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Abstract

While examining the macroeconomic effects of increased government control of the informal sector, this paper develops a two-sector general equilibrium model featuring matching frictions on the labour market and a social norm. Conducting informal work, or employing a worker informally, is associated with expected punishment fees and payments of a moral cost, given that there is a social norm against tax evasion. This framework facilitates an analysis of how wage setting, unemployment and the size of the informal sector are affected by punishment policies, which has been ignored in the previous literature. Furthermore, the inclusion of an endogenously determined norm against tax evasion may explain differences in-between regions or countries in relative sizes of the formal and the informal sectors for similar tax- and punishment policies.

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1 Introduction

In all economies, a part of the output is produced in a formal sector, where firms and workers pay taxes. Another part of the output is produced informally, where production of the informally produced good is associated with tax evasion. For example, in Southern Europe informal sector production is estimated to 17-18 percent of GDP (Spain and Italy, see Ahn and De la Rica (1997) and

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Siesto (1992)), whereas it comes to 2-6 percent of GDP in the Nordic Countries (Pedersen and Smith (1998)).

Informal sector firms and workers are exposed to a probability of detection. Knowing that detection implies payments of punishment fees, may prevent workers and firms, otherwise motivated by tax evasion, from entering the informal sector. Hence, differences in the size of the informal sector across countries may be due to different tax- and punishment policies.

However, there may be other obstacles towards informal sector activities than legal ones. Firm owners and workers may simply incur a moral cost if detected evading taxes. The moral cost could come about due to that a worker or a firm owner feels ashamed when revealed performing informal sector activities. Furthermore, a casual observation is that in some regions or countries the aversion towards informal sector work is more pronounced than in others, despite facing the same tax and punishment policies. Why are some regions or countries inhabited by workers and firm owners with more aversion towards tax evasion than others? Could it be that a large fraction of workers and firms already situated in the informal sector reduces the 'bad feeling' related to being detected performing informal sector activities? This indicates the possibility of an endogenous social norm against tax evasion, where the social norm against tax evasion falls with the size of the informal economy. Equilibria with a high number of informal sector workers and a low number of informal sector workers may hence coexist.

In this paper, we include all these features in an equilibrium model with matching frictions on the labour market, and examine the consequences for wages, unemployment and the size of the informal sector from more severe punishment policies of the informal sector.

The main novelties of this paper are the following. Firstly, we incorporate an imperfectly competitive labour market. This facilitates an analysis of how punishment policies affect wage setting and unemployment. Previous literature on tax evasion has either assumed that wages are fixed or determined by market clearing, which obviously is an inadequate framework to use when analyzing how tax evasion opportunities affect wage setting and unemployment.[1] Secondly, we include moral costs and a social norm against tax evasion, which may serve to explain large variations in-between sizes of the informal sector.

The paper is organised as follows. In Section 2 the model is described, Section 3 describes the equilibrium and Section 4 derives the effects of a higher audit rate, and higher punishment fees, on labour market tightness, wages, unemployment rates, the size of the informal sector and total unemployment. Section 5 extents the model to include endogenous moral costs and the last section concludes.

[1] An exception is Chang and Ching-Chong (1996) who examine the relationship between underreporting of income and total tax revenues taking into account the efficiency wage hypothesis.

2 The model

The economy consists of two sectors, a formal sector and an informal sector. Workers search for jobs in one of the two sectors. The workers have, via their connection to the labour market, information making them able to distinguish the two sectors. They search for jobs in the sector that gives them the highest expected value of unemployment. Unemployed workers searching for formal work expect to earn the formal wage net of taxes, whereas workers searching for informal work expect to earn the informal wage net of the expected costs of punishment. The expected costs of punishment include payments to the tax authorities as well as a moral cost. Both the fee paid to the tax authorities and the induced moral cost are paid only if the worker is detected. The moral cost captures that a worker feels ashamed when revealed performing informal work and hence evading taxes. This cost comes about due to a social norm against performing informal sector work.

Analogously, firm owners pay a fee to the tax authority, as well as a moral cost, upon detection.

Different goods are produced in the two sectors. We could, for example, think of the informal sector as supplying cleaning to private homes whereas the formal sector produces a composite good consisting of all other goods demanded by the consumer.

The government audits the economy. How come the workers and consumers are able to locate the informal firms whereas the tax authorities are not fully able to? One answer is that there are many workers and firms each searching for work and demanding the good. The tax authorities cannot officially search in the same way and would need to use searching methods corresponding to each individual consumer. This is a time-consuming and expensive process, whereby only a fraction p of all informal firms and workers is detected.[2] In the example of cleaning services to private homes, the tax authorities know what kind of firms to search for, but they do not know where to find them and their employees. The firms are not registered, they do not exist in any statistics, and officially their employees are unemployed.

Once detected, a match will be dissolved with probability ξ, where $\xi \in [0,1]$. We allow for different values of ξ as it is not immediately clear what happens after detection of an informal sector firm and worker. The important issue is whether the firm can continue as before or not. One possibility is that the company after detection pays a fine but then changes its name and continues business as before with the same employees.[3] No separation takes place; corresponding to $\xi = 0$. At the other extreme, the detected is taken to

[2] For example, suppose the tax authorities put up an advertisement, searching for cleaning in a private home. It has to set up an address where the cleaning company can inquire. Some firms may then offer their services at this address corresponding to their detection, others may know the true identity of this 'home', perhaps inhabited by one of the employees in the Ministry of taxation. All in all, this may be a time-consuming and expensive process confirming that tax authorities only detect an informal worker-firm pair with a certain probability, p.

[3] In the model we actually assume that each firm only employs one worker, but this is for exposional reasons and without loss of generality.

court (and the court process takes such a long time that the employees search for a new job) and/or the tax authority returns to the firm and workers with probability one, and hence all matches are dissolved after detection, $\xi = 1$. When $0 < \xi < 1$, we have the intermediate case where some detections are followed with dissolvement and other informal sector firms and workers succeed in continuing in business after detection.

2.1 Matching

Unemployed workers search for employment in either the informal or the formal sector. That is, they direct their search towards one of the two sectors. The matching function represents the matching rate associated with every possible vacancy-unemployment pair. As workers direct their search, matching is characterised by:

$$X^j = A^j \left(v^j\right)^{1-\eta} \left(u^j\right)^{\eta}, j = F, I,$$

where u^j and $v^j, j = F, I$ are the unemployment- and vacancy rates for the two sectors, the formal sector F or the informal sector I. Search may be more cumbersome to conduct in the informal sector as only unofficial channels may be used, whereas both official and unofficial search channels may be used in the formal sector. Hence, we allow for different search efficiencies, A^j, in the two sectors, $A^F > A^I$. The rates are defined as the numbers relative to the sector labour forces in the two sectors. The total labour force is normalized to unity, which is divided into the two sectors: the informal sector labour force is denoted by ε and the formal sector labour force is then $1 - \varepsilon$. The worker's and firm's transition rates are $\lambda^j = X^j/u^j = A^j \left(\theta^j\right)^{1-\eta}, j = F, I$ and $q^j = X^j/v^j = A^j \left(\theta^j\right)^{-\eta}, j = F, I$. The variable $\theta^j = \frac{v^j}{u^j}, j = F, I$ denotes labour market tightness.

2.2 The formal and the informal sector

When determining whether to search for work in the formal or the informal sector, each worker compares the values of search in the two sectors.

