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Exploring Informal Employment and Retirement : Family Support as a Substitute for Pension Benefit

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Informal Employment and Retirement: Family Support as a Substitute for Pension Benefit

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Abstract

This paper suggests a demand side analysis of informal employment characterised by incompliances with labour tax regulation using a general equilibrium model with overlapping generations. A public social insurance provide benefits to formal employees in retirement, while we allow for an informal insurance mechanism for informal employees through a social norm of mutual support. The objective of the paper is to evaluate impact of auditing policy and social norms on growth and social welfare. We define the level of private transfers to the uncovered share of the population and provide an analysis on the impact of social support networks as well as auditing policies to wage levels, growth and welfare.

1 Introduction

The latest survey on Turkish Family Structure (2006) reveals interesting facts concerning conception of retirement by individuals. Social norms and customs indirectly alleviate financial concerns of individuals in retirement through familial bonds i.e. 55% of elderly participants living with their children declare customs, willingness of their children and mutual support as reasons for this choice and almost 90% of all participants agree that children should financially support and take care of their parents. These striking statistics point out to an interesting aspect of risk insurance mechanisms in developing countries. In many developing countries, social norms and customs allow different support networks to deal with different risks. While the second half of the twentieth century is characterised by expansion of public insurance systems. We still observe that an important share of employees are working informally, thus stay uncovered by public social insurance system. Social support networks, prevailing together with public insurance systems, reduce negative effects of informal employment and rationalise informal employment relationships without much social and political controversy[1]. Thus, in those countries, informal employment may also be characterised by its persistance[2].

Connections of institutional framework with informal employment have inspired many theoretical and empirical works[3]. From a supply side perspective, recent studies mostly emphasise that

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[1]In Turkey, the share of unregistered employment was 50% in 2004 and only recently Turkish government has shown its decisive attitude toward reduction of informal economy through increasing efficiency and capacity of auditing policy as well as introducing tax subsidies for younger employees to reduce labour cost. In 2006, the Ministry of Labor and Social Security has implemented a project targeting reductions in informal employment, DPT (2007) stated the primary objective of government as the struggle against informal economy and in 2008, Revenue Administration has published a policy circular that presents an Action Plan against informal economy. Thanks to these targeted policies, the share of unregistered employment has decreased to only 43% in 2010. The latter still means that out of 22.6 million of employees, 9.8 million are uncovered by public retirement insurance.

[2]Informal employment constitutes more than 50% of employment in non-agricultural sectors in developping countries and even reaches 90% of total employment in some countries of Sub-Saharan Africa and South Asian region (Huitfeldt and Jütting (2009), Chen (2005).

[3]Previously, segmented labour market hypothesis (Lewis (1954), Harris and Todaro (1970), Fields (1975)) has long been discussed in theory and in empirical works to explain informal employment in developing countries. While theory

informal employment may not be as bad as it is argued and non-pecuniary rewards and alternative employment ethics and insurance networks that they allow should also be considered to understand its persistence in developing countries (De Soto (1989), Maloney (2004), Kucera and Roncolato (2008)). From a demand side perspective, arguments such as unionisation levels, labour market rigidities and distortions created by regulations and taxes were also investigated (Galli and Kucera (2004), Heckman and Pages' Serra (2000), Saavedra and Torero (2004)). Studies on institutional determinants of informal employment find a negative relationship between informality and institutional quality defined by the level of legal enforcement (Dabla-Norris et al. (2008), Dreher et al. (2009)). Finally, a general equilibrium framework provided by Amaral and Quintin (2006) formalise a unique and competitive labour market where workers are supposed to be indifferent between formal and informal employment and firms differ in their managerial ability, size, access to credit markets and compliance with tax regulations and shows that large firms operate formally and small firms informally and a competitive labour market equalises formal and informal wages for workers with same ability. We can also refer to dynamic models analysing the evolution of informal employment provided by Araujo and Souza (2010) and Goktuna and Dayangac (2011). These papers show that there is an evolutionarily stable share of informality in the economy. The first study links the impact of excessive regulatory system with dynamics of workers and firms' entrance and withdrawal of formal and informal economy and evaluates the optimal relation between regulatory and enforcement action by the government. The second study provides an evolutionary explanation for existing informal labour share in the economy given the impact of social support networks. These studies conceive informal employment as a strategic choice by workers and analyse the effects of public policies on steady states of evolutionary dynamics.

