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Abstract

We build a general equilibrium model in terms of a search and matching model with an informal sector. We consider the impact of the traditional policy instruments considered in the tax evasion literature, such as changes in the tax- and punishment system as well as changes in the employment protection legislation and concealment costs, on labour market outcomes. To this end, we set-up a model which allows workers to allocate their search for formal and informal sector jobs optimally. We calibrate and simulate the model to fit the North and the South of Europe, where the share of informal sector workers is equal to three percent in the North and more than 4 times as high in the South. We consider the impact of concealment costs, as there are large differences in terms of tax administration procedures between the South and the North, in terms of that Northern countries make more extensively use of third-party reporting. We also examine whether stricter employment protection legislation in Southern Europe may explain the observed fact.

1 Introduction

There is a large interest in combatting work in the informal economy across the industrialised world. There is a number of reasons for that. From a social point of view, informal workers have limited access to social protection and insurance, which may have severe consequences for inequality and poverty in the long run. Moreover, informal work will deprive countries from revenues needed in order to finance the provision of public services, and thus counteracting the very base of a welfare state. In addition, informal work affects labour market outcomes.

The ambition to fight tax evasion in general (and in fact also avoidance) has recently increased.[1] In 2007 the European Commission started the first EU wide cross national comparable questionnaire to increase the knowledge about tax evasion and undeclared work in Europe in order to combat it (see EC, 2007, 2014).[2] However, as individuals and firms engaged in the informal economy do not wish to be identified, it is notoriously difficult to collect accurate information about undeclared work. Still survey data, such as the Eurobarometer on undeclared

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[1] In 2015, the European Commission launched their ambition to step up efforts to combat tax evasion and tax fraud in order to have a more fair and transparent taxation. The Tax Transparency Package presented in 2015 was followed by the Anti Tax Avoidance Package in 2016. Also, the parliament has endorsed establishing a European platform to stimulate cooperation in combatting undeclared work (EU 2016). The OECD has also increased their ambition to reduce tax evasion. The OECD initiated the Global Forum of Transparency and Exchange of Information for Tax Purposes in the early 2000s, and it now constitutes the largest tax organisation in the world including both OECD and non-OECD countries (see http://www.oecd.org/tax/transparency/). The progress on these issues was presented to the G20 leaders earlier this summer (OECD 2017). See http://www.oecd.org/tax/oecd-secretary-general-tax-report-g20-leaders-july-2017.pdf.

[2] For the 2007 survey see http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_284_en.pdf. For the 2014 survey see http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_402_en.pdf

work, have been widely used to measure informality. The drawbacks with these types of data when the aim is to measure the overall size of the informal economy, or to capture long run effects working through the price channels, are however significant. General equilibrium effects are simply not likely to be captured using micro level data on individuals or firms of this type.

The aim of this paper is instead to capture the equilibrium effects working through the price channels by building a search and matching model with an informal sector. We consider the impact of the traditional policy instruments considered in the tax evasion literature, such as changes in the tax- and punishment system as well as changes in the employment protection legislation, on labour market outcomes. Moreover, we consider the impact of what we refer to as concealment costs of tax evasion. These types of costs reflects that it is difficult, and costly, to hide income from the tax authorities. Such costs have recently gained grounds in the tax evasion literature when it comes to explaining observed tax evasion. The reason is that the traditional policy instruments (employment protection legislation, taxes and punishment policies) have a difficult time explaining the low amount of tax evsion observed. Despite high taxes, stringent employment protection legislation and mild sanctions, we simply observe significantly less tax evasion than what we should expect from traditional theory.

Concealment costs can, for example, capture the use of third-party reporting in an economy.[3] Also, there is a growing body of literature that stresses the importance of non-economic factors such as morality, guilt and shame as key factors in explaining the puzzle of why tax compliance, after all, is so high.[4] If there is a strong social norm of tax compliance, it may be socially costly for individuals to evade taxes. These social norms, which in turn can be induced by the institutions and governance structure in the economy, is then proposed candidates for explaining the low amount of tax evasion observed. We let also these types of social costs be captured by the concealment costs.

To analyse the full impact of combatting undeclared work through these policies requires a general equilibrium framework. The model set-up will allow workers to 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, we account for only a few differences between the formal and the informal sector. The first, and most obvious, 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. Informal sector firms also face concealment costs, which captures that it is costly to hide income from the tax authorities. In addition, formal sector firms will face costs due to employment protection legislation.

We find that increased costs of evasion, either through increased audit rates, more extensive sanctions or third-party reporting, or even through policies increasing social costs, induce a reallocation of firms and workers towards the formal sector. While this is somewhat expected, it is less clear from an a prior point of view, how wages

[3] See Gordon and Li (2009), Kleven et al. (2011), Kleven (2014), Kleven et al. (2016), Pomeranz (2016), and Kushumova (2017).
[4] See Andreoni et al. (1998), Perry (2007), and Packard et al. (2012).

and aggregate unemployment are affected by such policy. We find that informal sector producer wages increase and formal sector producer wages fall, and that more workers are going to find themselves without a job although the formal unemployment rate goes down. Thus less formal jobs are created than informal jobs being destroyed. This follows as the aggregate wage pressure increases.

Increased costs of taxation will instead induce movements towards the informal sector, boosting job creation in the informal sector and reducing the number of workers without a job. Stricter employment protection legislation, will also induce a movement from the formal sector to the informal sector. However, this will not necessarily increase the number of people in a job.

We also calibrate and simulate the model to fit the North and the South of Europe. Although taxes and punishment policies affects the size of the informal sector in both Northern and Southern Europe, these policy instruments cannot explain the rather large difference in the informal sector share observed in these regions. This follows as the taxation of labour, and the probability of being detected and punished doing informal sector work, is not that different between the regions.

The slightly stricter employment protection legislation in Southern Europe can partly explain why more tax evasion can be observed in Southern than in Northern Europe. However, concealment costs, also needs to be lower in Southern compared to Northern Europe for the model to be able to explain the observed differences in informal sector work between the regions. This is in line with the observed differences in terms of tax administration procedures, where the Northern countries make more extensively use of third-party reporting, and also in line with the empirical evidence on tax morale and social costs of tax evasion for the regions.

This numerical exercise also enables us to estimate how many formal sector jobs will be created when informal sector jobs are destroyed due to that wages will adjust in the long run perspective. We find that a substantial amount of formal sector jobs are created in the long run due to wage adjustment process when informal sector jobs are destroyed. Given the simplicity of the model, however, this quantitative exercise should be interpreted with great caution. The results should only be viewed as illustrative in order to shed light on the mechanism for long run outcomes.

The literature on tax evasion is extensive. 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.[5] Also equilibrium models with tax evasion have been developed, as for example the early study by Cremer and Gahvari (1993) and the studies by Tonin (2010) and Prado (2011).

Recently, also a number of models featuring search and matching frictions addressing issues of tax evasion and undeclared work has been presented. The main bulk of these studies have been on informal sector work from the point of view of low- and middle-income countries. As one can argue that the nature of the informal sector can be quite different in low- and middle income countries compared to high-income countries, the modelling strategies

[5]Subsequent papers have since then enhanced the basic model of individual behaviour by, for example, incorporating endogenous labour supply decisions. See for example Sandmo (1981) for an early contribution of endogenous labour supply and underreporting of income.

usually differ in these set-ups. As pointed out by la Porta and Shleifer (2014), the informal sector in low- and middle-income countries is usually huge and contains small, unproductive, and stagnant firms. Moreover, the informal sector in this literature is usually seen as an unregulated sector. For example, taking a Latin American perspective, Albrecht et al. (2009) account for worker heterogeneity in a search framework, while considering the impact of payroll taxes and severance pay on unemployment in the presence of an informal sector.[6] The study by Meghir et al. (2015) takes a slightly different modelling approach in its focus on underground activities in Brazil as their paper considers on-the-job-search and firm heterogeneity. Workers may search for jobs both in the formal and the informal sector, and search frictions make it profitable for firms to start both types of jobs.[7]

The literature now also includes a number of studies using search and matchings set-ups from the perspective of a high-income countries. These studies usually need to assume an asymmetry across the formal and the informal sector in order to generate an informal sector beside the formal sector. 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 study by Fugazza and Jacques (2004) and Kolm and Larsen (2005), on the other hand, explores the consequences for unemployment when workers have moral considerations when deciding on informal sector work. With workers being heterogeneous with respect to moral, only workers with low moral are willing to work in the informal sector. The paper by Boeri and Garibaldi (2002), 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. In contrast, the study we present in this paper investigates the impact of tax and punishment polices on labour market performance in an equilibrium search and matching model where co-existence of both sectors are not based on an exogenously imposed asymmetry across the two sectors.

The paper is organised as follows. In Section 2 we set up a model including tax and punishment policy as well as concealment costs and employment protection legislation. In the following section we consider the impact on the informal sector size and unemployment from concealment costs, tax and punishment policy and employment protection legislation. Section 4 provides us with the numerical solutions and the last section concludes.