The present discounted values of formal unemployment, U^F, and formal employment, E^F are determined by the equations:

$$rU^F = \frac{R}{P} + \lambda^F (E^F - U^F), \quad (1)$$

$$rE^F = \frac{R}{P} + \frac{w^F (1-t)}{P} + s(U^F - E^F), \quad (2)$$

where R is a lump sum transfer received by the government; the parameter r is the exogenous discount rate; w^F denotes the formal sector wage; and the parameter s is the exogenous separation rate. Formally employed workers pay the proportional tax rate, t. For simplicity, we assume that unemployment benefits are equal to zero. However, also including unemployment benefits related

to net wages, $bw^F(1-t)$, which should be received by all unemployed workers and informal sector employed workers, would not qualitatively modify our results.[4] The immediate income received in each state is expressed in real terms by division with the general price level, P. P is the cost-of-living index which is linear homogenous in the two goods prices, P^F and P^I, and can be derived from consumer preferences.[5] The goods prices, and hence the general price level, are in equilibrium determined by market clearing and are taken as given by the individual firms and workers. It is of no importance for the results whether the flow value equations in this section and the next section are given in real or in nominal terms.

Informal sector workers face the arbitrage equations determining the values of informal unemployment, U^I and informal employment, E^I :

$$rU^I = \frac{R}{P} + \lambda^I(E^I - U^I), \tag{3}$$

$$rE^I = \frac{R}{P} + \frac{w^I(1-p(\delta+c))}{P} + (s+\xi p)(U^I - E^I), \tag{4}$$

where p is the rate by which an informal sector worker is detected by the government, and δ is the proportion of evaded income the worker has to pay as a punishment fee if detected. Upon detection, the informal sector worker also pays a moral cost, which is given by $c\frac{w^I}{P}$. The larger the labour income from informal sector work, the higher will the induced moral cost be in case of detection.

Moral cost may be exogenous, or it may be endogenous reflecting a social valuation against informal sector work. If the social norm is to perform formal sector activities, and hence not perform illegal activities, the costs of tax evasion may increase with the relative size of formal sector employment. In economies where a rather large fraction of the population is employed in the informal economy, the induced moral cost when detected is low compared to the cost in an economy where a rather small fraction of the population is evading taxes.

We return to the issue of endogenising the moral cost in Section 5. Until then we treat c as exogenous. The informal worker faces the separation rate $s+\xi p$ as he may be separated from his job due to an exogenous market separation or due to detection.

Firms in the two sectors are characterized by the arbitrage equations:

$$rJ^j = \frac{y^j P^j}{P} - \frac{\omega^j P^j}{P} + s^j(V^j - J^j), j = F, I, \tag{5}$$

$$rV^j = q^j(J^j - V^j) - k\frac{y^j P^j}{P}, j = F, I, \tag{6}$$

where J^j and V^j give the values of a filled and an unfilled job. Each worker has productivity, $y^j, j = F, I$. The variables $\omega^F = w^F(1+z)/P^F$ and $\omega^I =$

[4] The parameter b will show up in formal sector wages and in the budget constraint for the government.

[5] Homothetic preferences are assumed which implies that all consumers face the same price index.

$w^I\left(1+p\left(\alpha+c\right)\right)/P^I$ denote producer wages in the two sectors; z is the payroll tax rate and α is the proportion of the evaded wage which the informal firm has to pay as a punishment fee if detected. For simplicity, the moral cost c is defined as being equal for workers and firms. It is of no importance for the results. Separation rates are $s^F = s$ and $s^I = s + \xi p$. The (nominal) cost of holding a vacancy open is $kP^j y^j$, where $k < 1$.[6]

2.3 Wage determination

Matching friction creates quasi-rents for any matched pair providing a scope for bilateral bargaining after worker and employer meet. The baseline wage specification assumption found in the literature on search equilibrium is the generalized axiomatic Nash bilateral bargaining outcome with 'threat point' equal to the option of looking for an alternative partner.[7] Assuming that the worker has the bargaining power, γ, the solutions to the Nash bargaining problems satisfy the first order condition:

$$\frac{\gamma}{1-\gamma}\frac{1}{\phi^j}\left(J^j - V^j\right) = E^j - U^j, j = F, I, \tag{7}$$

where $\phi^F = \frac{1+z}{1-t}$ and $\phi^I = \frac{1+p(\alpha+c)}{1-p(\delta+c)}$ are the tax and punishment wedges, where the latter includes the moral cost, c.

By use of equation (1)-(6) in equation (7), assuming free entry, $V^j = 0$, $j = F, I$, and symmetric conditions facing agents within each sector, producer wages are:

$$\omega^F = \frac{w^F\left(1+z\right)}{P^F} = \gamma y^F\left(1+k\theta^F\right), \tag{8}$$

$$\omega^I = \frac{w^I\left(1+p\left(\alpha+c\right)\right)}{P^I} = \gamma y^I\left(1+k\theta^I\right), \tag{9}$$

We note that the tax and punishment rates (t, z, δ, α) have no impact on producer wages.[8]

[6] One interpretation of this specification of the vacancy cost is that the firm allocates its work force optimally between production and recruitment activities. The cost of hiring is its alternative cost, i.e. the value of the marginal product of labour.

[7] See Pissarides (2000), among others.

[8] The fact that taxes are fully borne by labor is a standard result in many models of equilibrium unemployment considering the standard assumptions made; see for example Pissarides (1998).

2.4 Labour market tightness

Labour market tightness for the two sectors are determined by equations (5) and (6) using the free entry condition and the wage equations (8) and (9):

$$\frac{k\left(r+s\right)}{q^F} = \left(1-\gamma\right)-\gamma\theta^F k, \tag{10}$$

$$\frac{k\left(r+s+\xi p\right)}{q^I} = \left(1-\gamma\right)-\gamma\theta^I k. \tag{11}$$

Changes in the tax and punishment rates, (t, z, δ, α), do not have any impact on tightness in the two sectors. However, changes in the audit rate, p, will have an impact on tightness in the informal sector. An increase in p reduces the average length of an informal sector job, and it becomes less profitable to enter the informal sector; θ^I falls.[9] Note that this is a fully financed change in p since changes in the tax rates (t, z) have no impact on tightness and hence these parameters can always be altered in order to balance the government budget.

Labour market tightness is higher in the formal than in the informal sector, $\theta^F > \theta^I$, since $s + \xi p \geq s$ and $A^F > A^I$.

2.5 Unemployment

Steady state employment and unemployment rates are derived by considering the flows into and out of employment. The equations determining the unemployment rates u^F and u^I are given by:

$$\begin{aligned} \lambda^F u^F\left(1-\varepsilon\right) &= s\left(1-u^F\right)\left(1-\varepsilon\right), \\ \lambda^I u^I \varepsilon &= \left(s+p\xi\right)\left(1-u^I\right)\varepsilon, \end{aligned}$$

where ε and $1-\varepsilon$ define the labour forces in the informal and the formal sector. The unemployment and employment rates can then be solved from the flow equations as:

$$u^F = \frac{s}{s+\lambda^F}, \tag{12}$$

$$u^I = \frac{s+\xi p}{s+\xi p+\lambda^I}, \tag{13}$$

$$n^F = \frac{\lambda^F}{s+\lambda^F}, \tag{14}$$

$$n^I = \frac{\lambda^I}{s+\xi p+\lambda^I}. \tag{15}$$

The unemployment rate facing workers searching for formal sector jobs is lower than for workers searching for informal sector jobs as $s + \xi p \geq s$ and $\lambda^F > \lambda^I$. Similarly, the formal sector employment rate is higher than the

[9] This is, of course, only true for $\xi > 0$.

informal sector employment rate. The total number of workers employed in the informal sector, relatively to the number of workers employed in the formal sector depends on the size of each sector's labour force, which will be determined below.