In this study, we suggest a demand side analysis characterised by non-compliance with labour tax regulations. Here, a public social insurance provide benefits to formal employees in retirement, while we allow for an informal insurance mechanism for informal employees through a social norm of mutual support. We compute the level of transfers to the uncovered share of the population and provide an analysis on the impact of social support networks to wage levels, growth and welfare. From this aspect, we see that an alternative insurance network alleviates financial burden of informal carriers in retirement, thus contributes to the inefficiency of policies against informality. The paper is organised as follows: the first section describes the theoretical model, the second section provides with equilibrium and steady state of model economy and analyses impact of political and institutional factors on growth and welfare and the last section presents conclusion.

2 The Model

The economy consists of three agents: firms, households and a public social security institution. Firms produce one good that can be used as a consumption and capital good. Households own capital and inelastically supply labour for production. Firms use capital and labour as inputs in the production process and have the opportunity to hire unregistered workers, in other words, income taxes and pension contributions of a certain share of their total labour demand are not paid to government. Auditing agency operates under the public social security institution and engages in auditing activity to catch this illegal employment practice and a penalty is imposed in such situations. During retirement period, registered workers receive pension benefits from a public scheme. Retirees that have not been registered receive transfers from working members of their family. This modelisation allow for a non-market mean of intergenerational risk sharing.

suggests interesting results, empirical studies can not find strong evidence to conclude for such a segmentation in many cases. For studies testing segmented labour market hypothesis as formal and informal see Magnac (1991) for Colombia, Maloney (2004) for Mexico, Pratap and Quintin (2002) and Pratap and Quintin (2006) for Argentina and for a set of developing countries respectively.

2.1 Firms

The production requires labour and capital and we suppose that firms do not register a part (λ) of total labour employed in the production process and for cost minimisation purposes employ unregistered workers illegally. We suppose that there is no productivity difference between formal and informal workers, then we can denote two labour inputs as perfect substitutes. We suppose that production technology can be represented by a Cobb-Douglas production function as follows

$$y(k, l^{1,d}, l^{2,d}) = k^{\alpha}(l^{1,d} + l^{2,d})^{1-\alpha} \tag{1}$$

where $l^{1,d}$ is the demand of unregistered labour and $l^{2,d}$ is the demand for registered labour, α is the output elasticity of capital. As firms decide on the share of different types of labour, total labour demand is expressed as follows: $l^d = l^{1,d} + l^{2,d} = \lambda l^d + (1-\lambda)l^d$. We suppose that the production technology has constant returns to scale in labour and capital and capital depreciates fully. The total cost of one unit of capital is then $(1+r)$. The cost of registered workers includes, in addition to gross wage w, a payroll tax at a rate τ_w and the cost of unregistered workers equals net wage of a registered employee (out of employee's pension contribution at a rate θ_u). Employment of unregistered labour is subject to the payment of gross wage, payroll tax, a proportional penalty ϕ if this behaviour is caught through auditing. We suppose that as auditing is costly, government audits firms with probability z, only firms selected with probability z are audited and the detection probability becomes $f(\lambda_t) = z\lambda_t$. This can allow for a certain share of tax evasive behaviour in the economy. Remark that firms choose how much unregistered labour they will employ since there are no productivity differences between these workers and there might be cost minimisation in employing workers without registering them. The firm's problem is to maximise the profit Π with respect to labour, capital and evasion from tax:

$$\underset{\{k_t, l_t^d, \lambda_t\}}{Max}\ \Pi_t = y_t - (r_t+1)k_t - (1+\tau_w)w_t l_t^{2,d} - (1-f)(1-\theta_u)w_t l_t^{1,d} - f(1+\phi+\tau_w)w_t l_t^{1,d} \tag{2}$$

Given pension contribution, input prices and penalty rule firms determine their optimal factor demands.

