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Francesco Busato
Bruno Chiarini
Elisabetta Marzano

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Abstract

Informal firms play a crucial role in both developing and developed countries, and there is evidence of a larger presence of moonlighting firms over ghost firms. The former are firms that operate simultaneously in the official and unofficial sectors, whereas the ghost firms undertake their production only underground. In order to deal with this evidence, through an ad-hoc assumption we represent a specific technological advantage of moonlighting firms over ghost firms, modelled through an aggregate-capital externality. In this setting we examine the steady state effect of fiscal policies aimed to support firms, in particular investment subsidies and tax allowances, on firm size and underground production. Among the main results, a tax cut (rise), induces the moonlighting firm to engage in more (less) official production. Contrary to the presumption that subsidies may also be useful for pushing firms to operate over ground, in the presence of moonlighting technology, the incentives to improve capital stock turn out to be counterproductive in that they increase the unofficial economy overall.

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Francesco Busato
Department of Economic Studies
University of Naples Parthenope
Italy
busato@uniparthenope.it

Bruno Chiarini
Department of Economic Studies
University of Naples Parthenope
Italy
chiarini@uniparthenope.it

Elisabetta Marzano
Department of Economic Studies
University of Naples Parthenope
Italy
elisabetta.marzano@uniparthenope.it

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1.Introduction

This paper aims to investigate the effects of the public policies on the partially registered firms (the moonlighting firm), by which we mean a firm that operates simultaneously in the official and unofficial sectors, using the same stock of capital while evading taxation for the activities that are undertaken underground. Such a firm is able to evade taxation, like ghost firms that operate only in the underground economy, but in addition, it can exploit technological/institutional advantages conferred by its above ground activities.[2]

The paper presents an optimal-investment model in which a representative firm, who produces a homogenous output with two different technologies, maximizes its expected cash flow, choosing simultaneously an optimal combination of aggregate capital stock (i.e. firm size) and its allocation between official and unofficial technology, conditional on a set of fiscal policy and technological parameters. We have a non-linear system described in a three-dimensional space and in order to find the steady state characteristics we calibrate and simulate the system.

The paper examines the impact of fiscal policies, in particular investment subsidies and tax allowances, on the firm's size and its unreported production. Subsidy programmes and tax advantages for infant industries or depressed areas are often justified because the industry is not competitive enough and prices do not show full flexibility. Granting capital subsidies and tax allowances to firms also has important implications for underground activities and tax evasion, since very often the main recipients of these policies are small and medium sized enterprises.

Section 2 reports the model whereas the steady state fiscal policy effects are commented in Section 3.

2. The Model

2.1 Tax Evasion

Each firm produces a homogeneous good with two different technologies, one used in the official sector and the other in the unofficial sector.

We define total output as Y, and its two components, officially and unofficially produced output, respectively as Y^O and Y^U. For a given triplet of tax-enforcement parameters (ρ, τ, s), i.e., a proportional sales tax rate, τ, a fixed and exogenous probability of being detected and fined, ρ, and a fixed surcharge s for income discovered (by the authorities) to be concealed, then the expected after-tax revenues are:

$$(1-\tau)Y + \tau(1-\rho s)Y^U \qquad s > 1, \tag{1}$$

where the second term in **Eq. 1** stands for the expected return of tax evasion, and is given by: τ with probability $(1-\rho)$ and $(\tau - \tau s)$ with probability ρ. The two extreme situations of full compliance and total evasion occur, respectively, when $\tau = 0$ and, in the case of confiscatory taxation, $\tau = 1$. We are interested in studying the implications of tax evasion and assume that $0 < \tau < 1$; $(1-\rho s) > 0$. These conditions ensure that firms would have an incentive to produce both officially and unofficially.