The total number of unemployed workers are given by the following expression:

$$U_{TOT} = u^F (1 - \varepsilon) + u^I \varepsilon. \tag{16}$$

Observable unemployment consists of all informal sector workers and the unemployed workers searching for formal sector work:

$$U^o_{TOT} = u^F (1 - \varepsilon) + \varepsilon. \tag{17}$$

2.6 Sector division

When workers enter the labour force, they choose whether to apply for formal or informal jobs. In making their choice, they compare the values of being in the two sectors. If the value of unemployment is higher in the formal sector, they choose to apply for a job in the formal sector and vice versa. In equilibrium, workers are therefore indifferent between entering the formal or the informal sector, that is $rU^F = rU^I$.

This condition may be rewritten in two different ways. If we substitute for the employment gains by using equations (1)-(4), we have:

$$\mu^I w^I (1 - p(\delta + c)) = \mu^F w^F (1 - t), \tag{18}$$

where $\mu^F = \frac{\lambda^F}{r+s+\lambda^F}$ and $\mu^I = \frac{\lambda^I}{r+s+p+\lambda^I}$ are the weights associated with the payoffs in the formal and informal sector, respectively. Note that with $r = 0$, we have $\mu^j_m = n^j_m, j = 1, i$, since with no discounting the value attached to payoffs in the informal sector is the expected proportion of time spent as employed in the sector considering all future periods. With $r > 0$, the future is less important than the presence, and unemployed workers value future payoffs from employment slightly lower than the employment rates. Substituting for consumer wages from equations (8) and (9) gives:

$$\frac{\mu^I \omega^I}{\mu^F \omega^F} \frac{1}{\psi} = \frac{P^F}{P^I},$$

Alternatively, we use equation (1) and (3), then equation (7), free entry ($V^j = 0$), $y^F = y^I$[10] and $J^j = \frac{kyP^j}{q^j}, j = F, I$ to obtain

$$\frac{\theta^I}{\theta^F} \frac{1}{\psi} = \frac{P^F}{P^I}, \tag{19}$$

[10] There is no a priori reason to assert that a formal sector worker is more productive than an informal sector worker or the reverse.

where $\psi = \frac{\phi^I}{\phi^F}$, which we refer to as the wedge.

With labour market tightness being determined by equations (10) and (11), equation (19) determines the relative price, $\frac{P^F}{P^I}$. Hence the allocation of workers across the two sectors determines the equilibrium relative price independent of consumer preferences, i.e. the relative price is solely determined by the supply side.

When an unemployed worker enters into one of the two sectors, the number of unemployed workers in that sector increases. This, in turn, tends to reduce the chance of getting a job for all unemployed workers in the sector. However, as firms are profit maximizers and enter into the sector as long as it is profitable to do so, firms will also allocate into the sector leaving the sector ratio between vacancies and unemployed workers unaffected, i.e. leaving θ^j unaffected. Hence, the employment probabilities are unaffected by a reallocation of workers across the two sectors. But the reallocation of workers (and hence firms) across the two sectors will affect the sector labour force and the relative supply of goods which will become clear from the next section.

2.7 Product market equilibrium

Product markets clear in each period. First, we consider the demand side. We assume that individuals have homothetic preferences represented by the instantaneous utility function $U\left(C_i^F, C_i^I\right)$ where C^F is produced in the formal sector and C^I is produced in the informal sector.[11] With homothetic preferences we have the aggregate demand function for the two goods given from the first-order condition for the individual consumer's optimal mix of commodities, i.e. $\frac{U_F\left(C^F,C^I\right)}{U_I\left(C^F,C^I\right)} = P^F/P^I$, in conjunction with the aggregate (economy wide) budget constraint.

Next, we consider the supply side. The aggregate supplies of the two goods (with one worker employed in each firm and the labour force normalised to unity) are given by production deducted vacancy costs. In the formal sector, we have $(1-\varepsilon)\, n^F$ workers employed, each producing y^F. There are $(1-\varepsilon)\, v^F$ vacancies at costs $y^F k$ giving the aggregate supply in the formal sector, $Y^F = (1-\varepsilon)\, y^F \left(n^F - kv^F\right) = (1-\varepsilon)\, y^F n^F \left(1 - \frac{ks}{q^F}\right)$. Similarly, in the informal sector, aggregate supply of the informal good is $Y^I = \varepsilon y^I \left(n^I - kv^I\right) = \varepsilon y^I n^I \left(1 - k\frac{s+\xi p}{q^I}\right)$.

Equalising aggregate demand and aggregate supply leads to the following equation:

$$\frac{\sigma}{1-\sigma} \frac{n^I \varepsilon}{n^F (1-\varepsilon)} \frac{\left(1 - k\frac{s+\xi p}{q^I}\right)}{1 - k\frac{s}{q^F}} = \frac{P^F}{P^I}, \tag{20}$$

[11] U_F, $U_F > 0$, and U_{FF}, $U_{II} < 0$. Homothetic preferences allow for aggregation of demand across individuals with different incomes, although the less restrictive assumption of quasi homothetic preferences would be enough. It is, however, convenient to have one encompassing price index for all individuals which is assured by the assumption of homothetic preferences.

where we for simplicity have used a Cobb-Douglas utility function, i.e., $U\left(C^F, C^I\right) = \left(C^F\right)^{\sigma}\left(C^I\right)^{1-\sigma}$,[12] and used equations (12)-(15). This is an equation in the four unknowns: labour market tightness for the two sectors, θ^F, θ^I, the informal sector labour force, ε, and the relative price, P^F/P^I. Labour market tightness for the two sectors are determined by equations (10) and (11), and the relative price follows from equation (19). Finally, equation (20) determines ε.[13]

3 Equilibrium

The four equations characterising the equilibrium are repeated here for convenience:

$$\frac{k\left(r+s\right)}{q^F} = \left(1-\gamma\right) - \gamma\theta^F k, \tag{21}$$

$$\frac{k\left(r+s+p\right)}{q^I} = \left(1-\gamma\right) - \gamma\theta^I k, \tag{22}$$

$$\frac{\theta^I}{\theta^F}\frac{1}{\psi} = \frac{P^F}{P^I}, \tag{23}$$

$$\frac{\sigma}{1-\sigma}\frac{\frac{\lambda^I}{s+p+\lambda^I}\varepsilon}{\frac{\lambda^F}{s+\lambda^F}\left(1-\varepsilon\right)}\frac{1-k\frac{s+p}{q^I}}{1-k\frac{s}{q^F}} = \frac{P^F}{P^I}. \tag{24}$$

The system is recursive. The first two equations determine labour market tightness in the formal sector, θ^F, and in the informal sector, θ^I, independently. The third equation then determines relative prices, $\frac{P^F}{P^I}$, and finally the last equation determines the informal sector labour force, ε.