2.2 Households

The life span is two periods: working and retirement. As such, population consists of working and retired agents. The population growth is zero. The households invest in capital market s_t^h given r_t real interest rate and the labour supply is one unit of labour in each period at the wage w_t. In addition to private savings, we suppose that working generation share their wage at a rate θ_q with uncovered members of the population. The lifetime utility of the household h is a function of instantaneous consumption: c_t^h in working period and d_{t+1}^h in retirement period. If we denote the time preferences by ρ, we have the following discounted lifetime utility function:

$$\bar{U}^h = U(c_t^h) + \beta U(d_{t+1}^h) \tag{3}$$

where $\beta = \frac{1}{1+\rho}$ is the subjective discount factor with $\rho \geq 0$, the instantaneous utility is supposed to take the following form: $U(c) = \ln c$. The first and second period budget constraints are:

$$\begin{aligned} c_t^h + s_t^h &= (1-\theta_u-\theta_q)w_t \\ d_{t+1}^h &= q_{t+1}^h + R_{t+1}s_{t+1}^h \end{aligned} \tag{4}$$

where $R_{t+1} = (1+r_{t+1})$, c_t^h, $d_{t+1}^h \geq 0$ and $s_t^h \geq 0$ and $s_{t+1}^h = 0$. The restriction on $s_{t+1}^h = 0$ implies that there is no bequest motive at the end of the life and $s_t^h \geq 0$ means that agents are liquidity constrained. The income of the elderly q_t^h is defined as follows:

$$q_t^h = \begin{cases} b_t^u & \text{for } h = 2 \\ b_t^q & \text{for } h = 1 \end{cases} \tag{5}$$

Here we account for two levels of retirement income: the retirement income of a formal employee and an informal employee caught during inspection and the retirement income of an informal employee. For the first case ($h = 2$), formal employee and informal employee caught with inspection will have equal income b_t^u with probability $m_t = (1-\lambda_t)+\lambda_t f(\lambda_t)$. For the second case ($h = 1$), the probability is than $1 - m_t$. Agents solve an intertemporal maximisation problem subject to (4) to choose their lifetime consumptions and savings as follows:

$$\underset{c_t^h, d_{t+1}^h}{Max} \left\{ U(c_t^h) + \beta U(d_{t+1}^h) \right\} \tag{6}$$

2.3 Social Insurance

We consider a defined contribution public unfunded (PAYG) scheme and an informal support system by private transfers from young to old supplementing public social protection.

2.3.1 Formal social insurance - PAYG

The unfunded PAYG pension scheme is self-financing. The contributions of young registered workers pay the benefits of registered retirees. The budget constraint is then:

$$(\theta_u + \tau_w) m_t l_t^d w_t = m_{t-1} l_{t-1}^d b_t^u \tag{7}$$

where $m_t l_t^d$ is the share of formal employees contributing to pension scheme. The pension benefit of a retired agent is defined by $b_t^u = \varphi_t w_t$ thus the accrual rate φ_t is equal to $\frac{(\theta_u+\tau_w) m_t l_t^d + b_t^a}{m_{t-1} l_{t-1}^d}$. Note that, as such, public pension system includes both contributory and redistributive elements.

We suppose that the auditing agency works related to the social security institution and affects the size of the informal sector by influencing the decision of firms through changes in penalties and auditing probabilities. Auditing is costly and total cost e depends on the product of auditing frequency with total labour demand reflecting the volume of auditing activity and we suppose that the unit cost of auditing is χw_t i.e. $e(z) = \chi w_t z l_t^d$. As such, the parameter χ expresses the efficiency of auditing. If χ decreases, auditing becomes less costly, thus more efficient. The auditing agency operates with a balanced budget: $b_t^a = f\lambda_t \phi w_t l_t^d - \chi z w_t l_t^d = 0$. Then, we obtain the following relation: $\phi = \frac{\chi}{\lambda_t^2}$. The auditing agency can choose between two instruments: penalty levels or frequency of auditing to fight against unregistered employment. Note that changing the frequency auditing is easier than changing penalty rate since determination of penalty rate requires a legal step however changing the frequency of auditing is an administrative measure. While we analyse the impact of both instruments, in fact governments mostly choose to play with the frequency of auditing.