2 The Model

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 formal sector

[6] See also Bosch and Esteban-Pretel (2012) for a model based on a similar set-up calibrated by use of flow data from Brazil. Also Ulyssea (2010) uses Brazilian data to calibrate a search model where firms need intermediate goods from both a formal and an informal sector in their production process of a final good.

[7] There are also numerous empirical studies on issues of informality in low- and middle-income countries. See for example Günther and Launov (2012).

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. In addition, informal sector activities are associated with costs for concealing the activity. Finally, formal sector firms may face costs related to employment protection, such as firing costs or costs related to providing workers with a safe work environment. For completeness, we include these costs in the model as well.

2.1 Matching

The matching function for the formal (F) and the informal (I) sector respectively is given by $X^j = (v^j)^{1-\eta}(\sigma^j)^{\gamma}u^{\eta}$, $j = F, I$, where X^j is the number of matches, M^j is a parameter capturing matching efficiency, v^j is the number of vacancies in the sector, and u is the number of unemployed workers. The unemployed workers allocate their search effort optimally between the formal and the informal sector. On the job search is disregarded for simplicity. Each worker's total search time is exogenously given and normalised 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 $\lambda_i^F = (1-\sigma_i)^{\gamma}\left(\theta^F\right)^{1-\eta}$ and $\lambda_i^I = (\sigma_i)^{\gamma}\left(\theta^I\right)^{1-\eta}$, where $\theta^F = v^F / \left((1-\sigma)^{\gamma} u\right)$ and $\theta^I = v^I / (\sigma^{\gamma} u)$ are labour market tightness measured in effective search units. The rates at which vacant jobs become filled are $q^j = \left(\theta^j\right)^{-\eta^j}$, $j = F, I$.

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:

$$rU_i = R + \lambda_i^F\left(E^F - U_i\right) + \lambda_i^I\left(E^I - U_i\right), \tag{1}$$

$$rE_i^F = R + w_i^F(1-t) + s\left(U - E_i^F\right), \tag{2}$$

$$rE_i^I = R + w_i^I(1-p\delta) + s\left(U - E_i^I\right), \tag{3}$$

where r is the exogenous discount rate, s is the exogenous separation rate, and w^j is the sector wage. R is a lump-sum transfer that all individuals receive from the government which reflects that the government has some positive revenue requirements.[8] 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.

The unemployed worker i allocates search, σ_i, between the formal and the informal sector in order to maximise the value of unemployment, rU_i. A necessary condition for an interior solution is that $\gamma < 1$, which holds by assumption. The first order condition can be written as:

$$\frac{(1-\sigma_i)^{1-\gamma}}{(\sigma_i)^{1-\gamma}} = \left(\frac{\theta^F}{\theta^I}\right)^{1-\eta} \frac{\left(E^F - U_i\right)}{\left(E^I - U_i\right)}, \tag{4}$$

where workers allocate their search between the formal and the informal sector so to equalise the net returns to search effort across the two sectors.

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 value functions for a job paying the wage w_i^F and a vacant job in the formal sector are then

$$rJ_i^F = y - \mu - w_i^F (1+z) + s\left(V^F - J_i^F\right), \tag{5}$$

$$rV^F = q^F\left(J^F - V^F\right) - k, \tag{6}$$

where μ captures costs due to employment protection legislation. Analogous notation for the informal sector yields:

$$rJ_i = y - w_i^I (1 + p\alpha + \kappa) + s\left(V^I - J_i^I\right), \tag{7}$$

$$rV^I = q^I\left(J^I - V^I\right) - k, \tag{8}$$

where z is the payroll tax rate, y is productivity, and vacancy costs are denoted k. The parameter α is the proportion of the evaded wage the firm has to pay as a punishment fee if detected. The concealment cost parameter, κ, captures that it is costly to hide income from the tax authorities. The costs could, for example, capture what Kleven et al (2011) refer to as third-party reporting. When there is third-party reporting of income, such as the firm reporting the wage payments directly to the tax authorities, and deviations from this has to be agreed upon also by the worker, which is costly. These concealment costs could also be other costs associated with concealing evasion,

[8]The government cannot exclude the informal sector workers when distributing the transfer as the government does not know who the informal sector workers are (if it did, it could just punish all of them).

such as costs due to morality, guilt and shame. These costs are levied on firms in the model, but with qualitatively the same results, these costs could equally well be levied on workers. Thus κ can be seen as capturing the firm's and the workers's concealment costs of evasion.

2.3 Wage Determination

When a worker meets either a firm offering a formal sector job or a firm offering a job in the informal sector, they bargain over the wage, w_i^j , taking economy wide variables as given. With symmetric bargaining between the worker and firm, the first order conditions from the Nash bargaining solutions is:

$$\frac{1}{\phi^F} J_i^F = E_i^F - U, \tag{9}$$

$$\frac{1}{\phi^I} J_i^I = E_i^I - U, \tag{10}$$

where $\phi^F = \frac{1+z}{1-t}$ and $\phi^I = \frac{1+p\alpha+\kappa}{1-p\delta}$ are the tax and punishment wedges, when we have imposed symmetry within each sector 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 equilibrium by substituting (9) and (10) into (4) and using that $J^F = k/q^F$ and $J^I = k/q^I$ from (6) and (8) together with free entry. This yields the following core equation:

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

where $\psi = \phi^I/\phi^F = \frac{1+p\alpha+\kappa}{1-p\delta} / \frac{1+z}{1-t}$ is the wedge between the informal sector and the formal sector. We can interpret a $\psi > 1$ as the case when it is more costly in terms of expected punishment and concealment costs in the informal sector relative to the cost of taxation in the formal sector. This case is in line with the results found in Kleven et al (2011) where it was shown that concealment costs are likely to be very high due to third-party reporting in high-income countries, indicating that $\psi > 1$. This case is also in line with the growing body of literature pointing towards the importance of non-economic factors, such as costs due to morality, guilt and shame, explaining the rather high tax compliance despite high tax rates, low audit rates, and fairly modest fines.)

We observe that workers allocate their search between the formal and the informal sector in equilibrium, they account for the wedge, ψ, and for the formal relative to the informal sectorial tightness, θ^F/θ^I. It follows that relatively more search will be directed towards the formal sector if expected punishment plus concealment costs are higher than the tax rates, i.e. if $\psi > 1$ and/or if formal sector tightness exceeds informal sector tightness, i.e., $\theta^F/\theta^I > 1$. And vice versa when $\psi < 1$ and $\theta^F/\theta^I < 1$.

By use of equation (1)-(8) and (11) in equations (9) and (10), equilibrium producer wages, $\omega^j,\ j = F, I$, are given by:

$$\omega^F = w^F(1+z) = \frac{1}{2}\left((y-\mu) + \frac{k\theta^F}{(1-\sigma)^{1-\gamma}}\right), \tag{12}$$

$$\omega^I = w^I(1+p\alpha+\kappa) = \frac{1}{2}\left(y + \frac{k\theta^I}{\sigma^{1-\gamma}}\right). \tag{13}$$

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 relatively easier to match with a new worker in case of no agreement. Higher search effort into a sector then reduces the worker's relative bargaining position, resulting in lower wage demands.

3 Informal Sector Size and Unemployment

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

$$n^j = \frac{\lambda^j}{s+\lambda^I+\lambda^F}, j = F, I,\ u = \frac{s}{s+\lambda^I+\lambda^F},\ u^o = \frac{s+\lambda^I}{s+\lambda^I+\lambda^F}. \tag{14}$$

Note that as official 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 unemployment rate falls. The share of informal employment, ρ, will then be given by

$$\rho = \frac{n^I}{n^F+n^I} = \frac{\lambda^I}{\lambda^F+\lambda^I}. \tag{15}$$

As the transition rates, $\lambda_i^F = (1-\sigma_i)^\gamma \left(\theta^F\right)^{1-\eta}$ and $\lambda_i^I = (\sigma_i)^\gamma \left(\theta^I\right)^{1-\eta}$, are pinned down by labour market tightness in the sectors and search intensity, deriving search intensity, σ, formal sector labour market tightness, θ^F and informal sector labour market tightness, θ^I, are then key for determining the size of the informal sector and the actual and official unemployment in the economy. Using equations (5), (6), (7) and (8) and free entry and then inserting for wages from equation (12) and (13), and we have the equations determining labor market tightness in the formal and the informal sector. These equations and the search equation in (11), repeated below, give the three equations determining search intensity, σ, formal sector labour market tightness, θ^F and informal sector labour

market tightness, θ^I :

$$\frac{(1-\sigma)^{1-\gamma}}{(\sigma)^{1-\gamma}} = \frac{\theta^F}{\theta^I}\psi, \tag{16}$$

$$2\left(r+s\right)k\left(\theta^F\right)^{\eta} = (y-\mu) - \frac{k\theta^F}{(1-\sigma)^{1-\gamma}} \tag{17}$$

$$2\left(r+s\right)k\left(\theta^I\right)^{\eta} = y - \frac{\psi k\theta^F}{(1-\sigma)^{1-\gamma}} \tag{18}$$

As is clear from equations (16)-(18), important determinants are the wedge, ψ , and costs of employment protection legislation, μ.