4 Comparative statics

This section is concerned with the impact of the punishment system on tightness, equilibrium producer wages, employment- and unemployment rates, the number of unemployed workers and the division of workers into the formal- and informal sector. We consider how an increase in the audit rate, p, and an increase in a punishment fee, α or δ, affect the equilibrium variables. We only consider fully financed changes in the punishment system. Hence, changes in p, α, and δ are always followed by adjustments in the tax rates t and/or z in order to balance the government budget. As is clear, by inspection of (21)-(24) and (8)-(9) and (12)-(17), the equilibrium variables will be affected by the audit rate p, where we

[12] Any homothetic utility function will generate qualitatively the same comparative statics results.

[13] Note that the income level restricting consumption for consumers in each period is of no importance for the relative price, due to the assumption of homothetic preferences. Hence, it is not necessary to assume that all income is consumed in each period.

note that p appears both in the wedge, ψ, and in the informal sector separation rate, $s + \xi p$. The tax rates, t and z, and the punishment rates δ and α, only affects the equilibrium variables through the wedge, ψ. In order to have fully financed changes in the punishment system, the government budget restriction needs to be balanced at all times. The budget restriction[14] is given by:

$$R = w^F (t + z) n^F (1 - \varepsilon) + w^I (p\delta + p\alpha) n^I \varepsilon, \tag{25}$$

which can be rewritten as:

$$R = \omega^F \left(1 - \frac{1}{\phi^F}\right) n^F (1 - \varepsilon) + \omega^I \left(1 - \frac{1}{\phi^I}\right) n^I \varepsilon. \tag{26}$$

The budget restriction is a function of the tax- and punishment wedges, ϕ^F and ϕ^I, and the audit rate, p.[15] From (26) it is clear that an increase in ϕ^F and ϕ^I, that leaves ψ and p unaffected, considering the determination of the equilibrium variables, will increase the government revenue. Hence, for a given wedge, the government can choose t, z, δ and α so as to reap any level of revenue. This is very convenient and implies that we can investigate the impact of a fully financed increase in p on the equilibrium variables, without explicitly incorporating the government budget restriction.

The impact on the equilibrium variables of a fully finance change in δ or α, will be equivalent to analysing the impact on the equilibrium variables of a change in ψ. An increase in δ or α, will have a direct positive effect on ψ.

[14] It is straight forward to add a term $-f\left(p\varepsilon n^I\right)$, where $f'(.) > 0$, to the government budget restriction. This term captures that it is costly for the government to audit the informal sector. The government knows which sector to audit and it has an idea about the size of the informal sector, although it cannot costlessly allocate all firms and workers in the sector. An increase in p may induce a government surplus or a government deficit, as can be seen from (26), irrespective of whether this cost function of auditing is added to the budget constraint or not. This surplus or deficit can, however, be eliminated by adjustments in α, δ, t, z, in order to leave ψ unaffected. This fact implies that any change in p given in the comparative statics section is always fully financed. Adding a term $-f\left(p\varepsilon n^I\right)$ to the government budget restriction will not change this fact. Furthermore, the qualitative comparative statics result throughout the section is also maintained when including a cost of auditing. The reason is the same as described in the text and in footnote (16). Also the result in proposition 8, when assuming endogenous moral costs hold when including a cost of auditing.

In the literature on tax evasion one usually assumes that auditing is costly, whereas fining can be done without a resource cost. This implies that the government concerned with maximising utility of its representative citizen will want to set the fine as high as possible and the audit rate as low as possible. This policy of "hanging violators with a probability of zero" deters evasion while minimising the resource costs. As hanging tax evaders at probability of zero does not rhyme well with a democratic society, analytical models therefore usually assume a ceiling on the fines. See Slemrod and Yitzhaki (2000) for summary of the literature.

[15] The tax rates, t and z and δ and α, will not appear in the government budget restriction or in the equations determining the equilibrium variables. This reflects that t and z are equivalent instruments, and so are δ and α. Hence it does not matter if we tax (punish) the firm side or the worker side. A change in δ or α is captured by a change in ϕ^I, and a change in z or t is captured by a change in ϕ^F.

This induces a government surplus or deficit, which calls for adjustments in t and/or z. These tax adjustments will also affect ψ. The most plausible case is, of course, that an increase in δ or α induces a government surplus which calls for reductions in t and/or z in order to balance the government budget. The direct effect of an increase in δ or α increases ψ, and the tax rate reductions will, in this case, reinforce the increase in ψ. However, the analysis does not need to impose any restrictions on the dynamic effects of the government budget restriction, although we will express the propositions below as if an increase in δ or α induces an increase in ψ, in order to make the intuition transparent. The reform considered by investigating how an increase in ψ affects the equilibrium variables simply considers a fully financed change in the tax- and punishment system that reduces the relative attractiveness of the informal sector.[16] We can hence also in the case of changes in the punishment fees investigate the impact of a fully finance change in δ or α on the equilibrium variables, without explicitly incorporating the government budget restriction.

The results given in this section are for $\xi > 0$. We do not explicitly consider how variations in the moral cost parameter c affect the equilibrium values. However, impacts on equilibrium values from a higher c are analogous to impacts from a higher punishment fee, α or δ.

4.1 Labour market tightness

This section considers fully financed changes in the punishment system on labour market tightness. The effects on tightness are summarized in the following proposition.

Proposition 1 *A fully financed increase in the audit rate, p, will have no impact on formal tightness, θ^F, and reduce informal tightness, θ^I. Both θ^F and θ^I are unaffected by fully financed changes in the punishment fees, δ and α.*

Proof. From equation (10) it is apparent that tightness in the formal sector is neither affected by changes in the tax rates nor by changes in the punishment fees, or the audit rate, $\frac{\partial \theta^F}{\partial p} = \frac{\partial \theta^F}{\partial \psi} = 0$. Differentiating equation (11) with

[16] As written in the text, we do not rule out less plausibe cases when considering the tax adjustments in order to balance the government budget restriction. Consider for example the case with Laffer effects, i.e., $\partial R/\partial x_2 < 0$, $x_2 = t, z$. If an increase δ or α induces a government surplus, increases in the tax rates t and/or z are called for in order to balance the government budget restriction. If the needed increases in the tax rates are small, ψ still increases with the reform, although the tax adjustment process dampens the direct positive effect on ψ of an increase in δ and α. If, on the other hand, the needed tax increases are substantial, ψ may actually fall in equilibrium due to this reform (large Laffer effects). In this rather perverse case, the reform considered by increasing ψ, is instead a substantial reduction in the formal tax rates, t and/or z, financed by small reductions in δ and/or α, so to make the informal sector relatively less attractive.

respect to p and ψ:

$$\begin{aligned}\frac{\partial\theta^I}{\partial p} &= -\frac{\frac{1}{q^I}}{\gamma - \frac{r+s+\xi p}{(q^I)^2}\frac{\partial q^I}{\partial\theta^I}} = -\frac{\frac{1}{q^I}}{\gamma + \eta\frac{r+s+\xi p}{q^I\theta^I}} < 0, \qquad (27)\\ \frac{\partial\theta^I}{\partial\psi} &= 0.\end{aligned}$$

■

When the audit rate increases, the expected duration of an informal match decreases. It is therefore less profitable for a firm to open informal vacancies, whereby vacancies relative to unemployed workers in the informal sector decrease.