2.3.2 Informal social insurance - Altruistic transfer

The retirement period of employees that have worked informally and not been caught during inspection is financed by transfers from all working agents. We suppose that young agents share their income at rate θ_q with these elderly having no pension benefit. θ_q is determined by social consensus. The private transfer received by an elderly without a formal social insurance b_t^q is given by the following budget constraint:

$$\theta_q l_t^d w_t = (1 - m_{t-1}) l_{t-1}^d b_t^q \tag{8}$$

We see that this rate imposed by social consensus operates as taxation for formal employees. Now we can define $Q_t^h = (1 - \theta_u - \theta_q) w_t + \frac{b_{t+1}}{R_{t+1}}$ as lifetime income. The income for registered employees is $Q_t^2 = (1 - \theta_u - \theta_q) w_t + \frac{b_{t+1}^u}{R_{t+1}}$ where $b_{t+1}^u = \frac{(\theta_u+\tau_w) m_{t+1} w_{t+1}}{m_t}$ from pension scheme rules. The lifetime income for unregistered employees is $Q_t^1 = (1 - \theta_u - \theta_q) w_t + \frac{b_{t+1}^q}{R_{t+1}}$ where $b_{t+1}^q = \frac{\theta_q w_{t+1}}{(1-m_t)}$ from private transfer rules.

2.4 Markets

Each period, households' total saving is invested and determines next period capital stock. With full capital depreciation, we can express the capital market equilibrium as follows:

$$l_t^d(m_t s_t^2 + (1-m_t)s_t^1) = k_{t+1}$$

The labour market clearing condition implies that the demand for labour by the representative firm l_t^d equals the supply of labour by the representative household l_t^s. But we have assumed above that the household can and does supply one unit of labour in each period, so that the labor market clearing condition is $l_t^d = 1$. We suppose that the only good produced in the economy is used as a consumption good as well as a capital good. In equilibrium, sum of consumption of working generations and retirees, investment and public expenditure is equal to output produced in the economy. Goods market equilibrium can be written as follows:

$$y_t = l_t^d(m_t c_t^2 + (1-m_t)c_t^1) + l_{t-1}^d(m_{t-1}d_t^2 + (1-m_{t-1})d_t^1) + k_{t+1} \tag{9}$$

3 Equilibrium and steady state

3.1 Equilibrium

Given a set of policy rules $\{\tau_w,\ \phi,\ z\}$, contribution rate to PAYG pension scheme and private transfer rate $\{\theta_u,\ \theta_q\}$ and an initial capital level $\{k_0\}$, probability of detecting informal employment $f(\lambda_t)$, an equilibrium for this economy satisfies the following: the sequence of decision rules $\{c_t^{h,e},\ d_{t+1}^{h,e}\}$ solves consumer optimisation problem, the allocation rule $\{w_t^e,\ r_t^e,\ \lambda_t^e\}$ solves firms' maximisation problem and goods, capital and labour markets clear. Appendix A provides with the computation of equilibrium wage and capital path. Next by using equilibrium and steady state results, we will consider the impact of parameters regarding social network and auditing policy on capital accumulation and social welfare.

3.1.1 Impact of social network

For welfare evaluation purposes, we consider a utilitarian social welfare function given steady state levels. We note lifetime discounted utility of segment h by $\bar{U}^h = U_i^h + \beta U_j^h$ where i and j refer to working and retirement period respectively. Social welfare is given as follows:

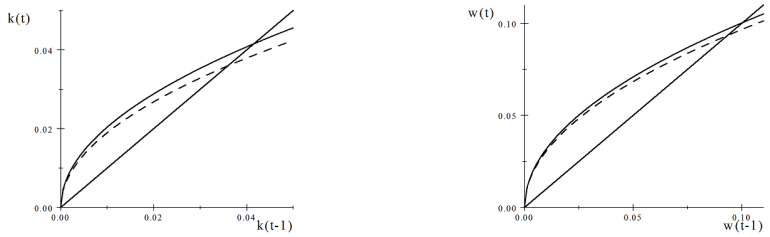
$$\begin{aligned} SW^* &= \bar{U}_j + \sum_{t=0}^{\infty} \beta^t \bar{U} \\ &= \bar{U}_j + \frac{1}{1-\beta}\bar{U} \end{aligned}$$

where $\bar{U} = \frac{m}{2}\bar{U}^2 + \frac{1-m}{2}\bar{U}^1$ is weighted generational lifetime discounted utility and $\bar{U}_j = \frac{m}{2}\bar{U}_j^2 + \frac{1-m}{2}\bar{U}_j^1$ is weighted retirement welfare[4].

