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Taxes, social insurance contributions, and undeclared labour in unionized oligopoly

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HIGHLIGHTS

- The paper endogenizes the firms' choice of undeclared labour in a unionized Cournot oligopoly.
- We suggest that a trade-off exists for employers, between their contribution rates for the social insurance of their employees and their profits tax rates.
- We show that the declared and undeclared labour equilibria arise from a different configuration among those rates.
- A proper configuration among those rates can thus be used as an effective policy tool to tackle undeclared labour.

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ABSTRACT

This paper studies the phenomenon of undeclared labour. In a unionized duopoly with decentralized wage setting and proportional taxation we show that a trade-off exists for employers between contributing to social insurance for their employees and incurring taxes on labour. The configuration among the tax and social insurance contribution rates may thus generate undeclared labour in equilibrium. Nonetheless, those rates can be handled by a social planner so as to tackle undeclared labour at no cost to social welfare, but with welfare distributive consequences.

1. Introduction

Undeclared labour is defined as any paid activity that is lawful as regards its nature but is not declared to public authorities.[1] It is a complex phenomenon associated with breaches of workers' rights, unfair competition, tax evasion and social security fraud. Undeclared labour affects governments, businesses and workers, and it concerns various types of activities ranging from informal household services to clandestine work by illegal residents; however, it excludes criminal activities. Thus far, there have been extensive empirical studies on undeclared labour in the relevant literature (e.g., Williams and Windebank, 2005; Chiarini and Marzano, 2009. Surveys from international organizations (such as the OECD, ILO, Eurofound, EU, etc.) – mostly based on state audits – are also notable. However, to the best of our knowledge, there has yet to be a coherent hypothesis explaining why and how undeclared labour may emerge in contemporary labour markets.[2]

In this paper, we endogenize the firms' choice to not declare labour in the context of a unionized oligopoly with decentralized wage setting and a proportional tax system for both profits and labour incomes. Our motivation for this modelling approach is

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[1] Stepping up the fight against undeclared work, in its 2007 Communication (COM/2007/0628), the European Commission, taking into account the differences in the regulatory systems of the member states, defined undeclared work as paid activities that are lawful in nature but not declared to public authorities.

[2] In an ad-hoc fashion, Di Porto and Elia (2015) estimated labour demand functions by postulating a Cobb–Douglas production function which – in the presence of undeclared labour – is furnished with a CES technology allowing substitution between the two types of labour (declared and undeclared).

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two-fold. First, there is an extensive literature on union–oligopoly bargaining to explain wage and employment determination in contemporary labour markets (e.g., Padilla et al., 1996; Petrakis and Vlassis, 2004 and the references therein). Second, since they typically cover any particular agent in any particular sector, various product and labour market institutions may trigger non-compliance – at least on the part of some of the involved agents – which may take several forms.[3] A similar enquiry therefore arises regarding undeclared labour in unionized oligopolies that has been omitted from the analysis to date.[4]

We show that a trade-off exists for employers between contributing to social insurance for their employees and incurring taxes on profits (effectively on declared labour) which may generate undeclared labour in equilibrium. We moreover suggest that a proper configuration among those rates can be used as an effective policy tool to tackle undeclared labour at no cost to social welfare, but with welfare distributive consequences.

2. The model

Consider a homogeneous goods market, where two symmetric firms compete by choosing quantities, the production technology of each firm i is of the Leontief type: $q_i = L_i$ (i = 1, 2), where q_i denotes output, L_i denotes employment, and labour productivity is normalized to unity. The inverse demand function for the good is of the simple linear form, $p(Q) = 1 - Q$, where Q is the aggregate output: $Q = q_1 + q_2$.

On principle, firms may apply undeclared labour to some of their workers, $a_i q_i$, and declared labour to the rest of their workers, $(1 - a_i)\, q_i$; $0 \leq a_{i=1,2} \leq 1$. Thus, the undeclared labour cost to the firm i is: $a_i w_i q_i$, while the declared labour cost is $(1+k)(1-a_i)w_i q_i$, where k stands for firm i's contribution rate $(0 < k < 1)$ to the social insurance of its declared workers. We assume a proportional taxation system (tax rate denoted as t) for the firms' profits as well as employees' incomes. Thus, firm i's payable taxes are $t\,(pq_i - (1+k)\,(1-a_i)\,w_i q_i)$. Note that the taxable profits are calculated by abstracting only the declared labour cost from firm i's revenues. The cost of undeclared labour remains unknown to the authorities.