2.2 The Moonlighting production structure

It is often assumed that firms operating in the underground economy are less efficient than regular

[2] World Bank (2000) point out that more than 60% of 3,818 interviewed enterprises, distributed over 54 countries, are used to operating both in the official and unofficial sector.

ones;[3] although this is plausible, we argue that firms operating simultaneously in the official and unofficial sectors (moonlighter) might overcome some of the shortcomings of fully underground production (ghost).[4]

In our setting, focused on small firms, the firm optimal size, K, is determined by understating the true value of the tax base (sales), by allocating only a share of total capital, μ, to honestly stated output. We model an external effect generated by underreporting, and not exploitable by wholly underground (ghost) firms, which we call the *moonlighting effect*. The latter, in a simplified framework with a single input of production, can be modelled as a total capital externality, allowing Total Factor Productivity (TFP) to be endogenous:

$$Y_{MOONL} = Y^O + Y^U = B(\mu K)^a + B'[(1-\mu)K]^a, \qquad B' = K^{a\sigma} \tag{2}$$

where a is the capital elasticity, B is the exogenous TFP, and B' is the endogenous TFP, modelled as a function of the firm-wide use of capital. The following condition suggests that the size of the externality (the moonlighting effect σ) should be sufficiently low as to ensure that returns to scale are not increasing at the firm level, $0 < \sigma < \frac{1-a}{a}$. Output elasticity is the same in the two productions when considering the allocated share of total capital, μK and $(1-\mu)K$, whereas output elasticity to firm-wide capital, K, is larger in unofficial production due to the moonlighting effect.

Choosing to allocate a share μ of total capital to the official economy implies a cost in terms of taxation, but involves a benefit in terms of an external effect going from the official to the unofficial production. In fact, despite the engagement in the unofficial economy, the moonlighting entrepreneur is able to benefit from participation in the official market: access to credit, banking services; public sector services, such as loans and capital subsidies; marketing and advertising services; trade marks, and so on. Furthermore, when comparing moonlighting firms with ghost firms, the former shows: 1) a reduced risk to be audited, given the use of official production as a convenient screen to fiscal audits; ii) a weaker constraint to size's expansion, given the additional official production; iii) a reduced exposure to bribery and similar costs.[5]

We will see how the optimal capital allocation involves a complex scenario of technological (B, a, σ) as well institutional (ρ, τ, s) parameters.

2.3 Value of the Firm

Each instant a firm maximizes the inter-temporal cash-flow function, choosing how many resources to allocate to official production, μ_t and how much revenue to invest, I_t. Investing is a costly process for firms, $C(I_t) = I_t^{\,b};\ \ b > 1$. Investments are encouraged by the government, which provides a capital contribution proportional to total investment, α, to firms which are willing to increase their capital

[3] Typical explanations include lower entrepreneurial ability, difficulty in getting financial support and high transaction costs due to the necessity to locate trustworthy trading partners. See Anderberg et al. (2003); Loayza (1994).

[4] The macroeconomic literature is increasingly examining the role of the informal sector, providing a clear-cut distinction between formal and informal sectors (Sarte 2000, Gibson 2005, Koreshkova 2006,Turnovsky and Basher 2009). In this paper we specify a unique sector with two technologies, see for instance, Hibbs and Piculescu (2010), Dabla-Norris and Koeda (2008).

[5] When the firm engages in moonlighting activity, it exchanges a share of the exogenous TFP (B) for an endogenous one ($K^{a\sigma}$). In order to ensure the advantage of the moonlighting technology, a sufficient condition is that Y(*ghost*)<Y(*moonl*) for a given capital stock, which reads as follows: $K^{a\sigma}/B > (1-\mu^a)/(1-\mu)$. This condition holds in all the parameterizations we use to define the steady state.

