

Larsen, Birthe; Kolm, Ann-Sofie

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Copenhagen Business School

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UNDERGROUND ACTIVITIES AND LABOUR MARKET PERFORMANCE

Ann-Sofie Kolm

Birthe Larsen

Underground activities and labour market performance

Ann-Sofie Kolm* and Birthe Larsen†

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Abstract

This paper develops a general equilibrium search and matching model where an underground economy co-exists along with the formal part of the economy. In analyzing how tax and punishment policies affect labour market performance, we find that punishment of informal sector activities induce workers and firms to reallocate towards the formal sector. However, more importantly, we find that this reallocation tends to improve efficiency in search, reduce the overall wage pressure, and reduce actual unemployment.

JEL-codes: H26, H24, J64

Keywords: Tax evasion, Underground economy, matching, unemployment.

*Department of Economics, Stockholm University, S-106 91 Stockholm, Ph. +46 8 163547, Fax +46 8 161425. E-mail address: ann-sofie.kolm@ne.su.se

†Copenhagen Business School, CEBR and Insead, Boulevard de Constance, FR-77305 Fontainebleau, E-mail address: birthe.larsen@insead.edu

1 Introduction

There is a large interest in combatting the underground economy across the industrialized world. Undeclared work will, among other things, deprive countries from revenues needed in order to finance the provision of public services. Estimates of the amount of undeclared work in the European union amounts to between 7 and 16 percent of EU's GDP, which translates into about 10 million to 28 million jobs.¹ However, it is unclear if, and if so how, undeclared work can be turned into declared work and thus into increased government revenues. Will policies reducing underground job opportunities really increase formal sector employment opportunities? However, if so is the case, to what extent will formal sector jobs replace jobs in the underground economy? Moreover, through what mechanisms will these policies affect the creation of jobs in the formal and the informal sector? To analyze the full impact of combatting undeclared work requires a general equilibrium framework.

In this paper we build an equilibrium search and matching model with an informal sector. Workers will allocate their search for formal and informal sector jobs optimally. Wages are set in wage negotiations between workers and firms and unemployment features as an equilibrium outcome. To keep the model simple and transparent, the differences between the formal and the informal sector are kept at a minimum. In fact, the only difference between the formal and the informal sector is that taxes are paid in the former and a fine is paid upon detection in the latter. We also allow the separation rate

¹See European commission COM/98/0219. The commission has also conducted the first EU wide cross-nationally comparable questionnaire to increase the knowledge about tax evasion in Europe in order to combat it (see EC, 2007). Also the OECD stresses the importance of combating tax evasion as it threatens government revenues, and has initiated the "Global forum of transparency and exchange of information for tax purposes" (OECD, 2010).

to be higher for informal sector workers than for formal sector workers, as the former faces an additional probability of separation in case of detection. The assumption of separation upon detection is however not important for the results.

The model is used to analyze the impact of tax and punishment policies on labour market performance. We find that increased punishment of the informal sector induces a reallocation of firms and workers towards the formal sector. While this is somewhat expected, it is less clear from an a priori point of view, how wages and aggregate unemployment are affected by such policy. We find that informal sector producer wages increase and formal sector producer wages fall, and that unemployment most likely falls with increased informal sector punishment. Thus, formal sector employment increases by more than informal sector employment falls. This follows as workers allocate too much time to search for informal sector jobs as these jobs are untaxed. Thus, as firms and workers reallocate towards the formal sector, search becomes more efficient, aggregate wage pressure falls, and aggregate job creation increases.

Early theoretical analyses of tax evasion are provided by Allingham and Sandmo (1972) and Srinivasan (1973), where under-reporting of income is modelled as a decision made under uncertainty. Subsequent papers have enhanced the basic model of individual behavior by, for example, incorporating endogenous labour supply decisions.² Also equilibrium models with tax evasion have been developed (for examples see the early study by Cremer and Gahvari (1993) and the recent study by Tonin (2010)). These models of tax evasion, however, features perfectly competitive labour markets. The principal contribution of the analyses in this paper is that we consider tax evasion in a model featuring involuntary unemployment, which, in contrast to most

²See for example Sandmo (1981) for an early contribution of endogenous labour supply and underreporting of income.

previous work on tax evasion, enables us to study the impact of tax evasion on wage formation and unemployment.