4.2 Producer wages

This section considers fully financed changes in the punishment system on real producer wages (equations (8)-(11)). We summarize the effects on producer wages in the following proposition:

Proposition 2 *A fully financed increase in the audit rate, p, will have no impact on formal producer wages, ω^F, and reduce informal producer wages, ω^I. Both ω^F and ω^I are unaffected by a fully financed increase in the punishment fees, δ and α.*

Proof. Differentiating equation (8), first with respect to p and then with respect to ψ gives, $\frac{\partial\omega^F}{\partial p} = \frac{\partial\omega^F}{\partial\psi} = 0$. Differentiating equation (9), considering that tightness is affected according to (11), with respect to p and ψ yields:

$$\begin{aligned}\frac{\partial\omega^I}{\partial p} &= \gamma k y^I \frac{\partial\theta^I}{\partial p} < 0,\\ \frac{\partial\omega^I}{\partial\psi} &= \gamma k y^I \frac{\partial\theta^I}{\partial\psi} = 0.\end{aligned}$$

■

When the audit rate increases, informal tightness decreases, whereby lower hiring costs are induced. Hence, informal sector producer wages decrease. Formal producer wages are unaffected by higher audit rate or punishment fees as formal labour market tightness is not affected.

4.3 Relative prices

A fully financed change in the audit rate or the punishment fees has the following impact on relative prices.

Proposition 3 *A fully financed increase in the audit rate, p, or the punishment fees, δ and α, will decrease the relative price, $\frac{P^F}{P^I}$.*

Proof. Differentiating equation (19) with respect to $\frac{P^F}{P^I}$ and p gives:

$$\frac{\partial \frac{P^F}{P^I}}{\partial p} = \frac{1}{\psi}\left(\frac{1}{\theta^F}\frac{\partial \theta^I}{\partial p} - \frac{P^F}{P^I}\frac{\partial \psi}{\partial p}\right) < 0.$$

Differentiating equation (19) with respect to $\frac{P^F}{P^I}$ and ψ yields:

$$\frac{\partial \frac{P^F}{P^I}}{\partial \psi} = -\frac{1}{\psi^2}\frac{\theta^F}{\theta^I} < 0.$$

Recall that we only need to consider the direct effects of the punishment parameters to consider a fully financed reform with the financing schemes considered. ■

The increase in the wedge, ψ, either through an increase in the audit rate or the punishment fees, reduces the relative attractiveness of the informal sector corresponding to a reduction in the relative price.

Considering the impact from a higher p, there is an additional impact through the effect on informal sector labour market tightness. Informal sector labour market tightness is reduced which again reduces the relative price.

4.4 Unemployment rates

The impact on unemployment follows directly from the previously derived results.

Proposition 4 *A fully financed increase in the audit rate, p, has no impact on the unemployment rate in the formal sector, u^F, and increases the informal sector unemployment rate, u^I. Neither u^F nor u^I are affected by fully financed increases in the punishment fees, δ and α.*

Proof. Differentiating equation (12) first with respect to p and then with respect to ψ yields, $\frac{\partial u^F}{\partial p} = 0$, and $\frac{\partial u^F}{\partial \psi} = 0$. Differentiating the unemployment equation, equation (13,), first with respect to p and then with respect to ψ, we have:

$$\begin{aligned} \frac{\partial u^I}{\partial p} &= \frac{\lambda^I - (s+\xi p)\frac{\partial \lambda^I}{\partial p}}{\left(s+p+\lambda^I\right)^2} > 0, \qquad (28) \\ \frac{\partial u^I}{\partial \psi} &= 0. \end{aligned}$$

■

The informal unemployment rate increases for two reasons. A higher audit rate increases the separation rate in the informal sector, thus increasing the outflow from informal employment. A higher p also reduces sector tightness and thereby reduces the unemployed worker's transition rate into informal sector employment. Both effects increase the informal sector unemployment rate.

A related question to address is what happens to relative employment, $\frac{n^I\varepsilon}{n^F(1-\varepsilon)}$, i.e. what happens to the number of informal sector workers, $n^I\varepsilon$, relatively to the number of formal sector workers, $n^F(1-\varepsilon)$, when p,α or δ increases.

Proposition 5 *Relative employment, $\frac{n^I\varepsilon}{n^F(1-\varepsilon)}$, decreases with a fully financed increase in the punishment fees, α and δ. The impact on relative employment from a higher audit rate p is ambiguous.*

Proof. Differentiating equation (24) with respect to $\frac{n^I\varepsilon}{n^F(1-\varepsilon)}$ and ψ gives:

$$\frac{\partial \frac{n^I\varepsilon}{n^F(1-\varepsilon)}}{\partial \psi} = \frac{\frac{n^I\varepsilon}{n^F(1-\varepsilon)}}{\frac{P^F}{P^I}} \frac{\partial \frac{P^F}{P^I}}{\partial \psi} < 0. \tag{29}$$

We differentiate equation (24) with respect to $\frac{n^I\varepsilon}{n^F(1-\varepsilon)}$ and p. We substitute for the derivatives $\frac{\partial \frac{P^F}{P^I}}{\partial p}$ and $\frac{\partial \theta^I}{\partial p}$ and use equation (24) to obtain:

$$\frac{\partial \frac{n^I\varepsilon}{n^F(1-\varepsilon)}}{\partial p} = \frac{n^I\varepsilon}{n^F(1-\varepsilon)} \left(-\frac{\frac{1}{q^I\theta^I}}{\gamma + \eta \frac{r+s+p}{q^I\theta^I}} - \frac{1}{\psi}\frac{\partial \psi}{\partial p} + \frac{k\frac{1}{q^I}}{1-k\frac{s+p}{q^I}} \frac{\gamma + \eta \frac{r}{q^I\theta^I}}{\gamma + \eta^I \frac{r+s+p}{q^I\theta^I}} \right), \tag{30}$$

where we have used proposition (3) to sign the derivatives. Recall that we only need to consider the direct effects of the punishment parameters to consider a fully financed reform with the financing schemes considered. ■

Whenever the punishment fee, α or δ, increases, the implied reduction in relative prices increases relative demand for the formal sector produced good. This corresponds to a decrease in employment in the informal sector relatively to employment in the formal sector.

When the audit rate, p, increases, the result is more dubious. We have a negative impact from a reduced relative price and a positive impact from higher hiring costs. A reduced relative price tends to decrease demand for informally produced goods and thereby reduce employment in the informal sector, which is captured by the first two terms in equation (30). However, hiring costs are also affected. The decrease in informal sector labour market tightness tends to reduce vacancy costs. Reversely, a higher separation rate, $s + \xi p$, tends to increase vacancy costs. We can show that the latter effect dominates the former. Increased hiring costs reduce actual informal sector goods supply. The impact from hiring costs implies that relative employment must increase to meet demand. If hiring costs are not too high, k is small, the relative price impact dominates the effect on hiring costs and informal sector employment decreases relatively to formal sector employment.