Recall, that the wedge between the informal sector and the formal sector is given by

$$\psi = \phi^I/\phi^F = \frac{1+p\alpha+\kappa}{1-p\delta} / \frac{1+z}{1-t} \tag{19}$$

The wedge between the informal and formal sector has several components. The tax system will clearly have an influence on the wedge as will the audit and punishment rates. The other important component in the wedge is the concealment costs, denoted by κ. Next, in turn, we will discuss the impact of the different factors affecting unemployment and the size of the informal sector derived from the model. We will also discuss the expected effect of these factors based on the previous literature.

3.1 Concealment Costs

The concealment costs, κ, capture that it is costly to hide income from the tax authorities. This component has recently gained grounds in the tax evasion literature when in comes to explaining the low level of observed tax evasion. The reason is that the traditional policy instruments (employment protection legislation, taxes, and punishment policies), have a difficult time explaining the observed tax evasion. Despite high taxes, stringent employment protection legislation and mild sanctions, we simply tend to observe significantly less tax evasion than what we should expect.

High concealment costs can, for example, be due to extensive use of third-party reporting. Also, there is a growing body of literature that stresses the importance of non-economic factors such as morality, guilt and shame as key factors in explaining the puzzle of why tax compliance, after all, is so high despite high taxes and low audit and punishment rates (see Andreoni et al. (1998), Perry (2007), and Packard et al. (2012)).

It is easy to understand that an extensive system of third-party reporting makes it difficult, and thus costly, for firms and workers to evade taxes. For example, employers withholding taxes at the source, and reporting the income of their employees directly to the tax authorities, makes it difficult for employees to under-report income and evade taxes. And vice versa, it will be difficult for the firm to deviate from what is reported to the

tax authorities when it pays out the wage income to an employee, unless the employee is in agreement with the employer. Thus, to evade taxes, the firm and the worker need to collude on a non-compliance behaviour.

There is a wide support in the literature, both theoretical and empirical, for that the presence of third-party reporting induce strong incentives for tax compliance, whereas the opposite holds when there is no third-party reporting in place. For example, Kleven at al (2016) develops a theoretical model where employees are potential whistleblowers, explaining the importance of third-party reporting for tax compliance.[9] See also Kleven et al (2011) and Pomeranz (2015) for two studies making use of field experiments to identify the importance of third-party reporting for tax compliance and evasion.

Non-economic factors such as social costs of evasion can also play an important role explaining the low amount of tax evasion observed. If there is a strong social norm of tax compliance, it may be socially costly for individuals to evade taxes, which would be reflected in a high κ and limited evasion. Social norms, which in turn are induced by the institutions and the governance structure in an economy, is then a proposed candidate for explaining why we observe less tax evasion in the economy than what is expected from traditional theory.

Empirical evidence indicates that there is an inverse relationship between the size of the informal economy and tax morale in an economy (see Packard et al, 2012). Based on a review of the empirical literature, Torgler (2011a) presents characteristics of institutions and the governance structures which tends to increase tax moral in an economy. More specifically, he stresses the government's effectiveness, control of corruption, rule of law, and regulatory quality, as being important factors for tax morale. An efficient government with no, or limited, corruption increases the trust for the authorities and improves the incentives to cooperate and contribute to the economy. Tax compliance then increases.[10] Moreover, Frey and Torgler (2007) explicitly explore the importance of trust between tax payers and the state and the impact it has on tax compliance. They find that a one unit increase in their trust measure for the justice system increases the population who reports the highest tax moral by more than three percentage points.

In our model, the parameter κ captures concealment costs of all these types, and the effect of an increase in κ is derived in the following proposition:

Proposition 1. *Higher concealment costs, κ, will induce workers to reallocate search intensity towards the formal sector (σ falls). Furthermore, it 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). The share of informal sector employment, ρ, therefore falls and official unemployment, u^o, falls.*

When underground activities are more difficult, and thus more costly, to conceal, for example due to third-party

[9] They provide an explanation for why development may reduce tax evasion as development is often associated with employment growth, and thus more whistleblowers

[10] See Packard et al (2012) for a discussion.

reporting or social norms, unemployed workers will find it optimal to reallocate their search effort towards the formal 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. Firms will find it relatively more profitable to open formal sector jobs, leading to an increase in formal sector employment at the expense of informal sector jobs.

The fact that the informal sector is reduced when it becomes more costly to evade taxes is not surprising. The formal sector will, on the other hand, increase in size, and the model provides the mechanisms where wage adjustments turns out to play a key role for long run effects. Thus, formal sector jobs will to some extent replace forgone jobs in the informal sector in a long run general equilibrium setting. The question is, however, to what extent formal sector jobs are created as informal sector jobs are destroyed. The results depends on the size of the wedge in relation to employment protection legislation:

Proposition 2. *The impact of higher concealment costs, κ, on actual unemployment depends on employment protection legislation μ and the informal sector wedge ψ. In the absence of employment protection legislation, $\mu = 0$, then higher concealment costs, κ will decrease actual unemployment, (u falls), if $\psi < 1$ and increase unemployment if $\psi > 1$ (u increases). In the presence of employment protection legislation, $\mu > 0$, then there exists a $\psi^* > 1$ where unemployment falls (increases) with κ for $\psi < (>)\psi^*$.*

In an economy with no employment protection legislation for the formal sector workers then actual unemployment increases (decreases) when it becomes more costly to be informal if $\psi > (<)1$. Considering the case when it is more costly in terms of expected punishment and concealment costs in the informal sector relative to the cost of taxation in the formal sector, i.e., $\psi > 1$, as this case implies higher tax compliance than non-compliance. The large concealment costs then discourage workers from searching, and firms from opening vacancies, in the informal sector. In fact, too few firms and too little search are allocated into the informal sector from an efficiency point of view. Increased punishment of the informal sector will encourage further reallocation of search and workers away from the informal sector, where relatively efficient search methods are used, towards the formal sector. Total search efficiency then falls, inducing unemployment to increase. The fact that search becomes less 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 the efficiency of search in the formal sector increases by less than the efficiency of search in the informal sector is reduced, the informal sector wage push will dominate the

formal sector wage moderation. Thus, the incentives to open up a vacancy in the formal sector sub-seeds the disincentives to open up a vacancy in the informal sector; formal sector tightness will increase by less than informal sector tightness falls when $\psi > 1$. Thus, although destruction of informal sector jobs stimulates formal sector job openings in equilibrium, formal sector jobs will not be opened to the same extent as informal jobs are destroyed; actual unemployment increases.

The opposite holds if $\psi < 1$. In this case too much search, and too many firms, are allocated into the informal sector as there is a relative cost advantage of producing underground. Total search efficiency would then improve when the government tries to combat the informal sector.

In the presence of employment protection legislation, $\mu > 0$, the informal sector becomes relatively more attractive and more search will be directed towards the informal sector than is the case when $\mu = 0$. Therefore even for the wedge larger than unity, actual unemployment will fall until when labour market tightness in the formal sector is equal to labour market tightness in the informal sector and σ is equal to a half, that is, when $\psi = \psi^* > 1$.

The results in proposition 2 capture how formal sector jobs are replacing informal sector jobs through general equilibrium effects. To account for the effects working through wage adjustments turns out to be key when deriving the long run effects. There are no empirical studies considering this issue, due to the implied extensive challenges with respect to data. However, considering the importance of the research question, the model serve as a guideline for the potential mechanism that this process works through. Section 4 takes the model to data in order to provide a rough estimate of how many formal sector jobs are created when informal sector jobs are destroyed.

3.2 Tax and punishment policies

It is clear that taxes are crucial for the size of the informal sector. In fact, in absence of taxes the informal sector by definition may not exist.[11] The impact of taxes and enforcement policies have also been investigated in a number of theoretical and empirical studies. According to theory higher taxes, and lower enforcement, induce more tax evasion. See, for example, the seminal paper by Allingham and Sandmo where individual tax evasion was modelled as a decision made under uncertainty. There is also evidence for that taxes play an important role, not only in theory, when explaining workers' and firms' decision to engage in informal activities. According to the Europbarometer survey (EC 2007, 2014), where individuals are asked to report undeclared work, taxes are stressed as an important factor for choosing to work informally. Also, surveys directed to firms suggest that high taxes are obstacles for firms in the formal sector (see World Bank enterprise surveys).[12]

[11] This holds for many definitions of informal activities such as activities that are legal but are not declared to tax authorities or social security institutions (EC, 2007, Hojsgaard et al, 2017). However, other definitions implies that there could be an informal sector although no taxes need to be paid. For example definitions based on activities carried out without following the employment protection legislation.

[12] See Buehn and Schneider (2012) for a cross country comparison approach using the MIMIC method where the importance of taxes and enforcement policies for informal activities are shown.