In summary, firm i's profit function is as follows:

$$\Pi_i = (1-t)\,[pq_i - ((1-a_i)(1+k)w_i q_i)] - a_i w_i q_i \tag{1}$$

Any worker in the considered sector is organized into a firm-specific union. Unions aim to maximize their members' rents from employment. For simplicity, however, we normalize the union members' reservation wage to zero. Thus, each union's welfare is comprised of:

- the income of its undeclared members $a_i w_i q_i$,
- the income of its declared members $(1 - a_i)\, w_i q_i$ and
- the value of the social insurance of the declared members, $k\,(1 - a_i)\, w_i q_i$, minus
- the income tax of the union's declared members $t\,(1 - a_i)\, w_i q_i$.

In summary, the union i's maximand is as follows:

$$U_i = a_i w_i q_i + (1 + k - t)\,(1 - a_i)\, w_i q_i \tag{2}$$

[3] For instance, non-compliance by means of underground wages may arise under wage centralization in unionized sectors (e.g., Vlassis, 2003).

[4] The notion of underground wages is different than that of undeclared labour. Under the former the sector-wide official wage contracts are downwards violated inside the firm/union unit, while under the latter the firm's payroll is misreported to the authorities.

The wage bargaining structure is assumed to be decentralized. For simplicity, we also assume that each union possesses a bargaining power of one (monopoly union) over the firm-specific wage bargain.

Arising from the above, a two-stage game can be formally addressed as follows.

Stage 1. Unions independently set the firm-specific wages.[5]
Stage 2. Firms independently determine their quantities in the market (Cournot Competition) as well as their optimal levels of undeclared labour.

3. Equilibrium analysis

Using backwards induction, let first consider the second stage of the game. From the first order conditions (focs) of the profit functions (1), with respect to (w.r.t.) quantities (q_i) and the rates of undeclared labour (a_i), we derive the optimal output functions. However, the first order partial derivative of firm i's profit function w.r.t. a_i result in:

$$\frac{\partial \Pi_i}{\partial a_i} = (k\ -(1+\ k)\,t)\ q_i\ w_i$$

Hence, the profit function is monotonic with a_i:

$$\begin{cases} \dfrac{\partial \Pi_i}{\partial a_i} > 0, \ \forall\ t < \dfrac{k}{1+k} \\ \dfrac{\partial \Pi_i}{\partial a_i} < 0, \ \forall\ t > \dfrac{k}{1+k} \end{cases}$$

Therefore, firms maximize their profits (w.r.t. to $a_i \in [0, 1]$) by setting:

$$\begin{cases} a_i^* = 1\ \forall\ t < \frac{k}{1+k} \\ a_i^* = 0\ \forall\ t > \frac{k}{1+k} \end{cases}$$

It follows that the profit function (1) is split into two different (candidate) forms, depending on the value of t relative to k:
- Undeclared Labour (U) case[6]: for $t < \frac{k}{1+k} \rightarrow a_i^* = 1 \rightarrow$

$$\Pi_i = pq_i - w_i q_i - tpq_i \tag{3}$$

- Declared Labour (D) case[7]: for $t > \frac{k}{1+k} \ \rightarrow a_i^* = 0 \rightarrow$

$$\Pi_i = pq_i - (1+k)w_i q_i - t\,[pq_i - (1+k)w_i q_i] \tag{4}$$

Thus, from the focs of (3) and (4), w.r.t. q_i, we respectively derive the optimal output functions in either (candidate) equilibrium.[8]

$$q^U = \frac{1 - t - 2w_1 + w_2}{3 - 3t} \tag{5^U}$$

$$q^D = \frac{1 - 2(1+k)w_1 + (1+k)w_2}{3} \tag{5^D}$$

We then proceed to Stage 1. By virtue of (3), (4), and (5), from the focs of (2) w.r.t. firm-specific wages (w_i), the following wages emerge in either equilibrium.

$$w^U = \frac{1-t}{3} \tag{6^U}$$

[5] This results from our monopoly union assumption. Effectively, there is no active firm–union wage bargaining at Stage 1; unions simply set their firm-specific wages so as to maximize their own maximands (2).

[6] If $a_i^* = 1$, firms maximize their profits by declaring none of their workers in the equilibrium.

[7] If $a_i^* = 0$, firms maximize their profits by declaring all their workers in the equilibrium.