Proposition 1 *1. Private transfers affect negatively steady state wage and capital:* $\frac{\partial w^*}{\partial \theta_q} < 0$ *and* $\frac{\partial k^*}{\partial \theta_q} < 0$.

2. There exists at least one private transfer rate maximising social welfare $\theta_q^s < 1 - \theta_u$ *if* $\frac{\partial SW^*}{\partial \theta_q}\Big|_{\theta_q=0} > 0$.

[4]Note that $\beta < 1$.



(a) Capital (b) Wage

Figure 1 – Dynamics by θ_q

We see that social cohesion decreases wage levels in the economy. This is a very familiar picture for underdeveloped and developing countries where public insurance system is coupled with informal insurance networks, generally based on familial bounds. In fact, such social support networks creates room for lower wage levels by reducing the stress of workers to insure several risks solely with their own income. Another impact of this social cohesion can be the difficulty to catch-up with developed countries as savings are done through private networks.

Example 2 *We have used Turkish data and pension contribution rates to provide an illustration of this result*[5]*. In Figure 1, dynamics of wage and capital have been plotted for different values of θ_q. In fact, we have used two extreme values for θ_q: the solid line represents the case with no private transfer ($\theta_q = 0$) and the dashed line is the case where private transfer rate is equal to pension contribution rate ($\theta_q = \frac{\theta_u}{2}$). The intersection with 45 degree line shows steady state values of capital, decreasing with the introduction of private transfers.*

The private transfer rate has definitely a negative impact on growth but we should consider social welfare before making a policy statement on the existence of informal social insurance mechanism. The impact of any change on the steady state level of social welfare will be:

$$\frac{\partial SW^*}{\partial \theta_q} = \frac{1}{(1-\beta)\theta_q}\left(m\xi^{Q^2}_{\theta_q} + (1-m)\xi^{Q^1}_{\theta_q} + \frac{1}{2}\xi^{R}_{\theta_q}\right)$$

where ξ is the elasticity of the variable at the superscript with respect to private transfer rate θ_q and Q^h is steady state lifetime income. The second part of proposition (1) relates to the impact of private transfers on social welfare. Even though growth necessitates a decrease in private transfers, we see that a positive level of private transfer may be necessary for the optimisation of social welfare.

3.1.2 Impact of auditing policy

As auditing agency operates with balanced budget, depending on the choice of policy instrument, we will obtain a level of auditing probability given penalty rate (given ϕ, $z^e = \frac{\tau_w+\theta_u}{2(\tau_w+\theta_u+\phi)}\sqrt{\frac{\phi}{\chi}}$) or a penalty rate given auditing frequency (given z, $\phi^e = (\tau_w+\theta_u)(-1+\frac{\tau_w+\theta_u}{8z^2\chi}(1-\sqrt{1-\frac{16z^2\chi}{\tau_w+\theta_u}}))$). Obviously, these instruments have a negative impact on wage levels and capital as they increase labour cost. Auditing agency could determine ϕ to maximise steady state social welfare. The impact of a change in penalty rate on the steady state level of social welfare will be:

$$\frac{\partial SW^*}{\partial \phi} = \frac{1}{(1-\beta)\phi}\left(m\xi^{Q^2}_{\phi} + (1-m)\xi^{Q^1}_{\phi} + m\xi^{m}_{\phi}\ln\frac{Q^2}{Q^1} + \frac{1}{2}\xi^{R}_{\phi}\right)$$