In our model, a higher expected punishment of the informal sector relative to taxes, that is higher $p\alpha$ or $p\delta$ relative to z or t increases the wedge ψ and therefore has the following impact on the economy:

Proposition 3. *Higher expected punishment of the informal sector relative to taxation, i.e., a higher $p\alpha$ or $p\delta$ relative to ϕ^t , which increases the wedge ψ, will induce workers to reallocate search intensity towards the formal sector (σ falls). Furthermore, it 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). The share of informal sector employment, ρ, therefore falls and official unemployment, u^o, falls.*

In addition, the impact on actual unemployment, which depends on the size of the wedge in relation to the employment protection legislation, is presented here:

Proposition 4. *The impact of higher expected punishment of the informal sector relative to taxation, i.e., a higher $p\alpha$ or $p\delta$ relative to ϕ^t, which increases the wedge ψ, on actual employment depends on employment protection legislation μ. In the absence of employment protection legislation, $\mu = 0$, then higher $p\alpha$, $p\delta$ or lower ϕ^t, will decrease actual unemployment, (u falls), if $\psi < 1$ and increase unemployment if $\psi > 1$ (u increases). In the presence of employment protection legislation, $\mu > 0$, then there exist a $\psi^* > 1$ where unemployment falls (increases) with $l = p\alpha, p\delta, 1/\phi^t$, for $\psi < (>)\psi^*$.*

When the informal sector experiences more extensive punishment of the informal sector, or taxation is reduced, the informal sector wedge, ψ , increases. Workers will find it optimal to reallocate their search effort towards the formal sector and official unemployment falls. Actual unemployment increases if we have a situation where compliance is higher than non-compliance; i.e, ψ is large enough, and vice versa if ψ is too low. These policy instruments (taxes and punishment policies) clearly have a similar impact on the size of the informal sector and the official and actual unemployment, as a more structured administrative process of third-party reporting, or social norms, which we considered above.

3.3 Employment protection legislation

Employment protection legislation is in the literature put forth as an important factor explaining informal activities. A stricter employment protection legislation simply increases the costs for formal sector firms but not so for informal sector firms, which increases the incentives to engage in informal activities. Empirical cross country comparisons unambiguously support this hypothesis.[13]

[13]See Fialova and Schneider (2011) and Hazans (2011).

The impact of stricter employment protection legislation in our model is captured by μ. When the formal sector faces employment protection, this per se, tends to reduce labour market tightness in the formal sector relatively to in the informal sector. Hence even for $\psi = 1$ we have that the informal sector labour market tightness exceeds formal sector tightness. Thus, when considering the symmetric case, we need the wedge to be larger than one, $\psi > 1$, in order to obtain that formal sector tightness is higher than informal sector tightness. The impact on the equilibrium from more employment protection is given by the following proposition.

Proposition 5. *A higher employment protection legislation, μ, will reduce formal sector labour market tightness and employment, $\left(\theta^F, n^F\right)$, and increase informal sector labour market tightness and employment, $\left(\theta^I, n^I\right)$. Search into the informal sector, σ, increases and official unemployment, u^o, increases. The share of informal sector employment increases, that is, ρ increases.*

When formal sector firms face employment protection legislation, the jobs are more costly and fewer formal sector jobs are supplied. Unemployed workers will find it optimal to reallocate their search effort towards the informal sector. However, when search is reallocated towards the informal sector, wage pressure in the informal sector falls whereas wage pressure in the formal sector increases. Workers' increased search for informal sector jobs reduces the workers' relative bargaining position which restrains informal wage demands. In contrast, the reduced search in the formal sector strengthens workers' relative bargaining position in the formal sector inducing formal wages to increase. Firms will find it even more more profitable to open informal sector jobs, leading to an increase in the informal sector relative to the formal sector. Official unemployment increases and the share of informal employment increases. The impact on actual unemployment is ambiguous.

4 Numerical Exercises

In this section we calibrate the model in order to see how important the factors discussed in section 3 are in explaining differences in informal sector activities across regions. We base this numerical exercises on a comparison between four North European countries (Denmark, Finland, Noway, and Sweden) and four South European countries (Greece, Italy, Portugal, and Spain). We use this division of North and South as set out in Hazans (2011), and later used in the World Bank report on informal employment in Europe (Packard et al, 2012), except for that they in addition include Cyprus and Israel in the group South. We choose to exclude Israel in our comparison in order to focus on only European countries, and Cyprus is excluded because we base our calibrations mainly on OECD data.

The literature has estimated the size of the informal sector in different countries using various methods. A commonly used cross country comparison estimation of the informal sector size is presented in a series of papers by Schneider (see Schneider et al, 2010, Buehn and Schneider, 2012). These estimates are based on the MIMIC technique (multiple inputs multiple causes estimation), where instead of using a method where a single factor or indicator can capture all activities in the informal sector, such as the currency demand approach or the electricity approach, they estimate the size using a method which includes multiple indicators of the informal sector. These estimates measure the extent of informality in relation to GDP and the estimates are rather sizeable.

This paper will instead use the cross country estimations of the informal sector size presented in Hazans (2011). These measures capture the size of the informal sector in terms of the informal sector employment shares across countries. More specifically, we will use the estimates of the share of informal employees out of all employees, which is a measure that very closely corresponds to the variable derived in our model. The cross country estimates in Hazans (2011) are derived using data from the European Social Survey (ESS) and focus on dependent workers without contracts.[14]

Looking at the measures of the size of the informal sector, it is clear that informality is substantially more prevalent in the South than in the North. According to the estimates, the proportion of employees without a contract among all employees in 2008/2009 varies from 3 percent in the North to 13.6 percent in the South.[15]

In terms of official unemployment rates, the North performs better than the South. The average unemployment rate over the period 2006-2016 for workers in the age group 15-64 has been 6.2 percent in North and 14.2 percent in the South.

Considering taxation there are only marginal differences between the groups. According to data from the OECD, the average general government expenditures over the period 2006-2015 have been 51 percent of GDP for the four countries in North and 49 percent for the four countries in South.

Calculations of the tax wedge on wage income $(1+z)/(1-t)$ using OECD data draw a similar pattern for the two regions. More specifically, over the period 2006-2016, the tax wedge on wage income was 1.68 in North and 1.73 in South, thus indicating a slightly higher effective tax rate in the South than in the North.[16]

To get accurate numbers for the punishment policies, in terms of audit rates and punishment fees, is substantially more complicated. Such figures are simply not easily available in comparable cross country data sets. It is, however, evident that the effective expected punishment fees, $p\alpha$ and $p\delta$, are very low in most countries. Accord-

[14]See Packard et al (2011) for a discussion of the three most commonly used methods of how to define an informal employee; firm size criterion, social contribution criterion, and contract criterion. The contract criterion is considered the preferred proxy for measuring informal employees based on reliability when it comes to comparisons across countries, and the fact that it is less ambiguous and significantly more observable then the other criterions.

[15]The measure derived for Italy stems from 2006, whereas the rest of the countries derives from 2008/2009. Excluding Italy will increase the difference in the size of the informal sector between the regions, as will including Israel and Cyprus in accordance with the division between South and North in Hazans (2011).

[16]The OECD calculates country specific measures for a tax wedge by calculating the combined central and sub-central government income taxes paid plus the employee and employer social security contribution taxes paid as a share of labour costs defined as gross wage earnings plus employer social security contributions. In our model this corresponds to the following measure: $TW = (z+t)/(1+z)$ where TW denotes the OECD wedge. Using this measure, we can derive the measure for the tax wedge presented in section 2.3 as $(1+z)/(1-t) = 1/(1-TW)$. See http://stats.oecd.org/index.aspx?DataSetCode=TABLE_I5

ing to Packard et al (2012) the observed punishment fees are typically modest and seldom exceed more than the amount of unpaid taxes. This corresponds to that setting $\alpha = z$ and $\delta = t$ capture an upper bound on the punishment fees in our model, where z and t clearly are smaller than unity in non-confiscatory tax systems. Moreover, the percentage of individual income tax returns that are subject to a thorough tax audit is typically less than one percent of all returns according to Packard et al (2012). This corresponds to an audit rate of less than $p = 0.01$, which implies that $p\alpha$ and $p\delta$ are extremely small. As the expected punishment rates are very small both in North and South, and there are no specific cross country evidence arguing for larger or smaller rates in the North than in the South, we will not differentiate across North and South with respect to expected punishment rates in the numerical exercises.

To get accurate numbers for concealments costs in terms of κ for the two regions ais tricky as the variable captures a number of different things, and on top of that, these things are usually difficult to measure. The concealment costs could capture the cost of evasion due to third-party reporting, but also costs due to morality, guilt, and shame.

Although the research literature provides strong support for that third-party reporting effectively reduces tax evasion and increases tax compliance, there are no readily available cross country estimates on the degree of third-party reporting in our two regions. The evidence, however, shows that third-party reporting processes are more developed in the North than in the South.

To find an estimate on the degree of third-party reporting in the South and North, we make use of the OECD tax administration report on third-party reporting published in 2008 (OECD, 2008). The report focuses on the progress of third-party reporting in Denmark and Sweden, as these countries have served as role models when it comes to third-party reporting and, because of that, the implementation of pre-filled personal tax returns. Despite the focus on Denmark and Sweden, the report also provides information about the latest known developments regarding implementation of pre-filled personal tax returns that builds on third-party reporting in other countries. By using the amount of years these procedures were implemented prior to 2009 for each country in our two regions, we can calculate the average number of years the pre-filled personal tax return systems based on third-party reporting has been operating. In North the average number of years these procedures have been in place are 15 years, whereas the South has had these systems in place for two years on average. As was discussed in section 3, there is a growing body of literature that stresses the importance of non-economic factors such as morality, guilt and shame as key factors in explaining the puzzle of why tax compliance, after all, is so high.