During the last decade, however, there have been some studies of underground activity in models of involuntary unemployment; see Kolm and Larsen (2005, 2006), Boeri and Garibaldi (2002), Fugazza and Jacques (2004) and Albrecht et al (2009). The focus and modelling strategies are, however, different in these papers.

The recent paper by Albrecht et al (2009) considers the impact of payroll taxes and severance pay on unemployment in the presence of an informal sector. Their informal sector is modelled from a Latin American perspective where the informal sector is large and can be seen as an unregulated sector which is not affected by these policies. As their focus is not on the illegality of this sector, punishment policies of informality are not modelled.

Previous studies investigating the impact of punishment policies of the informal sector in models featuring equilibrium unemployment, assumes an *asymmetry* across the informal and the formal sector in order to generate coexistence of both sectors. The study by Kolm and Larsen (2006), for example, explores the consequences of punishment policies on labour market performance in an economy where the underground economy produces different goods as compared to the formal part of the economy. The coexistence of both a formal and an informal sector is generated only because workers like to consume both types of goods. The studies by Kolm and Larsen (2005) and Fugazza and Jacques (2004), on the other hand, explore the consequences for unemployment when workers have moral considerations when deciding on informal sector work. With workers being heterogenous with respect to moral, only workers with low moral are willing to work in the informal sector. The paper by Boeri and Garibaldi (2002), also considers punishment policies in a model of informal employment and involuntary unemployment. However, in order to generate coexistence of both formal and informal jobs in their

model, all jobs are started as legal jobs. Informal jobs come about as legal firms are hit by a bad productivity shock and face the option of becoming illegal.

The current paper, on the other hand, investigates the impact of tax and punishment policies on labour market performance in an equilibrium search and matching model where coexistence of both sectors is not based on an exogenously imposed asymmetry across the two sectors.

2 The model³

This section considers a two sector general equilibrium model featuring matching frictions and worker-firm wage bargaining. Workers search for jobs both in a formal sector and in an informal sector. The only difference between the two sectors are that the formal sector can be taxed whereas the informal sector can not. Rather than taxing the informal sector, the government audits the economy. With probability p a worker-firm pair in the underground economy is detected and then has to pay a punishment fee.⁴

2.1 Matching

The matching function for the formal (F) and the informal (I) sector respectively are given by $X^j = (v^j)^{1-\eta} ((\sigma^j)^\gamma u)^\eta$, $j = F, I$, where X^j is the number of matches, v^j is the number of sectorial vacancies, and u is the number of unemployed workers.

The unemployed workers allocate their search effort optimally between

³The model is along the lines of Pissarides (2000).

⁴For realism one may also assume that the match is dissolved as a consequence of detection. We introduce this feature in the model although no results depend on this. It will, however, reinforce the impact of tax and punishment policies on unemployment. This is discussed in the last section.

the formal and the informal sector. On the job search is disregarded for simplicity. Each worker's total search intensity is exogenously given and normalized to unity, where $\sigma^I = \sigma$ denotes search effort directed towards the informal sector, and $\sigma^F = 1 - \sigma$ denotes search effort directed towards the formal sector. The parameter $\gamma < 1$ captures that the effectiveness of search falls with search effort, i.e., the first unit of search in one sector is more effective than the subsequent units of search. This could capture that different search methods are used when searching for a job in a market. The more time that is used in order to search in a market, the less efficient search methods have to be used. This particular modelling strategy of search effort has a close resemblance to how search is modelled in van den Berg and van der Klaauw (2006), where search for a job can be conducted using different search channels.

The transition rates into formal and informal sector employment for a particular worker i , are $\lambda_i^F = (1 - \sigma_i)^\gamma (\theta^F)^{1-\eta}$ and $\lambda_i^I = \sigma_i^\gamma (\theta^I)^{1-\eta}$, where $\theta^F = \frac{v^F}{(1-\sigma)^\gamma u}$ and $\theta^I = \frac{v^I}{\sigma^\gamma u}$ are labour market tightness measured in effective search units. The rates at which vacant jobs become filled are $q^j = (\theta^j)^{-\eta}$, $j = F, I$.