stock.[6] The representative firm maximizes expected cash flow V subject to a constraint set:

$$\begin{aligned}
&\underset{I_t,\mu_t}{Max}\ V_t = \int_{t=0}^{\infty} e^{-rt}\Pi_t dt \\
&\text{s. to :} \\
&\Pi_t = (1-\tau)B(\mu_t K_t)^a + (1-\rho\tau s)(1-\mu_t)^a K_t^{a(1+\sigma)} - rK_t - I_t - I_t^{\,b} + \alpha I_t \\
&\dot{K}_t = I_t - \delta K_t \\
&0 \le \mu_t \le 1 \\
&K_0 > 0 \\
&\lim_{t\to\infty} e^{-rt}\phi_{0,t}K_t = 0 \\
&\alpha,\tau \in (0,1);\ s \ge 1;\ \rho s < 1;\ 0 < \sigma < \frac{1-a}{a}
\end{aligned} \tag{3}$$

The quantity $(1-\tau)B(\mu_t K_t)^a + (1-\rho\tau s)(1-\mu_t)^a K_t^{a(1+\sigma)} - rK_t$ represents the firm's expected revenues, net of taxation, I_t is the amount of gross investment, and δ is the physical depreciation rate of capital. The amount αI_t denotes an investment allowance, where α falls in the (0,1) interval.

2.4. Model parameterization

The model depends on five parameters which we calibrate for Italy, a country with a large-scale underground production and high proportion of small firms which simultaneously produce officially and unofficially. Moreover, the Governments in this country has repeatedly supported these firms with capital subsidies and tax allowances.[7]

Model Calibration : the benchmark									
α	B	τ	σ	r	ρ	s	a	δ	b
0.14	10	0.40	1	0.025	0.05	1.3	0.3	0.125	1.1

2.5 Steady State Relations $(K;\phi_0)$ and (μ, K)

The steady state relations derived from the first order conditions of **problem 3** can be geometrically represented in the space $(K_t;\phi_{0,t},\mu_t)$, where $\phi_{0,t}$ is the Lagrange multiplier. The left-hand panel in the Figure 1 displays the two steady state relations $\dot{\phi}_0 = 0$ (the shadow price of capital) and $\dot{K} = 0$ (the stock of capital), which are standard in the literature on optimal investment.

[6] We assume that government is neither able to know whether new capital will be employed in official or unofficial production, nor has accountability tools at its disposal enforcing the firm to declare only the capital officially employed.
[7] For the size of the underground economy, see, Istat (2010), Schneider and Enste (2002), and Busato, Chiarini and Di Maro (2006). An outline of the State aid to firms in Italy may be found in Bosco (2002) and Ministero delle Attività Produttive (2005).

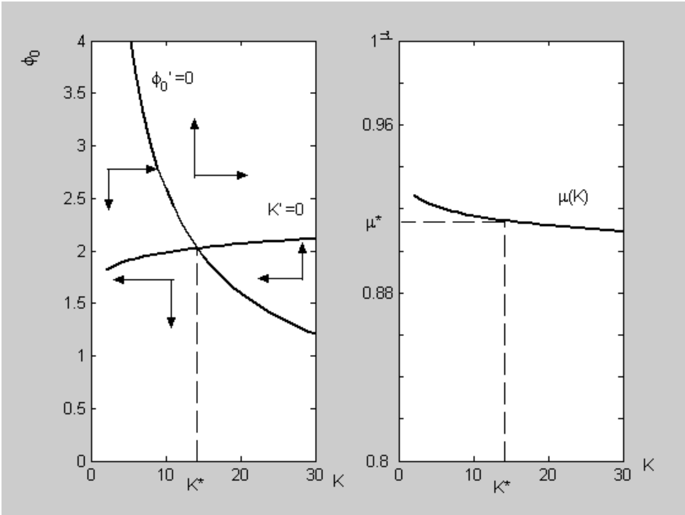

Fig. 1: *Points above the locus* $\dot{\phi}_0 = 0$ *are characterized, for each level of* K *, by a* ϕ_0 *higher than the equilibrium level; it implies a growth in the shadow price of capital (arrows pointing up). Similarly, when considering points above* $\dot{K} = 0$ *, we register for each K a* ϕ_0 *higher than the equilibrium level; given the investment function, and the dynamic of the system, it implies a growth of capital stock (arrows pointing right).*

The right-hand panel in Figure 1 represents the relationship between μ and K: for each level of K identified by the solution of the steady state system, a unique cash-flow maximizing value of μ is identified. The locus $\mu(K)$ is monotone and decreasing: given the nature of the moonlighting effect, the larger the amount of total capital, the more benefit is obtained in shifting it to underground production (e.g. μ drops).