[5]In Turkey, employees contribute 9% (θ_u) of their gross wage and employers contribution is 11% (τ_w). Yeldan and Voyvoda (2005) provides an estimate of 10% for Turkish real interest rate, the implied value of discount factor β is then 0.909. The calibration of production function involves determination of parameters of Cobb-Douglas technology. According to the estimation of Saygılı et al. (2001) productivity of capital is approximately 0.5. Parameters of auditing agency are chosen deliberately to visualise the results.

where ξ is the elasticity of the variable at the superscript with respect to penalty rate ϕ. We see that the first part of this derivative ($m\xi_\phi^{Q^2} + (1-m)\xi_\phi^{Q^1}$) is negative as penalties have a negative impact on wage and relative wage, but the second part is positive ($m\xi_\phi^m \ln \frac{Q^2}{Q^1} + \frac{1}{2}\xi_\phi^R$) as there will be a positive income effect in retirement thanks to decrease in informalisation through penalties and increase in interest rate. The calculation of this derivative does not give an explicit result as to the existence of an optimal level of detection penalty. We can simply state that in this economy, if the impact of increase in income outweights the impact of penalties on wage, auditing agency can choose a positive level of penalty to control informal labour demand.

Another intuition regarding an optimal choice of penalty stems from short term analysis of welfare. It is obvious that an increase in penalty would immediately reduce working generation income and retired income through determination of elderly income by intergenerational distribution. There will be an increase in next retired generation income through formalisation but this will be outweighted by the decrease in wage. If auditing agency worked for a government which in turn had election concerns, this short term analysis suggests that there would be no penalties or very low level of penalties and government would follow a laissez faire policy.

Remark 3 *A general result is that if an economy is structured given a certain level of informalisation, in this model generated by demand side cost reducing purposes, the economy might be trapped in the persistence of informality and fights against informality have adverse consequences for different segments of the population i.e. formal agents suffer from a decrease in wage levels but some informal will be better off as they will get formal. The structural problem can be remedied, in our opinion, by multi-layered and coordinated policies i.e. higher syndicate activities, effective and efficient enforcement, active labour market policies etc. In that case, private transfers serving for intergenerational distribution of wealth to insure income risk of informal retirees may be channelled to capital accumulation.*

3.2 Comparison with benchmark economies

We now consider two benchmark cases for this economy: the first (Economy 1) is an economy where all employees are registered ($\lambda = 0$) and there is no auditing agency and social support network ($\theta_q = 0$) and the second (Economy 2) is characterised by a non-negative share of unregistered employment ($\lambda > 0$) with auditing and no informal social insurance network ($\theta_q = 0$). We will compare Economy 1 and 2 with model economy to provide insights related to the effects of informality, private transfers and penalties.

If we note the capital and wage levels in each case (k_1^*, w_1^*) and (k_2^*, w_2^*) then the following proposition will hold.

Proposition 4 *1.* $k_2^* > k^*$ *and* $w_2^* > w^*$
2. $k_2^* > k_1^*$ *and* $w_2^* > w_1^*$
3. $w_1^* < w^*$ *and* $k_1^* < k^*$ *if* $\theta_q < \bar{\theta}_q$
where $\bar{\theta}_q = \frac{(1-\theta_u)(1-m)(\theta_u+\tau_w)}{1+\tau_w}$.

We see that the steady state level of capital in Economy 2 is above the steady state capital in model economy and Economy 1 as informal employment allows for cost reduction and there are incentives on the demand side to employ unregistered labour. We see that the level of private transfers is crucial as private transfers should be below a certain limit to obtain a higher steady state capital. If elder informal agents requires working generation to be more generous then we see that the economy will be in a suboptimal capital level. The picture is not very clear when we look from welfare perspective. We have seen that a certain level of private transfers could be socially optimal. The low frequency of auditing activities and low penalties in detection in Turkish case suggest that political authorities have particularly chosen this attitude given a strong social network providing an informal insurance.