[8] All equilibrium expressions are denoted with the superscripts U for the undeclared labour case and D for the declared labour one. Moreover, since both equilibria are symmetric, there is no need to use subscripts 1 and 2.

$$w^D = \frac{1}{3+3k} \quad (6^D)$$

Substituting expressions (5)–(6) into (3)–(4) and (2), we subsequently derive the following equilibrium outcomes:

$$q^U = q^D = \frac{2}{9} \quad (7)$$

$$p^U = p^D = \frac{5}{9} \quad (8)$$

$$\Pi^U = \Pi^D = \frac{4(1-t)}{81} \quad (9)$$

$$U^U = \frac{2(1-t)}{27} \quad (10^U)$$

$$U^D = \frac{2(1+k-t)}{27(1+k)} \quad (10^D)$$

Given the above, let define tax revenues and social welfare. Tax revenues (R_t) consist of the taxation imposed on firms' profits $t\,(pq_i - (1-a_i)\,(1+k)\,w_i q_i)$ plus the taxation imposed on the net workers' income $t w_i\,(1-a_i)\,q_i$, which is shown in (11).

$$R_t^U = \sum_{i=1}^{2} (tpq_i) \quad (11^U)$$

$$R_t^D = \sum_{i=1}^{2} (t\,(pq_i - (1+k)\,w_i q_i) + t w_i q_i) \quad (11^D)$$

Social welfare (SW) subsequently results from the aggregation of the unions' utility, the firms' profits, the consumer surplus (CS) and the tax revenues (R_t)[9]:

$$CS = \frac{1}{2}(q_1+q_2)^2 \quad (12)$$

$$SW = U_1 + U_2 + \Pi_1 + \Pi_2 + CS + R_t \quad (13)$$

Substituting (6)–(10)(6–10) into (11)–(13) and simplifying the equations, we obtained the following equilibrium outcomes:

$$R_t^U = \frac{20t}{81} \quad (14^U)$$

$$R_t^D = \frac{4(5+2k)t}{81(1+k)} \quad (14^D)$$

$$CS^U = CS^D = \frac{8}{81} \quad (15)$$

$$SW^U = SW^D = \frac{28}{81} \quad (16)$$

4. Main findings

Let us first focus on the last stage of the game. Given the values of t and k – as set by the social planner – firms independently adjust their quantities and rates of undeclared labour to maximize their profits.[10]

Since their profit functions (1) monotonically increase with a, it proves that if t is lower than $\frac{k}{1+k}$, then firms maximize their profits by setting $a=1$, whereas if t is higher than $\frac{k}{1+k}$, then firms maximize their profits by setting $a=0$. That is, firms will apply undeclared labour for all their workers for relatively low values of t and declared labour for all their workers for relatively high values of t. It follows that – considering t is fixed – the former status emerges in cases that k is high enough and the latter emerges when k is low enough. Nonetheless, since $k \in [0,1] \rightarrow \frac{k}{1+k} \in [0, 0.5]$, if t is greater than 0.5 then (independently of the value of k), firms maximize their profits by applying declared labour for all their workers.

Proposition 1 summarizes.

Proposition 1. *Given t, if k is high enough, so as $t < \frac{k}{1+k}$, then undeclared labour emerges in equilibrium. In contrast, if k is low enough that $t > \frac{k}{1+k}$, then declared labour emerges in equilibrium. Yet, both equilibria yield the same output, and consequently, the same consumer surplus, employment and profits. Moreover, if t is high enough (higher than 0.5), then declared labour always emerges in equilibrium.*

Proposition 1 suggests that a trade-off exists for the firms between taxes and social security contributions. If, given the tax rate, a low enough social insurance contribution rate applies for employers or if the tax rate is high enough, then firms will pay their social insurance contributions by declaring all their workers. This is because they will report more expenses but fewer profits, thus reducing their payable taxes. However, provided that the tax rate is low enough and employers' contribution rate for social insurance is high enough, firms will apply undeclared labour by trading off high social insurance contributions for low taxes. It is not surprising, therefore, that undeclared and declared labour result at the same level of output and profits.[11]

Next, focus on the first stage. Unions adjust their wages contingent on the firms' labour demand and their foreseen decisions about a_i^* $(=1 \text{ or } =0)$. Note that, given $t < \frac{k}{1+k}$, if firms were somehow coerced into declaring labour, their profits would be suboptimal. Hence, in the absence of a public policy sustaining declared labour in equilibrium, unions have no other option but to set a wage consistent with undeclared labour. In other words, wage setting must be such as to retain sub-game perfection in either instance, $U\,[t < \frac{k}{1+k}, a_i = 1]$ or $D[t > \frac{k}{1+k}, a_i = 0]$. To subsequently check for the wage configuration across the two possible equilibria, we subtracted (6^D) from (6^U) to get:

$$w^U - w^D = \frac{1}{3}\left(\frac{k}{1+k} - t\right) \rightarrow \begin{cases} w^U - w^D > 0 \rightarrow w^U > w^D \text{ , for } t < \dfrac{k}{1+k} \\ w^U - w^D < 0 \rightarrow w^U < w^D \text{ , for } t > \dfrac{k}{1+k} \end{cases}$$

In addition, we subtracted (10^U) from (10^D), and doubled the result to get:

$$2(U^D - U^U) = \frac{4kt}{27+27k} > 0$$

This leads to the following proposition.