Institutions that tends to increase tax morale, and thereby increase the social cost of tax evasion, is the government's effectiveness, control of corruption, rule of law, and regulatory quality.[17] To find an estimate on the governance and credibility of institutions in the South and North for the year 2009, we make use of the World Bank's World Governance Indicates (WGI).[18] This index reflects perceptions of the quality of public services, the

[17] See Torgler (2011a).

[18] The Worldwide Governance Indicators (WGI) are a research dataset summarising the views on the quality of governance provided by a

quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. [19] [20]

In what follows, we will calibrate and simulate the model developed in the previous section to fit the North and the South. The aim is to pin down the importance of various factors in explaining the differences in the size of the informal economy in the South and the North. Moreover, the model enables us to quantitatively determine the actual unemployment rates for the regions, accounting also for informal employment. This is carried out with the caveat that, given the simplicity of the model, we consider these calculations as illustrative, without aiming to provide specific guidance in terms of specific policy conclusions regarding these policies in order to punish the informal sector and set taxes.

4.1 Calibration

The year is the basic time unit. Productivity y is normalised to 1 and the real interest rate r is 0.05. The values of η used in the literature vary widely. For instance, Hall (2005) uses 0.24, while Shimer (2005) uses 0.72.[21] Petrongolo and Pissarides (2001) in their literature survey consider $[0.5,\ 0.7]$ to be the range of plausible values. We therefore set η to 0.5 in both regions. The separation rate is $s = 0.08$ (See See Millard and Mortensen, 1997). We let the search efficiency parameter be relative low and equal for both regions, $\gamma = 0.35$. The tax wedges, ϕ^F, are set to 1.73 and 1.69 in the South and North, respectively, consistent with the measures given above. The expected punishment fees, $p\alpha$ and $p\delta$, are set to 0.0001, in both regions corresponding to very low detection rates. The employment protection legislation, μ, is set to $\mu_S = 0.0487$ in the South and $\mu_N = 0.0369$ in the North.[22] We include a constant match parameter M^j in front of the matching function in order to match the differences in unemployment rates between South and North more precisely. The parameters k_S, k_N, and M_S^j, and M_N^j, $j = F, I$ are set to replicate an average observable unemployment rate for the years 2006 to 2015 of $u_S^o = 14.2\%$ in the South and $u_N^o = 6.2\%$ in the North, the fraction of employed workers in the informal sector relative to all employed workers in the South given by $\rho_S = 13.6\%$ and $\rho_N = 3\%$ and average duration of unemployment of 1.1 years in the South and 0.6 years in the North. This gives $k_S = 0.2$, $M_S^F = 2.55$ and $M_S^I = 2.2$ for South, and $k_N = 0.4$ and $M_N^F = 2.4$ and $M_N^I = 1.8$ for the North. The parameters are presented in Table 1.

The concealment costs for the South and North are set to be, $\kappa_N = 1.1976$ for South and $\kappa_S = 1.525$ in North. This allow us to match precisely the observable unemployment rates in the two European regions as well as the fraction of informal sector workers in North whereas the calibrated value for the fraction of informal sector

large number of enterprise, citizen and expert survey respondents in industrial and developing countries. These data are gathered from a number of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. The index averages capturing government effectiveness in a country for the period 2006-2015 is 2.00 in North and 0.74 in South, where the estimates ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance.

[19] The index for the period 2006-2015 is 2,26 for the North and 0,31 for the South. The cross sectional numbers for 2009 is 2,28 for North and 0.54 for South, implying that the index is more than four times as high for the North than the South. This indicates that the North have a governance structure and institutions that to a substantially larger extent strengthen tax moral than what is the case in the South.

[20] The indexes for the rule of law, and regulatory quality shows the same pattern.

[21] See Gertler and Trigari (2009) for a review of values used in other studies.

[22] http://www.oecd.org/els/emp/oecdindicatorsofemploymentprotection.htm

Table 1: Parameter values

	y	r	s	γ	η	k	ϕ^t	μ	M^F	M^I	κ
South	1	0.05	0.08	0.35	0.5	0.2	1.73	0.0487	2.55	2.2	1.1976
North	1	0.05	0.08	0.35	0.5	0.4	1.69	0.0369	2.4	1.8	1.5248

Table 2: Calibrations for North and South

	Data				Calibration					
	u^0	ρ	u	κ	κ	ϕ^F	μ	u^0	ρ	u
South	14.2	13.6	-	-	1.1976	1.73	0.0487	14.20	12.35	2.11
North	6.2	3	-	-	1.5248	1.68	0.0369	6.2	3	3.31

workers in the South falls a bit short of the measured value and becomes $\rho_S = 12.35\%$. It is clear that concealment costs in the North need to be significantly larger than in the South in order to match the observed differences in the fraction of employed workers in the informal sector to all employed across the regions. The difference in the concealment cost parameters for the North and South is, however, fully consistent with data, although it is not possible to derive an exact value for the concealment costs from the data, as is the case for the tax wedge. The actual unemployment rates are residually determined in the model and are relative low numbers for both South and North, namely $u_S = 2.12$ and $u_N = 3.31$. The actual values derived from data and the model values are summarised in table 2.

4.2 Impact of policy reforms

This paper has set up a model in order to evaluate how important concealment costs, taxes as well as employment protection legislation are when comparing the share of informal sector workers in the Northern and Southern European Countries. As the tax wedge is similar in the North and South, differences in this policy instrument cannot explain the observed difference in the size of the informal sector in terms of fraction of employed workers in informal sector employment. Employment protection and concealment costs, however, differ across the region and can clearly potentially explain the differences we observe across the regions. We will in this section consider the impact changes in concealment costs and employment protection legislation so as to examine how they differ for the two regions as well as to consider the impact on actual unemployment, where the model delivered more ambiguous results.

Considering Figure 1 and 2 we observe the following. When concealment costs increase in the South, there is a sharp decrease in the share of informal sector workers in Southern Europe, whereas in Northern Europe an increase in concealment costs would reduce the informal sector from an already low level to something tiny. Hence,

an increase in concealment costs will have a huge impact on the informal sector in both regions.[23] The observable unemployment rate also falls in both regions, the impact again being stronger in the South than in the North.

Consistent with Proposition 2 the impact on actual unemployment is negative as long as the wedge between the informal sector and the formal sector below $\psi^* > 1$, which corresponds to when $\sigma = 0.5$, where search is equal into the informal and the formal sector (see the graph representing unemployment and the graph for σ in Figure 1 and 2). When search into the informal sector becomes below $\sigma = 0.5$ then any additional unit of search into the formal sector is less efficient in terms of job matching than it would have been into the informal sector and actual unemployment therefore increases. This lower bound of unemployment corresponds to higher concealment costs in the South than in the North as the calibration of the economy in the South is consistent with a lower concealment costs level.

In Figure 3 and 4, we consider the change caused by a reduced employment protection legislation. We notice that the share of informal sector workers increases more in the South than in the North when μ increases. Examining the graph representing unemployment and the graph for σ in Figure 3 and 4, we again have that when search into the informal sector becomes below $\sigma = 0.5$, then any additional unit of search into the formal sector becomes less efficient than if the same amount of search would have been conducted in the informal sector, whereby actual unemployment increases. The lowest reachable unemployment rate in the North corresponds to higher employment protection legislation than it does in the South as the economy in the South is calibrated to a higher employment protection legislation level.

4.3 Counterfactuals

The previous sections confirmed that higher concealment costs or lower employment protection legislation reduce the share of informal sector employment. We did not consider the impact of lower taxes as the tax wedges are very similar in the North and in the South and different tax levels are therefore not the explanation behind the differences in the sizes of the informal sector in the South and in the North. In this section we conduct the following experiments. We consider the Southern part of Europe where the share of informal sector employment is more than four times higher than in the Northern part of Europe and examine how much concealment costs would need to increase in the South in order to obtain the same size of the informal sector in the South as in the North. We then evaluate the impact on observable and actual unemployment. Next, we perform a similar experiment with the costs of employment protection legislation.

The result we obtain is that concealment costs have to increase by 3.8 percent to $\kappa_S' = 1.236$ in order for the South to obtain the same share of informal sector workers as in the North, $\rho_S \mid_{\kappa_S'=1.236} = \rho_N = 3\%$. This results in

[23] This is in line with the result from the field experiment in Denmark by Kleven et al (2011) who concluded that third-party was a very efficient way to reduce tax evasion. They found that emploees almost never evaded taxes, whereas self-employed, where the cost of evasion can be considered to be substantially lower due to the absence of third-party reporting, did. Although, this model does not contain self-employed, it illustrates the potential efficiency of the policy instrument.

