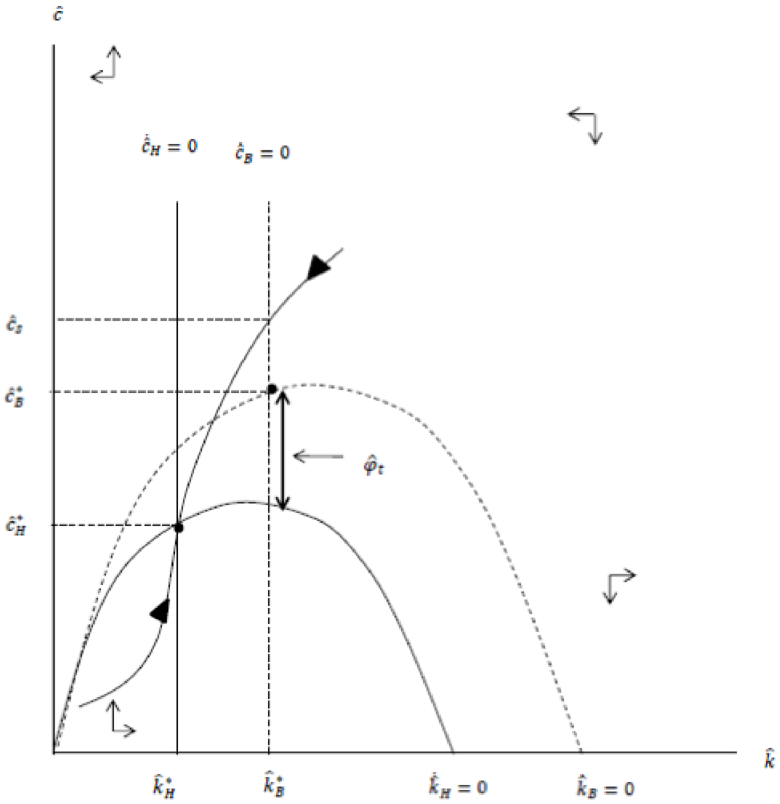
$g = \frac{\dot{A}_t}{A_t}$. Therefore, the system of differential equations can be seen in equations (23) and (24).

$$\dot{\hat{c}}_t = \frac{\hat{c}_t}{\theta}\left[(1-\phi\tau)(f'(\hat{k}_t) - \delta - \rho - \theta g\right] \tag{23}$$

$$\dot{\hat{k}}_t = (1-\phi\tau)\left[f\left(\hat{k}_t\right) - \delta\hat{k}_t\right] - \hat{c}_t - g\hat{k}_t. \tag{24}$$

The phase diagram for these two equations is show in 1.

Figure 1. *Phase Diagram*



The interesting implications for this model is the level of tax evasion and its effects throughout the economy. For comparative purposes, a baseline, indexed with a *B* on the graph, level of tax evasion is assumed and then this level is increased. The increased level of evasion is indexed with an *H*. This allows for the model to show how an increase in the level of evasion affects the economy. The tax rate faced by agents in this model is assumed to be constant throughout the analysis. The isocline for the increased level of evasion is rotated downward when compared to the isocline of the baseline level of tax evasion. Due to this difference between the isoclines, the higher level of tax evasion leads to lower steady-state levels of capital and consumption.

To see the effects of an increase in tax evasion on capital and consumption levels over time it is useful to take a look at the time paths for these two variables. At the baseline level of tax evasion, the economy is in a steady state. There are two effects at play here, the substitution and income effects. The substitution effect is evident when a lower level of tax evasion leads to a decrease in an agent's return on savings, therefore it is more worthwhile to consume today. But the income effect is leading to a different outcome, where the lower level of evasion leads to the agent becoming poorer therefore they are forced to consume less today. To be able to draw the time paths, one of the effects has to dominate. Moving forward, the substitution effect overrides the income effect, therefore, $\hat{c}_S > \hat{c}_B^*$. Before the time paths for capital and consumption can be drawn, one final illustration must be made. Remember $\hat{k} = \frac{k}{A}$, therefore $k = \hat{k}A$ and after logging and differentiating this representation of capital it can be seen that Equation (25) shows that

$$\frac{\dot{k}}{k} = \frac{\dot{\hat{k}}}{\hat{k}} + \frac{\dot{A}}{A} \Longrightarrow \gamma_k = \gamma_{\hat{k}} + g \quad (25)$$

when $\hat{k}$ is at its steady-state level, when $\hat{k} = \hat{k}^*$, the economy never stops accumulating capital. And this growth in capital is exactly equal to productivity growth. The same analysis can be done for consumption and the results tell the same story, $\gamma_c = \gamma_{\hat{c}} + g$. See Figures 2 and 3 for the time paths of capital and consumption respectively.

