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Indeterminacy, underground activities and tax evasion ☆

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A B S T R A C T

This paper introduces underground activities and tax evasion into a one-sector dynamic general equilibrium model with aggregate external effects. The model presents a novel mechanism driving the self-fulfilling prophecies, which is characterized by well behaved (downward sloping) labor demand schedules. This mechanism differs from the customary one, and it is complementary to it. Compared to traditional labor market income, the income derived from underground labor activity is subject to a lower expected tax rate when considering both the probability of detection and the evasion penalty. During a belief-driven expansion, the household allocates more time to both traditional and underground labor supply. In equilibrium, this action serves to lower the effective labor tax rate faced by the household, thus providing stimulus to aggregate labor supply so as to make the initial expansion self-fulfilling. The mechanism here is akin to a "regressive tax"; the household's effective tax rate depends negatively on the level of total labor income. We argue that an underground sector, and the associated tax evasion, offer a good economic rationale for a regressive tax rate.

1. Introduction

This paper introduces underground activities and tax evasion into a one-sector dynamic general equilibrium model with external effects, and shows that these phenomena are a possible source of local indeterminacy of the equilibrium path. We present a one-sector dynamic general equilibrium model in which there are three agents: firms, households and a government; furthermore, there is one homogeneous consumption good and three production factors: regular labor, underground labor, and a capital stock. Government levies income taxes on regularly produced income flows, and labor taxes on regular labor services, and balances its budget (in expected terms) for each period. Firms and households, being subject to distortionary taxation, use the underground labor input to evade taxes. Government faces tax evasion originating from the underground sector, and coordinates strategy to address abusive tax evasion schemes.

The introduction of underground labor services eases the necessity of having an upward sloping labor demand schedules.[1] In addition, a plausibly-calibrated underground sector can reduce the required degree on increasing returns for indeterminacy to around 1.4, as compared to a value of about 1.6 in a model without underground labor (recent estimates suggest that the United States economy returns to scale are no larger than 1.2; see, among the others, Basu and Fernald, 1997; Sbordone, 1997; Jimenez and Marchetti, 2002). Still notice that the reduction of the aggregate degree of returns to scale is not the main goal of the paper, especially because the literature proposes several mechanisms capable of reducing the required degree of returns to scale for indeterminacy to figures even smaller than the actual one. These mechanisms can be summarised into three broad classes: i) the introduction of factor hoarding within one-sector models (e.g. Wen, 1998; Weder, 2003)[2]; ii) the explicit specification of a second sector (e.g. Benhabib and Farmer, 1996; Perli, 1998;

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[1] There is no universal agreement on what defines the underground economy. Most recent studies use one of more of the following definitions: (a) unrecorded economy (failing to fully or properly record economic activity, such as hiring workers off-the-book); (b) unreported economy (legal activity meant to evade the tax code); (c) illegal economy (trading in illegal goods and services). Obviously, the difficulty in defining the sector extends to the estimation of its size. We are concerned with the size of the underground economy as encompassing activities which are otherwise legal but go unreported or unrecorded.

[2] The introduction of factor hoarding can sensibly reduce the amount of externality needed for having indeterminacy. For instance, in a model with variable capacity utilization, Weder (2003) shows how indeterminacy can arise by assuming low externalities coupled with factor hoarding. Analogous results can be obtained by introducing the need for firms to devote a share of labor services to the maintenance of capital stock, as in Guo and Lansing (2004).

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Nishimura and Venditti, 2007);[3] iii) the specification of non-separable preferences for consumption and labor (e.g. Bennet and Farmer, 2000; Hintermaier, 2003; Pintus, 2007), or the use of a linear homogeneous utility function (i.e. Lloyd-Braga et al., 2006). In some of these contributes (e.g., Pintus, 2006; Lloyd-Braga et al., 2006) an upward sloping labor demand function is not even required. Our main interest is in the theoretical mechanism operating under tax evasion. Of course the model could accommodate several extensions including various mechanisms capable to further reduce the degree of increasing returns to scale needed for indeterminacy.

The economic mechanism is triggered by the reallocation of resources to the underground sector to avoid the excess tax burden. This mechanism differs from the customary one, and it is complementary to it. It turns out that prophecies of a higher expected income, triggered by a sunspot shock, are self-fulfilled through a resource reallocation toward the underground labor services; this allows to evade taxes, and therefore to have additional resources (the tax wedge) for satisfying the higher desired consumption profile.

In other words, compared to traditional labor market income, the income derived from underground labor activity is subject to a lower expected tax rate when considering both the probability of detection and the evasion penalty. During a belief-driven expansion, the household allocates more time to both traditional and underground labor supply. In equilibrium, this action serves to lower the effective labor tax rate faced by the household, thus providing stimulus to aggregate labor supply so as to make the initial expansion self-fulfilling.