4 Determination of private transfers

Note that only employees working informally when young face the risk of having no pension benefit when retired and these agents will have an incentive to determine $\theta_q^{1,*} > 0$. We suppose that the individually optimal rate of private transfer is determined given the steady state of the economy. When an agent accepts to work informally, his expected retired utility accounting for the risk of being without social insurance when old is as follows: $u(\theta_q^1) = (1-f)\ln(\theta_q^1 \frac{w}{(1-m)R}) + f\ln((\theta_u+\tau_w+\frac{b^a}{m})\frac{w}{R})$. The maximisation of utility implies: $\frac{\partial u}{\partial \theta_q} = (1-f)\frac{1}{\theta_q \frac{w}{(1-m)R}} \frac{\partial(\theta_q \frac{w}{(1-m)R})}{\partial \theta_q} + f\frac{1}{(\theta_u+\tau_w)\frac{w}{R}} \frac{\partial((\theta_u+\tau_w)\frac{w}{R})}{\partial \theta_q} = 0$. If we note the elasticity of discounted wage rate to private transfer rate by $\xi_{\theta_q}^{\frac{w}{R}} = \frac{\partial(\frac{w}{R})}{\partial \theta_q}\frac{\theta_q}{\frac{w}{R}}$, informal agents choose their individually optimal private transfer rate $\theta_q^{1,*}$ where $\xi_{\theta_q}^{\frac{w}{R}} = -(1-f)$. Young agents working formally would have no intention to provide transfers if only their choice was concerned $\theta_q^{2,*} = 0$ as these transfers decrease only income when young and do not generate any effect on lifetime utility and income when retired. We could argue that an average private transfer rate $\theta_q^* = (1-m)\theta_q^{1,*} + m\theta_q^{2,*}$ becomes a social norm through familial bonds and legal enforcement.

Proposition 5 *There exist a socially determined private transfer rate $\theta_q^* > 0$.*

The proof for the existence is provided in Appendix C. At this point, we can consider if the socially determined level of private transfers in the economy is efficient in terms of welfare and growth. We think that upper bound for private transfers defined previously in the context of comparison of model economy with benchmark economies ($\bar{\theta}_q$) and socially optimal level of private transfer (θ_q^s) can provide an intuition in this context. We will use an example to illustrate.

Example 6 *If we consider the economy described in above examples, inspired from Turkish economy, the socially optimal level of private transfers is $\theta_q^s = 0$ and $\theta_q^* = 0.074$ with $\bar{\theta}_q = 0.082$. Note that welfare optimisation requires that no transfer is made at the steady state. Social norms on the other hand dictates a positive level of transfer. However, as $\theta_q^* < \bar{\theta}_q$, we can still argue that this level will provide with an economy where wage and capital are higher than an economy with no informality. Consider, an economy where production is labour intensive ($\alpha = 0.3$) and there is low penalty and little auditing activity with same efficiency for auditing activity $\chi = 0.01$ ($\phi = 0.005 \rightarrow z = 0.0345$). Here, the optimal level of private transfers is positive, $\theta_q^s = 0.016$ and $\theta_q^* = 0.112$ with $\bar{\theta}_q = 0.119$. Note that again θ_q^s is well below θ_q^*. This means that informal employees will require from social support networks a level of transfers that will not be socially optimal. Remark that for this economy, $\theta_q^* < \bar{\theta}_q$, we see that informalisation provides higher wage and capital levels than in an economy with no informality. Consider a variation of labour intensive case, this time, there is high penalty and more frequent auditing activity with same efficiency for auditing activity $\chi = 0.01$ ($\phi = 0.03 \rightarrow z = 0.75$). We have $\theta_q^s = 0$ and $\theta_q^* = 0.058$ with $\bar{\theta}_q = 0.054$. Note that for this economy, $\theta_q^* > \bar{\theta}_q$, we see that increased auditing activity and more severe penalisation of incompliances with labour regulations reduces wage and capital levels below the levels of Economy 1.*

4.1 Comparison of θ_q^* with $\bar{\theta}_q$

If private transfer rate is less than upper bound transfer rate then, even though the economy allows for a certain level of informalisation, growth and wage rates would not be worse than the case with no informality. The following proposition gives the condition under which model economy will perform better than Economy 1 where there is not any informal employment.