Figure 1: Impact of Concealment Costs, South

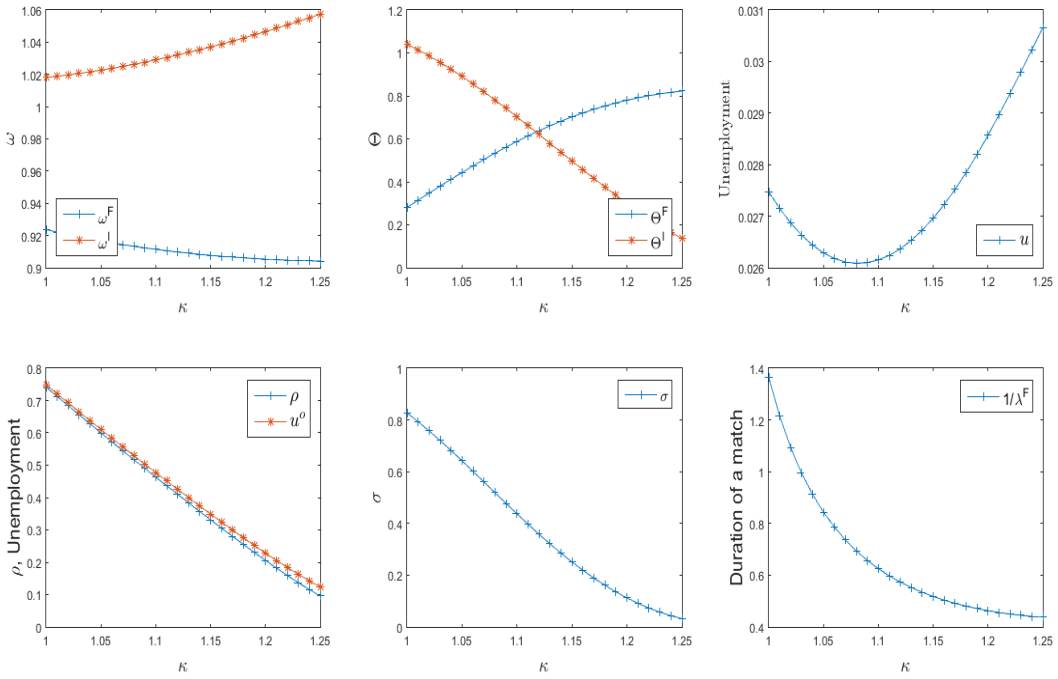


Figure 2: Impact of Concealment Costs, North

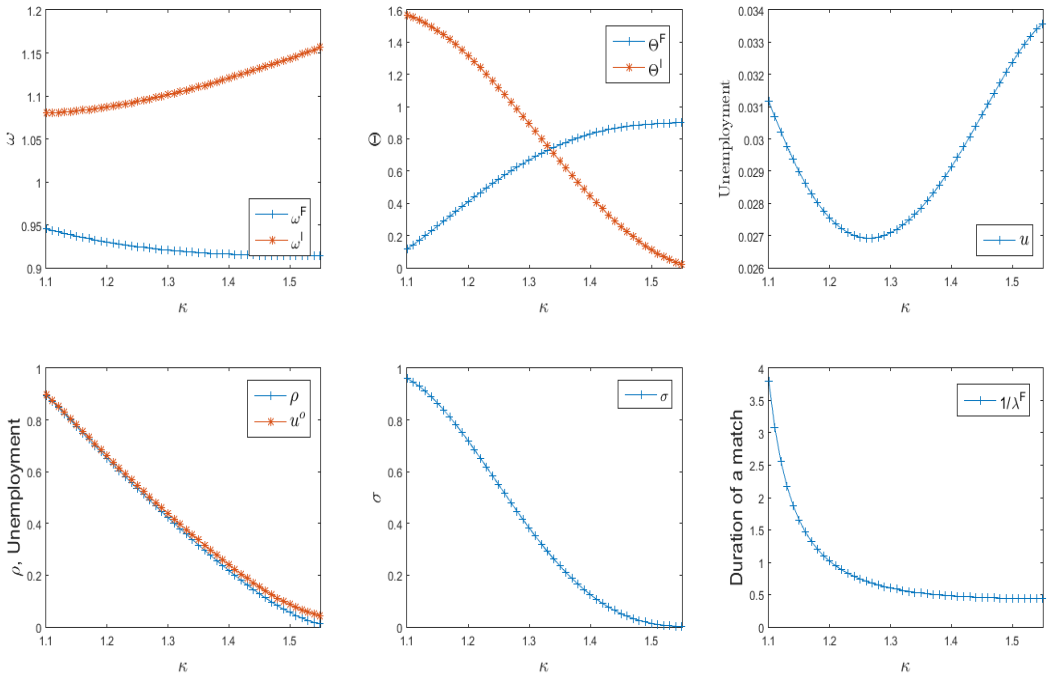


Figure 3: Impact of Employment Protection Legislation, South

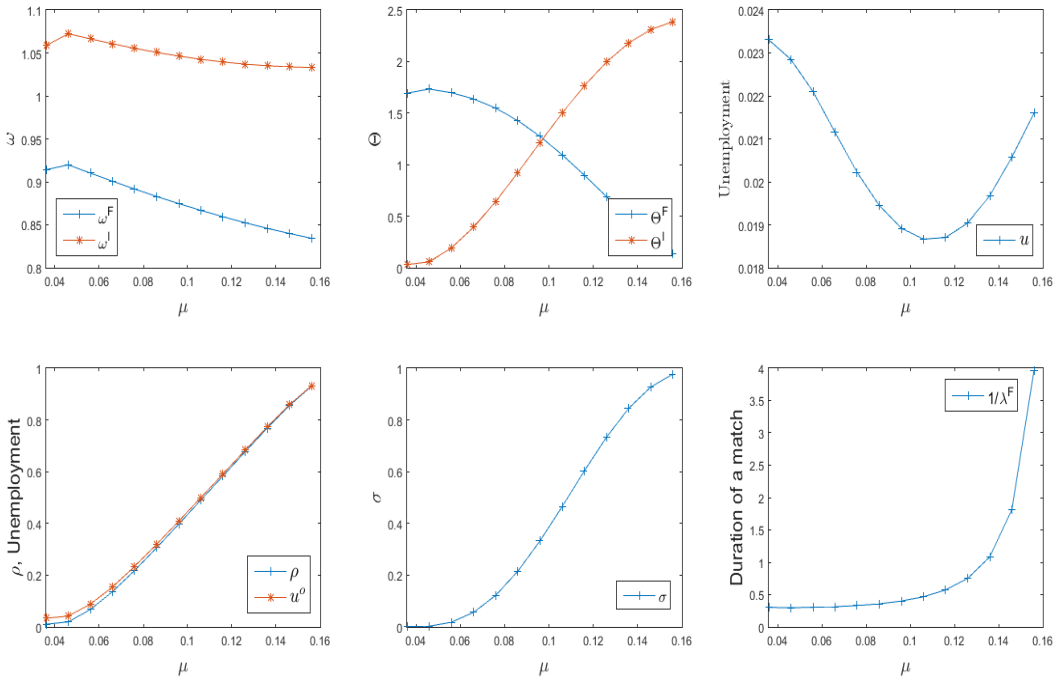
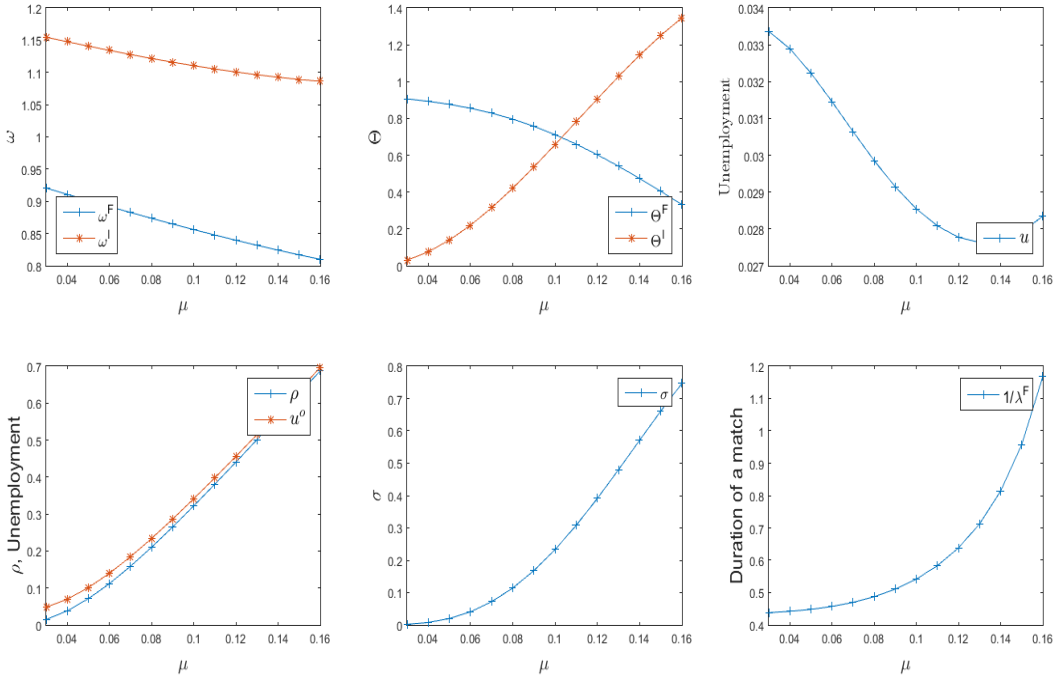


Figure 4: Impact of Employment Protection Legislation, North



an observable unemployment rate in the South of $u_S^o \mid_{\kappa=2.236}= 5.2$ and an actual unemployment rate in the South given by $u_S \mid_{\kappa'_S=1.236}= 2.27$. Concealment costs do therefore not need to increase all the way up to being at the same level as in the North, given the calibrated equilibrium. Hence, while actual unemployment does indeed increase when the number of people working in the informal sector falls, the implied impact on wages and job supply and search into the formal sector leads to that the long run impact on actual unemployment is only equal to an increase of 16 percent or 0.17 percentage points.