The mechanism here is akin to a “regressive tax”; the household's effective tax rate depends negatively on the level of total labor income. We argue that an underground sector, and the associated tax evasion, offer a good economic rationale for a regressive tax rate.[4]

The model is calibrated for the United States economy, where the size of the underground economy ranges between 5% of GNP (Tanzi, 1980) and 9% of GDP (Schneider and Enste, 2000; Paglin, 1994). Even though these figures are below the OECD countries average (17%, according to Schneider and Enste, 2000), they still represent a significant amount of resources absconded from tax collection. Notice, more importantly, that even a tiny underground sector matters for inducing local indeterminacy of the equilibrium path; and the United States underground sector's size is above this threshold.

The paper is organized as follows. Section 2 details the model; Section 3 presents the topological properties of stationary state, discusses conditions for indeterminacy and describes the theoretical mechanism. Next Section 4, presents the model's implication for the overall level of returns to scale, and Section 5 checks the results' robustness through a sensitivity analysis. Finally Section 6 concludes, while proofs and derivations are included in the Appendix.

2. The model

2.1. Firms

Assume that there exists a continuum of firms, uniformly distributed over the unit interval. Production technology for the homogenous good uses three inputs: physical capital, regular labor services, and underground labor services. The production function of firm $j \in [0,1]$ reads:

$$y_t^j = A_t (k_t^j)^{\alpha} (n_{M,t}^j)^{1-\alpha-\rho} (n_{U,t}^j)^{\rho}, \ \alpha, \rho \in (0,1), \tag{1}$$

where k_t^j denotes capital stock, $n_{M,t}^j$ is regular labor, $n_{U,t}^j$ represents underground labor, and the quantity A_t is an aggregate production externality (defined below). A different modelling option is that of Busato and Chiarini (2004), who set up a two sector model with underground economy; as they show that the model has an interior solution for a standard parametrization, we think that the use of a one-sector formulation as in Eq. (1) is not a strong assumption. The production function follows a “*moonlighting production scheme*”, where underground labor services use the same capital stock that is used by regular labor.[5] We could imagine, for example, that the same firm produces in the regular economy by day, and in the underground economy by night. The model implicitly assumes that firms always use some underground labor services. In this regard this model applies to an economy where there exists at least one firm hiring at least one worker in the underground labor market. We think, however, that this is still a general formulation, because it would be difficult to find economies without any form of tax evasion. In addition, official GDP estimates incorporate an estimate of the contribution produced by the underground sector.

The aggregate production externality A_t is defined below:

$$A_t = \underbrace{\{(K_t^{\alpha} N_{M,t}^{1-\alpha-\rho}\}^{\eta}}_{\text{Marshallian Ext.}} \underbrace{\{N_{U,t}^{\rho}\}^{\zeta}}_{\text{Underground Labor Ext.}} \quad \zeta, \eta \geq 0, \zeta \gtrless \eta, \tag{2}$$

where capital letters denote aggregate quantities (in a perfect foresight symmetric equilibrium; details below).[6] We distinguish between the “regular” externality $\{(K_t^{\alpha} N_{M,t}^{1-\alpha-\rho}\}^{\eta}$ that is related to the well known Marshallian effect, and the underground labor external effect $\{N_{U,t}^{\rho}\}^{\zeta}$; as the model has just one homogenous good, ζ represents an “input specific” externality, rather than a sector specific one. Once we allow for labor heterogeneity at the firm and individuals' level, it is natural to do the same at the aggregate one.[7] The underground externality can be tied, for example, to the fact that there are young pensioners entering the underground labor market. These workers have a high productivity, but choose to work in the underground sector for an additional income, while keeping their pensions at the same time. Needless to say, this would not be possible if they were hired under a regular labor contract. There is more. A significant part of the underground labor force is made of immigrants,

[3] The introduction of a second sector solves this problem. Perli (1998) explicitly introduces a household production sector into a model with externalities and increasing returns. He shows that cycles driven by self-fulfilling prophecies can exist with external effects in labor and capital that are sensibly smaller than previously thought. He also shows that the equilibrium labor demand of his model is well behaved, in the sense that it slopes down. A similar result (indeterminacy with low externalities) has been obtained by Benhabib and Farmer (1996) in a two sector model with sector specific instead of aggregate externalities. Their model, however, may have equilibria where consumption and hours are negatively correlated when the driving force is a sunspot rather than a technology shock.

[4] As expected, the explicit introduction of distortionary taxation combined with these phenomena into a one-sector general equilibrium model allows to reduce the aggregate degree of increasing returns required for indeterminacy, and for having well behaved demand schedules for production inputs (in the sense that they slope down).

[5] See Bajada (1999) and Cowell (1990) for a detailed definition of moonlighting production scheme.

[6] The aggregate value of a variable z_j is defined as: $Z = \int_0^1 (z_j) dj$.

[7] This formulation also adds generality to the analysis: when $\eta = \zeta$ and there are neither tax evasion nor distortionary taxations, the model reduces to one of Farmer and Guo's.