4.5 Informal sector labour force

In this section, we examine the impact on the informal labour force following an increase in the audit rate, p, or the punishment fees, α or δ. We summarize the results on the informal sector labour force in the following proposition:

Proposition 6 *A fully financed increase in the audit rate, p, has an ambiguous impact on the informal sector labour force, ε. Fully financed increases in the punishment fees, δ and α, reduce the informal sector labour force, $\frac{\partial \varepsilon}{\partial x_1} < 0, x_1 = \alpha, \delta$.*

Proof. Differentiating equation (24) with respect to ε and p yields:

$$\frac{1}{1-\varepsilon}\frac{1}{\varepsilon}\frac{d\varepsilon}{dp} = \frac{1}{\frac{P^F}{P^I}}\frac{\partial \frac{P^F}{P^I}}{\partial p} - \frac{\frac{1}{\lambda^I}\frac{\partial \lambda^I}{\partial \theta^I}(s+p)}{s+p+\lambda^I}\frac{\partial \theta^I}{\partial p} + \frac{1}{s+p+\lambda^I} + \frac{k\frac{1}{q^I}}{1-k\frac{s+p}{q^I}} - \frac{k\frac{s+p}{(q^I)^2}\frac{\partial q^I}{\partial \theta^I}}{1-k\frac{s+p}{q^I}}\frac{\partial \theta^I}{\partial p}.$$

We substitute for the derivatives $\frac{\partial \frac{P^F}{P^I}}{\partial p}$, $\frac{\partial \theta^I}{\partial p}$ and use equation (13) to obtain:

$$\frac{1}{1-\varepsilon}\frac{1}{\varepsilon}\frac{d\varepsilon}{dp} = -\left(1-\left(1-\eta^I\right)u^I - \frac{k\theta^I\left(\gamma+\eta\frac{r}{q^I\theta^I}\right)}{1-k\frac{s+p}{q^I}}\right)\frac{\frac{1}{q^I\theta^I}}{\gamma+\eta\frac{r+s+p}{q^I\theta^I}} - \frac{1}{\psi}\frac{\partial \psi}{\partial p} + \frac{u^I}{s+p}. \tag{31}$$

Differentiating equation (24) with respect to ε and ψ gives:

$$\frac{\partial \varepsilon}{\partial \psi} = \frac{(1-\varepsilon)\varepsilon}{\frac{P^F}{P^I}}\frac{\partial \frac{P^F}{P^I}}{\partial \psi} < 0, \tag{32}$$

where we have used proposition (3) to sign the derivatives. Recall that we only need to consider the direct effects of the punishment parameters to consider a fully financed reform with the financing schemes considered. ■

Higher punishment fees decrease relative demand for the informal sector produced good, due to the decrease in relative prices, $\frac{P^F}{P^I}$. Thereby, the informal sector labour force is reduced. When the audit rate, p, increases, referring to the discussion in the previous subsection concerning the impact on relative employment, $\frac{n^I\varepsilon}{n^F(1-\varepsilon)}$, the result is more ambiguous. Furthermore, here we have an additional positive effect on informal sector employment through the decrease in the informal sector employment rate, n^I. The reduction in the informal sector employment rate, n^I, calls for a higher informal sector labour force in order to match demand for given relative prices. This impact is captured by the second and last term in equation (31). For the informal sector labour force to decrease, the decrease in relative prices has to dominate both the impact from increased hiring costs and the impact from the reduced informal sector employment rate.

4.6 Total unemployment

Finally, we consider the impact on total unemployment, which is summarized in the following proposition.

Proposition 7 *A fully financed increase in the audit rate, p, has an ambiguous impact on total unemployment, U_{TOT} and decreases observable unemployment, U^o_{TOT} if $\frac{\partial \varepsilon}{\partial p} < 0$. A fully financed increase in a punishment fee, α or δ, reduces total actual and observable unemployment, U_{TOT},U^o_{TOT}.*

Proof. Differentiating equation (16) with respect to U^{TOT}, and p gives:

$$\frac{\partial U_{TOT}}{\partial p} = \frac{\partial \varepsilon}{\partial p}\left(u^I - u^F\right) + \varepsilon \frac{\partial u^I}{\partial p}. \tag{33}$$

Differentiating equation (16) with respect to U^{TOT}, and ψ gives:

$$\frac{\partial U_{TOT}}{\partial \psi} = \frac{\partial \varepsilon}{\partial \psi}\left(u^I - u^F\right) < 0.$$

Observable unemployment is affected as

$$\frac{\partial U^o_{TOT}}{\partial p} = \frac{\partial \varepsilon}{\partial p}\left(1 - u^F\right), \tag{34}$$

$$\frac{\partial U^o_{TOT}}{\partial \psi} = \frac{\partial \varepsilon}{\partial \psi}\left(1 - u^F\right) < 0, \tag{35}$$

where $\frac{\partial \varepsilon}{\partial p} \lessgtr 0$, $\frac{\partial \varepsilon}{\partial \psi} < 0$ from the proof of proposition (6) and $\frac{\partial u^I}{\partial p} > 0$ from (28). Recall that we only need to consider the direct effects of the punishment parameters to consider a fully financed reform with the financing schemes considered. ■

If a higher p induces a reallocation of workers towards the formal sector, $\frac{\partial \varepsilon}{\partial p} < 0$, this unambiguously reduces observable unemployment as the unemployment rate is relatively smaller in the formal sector. However, the unemployment rate in the informal sector increases which tends to raise total unemployment. The overall effect on total actual unemployment of an increase in the audit rate is hence ambiguous. An increase in the punishment fees, α and δ, will unambiguously reduce total unemployment due to the reallocation of workers towards the formal sector.

4.7 Discussion

We have seen how differences in tax and auditing policies may explain differences in equilibrium values of labour market tightness, producer wages, relative prices, relative employment, the informal sector labour force and total unemployment. The results concerning higher punishment fees were unambiguous.

We saw that a higher punishment fee resulted in lower relative prices, reduced relative employment, reduced informal sector labour force and lower total unemployment. Implicitly, we have also shown that differences in moral costs may cause differences in-between regions or countries. The impact on equilibrium values resulting from higher moral costs corresponds to the impact from a higher punishment fee. Hence, if we observe differences in-between regions and countries in, for example, the size of the informal sector, this may be due to different moral costs. Higher moral costs reduce the size of the informal sector. However, why are some regions or countries inhabited by workers and firm owners with lower moral costs than others? Could it be the case that moral costs are related to a social norm against or pro informal sector work. Could a large fraction of workers and firms already situated in the informal sector reduce the 'bad feelings' related to being detected performing informal sector activities? Here we consider whether there is a social norm saying that informal sector work is a good or a bad thing, and in this way related to high or low moral costs being associated with detection. In this case, we may have that, for some reason, one region has ended in an equilibrium with a relatively small informal sector and thereby high moral costs. Whereas another region has ended up in an equilibrium with a relatively large informal sector and thereby low moral costs. We turn to this issue in the next section.

5 Endogenous moral costs and social norm

In this section we extend the model to include endogenous moral costs. In order to increase the transparency of the analysis, we simplify the model by assuming that $\xi = 0$. This implies that we no longer have any impact on informal sector labour market tightness following an increase in p. We assume that the moral cost, c, is an increasing function of employment in the formal sector relatively to employment in the informal sector. More specifically, we assume:

$$c = \tilde{c}\rho,$$

where $\rho = \frac{n^F(1-\varepsilon)}{n^I\varepsilon}$. The larger the informal sector, i.e. the lower is ρ, the more generally accepted is tax evasion, and the lower will the moral cost upon detection be.