When the capital stock dimension is lower than the optimal level, the official capital share, μ is higher than optimal (see also the right-hand panel in Figure 1); during the process of capital accumulation, the firm also shifts capital into underground technology (i.e. μ drops). This allocating process lasts until the marginal productivity is equal across sectors.

3. Policy Implications and concluding remarks

This section presents the effects of selected fiscal policy experiments. Useful insights may be drawn from the analysis of the reaction functions, which express the estimated steady state of total capital and its officially deployed share as a function of each single fiscal policy parameter. The graphs of Figure 2 show the effects of a variation in tax rate, capital subsidy and moonlighting effect on the size of total capital stock and the resources allocated to official production μ in steady state.

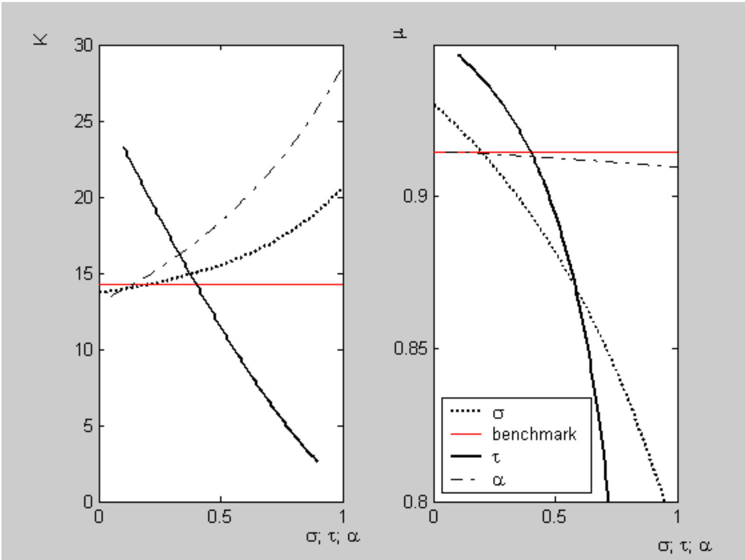

Fig. 2: Reaction of the equilibrium capital stock (K), equilibrium capital allocation (μ *) to: taxation; investment subsidy; moonlighting effect.*

Figure 2 shows that tax policy is the only measure able to generate a positive co-movement between total capital and official capital share.[8] Hence, a tax cut (rise), *ceteris paribus*, induces the moonlighting firm to engage in more (less) official production.

For the effect of investment subsidies, the important point is that, contrary to the presumption that subsidies may also be useful for pushing firms to operate over ground, in the presence of moonlighting technology, the incentives to improve capital stock are actually counterproductive in that they increase the unofficial economy overall. The stock of capital rises with an increase in subsidies but the firm still stays in the informality, remains inefficient and small.

Finally, the moonlighting effect, σ. Intuitively, a large (small) value for σ implies that the moonlighting firm strongly (weakly) benefits from the simultaneity of its two productions. For instance, a larger value of σ compared to the benchmark (σ =1) triggers an investment process and a drop in the officially deployed share of capital. While σ approaches the threshold excluding increasing returns of scale, the solution converges toward a ghost firm, i.e. $\mu \to 0$, while size is no longer determinate. [9]

[8] The reaction functions are always monotone, though non-linear.

[9] Graphically, the locus $\dot{K} = 0$ would have the usual increasing shape, but we would also observe an increasing locus $\dot{\phi}_0 = 0$ situated above the $\dot{K} = 0$ such that no equilibrium could be found.

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