Proposition 2. *Unions in equilibrium set higher wages under undeclared labour than under declared labour. However, their welfare is higher under declared labour than under undeclared labour in equilibrium.*

Proposition 2 suggests that since output and employment remain unchanged across the two states, unions set higher wages under undeclared labour in order to compensate for the income loss due to the forgone social security contributions on the part of their employers. Yet, despite that their members pay no taxes

[9] Note that we did not include the revenues from social insurance contributions in the calculation of SW. The reason is that social insurance contributions are subtracted from firms' profits, and added to unions' utilities, with no surplus left to finance any additional public merit.

[10] Note that in our context of analysis, undeclared labour is treated as if it is a legal choice.

[11] In our setup (Cournot oligopoly) profits are always equal to the squared output level.

under undeclared labour, this is not enough to compensate the loss in union welfare compared to declared labour status.[12]

Subsequently, regarding the effect of undeclared labour to tax revenues, we subtracted (14^{U}) from (14^{D}) to get:

$$R_t^D - R_t^U = -\frac{4kt}{27\,(1+k)} < 0$$

The following proposition is thus in order.

Proposition 3. *Under undeclared labour, firms report higher (pre-tax) profits; hence, they pay higher taxes. Therefore, tax revenues are higher under undeclared labour than under declared labour, despite workers paying no taxes under the former status.*

By virtue of Propositions 2 and 3, it is now clear why $SW^{U} = SW^{D}$ (as shown in [16]). The unions' gain in welfare under the declared labour equilibrium exactly compensates for the loss in tax revenues; hence, for the loss in the general public merit which is – on principle – financed by the tax revenues. As suggested in Proposition 1, both profits and consumer surplus remain unchanged across the two equilibria. In effect, a reallocation of welfare – from the general public merit to the unions – similarly arises.

Proposition 4 summarizes.

Proposition 4. *The undeclared and declared labour equilibria yield equal social welfare. However, the latter compared to the former equilibrium entails welfare reallocation from the general public merit to the unions.*

Propositions 1–4 deliver few clear and significant policy messages. Given a sufficiently low tax rate (< 0.5), a social planner aiming to dismiss undeclared labour with (at least) no cost to social welfare, should properly adjust social insurance contributions (so that $t > \frac{k}{1+k}$) to achieve this goal.[13] However, the social planner must be aware that such a policy entails welfare reallocation from the general public merit to the unions. Nonetheless, if the tax rate is high enough (> 0.5), the labour market would be self-regulated regarding the declaration of labour, yet it would still imply lower tax revenues than those emerging under undeclared labour. Therefore, our analysis moreover suggests that, under a proportional tax system, declared labour always entails lower tax revenues than undeclared labour in equilibrium.

5. Conclusions

In this paper, we have developed a simple game-theoretic framework endogenizing the firms' choice not to declare labour, in the absence of any governmental surveillance and sanction mechanisms (penalties, fines, etc.) to impose declared labour. We are aware that our findings quantitatively depend on the proportional tax system employed.[14] We are also aware that our analysis suggests that firms either declare or do not declare all of their employees. To compensate for these limitations in further research, we might assume a progressive taxation system resulting in more realistic rates of undeclared labour ($0 < a_i^* < 1$). Moreover, instead of monopoly unions, an extension of our present work could consider firm–union wage bargaining, in order to examine whether a lower (than one) union power in wage setting would alter output neutrality across the undeclared and declared labour equilibria as well as its welfare consequences.[15]

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12 In contrast, the wage set, along with the social insurance contributions gained, in the declared labour equilibrium prove more than enough to compensate for the loss in union welfare due to payable taxes.

13 Note that a welfare neutral transition from a state of undeclared labour (t_1, k_1) to a declared labour (t_2, k_2) one, entails $U_i^U(t_1, k_1) < U_i^D(t_2, k_2) \Rightarrow \frac{2}{27}(1 - t_1) < \frac{2(1+k_2-t_2)}{27(1+k_2)}$. Hence, as a referee has pointed out, since their welfare decreases under undeclared labour, unions may coordinate with the social planner in order the latter to dismiss undeclared labour by setting $k_1 > k_2 > (t_2 - t_1)/t_1$ in equilibrium.

14 Of course, such a system is not realistic regarding personal income taxation. Yet, it is widely applied regarding corporate income (profits) taxation.

15 If – on the other extreme – zero union bargaining power is assumed, it can be easily checked that our model reduces to a duopoly with exogenous (competitive) wages. However, there would be no change in our key finding regarding the t and k configurations that may generate declared or undeclared labour in equilibrium.