2.2 Value functions

Let U , E^F , and E^I denote the expected present values of unemployment, and employment in the two sectors. The value functions for worker i then reads:

$$rU_i = R + \lambda_i^F(E^F - U_i) + \lambda_i^I(E^I - U_i), \quad (1)$$

$$rE_i^F = R + w_i^F(1 - t) + s(U - E_i^F), \quad (2)$$

$$rE_i^I = R + w_i^I(1 - p\delta) + (s + p)(U - E_i^I), \quad (3)$$

where r is the exogenous discount rate, w^j is the sector wage, and s is the exogenous separation rate. R is a lump sum transfer that all individuals

receive from the government which reflects that the government has some positive revenue requirements.⁵ The parameter t is the proportional income tax rate, p captures the probability of being detected working in the informal sector, and δ is the proportion of the evaded income the worker has to pay as a punishment fee if detected. For realism we here introduce the assumption that the match is dissolved when detected. However, no results will depend on this assumption. In fact, the only real implication of this assumption is that the effect of tax and punishment policies on unemployment is reinforced. A separate proposition is included to discuss the implications of this assumption.

For simplicity, we disregard from unemployment benefits.

Let J^F and V^F represent the expected present values of an occupied job and a vacant job in the formal sector, respectively. The arbitrage equations for a job paying the wage w_i^F and a vacant job in the formal sector are then

$$rJ_i^F = y - w_i^F(1 + z) + s(V^F - J_i^F), \quad (4)$$

$$rV^F = q^F(J^F - V^F) - k, \quad (5)$$

where z is the payroll tax rate and y is productivity. Vacancy costs are denoted k . Analogous notation for the informal sector yields:

$$rJ_i^I = y - w_i^I(1 + p\alpha) + (s + p)(V^I - J_i^I), \quad (6)$$

$$rV^I = q^I(J^I - V^I) - k, \quad (7)$$

where α is the proportion of the evaded wage the firm has to pay as a punishment fee if detected.

The unemployed worker i allocates search, σ_i , between the formal and the informal sector in order to maximize the value of unemployment, rU_i .

⁵Everyone receives this transfer. The government cannot exclude the informal sector workers as the government does not know who the informal sector workers are (if it did, it could just punish all of them).

A necessary condition for an interior solution is that $\gamma < 1$, which holds by assumption. The first order condition can be written as:

$$\frac{(1 - \sigma_i)^{1-\gamma}}{(\sigma_i)^{1-\gamma}} = \left(\frac{\theta^F}{\theta^I} \right)^{1-\eta} \frac{E^F - U_i}{E^I - U_i}. \quad (8)$$

Workers allocate their search between the formal and the informal sector so to equalize the net returns to search effort across the two sectors.

2.3 Wage determination

When a worker and firm meet, they bargain over the wage, w_i^j , taking economy wide variables as given. The first order conditions from the Nash bargaining solutions, with the worker's bargaining power being equal to β , can be written:

$$\frac{\beta}{1 - \beta} \frac{1}{\phi^F} J^F = E^F - U, \quad (9)$$

$$\frac{\beta}{1 - \beta} \frac{1}{\phi^I} J^I = E^I - U, \quad (10)$$

where $\phi^F = \frac{1+z}{1-t}$ and $\phi^I = \frac{1+p\alpha}{1-p\delta}$ are the tax and punishment wedges, and where we have imposed symmetry and the free entry condition, $V^j = 0$, $j = F, I$.

We can now derive an equation determining how search is allocated between the two sectors in a symmetric equilibrium by substituting (9) and (10) into (8) and using that $J^F = \frac{k}{q^F}$ and $J^I = \frac{k}{q^I}$ from (5) and (7) together with free entry. This yields the following core equation:

$$\frac{(1 - \sigma)^{1-\gamma}}{(\sigma)^{1-\gamma}} = \frac{\theta^F}{\theta^I} \psi, \quad (11)$$

where

$$\psi = \frac{\phi^I}{\phi^F} = \frac{1 + p\alpha}{1 - p\delta} \frac{1 + z}{1 - t}, \quad (12)$$

is the wedge between the informal sector and the formal sector. We can interpret a $\psi < 1$ as if the informal sector is punished to a lesser extent than the formal sector is taxed.⁶

Recall from (8) that workers allocate their search between sectors so that the marginal net returns to search are equal in the two sectors. With wages being endogenously determined in equilibrium, this corresponds to account for the wedge, ψ , and for differences in sectorial labour market tightness, $\frac{\theta^F}{\theta^I}$, when deciding where to allocate search. For example, if the informal sector is punished to a lesser extent than the formal sector is taxed, $\psi < 1$, unemployed workers tend to direct more search into the informal sector. And, on the other hand, the relatively tighter the formal sector is, the larger formal sector search tends to be.