Next, we consider how much employment protection legislation needs to fall in the South for the South to reach the same share of informal sector workers as in the North. We here keep concealment costs at the original calibrated level, $\kappa_S = 1.1976$. We obtain that employment protection legislation has to fall to $\mu'_S = 0.0328$ to obtain $\rho_S \mid_{\mu'_S=0.0328}= \rho_N = 3\%$. In this case, employment protection legislation has to fall by a very large amount and almost become as low as in the North in order to reach the goal. The impact on observable unemployment as well as actual unemployment gives the following $u_s^o \mid_{\mu'_S=0.0328}= 4.32\%$ and $u_s \mid_{\mu'_S=0.0328}= 2.68\%$, which correspond to a larger increase in actual unemployment than when concealment costs increases are used to reduce the informal sector, the impact being 0.57 percent points or a 27 percent increase.

5 Conclusion

The aim of this paper was to capture the equilibrium effects by building a general equilibrium model in terms of a search and matching model with an informal sector. We considered the impact of the traditional policy instruments considered in the tax evasion literature, such as changes in the tax- and punishment system as well as changes in the employment protection legislation, on labour market outcomes. Next, we considered the impact of concealment costs, that is costs related to it being difficult and costly to hide earned income from the tax authorities, on tax evasion. Such costs have recently become important in the tax evasion literature when it comes to explaining observed tax evasion, as traditional policy instruments cannot explain the low amount of tax evasion observed. We therefore set-up a model which allowed workers to allocate their search for formal and informal sector jobs optimally. Wages were set in wage negotiations between workers and firms and unemployment was an equilibrium outcome. To keep the model simple, we accounted for only a few differences between the formal and the informal sector, the first difference between the formal and the informal sector being that taxes were paid in the former and a fine was paid upon detection in the latter. Informal sector firms also faced concealment costs, which captured it being costly to hide income from the tax authorities. Finally, we included employment protection legislation costs for formal sector firms.

We found that increased costs of evasion, either through increased audit rates, more extensive sanctions or third party reporting, or even through policies increasing social costs, induced a reallocation of firms and workers towards the formal sector. Corresponding to this, informal sector producer wages increased and formal sector

producer wages fell, and more workers became unemployed even though the observable unemployment rate decreased. Thus less formal jobs were created than informal jobs being destroyed. This was a result of that the aggregate wage pressure increased due to the reallocation process of workers and firms. Stricter employment protection legislation, was also found to induce a movement from the formal sector to the informal sector, and the impact on actual unemployment was in this case ambiguous.

Then we calibrated and simulated the model to fit the North and the South of Europe, where the share of informal sector workers is equal to three percent in the North and more than 4 times as high in the South, namely 13.6 percent. As the taxation of labour and the probability of being detected is not that different across regions, these policy instruments could not explain the rather large difference in the informal sector share observed in these regions. Therefore we considered the impact of concealment costs, as there are large differences in terms of tax administration procedures between the South and the North, in terms of that Northern countries make more extensively use of third-party reporting, and also in line with the empirical evidence on tax morale and social costs of tax evasion for the regions. Concealment costs could indeed be used to explain the difference in size of the informal sector in the South and in the North. Finally, OECD numbers for employment protection legislation showed a more severe employment protection legislation in the South than in the North. The simulations of the model confirmed that the stricter employment protection legislation in Southern Europe could partly be used to explain why more tax evasion is observed in Southern than in Northern Europe.

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6 Appendix

In this Appendix we derive the impact on labour market performance of higher conceilment costs, expected tax and punishment rates as well as higher employment protection.

6.1 Impact of conceilment costs when $\mu = 0$:

We consider the equilibrium when $\mu = 0$, which is given by equation (16), (18) and then equation (17) when $\mu = 0$, that is

$$2(r+s)k\left(\theta^F\right)^{\eta} = y - \frac{k\theta^F}{(1-\sigma)^{1-\gamma}} \tag{20}$$

We differentiate the three equations in σ, θ^F, θ^I and κ to obtain around the equilibrium and for $\psi > 1$:

$$\frac{d\sigma}{d\kappa} = \frac{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^F}{(1-\sigma)^{1-\gamma}}\right)}{D}\left(\theta^F\right)^{-1}\frac{1}{\psi}\frac{d\psi}{d\kappa} < 0,$$

$$\frac{d\theta^F}{d\kappa} = \frac{\frac{(1-\gamma)}{1-\sigma}\frac{k\theta^F}{(1-\sigma)^{1-\gamma}}}{-D}\frac{1}{\psi}\frac{d\psi}{d\kappa} > 0,$$

$$\frac{d\theta^I}{d\kappa} = \frac{\frac{(1-\gamma)}{\sigma}\frac{k\theta^I}{\sigma^{1-\gamma}}}{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\theta^I\frac{d\sigma}{d\kappa} < 0,$$

where

$$D = -\frac{\frac{(1-\gamma)}{1-\sigma}}{\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\frac{1}{\sigma}\left(\eta\left(y - \frac{k\theta^I}{\sigma^{1-\gamma}}\right)\left(y + \frac{(1-\eta)}{\eta}\frac{1}{\psi}\frac{k\theta^I}{\sigma^{1-\gamma}}\right) + \sigma\frac{k\theta^I}{\sigma^{1-\gamma}}y\left(1 - \frac{1}{\psi}\right)\right)\left(\theta^F\right)^{-1} < 0$$

The impact on unemployment is then:

$$\frac{du}{d\kappa} = \frac{-s}{\left(s + \lambda^F + \lambda^I\right)^2}\left(\frac{d\lambda^F}{d\kappa} + \frac{d\lambda^I}{d\kappa}\right).$$

Unemployment therefore increases if $\left(\frac{d\lambda^F}{d\kappa} + \frac{d\lambda^I}{d\kappa}\right) < 0$. We derive this sum to be

$$\frac{d\lambda^F}{d\kappa} + \frac{d\lambda^I}{d\kappa} = \sigma_i^\gamma\left(\theta^I\right)^{(1-\eta)}\frac{1}{\sigma}\left(\left(1 - \frac{\left(\theta^I\right)^\eta}{\left(\theta^F\right)^\eta}\frac{1}{\psi}\right)\gamma\frac{d\sigma}{d\kappa} - \frac{(1-\gamma)(1-\eta)}{-D}\frac{k\theta^I}{\sigma^{1-\gamma}}\left(\frac{\left(y + \frac{(1-\eta)}{\eta}\frac{1}{\psi}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}{\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)} - \frac{\left(\theta^I\right)^\eta}{\left(\theta^F\right)^\eta}\frac{1}{\psi}\frac{1}{\psi}\right)\left(\theta^F\right)^{-1}\frac{1}{\psi}\frac{d\psi}{d\kappa}\right)$$

for $\psi \gtreqless 1$. And hence unemployment decreases (is unchanged/increases) with conceilment costs, κ when $\psi \gtreqless 1$.

The impact on observable unemployment is

$$\frac{du^o}{d\kappa} = \frac{\frac{d\lambda^I}{d\kappa}\left(\lambda^F + \lambda^I\right) - s\left(\frac{d\lambda^F}{d\kappa}\right)}{\left(s + \lambda^F + \lambda^I\right)^2} < 0,$$

as

$$\frac{d\lambda^F}{d\kappa} = (1 - \sigma_i)^\gamma\left(\theta^F\right)^{(1-\eta)}\left(-\frac{\gamma}{1-\sigma}\frac{d\sigma}{d\kappa} + \frac{(1-\eta)}{\theta^F}\frac{d\theta^F}{d\kappa}\right) > 0$$

$$\frac{d\lambda^I}{d\kappa} = \sigma_i^\gamma\left(\theta^I\right)^{(1-\eta)}\left(\frac{\gamma}{\sigma}\frac{d\sigma}{d\kappa} + \frac{(1-\eta)}{\theta^I}\frac{d\theta^I}{d\kappa}\right) < 0.$$

The impact on relative employment is:

$$\frac{d\rho}{d\kappa} = \frac{\frac{d\lambda^I}{d\kappa}\left(\lambda^F\right) - \lambda^I\left(\frac{d\lambda^F}{d\kappa}\right)}{\left(\lambda^F + \lambda^I\right)^2} < 0.$$

6.2 Impact of expected tax and punishment rates when $\mu = 0$:

We again consider the equilibrium when $\mu = 0$, which is given by equation (16), (20) and (18.)