The first two equilibrium equations, (21) and (22), are now unaffected by changes in p,α, δ, t, and z. The last two equilibrium equations, (23) and (24), include the endogenous moral costs. As tightness is determined independently of the tax and punishment system from (21) and (22), we have (23) and (24) determining the relative price, $\frac{P^F}{P^I}$, and the relative employment, ρ, as a function

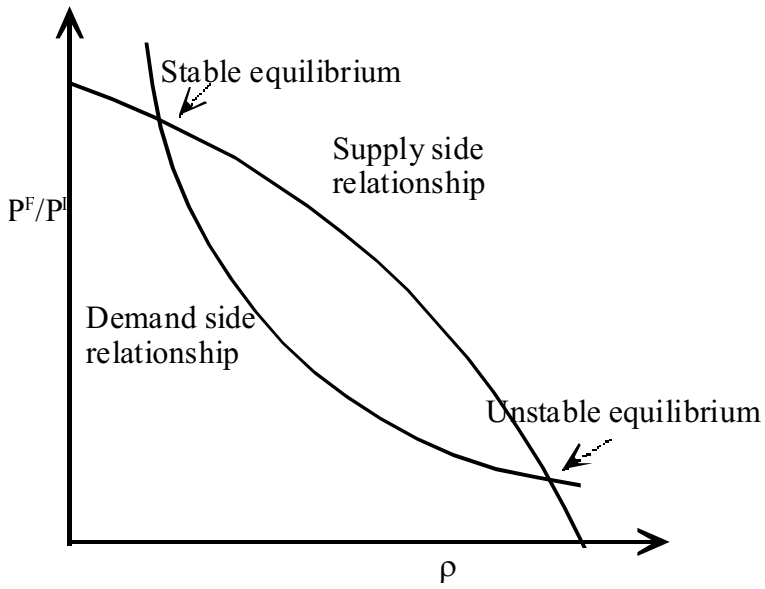

Figure 1: Equilibria with endogenous social norm

of the tax and punishment system. The two equations can be written:

$$\frac{P^F}{P^I} = \phi^F \frac{\theta^I}{\theta^F} \frac{1-p(\delta+\tilde{c}\rho)}{1+p(\alpha+\tilde{c}\rho)}, \tag{36}$$

$$\frac{P^F}{P^I} = \frac{\sigma}{1-\sigma} \frac{1-k\frac{s}{q^I}}{1-k\frac{s}{q^F}} \frac{1}{\rho}. \tag{37}$$

where we have used that $\psi = \phi^I/\phi^F$ and $\phi^I = \frac{1+p(\alpha+\tilde{c}\rho)}{1-p(\delta+\tilde{c}\rho)}$. The two equations (36) and (37) are illustrated in Figure 1. The demand-side relationship in (37) gives the hyperbolic-shaped curve in the figure, whereas the supply-side relationship in (36) gives the concave curve in the figure.[17]

As is clear from the figure, there will be two equilibria.[18] One equilib-

[17] The supply-side relationship becomes linear if we assume that only workers experience a moral cost upon detection, whereas the firms experience no moral cost. The intercept on the y-axis and the x-axis are, $\frac{\theta^I}{\theta^F}\phi^F \frac{1-p\delta}{1+p\alpha}$ and $\frac{1-p\delta}{p\tilde{c}}$, respectively. Note also that with no social norm against tax evasion, the supply-side relationship becomes independent of ρ, i.e. (36) is horizontal in the $P^F/P^I - \rho$ space.

[18] One could of course also have a case where there is no equilibrium. Moreover, one can have the very specific case of only one equilibrium, which is the case when $\zeta^2 - 4\chi p\tilde{c}(1+p\alpha) = 0$ and $\chi = \frac{\theta^F}{\theta^I}\frac{1}{\phi^F}\frac{\sigma}{1-\sigma}\frac{1-k\frac{s}{q^I}}{1-k\frac{s}{q^F}}$. In the first case, equation (36) is located fully to the left of (37) and there is no intersection of the two curves, whereas the second case is when the two curves are tangent.

rium corresponds to a high relative price and a large informal sector (low ρ), whereas the other equilibrium corresponds to a low relative price and a small informal sector (high ρ). Considering the empirical evidence presented in the introduction, one interpretation of these equilibria is that the first equilibrium corresponds to continental Europe where the underground economy seems to be rather large, whereas the second equilibrium corresponds to the Nordic countries where the underground economy is relatively small.

Formally, we can solve for ρ by eliminating P^F/P^I from (36) and (37). We get a second order equation determining ρ :

$$0 = p\tilde{c}\rho^2 + \chi\left(1 + p\alpha\right) - \rho\left(\left(1 - p\delta\right) - \chi p\tilde{c}\right), \tag{38}$$

where $\chi = \frac{\theta^F}{\theta^I}\frac{1}{\phi^F}\frac{\sigma}{1-\sigma}\frac{1-k\frac{s}{q^I}}{1-k\frac{s}{q^F}}$. Solving for ρ we obtain the two solutions:

$$\rho_1 = \frac{\zeta + \sqrt{\zeta^2 - 4\chi p\tilde{c}\left(1 + p\alpha\right)}}{2p\tilde{c}}, \rho_2 = \frac{\zeta - \sqrt{\zeta^2 - 4\chi p\tilde{c}\left(1 + p\alpha\right)}}{2p\tilde{c}},$$

where $\zeta = \left(\left(1 - p\delta\right) - \chi p\tilde{c}\right)$. For existence of two positive solutions for ρ we need that $\zeta^2 - 4\chi p\tilde{c}\left(1 + p\alpha\right) > 0$, and $\zeta > 0$. The large root, ρ_1, corresponds to a small informal sector. Reversely, the small root, ρ_2, corresponds to a large informal sector.

We ask whether one of these equilibria can be ruled out as being unstable. As these equilibria refer to steady state, we need to impose some dynamic adjustments in order to say something about stability. It seems natural to choose a price adjustment mechanism in analogy with the Walrasian auctioneer. As will become clear, it then follows that the large root is an unstable equilibrium. The result of comparative statics at the stable equilibrium is given by the following proposition:

Proposition 8 *Fully financed increases in the audit rate, p, or in the punishment fees, α and δ, will reduce the informal sector, i.e. $\frac{\partial \varepsilon}{\partial p} < 0, \frac{\partial \varepsilon}{\partial x_1} < 0, x_1 = \alpha, \delta$, considered that we are located on the positively sloped side of the Laffer curve.*

Proof. From (36) and (37), we can no longer express the equilibrium variables, ρ and $\frac{P^F}{P^I}$, as a function of p and ψ, which implies that the we need to incorporate the budget restriction explicitly when considering comparative statics. Differentiating the second equilibrium value of ρ with respect to p and α, δ

gives:

$$\begin{aligned}
\frac{\partial \rho_2}{\partial p}|_{\alpha,\delta,t,z} &= \frac{\zeta - p2b\tilde{c} - \sqrt{\zeta^2 - 4bp\tilde{c}\,(1+p\alpha)}}{\sqrt{\zeta^2 - 4bp\tilde{c}\,(1+p\alpha)}2p\tilde{c}p} > 0, \\
\frac{\partial \rho_2}{\partial \delta}|_{p,\alpha,t,z} &= \frac{\zeta - \sqrt{\zeta^2 - 4\chi p\tilde{c}\,(1+p\alpha)}}{\sqrt{\zeta^2 - 4\chi p\tilde{c}\,(1+p\alpha)}2\tilde{c}} > 0, \\
\frac{\partial \rho_2}{\partial \alpha}|_{p,\delta,t,z} &= \frac{1}{\sqrt{\zeta^2 - 4\chi p\tilde{c}\,(1+p\alpha)}}\chi p > 0, \\
\frac{\partial \rho_2}{\partial t}|_{p,\alpha,\delta,z} &= -\frac{\chi\frac{1+p\alpha}{1-t}}{\sqrt{\zeta^2 - 4\chi p\tilde{c}\,(1+p\alpha)}} < 0, \\
\frac{\partial \rho_2}{\partial z}|_{p,\alpha,\delta,t} &= -\frac{\chi\frac{1+p\alpha}{1+z}}{\sqrt{\zeta^2 - 4\chi p\tilde{c}\,(1+p\alpha)}} < 0.
\end{aligned}$$