Figure 2. *Time Path of Capital*

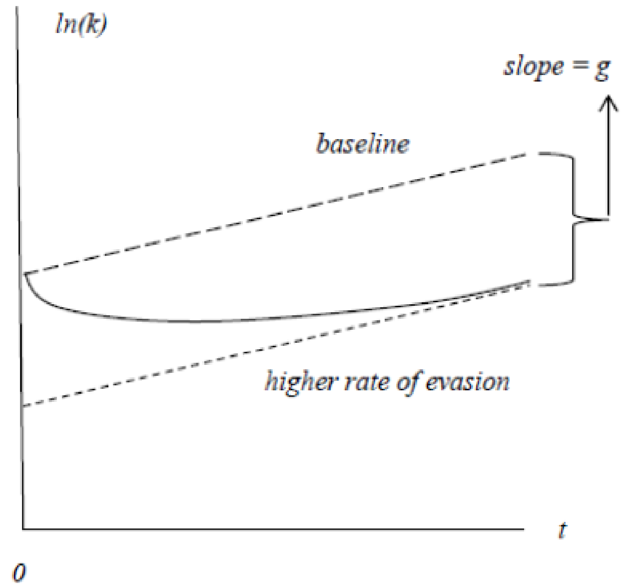
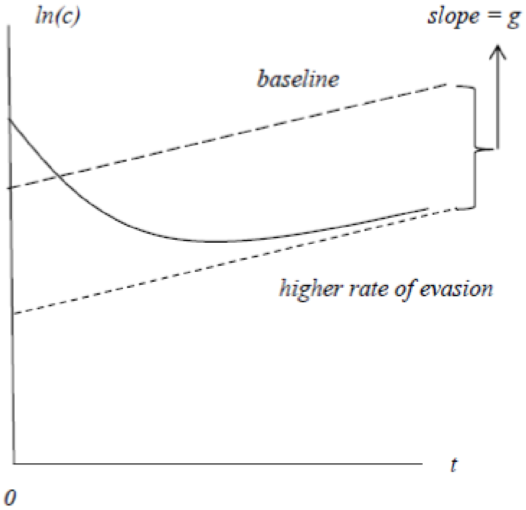


Figure 3. *Time Path of Consumption*



The results seen in the time paths show that the tax evasion activities do not affect the long term growth rate, which is only dependent on productivity growth. A higher rate of tax evasion leads to a lower level of capital per worker and, since the substitution effect outweighs the income effect, tax evasion leads to lower levels of consumption. No assumptions are made here as to what the self-employed agents will do with the income that they save from evading taxes.

How does this affect government revenue? As the level of tax evasion increases, $\phi \rightarrow 0$, the amount of government revenue decreases. Remember, $\varphi_t = \phi\tau[w_t + r_t a_t]$, and define, just as before $\hat{\varphi} = \frac{\varphi}{A}$. Now by looking at the phase diagram above it is easy to see the difference in government revenue due to tax evasion activities, $\hat{\varphi}_t$.

It is important to note that the previous model is only the beginning of the theoretical investigation of informal activities. The Ramsey model, and its possible extensions, offers a variety of ways to investigate the informal economy. For example, a functional form for the production function could be assumed. Also, the production function for formal production and informal production could be different and a producer would have to choose the output level that would maximize his or her profits. Producers in the models could also be assumed only to be entrepreneurs. Those types of extensions are future avenues of research.

Conclusion

All economies in the world face some level of informal activities, even those that have been historically considered ideal economic environments. It does not matter whether an economy is experiencing high rates of growth and is among the most developed in the world or if the economy is facing stagnant growth rates and is considered to be underdeveloped. There is no clear picture as to whether informal activities are indicators of a flourishing entrepreneurial environment or if it is a sign of an overly bureaucratic system. More often than not governments attempt to reduce the amount of informal economic activity that is happening in their economy. However, if that is the case and at the same time self-employed choose to be so to evade taxes then the government is working against the potential entrepreneurs in the economy. It is important to know, however not included in this model, what a tax evader does with the extra income that they save from evading taxes. The model here gives a simple look at the effects of tax evasion among the self-employed throughout the economy. One of the most obvious results is that as the level of tax evasion increases, government revenue decreases. The model also shows that investment into capital and levels of consumption will decrease as more taxes are evaded. However, the long term growth rate of the economy remains unchanged as a result of tax evasion. A possible extension of the model is to include assumptions about how the self-employed use the extra income they receive from evading taxes.

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