We differentiate the three equations in σ, θ^F, θ^I and $l = \frac{1+p\alpha}{1-p\delta}$, $\frac{1}{\phi^F}$, to obtain around the equilibrium and for $\psi > 1$:

$$\frac{d\sigma}{dl} = \frac{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^F}{(1-\sigma)^{1-\gamma}}\right)}{D}\left(\theta^F\right)^{-1}\frac{1}{\psi}\frac{d\psi}{dl} < 0,$$

$$\frac{d\theta^F}{dl} = \frac{\frac{(1-\gamma)}{1-\sigma}\frac{k\theta^F}{(1-\sigma)^{1-\gamma}}}{-D}\frac{1}{\psi}\frac{d\psi}{dl} > 0,$$

$$\frac{d\theta^I}{dl} = \frac{\frac{(1-\gamma)}{\sigma}\frac{k\theta^I}{\sigma^{1-\gamma}}}{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\theta^I\frac{d\sigma}{dl} < 0,$$

where

$$D = -\frac{\frac{(1-\gamma)}{1-\sigma}}{\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\frac{1}{\sigma}\left(\eta\left(y - \frac{k\theta^I}{\sigma^{1-\gamma}}\right)\left(y + \frac{(1-\eta)}{\eta}\frac{1}{\psi}\frac{k\theta^I}{\sigma^{1-\gamma}}\right) + \sigma\frac{k\theta^I}{\sigma^{1-\gamma}}y\left(1 - \frac{1}{\psi}\right)\right)\left(\theta^F\right)^{-1} < 0$$

The impact on unemployment is then:

$$\frac{du}{dl} = \frac{-s}{\left(s + \lambda^F + \lambda^I\right)^2}\left(\frac{d\lambda^F}{dl} + \frac{d\lambda^I}{dl}\right).$$

Unemployment therefore increases if $\left(\frac{d\lambda^F}{dl} + \frac{d\lambda^I}{dl}\right) < 0$. We derive this sum to be

$$\frac{d\lambda^F}{dl} + \frac{d\lambda^I}{dl} = \frac{\left(\theta^I\right)^{1-\eta}}{\sigma^{1-\gamma}}\left(\left(1 - \frac{\left(\theta^I\right)^{\eta}}{\left(\theta^F\right)^{\eta}}\frac{1}{\psi}\right)\gamma\frac{d\sigma}{dl} - \frac{(1-\gamma)(1-\eta)}{-D}\frac{k\theta^I}{\sigma^{1-\gamma}}\left(\frac{\left(y + \frac{(1-\eta)}{\eta}\frac{1}{\psi}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}{\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)} - \frac{\left(\theta^I\right)^{\eta}}{\left(\theta^F\right)^{\eta}}\frac{1}{\psi}\frac{1}{\psi}\right)\left(\theta^F\right)^{-1}\frac{1}{\psi}\frac{d\psi}{dl}\right) < 0,$$

for $\psi > 1$. And hence unemployment increases with expected auditing $l = \frac{1+p\alpha}{1-p\delta}$ and punishment rates and decreases with taxes, $l = 1/\phi^F$, when $\psi > 1$.

The impact on observable unemployment is then

$$\frac{du^o}{dl} = \frac{\frac{d\lambda^I}{dl}\left(\lambda^F + \lambda^I\right) - s\left(\frac{d\lambda^F}{dl}\right)}{\left(s + \lambda^F + \lambda^I\right)^2} < 0,$$

as

$$\frac{d\lambda^F}{dl} = (1-\sigma_i)^\gamma \left(\theta^F\right)^{(1-\eta)} \left(-\frac{\gamma}{1-\sigma}\frac{d\sigma}{dl} + \frac{(1-\eta)}{\theta^F}\frac{d\theta^F}{dl}\right) > 0$$

$$\frac{d\lambda^I}{dl} = \sigma_i^\gamma \left(\theta^I\right)^{(1-\eta)} \left(\frac{\gamma}{\sigma}\frac{d\sigma}{dl} + \frac{(1-\eta)}{\theta^I}\frac{d\theta^I}{dl}\right) < 0.$$

The impact on relative employment is

$$\frac{d\rho}{dl} = \frac{\frac{d\lambda^I}{dl}\left(\lambda^F\right) - \lambda^I\left(\frac{d\lambda^F}{dl}\right)}{\left(\lambda^F + \lambda^I\right)^2} < 0.$$

6.3 Higher Employment protection, higher μ.

We differentiate equation (16) - (18) with respect to σ, θ^F, θ^I and μ to obtain around the equilibrium:

$$\frac{d\sigma}{d\mu} = \frac{1}{-D}\left(\theta^F\right)^{-1} > 0,$$

$$\frac{d\theta^F}{d\mu} = \frac{\frac{(1-\gamma)}{\sigma}\left(\frac{1}{(1-\sigma)} - \frac{\frac{k\theta^I}{\sigma^{1-\gamma}}}{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\right)}{D} < 0,$$

$$\frac{d\theta^I}{d\mu} = \frac{\frac{(1-\gamma)}{\sigma}\frac{k\theta^I}{\sigma^{1-\gamma}}}{\eta\left(y + \frac{(1-\eta)}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\theta^I\frac{d\sigma}{d\kappa} > 0,$$

where

$$D = -\frac{\frac{1-\gamma}{1-\sigma}}{\left(y + \frac{1-\eta}{\eta}\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\frac{1}{\sigma}\left(\eta\left(y - \frac{k\theta^I}{\sigma^{1-\gamma}}\right)\left(y - \mu + \frac{(1-\eta)}{\eta}\frac{1}{\psi}\frac{k\theta^I}{\sigma^{1-\gamma}}\right) + \sigma\frac{k\theta^I}{\sigma^{1-\gamma}}y\left(1 - \frac{1}{\psi}\right)\right)\left(\theta^F\right)^{-1} < 0,$$

The impact on unemployment is then:

$$\frac{du}{d\mu} = \frac{-s}{\left(s + \lambda^F + \lambda^I\right)^2}\left(\frac{d\lambda^F}{d\mu} + \frac{d\lambda^I}{d\mu}\right).$$

The impact on unemployment therefore has the opposite sign of $\left(\frac{d\lambda^F}{d\mu} + \frac{d\lambda^I}{d\mu}\right)$ when $\eta = 0.5$:

$$\frac{d\lambda^F}{d\mu}+\frac{d\lambda^I}{d\mu}=\frac{\left(\theta^F\right)^{-1}}{D}\frac{\left(\theta^I\right)^{(1-\eta)}}{\sigma^{1-\gamma}}\gamma\left(\frac{1}{\psi}\frac{\left(\theta^I\right)^{\eta}}{\left(\theta^F\right)^{\eta}}-1+\frac{1}{\psi}\frac{\left(\theta^I\right)^{\eta}}{\left(\theta^F\right)^{\eta}}\frac{1-\gamma}{\gamma}\frac{0.5}{\sigma}\frac{y-\frac{k\theta^I}{\sigma^{1-\gamma}}}{\left(y+\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}+\left(\frac{1}{\psi}\frac{\left(\theta^I\right)^{\eta}}{\left(\theta^F\right)^{\eta}}-1\right)\frac{(1-\gamma)}{\gamma}\frac{\frac{k\theta^I}{\sigma^{1-\gamma}}}{\left(y+\frac{k\theta^I}{\sigma^{1-\gamma}}\right)}\right)$$

where the sign is negative for $\psi=1$.

The impact on observable unemployment is

$$\frac{du^o}{d\mu}=\frac{\frac{d\lambda^I}{d\mu}\left(\lambda^F+\lambda^I\right)-s\left(\frac{d\lambda^F}{d\mu}\right)}{\left(s+\lambda^F+\lambda^I\right)^2}>0,$$

as

$$\frac{d\lambda^F}{d\mu}=(1-\sigma_i)^{\gamma}\left(\theta^F\right)^{(1-\eta)}\left(-\frac{\gamma}{1-\sigma}\frac{d\sigma}{d\mu}+\frac{(1-\eta)}{\theta^F}\frac{d\theta^F}{d\mu}\right)<0$$

$$\frac{d\lambda^I}{d\mu}=\sigma_i^{\gamma}\left(\theta^I\right)^{(1-\eta)}\left(\frac{\gamma}{\sigma}\frac{d\sigma}{d\mu}+\frac{(1-\eta)}{\theta^I}\frac{d\theta^I}{d\mu}\right)>0.$$

The impact on relative employment is

$$\frac{d\rho}{d\mu}=\frac{\frac{d\lambda^I}{d\mu}\left(\lambda^F\right)-\lambda^I\left(\frac{d\lambda^F}{d\mu}\right)}{\left(\lambda^F+\lambda^I\right)^2}>0.$$