By use of equation (1)-(7) and (11) in equations (9) and (10), equilibrium producer wages, ω^j , $j = F, I$, are given by:

$$\omega^F = w^F (1 + z) = \beta \left(y + k \frac{\theta^F}{(1 - \sigma)^{1-\gamma}} \right), \quad (13)$$

$$\omega^I = w^I (1 + p\alpha) = \beta \left(y + k \frac{\theta^I}{\sigma^{1-\gamma}} \right). \quad (14)$$

Wages increase with labour market tightness and decrease with search intensity in each sector. This follows as a higher labour market tightness and a lower search intensity improve the worker's bargaining position. An increase in tightness makes it easier for a worker to find a job in case of job loss, and at the same time harder for a firm to fill a vacancy. This improves the worker's relative bargaining position, resulting in higher wage demands. The opposite holds when search increases as then firms will find it easier to

⁶In contrast, if $\psi = 1$, the informal sector is punished equally hard as the formal sector is taxed. With risk neutral individuals there is, in one sense, no substantial difference between the tax system and the punishment system since the punishment system is a randomized tax system.

match with a new worker in case of no agreement, and at the same time harder for workers to find a vacancy. Higher search effort into a sector then reduces the worker's relative bargaining position, resulting in lower wage demands.

From (13), (14) together with (11) it follows that producer wages in the formal sector exceed informal sector producer wages when $\psi < 1$, and vice versa when $\psi > 1$. Moreover, rewriting (13) and (14) in terms of consumer wages we have that consumer wages in the formal sector are lower than informal sector consumer wages when $\psi < 1$, and vice versa when $\psi > 1$. More specifically we have $\omega^F - \omega^I = \frac{\beta k \theta^F}{(1-\sigma)^{1-\gamma}} (1 - \psi)$ and $w^F (1 - t) - w^I (1 - p\delta) = \frac{\beta y}{\phi^I} (\psi - 1)$.

2.4 Labour market tightness

Labour market tightness for the formal sector and the informal sector are determined by equation (4),(5), (6) and (7) using the free entry condition and the wage equations (13) and (14):

$$k(r + s) (\theta^F)^\eta = (1 - \beta) y - \frac{\beta k \theta^F}{(1 - \sigma)^{1-\gamma}}, \quad (15)$$

$$k(r + s + p) (\theta^I)^\eta = (1 - \beta) y - \frac{\beta k \theta^I}{\sigma^{1-\gamma}}. \quad (16)$$

When $\psi < 1$, which can be considered to be the most realistic case, the informal sector is punished to a lesser extent than the formal sector is taxed. In this case, informal producer wages are lower than formal producer wages and hence the expected instantaneous profits in the informal sector exceed the instantaneous profits in the formal sector.⁷ This makes it more attractive for firms to enter the informal sector which tends to make informal tightness

⁷The right-hand side of equations (15) and (16), are simply the instantaneous profits, i.e., $\pi^F = y_m - \omega_m^F$ and $\pi^I = y_m - \omega_m^I$, where we from the previous section know that $\omega^F - \omega^I = \frac{\beta k \theta^F}{(1-\sigma)^\gamma} (1 - \psi)$.

exceed formal tightness, i.e., tends to raise θ^I relative to θ^F . However, if the separation rate in the formal sector is lower, $s < s + p$, which it is if the match is dissolved upon detection, the formal sector expected job duration is longer. The formal sector then, in this case, becomes more attractive to enter, tending to reduce θ^I relative to θ^F . Consequently, it is possible to have $\theta^F > \theta^I$, although $\psi < 1$. As discussed in section 2.2, different separation rates have no implications for the results.