From differentiating the government budget restriction for a given budget revenue requirement, R, we have $\partial x_2/\partial p < 0$, $\partial x_2/\partial x_1 < 0, x_1 = \alpha, \delta, x_2 = t, z$ if we are located on the positively side of the Laffer curve. It then follows:

$$\begin{aligned}
\frac{\partial \rho_2}{\partial p} &= \frac{\partial \rho_2}{\partial p}|_{\alpha,\delta,t,z} + \frac{\partial \rho_2}{\partial x_2}|_{p,\alpha,\delta}\frac{\partial x_2}{\partial p} > 0, \\
\frac{\partial \rho_2}{\partial \delta} &= \frac{\partial \rho_2}{\partial \delta}|_{p,\alpha,t,z} + \frac{\partial \rho_2}{\partial x_2}|_{p,\alpha,\delta}\frac{\partial x_2}{\partial \delta} > 0, \\
\frac{\partial \rho_2}{\partial \alpha} &= \frac{\partial \rho_2}{\partial \alpha}|_{p,\delta,t,z} + \frac{\partial \rho_2}{\partial x_2}|_{p,\alpha,\delta}\frac{\partial x_2}{\partial \alpha} > 0.
\end{aligned}$$

■

To capture the intuition of how changes in the punishment parameters (or the tax rates) affect the size of the informal sector, consider a reduction in p. When p is reduced, the attractiveness of the informal sector is increased. For a given relative price, workers and firms will find it optimal to reallocate towards the informal sector. Hence, there will be excess supply of goods produced in the informal sector and excess demand for goods produced in the formal sector. The relative price needs to increase in order to prevent workers and firms from leaving the formal sector for the informal sector. If the relative price is increased to prevent any of the workers and firms to reallocate towards the informal sector, there will be excess demand for goods produced in the informal sector as those goods now have become relatively cheaper. Hence, relative employment in the informal sector increases, i.e. ρ falls. As the informal sector increases in size, the moral cost of tax evasion is reduced, and again workers and firms want to reallocate towards the informal sector. This calls for further increases in the relative price. The economy converges to a new equilibrium where the formal sector relative price is higher and so is the size of the informal sector. We

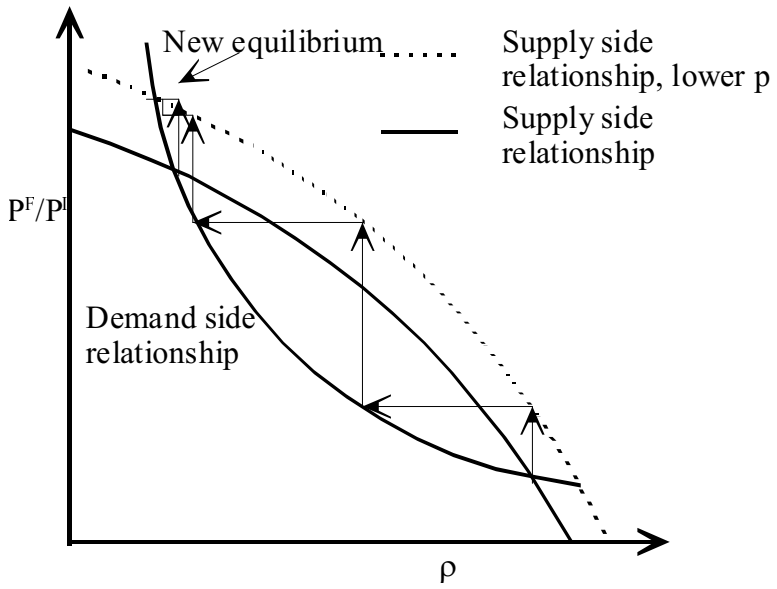

Figure 2: The impact on the equilibria from a reduction in p

note that the economy converges to a situation with a large informal sector, irrespective of whether the economy initially had a large *or* a small informal sector. That is, the economy converges to the stable equilibrium.[19] In Figure 2, a reduction in p is illustrated by an outward shift in (36).

In an initial situation where the informal sector is small, ρ is high, any increase in the formal sector relative price will make consumers eagerly willing to substitute formal goods for informal goods. A small increase in the relative price induces a rather large reduction in ρ. In addition, a given reduction in ρ will demand a large increase in the relative price in order to prevent workers and firms from reallocating towards the informal economy. Hence, the price adjustments accompanying with quantity adjustments are initially escalating following a reduction in p. However, when the informal sector is becoming large, consumers are not so eagerly willing to substitute formal goods for informal goods, and also the needed relative price increase, following reductions in ρ, is small as the moral cost of tax evasion is very small when ρ is small.

Consider the interpretation of the low ρ corresponding to continental Europe, and the high ρ corresponding to the Nordic countries. One could argue that the Nordic countries would, by reducing their audit rate and/or punish-

[19] An increase in p will, on the other hand, make the economy converge towards a new equilibrium in case we are initially at the low ρ equilibrium (the stable equilibrium), whereas an increase in p will make the economy diverge in case we are located at a high ρ equilibrium.

ment fees, increase the size of their underground economies. The increase in the underground economy will in itself give incentives to establish a culture where the public opinion is that tax evasion is acceptable. The size of the underground economy could then become rather large as only marginal moral costs prevent workers from entering the informal sector. Moreover, it may be hard to reestablish an economy with a small informal sector again once the social norm is that tax evasion is generally accepted.

6 Conclusion

We have shown that, in general, increased government control of the informal sector in terms of more frequent auditing, has an ambiguous impact on the size of the underground economy. On the one hand, increased auditing reduces the relative price, which tends to decrease the demand for informally produced goods and thereby reduce employment in the informal sector. On the other hand, more frequent auditing increases the informal sector vacancy costs. Increased vacancy costs reduce actual informal sector goods supply. This, in turn, implies that relative employment must increase in order to meet demand. If hiring costs are not too high, the relative price impact dominates the effect on vacancy costs and informal sector relative employment decreases.

We have also shown that increased auditing may not necessarily reduce overall unemployment. The ambiguous impact on overall unemployment stems from the reduced employment perspectives in the informal sector being counteracted by the fact that workers reallocate towards the formal sector where the unemployment rate is lower. Total observable unemployment falls as the informal sector is reduced.

Considering increased punishment fees, we concluded that the higher punishment fees reduce the size of the informal sector by reducing relative prices for informal sector workers. Moreover, higher punishment fees reduce overall unemployment, actual as well as official, through the reallocation of workers towards the formal sector.

Finally, we considered the inclusion of an endogenous social norm against tax evasion. The larger the fraction of the population employed in the informal economy, the weaker the social norm. We then showed the coexistence of two equilibria. One equilibrium with a weak social norm against tax evasion associated with large informal sector employment and another equilibrium with a strong norm against tax evasion associated with a small informal sector.

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