2.5 Unemployment

The employment rates for workers in the formal sector and the informal sector, n^F, n^I , and the unemployment rate, u , are determined by the flow equilibrium, $\lambda^I u = (s + p)n^I$, $\lambda^F u = sn^F$, and the labour force identity, $n^F + n^I = 1 - u$. The official unemployment rate for manual workers u^o , is given by $u^o = u + n^I$. Solving for the employment and unemployment rates yield:

$$n^I = \frac{\frac{\lambda^I}{s+p}}{1 + \frac{\lambda^I}{s+p} + \frac{\lambda^F}{s}}, n^F = \frac{\frac{\lambda^F}{s}}{1 + \frac{\lambda^I}{s+p} + \frac{\lambda^F}{s}}, \quad (17)$$

$$u = \frac{1}{1 + \frac{\lambda^I}{s+p} + \frac{\lambda^F}{s}}, u^o = \frac{1 + \frac{\lambda^I}{s+p}}{1 + \frac{\lambda^I}{s+p} + \frac{\lambda^F}{s}}. \quad (18)$$

Note that as observable unemployment includes the informal sector workers too, an increase in the transition rate into the informal sector increases the official unemployment rate, whereas the actual one falls.

3 Comparative statics

This section is concerned with the impact of the tax and punishment system on the allocation of search effort and firm activity across the formal and the informal sector, as well as the effect on aggregate unemployment. The proofs

of all propositions follow from straightforward comparative statics and are available upon request.

We consider fully financed changes in the punishment rates. Hence, changes in the punishment rates, α or δ , are always followed by adjustments in the tax rates, z or t , so as to balance the government budget restriction. The government budget restriction is given by:

$$n^F \omega^F \left(1 - \frac{1}{\phi^F}\right) + n^I \omega^I \left(1 - \frac{1}{\phi^I}\right) - \xi(p) = R, \quad (19)$$

where R is the exogenous revenue requirements and $\xi(p)$ is auditing costs.⁸

3.1 Wage formation and sector allocation

The effects on search effort and wage formation are summarized in the following proposition.

Proposition 1 *A fully financed increase in a punishment rate (δ or α) will reallocate search intensity towards the formal sector (σ falls). Furthermore, it will increase the producer wage in the informal sector (ω^I) and reduce the producer wage in the formal sector (ω^F).*

When underground activity is punished more severely, unemployed workers will find it optimal to reallocate their search effort towards the formal

⁸To tax (punish) the firm side or the worker side is equivalent for $\sigma, \theta^F, \theta^I, n^F, n^I, u, u^o$, as t, z, δ, α , does not appear in (19) and (17),(11),(15),(16),(18) other than through ϕ^F and ϕ^I . From (19) it follows that any R can be attained by increasing ϕ^F and ϕ^I simultaneously so to keep ψ constant. Also, as only ψ affects the variables, the effects of fully financed reforms can be considered by only looking at changes in ψ . For example, consider a fully financed increase in α . If α and t increases (reduces) R , the higher α induce a surplus (deficit) which calls for a reduction (increase) in t so to balance the budget. ψ increases with both the changes in α and t . If α affects R differently from t , ψ can either be increased by a smaller reduction in α compared to t , or by a larger increase in α compared to t .

sector. However, when search is reallocated towards the formal sector, wage pressure in the formal sector falls whereas wage pressure in the informal sector increases. Workers' increased search for formal sector jobs reduce the workers' relative bargaining position which restrains formal wage demands. In contrast, the reduced search in the informal sector strengthens workers' relative bargaining position in the informal sector inducing informal wages to increase.

In addition, let the effects on tightness and sector employment be summarized in the following proposition:

Proposition 2 *A fully financed increase in the punishment rates (δ or α) will increase tightness and employment in the formal sector (θ^F, n^F) and reduce tightness and employment in the informal sector (θ^I, n^I).*

As the producer wage facing informal firms tends to increase, whereas the formal producer wage tends to fall, firms' incentives to enter the formal sector instead of the informal sector increase; formal sector tightness increases whereas informal sector tightness falls. As formal sector tightness raises relative to tightness in the informal sector, search is further reallocated towards the formal sector. This effect becomes smaller and smaller until the new equilibrium is reached.

From the results presented so far, we obtain the expected result that increased punishment of the informal sector induces a reallocation of workers from the informal sector towards the formal sector. This is a consequence of that both vacancies and search effort is reallocated towards the formal sector; the job offer arrival rate for formal sector jobs increases, whereas it falls for informal sector jobs. However, the reallocation of search towards the formal sector also leads to increased informal sector wages and reduced formal sector wages.

3.2 Unemployment

We summarize the results of how the tax and punishment rates affect unemployment in the following proposition:

Proposition 3 *A fully financed increase in the punishment rate (δ or α) will always reduce official unemployment (u^o). Actual unemployment (u) falls with a fully financed increase in the punishment rate (δ or α) if $\psi < 1$.*

It is a priori not clear what would happen to aggregate unemployment. It turns out that the increase in formal sector employment more than outweighs the fall in informal sector employment as long as formal sector taxation exceeds informal sector punishment, i.e., if $\psi < 1$. Thus unemployment falls with increased punishment of the informal sector in this case.

The reason why unemployment falls with increased punishment is that search becomes more efficiently allocated when redirected towards the formal sector in the case when $\psi < 1$. With $\psi < 1$, attractive untaxed job opportunities in the informal sector induce workers to search too much for informal jobs. With decreasing returns to search in a sector, total search efficiency then improves when search is reallocated towards the formal sector in this case.

The fact that search becomes more efficient when reallocated towards the formal sector also has an impact on unemployment working through wage formation and tightness. As search is reallocated towards the formal sector, the wage demand is moderated in the formal sector and exaggerated in the informal sector. As search efficiency in the formal sector increases more than search efficiency in the informal sector is reduced, the formal sector wage moderation will dominate the informal sector wage push. Thus, the incentives to open up a vacancy in the formal sector exceeds the disincentives to open up a vacancy in the informal sector; formal sector tightness will increase by more than informal sector tightness falls when $\psi < 1$.

To sum up, an increased punishment of the informal sector tends to increase total search efficiency, moderate overall wages and increase total tightness if $\psi < 1$. This implies that the increase in formal sector employment exceeds the reduction in informal sector employment; unemployment falls.

None of the results derived in this paper hinges on the assumption that the match is dissolved upon detection. However, by assuming that matches dissolve upon detection, the negative impact of higher informal punishment on unemployment is further reinforced. This follows as workers are reallocated towards the formal sector where jobs on average last a longer time. This also implies that unemployment is reduced as a consequence of increased punishment of the informal sector even if ψ exceeds unity. However, if $\psi > 1$, that is the informal sector punishment exceeds the formal sector taxation, further punishment of the informal sector has an ambiguous effect on unemployment. Unemployment tends to increase as total search efficiency then falls although unemployment tends to fall as formal sector jobs on average have a longer duration. The results following the assumption of dissolution of the match upon detection is summarized in the following proposition.

Proposition 4 *Given a match is dissolved upon detection, a sufficient condition for actual unemployment (u) to fall with a fully financed increase in the punishment rate (δ or α) is $\psi \leq 1$.*

4 Conclusion

This paper investigated if, and to what extent, undeclared work could be turned into declared work and higher government revenues by a more severe punishment of the underground economy. Moreover, we analyzed through which channels these policies affected the creation of jobs in the formal and the informal sector.

To offer a proper investigation we built a general equilibrium search and matching model with an informal sector, where the coexistence of both sectors were not based on an exogenously imposed asymmetry across the two sectors. Workers allocated their search for formal and informal sector jobs optimally and wages were set through wage negotiations between workers and firms. In order to focus on the mere impact of tax evasion, the only difference between the formal and the informal sector was that taxes were paid in the former and a fine was paid upon detection in the latter. We did allow for an additional probability of separation in case of detection in the informal sector but this assumption was of no importance for the results.

We showed that increased punishment of the informal sector induced a reallocation of firms and workers towards the formal sector. Informal sector producer wages increased whereas formal sector producer wages fell. Unemployment was reduced if the government was unable to audit and punish the informal sector to the same extent as it could tax the formal sector. Thus, formal sector employment increased by more than informal sector employment fell. This was a consequence of that workers allocated too much time to search for informal sector jobs as these jobs were untaxed. Thus, the reallocation towards the formal sector improved search efficiency, reduced aggregate wage pressure, and increased total job creation.

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