Proposition 7 *There exists a lower bound $\bar{\chi}$ such that for all $\chi > \bar{\chi}$ then $\theta_q^* < \bar{\theta}_q$.*

We see that if there is a lower bound for efficiency of auditing activity, meaning that government shall conduct costly auditing activity, then model economy will perform better than an economy with no informal employment.

4.2 Comparison of θ_q^* with θ_q^s

We have seen that there exists at least one positive socially optimal private transfer rate under certain conditions. However, there is always a positive socially determined transfer rate. This means that in most of the economies, young generation transfer a certain share of income to uncovered retired population and this in turn is definitely not a socially optimal situation. As, socially optimal transfer rate is obtained by maximisation of the utility of all generations of formal and informal households and as the utility of all former and informal workers and formal retirees decreases with the level of transfers, the intuition is that the maximisation of social welfare will require a transfer level lower than socially determined rate.

5 Conclusion

We presented an economy characterised by informal employment and a social norm of elderly support. The equilibrium of the model suggests a positive level of private transfers dictated by the social norm affecting negatively wage level in the economy. This result coincides with the fact that in the presence of social support networks, workers face lower wage levels. The comparison of this economy with an hypothetical economy with no illegal informal labour demand shows that informalisation increases capital accumulation and wage levels (in case we allow for unemployment, reduces unemployment) if the requirement of social support networks is not very high. The existence of auditing agency only aggravates the situation with its negative impact on wages as well as capital. By comparing model economy with versions without informality and social network, we see that the possibility to underdeclare number of workers and evasion from responsibility in social insurance may have positive impact on the economy in the presence of social support networks. The fact that most governments do not prioritise fight against informalisation supports the results of the model.

Another issue concerns highly discussed and practiced pension reforms. Most countries are adopting funded schemes to replace PAYG pensions or mixed schemes where unfunded schemes prevail with voluntary individual accounts. We think that the institutional structure of economies should be discussed in those transitions. The model economy inspired from developping countries studies social support networks as one of the institutional characteristics. Remark that in model economy, informalisation is only a by-product of unfunded scheme and there will be no informal labour demand with the introduction of funded scheme as income taxes are not considered. Funded schemes supposed to channel pension contributions of working generations to the economy as investment means will suffer from the coexistence of non-market means of savings. As, in transition, some retirees will still need the support of working generation, this social support network would be hard to destroy. In fact, government intervention to ensure well being of those retirees may be necessary to reduce the role of family support in retirement. However, this will have little impact on income of young generations as additional taxation will be necessary to provide retirement support for informal elderly. We must consider possible consequences of a transition on fiscal policies and on income of present and future generations. If we have considered income taxes then we can suggest that funding pensions alone can not be a solution to reduce informality but a long-term and progressive reduction in informal employment should be targeted through a social and political awareness.

6 Equilibrium

We can write first order conditions for firm maximisation as follows:

$$r_t + 1 = \alpha \frac{y_t}{k_t} \tag{10a}$$

$$\tilde{w}_t = (1-\alpha)\frac{y_t}{l_t^d} \tag{10b}$$

$$\frac{df}{d\lambda}\lambda_t + f = \frac{\tau_w + \theta_u}{\tau_w + \theta_u + \phi} \tag{10c}$$

where $\tilde{w}_t = w_t(1+\tau_w+\lambda_t(f\phi-(1-f)(\theta_u+\tau_w)))$. Denote by g_t the multiplier of wage. When we solve for equation (10c), we get the optimal level of informal labour demand:

$$\lambda^e = \frac{\tau_w + \theta_u}{2z(\tau_w + \theta_u + \phi)}$$

$$g^e = 1 + \tau_w - \frac{(\tau_w + \theta_u)^2}{4z(\tau_w + \theta_u + \phi)}$$

Constant returns to scale and zero profit conditions imply $(\frac{1+r_t^e}{\alpha})^\alpha(\frac{\tilde{w}_t^e}{1-\alpha})^{1-\alpha} = 1$
First order condition of household maximisation problem are as follows:

$$\frac{(c_t^h)^{-1}}{\beta(d_{t+1}^h)^{-1}} = R_{t+1} \tag{11}$$

Given the intertemporal budget constraint, we can write optimal consumption schedules for working and retirement periods respectively.

$$c_t^h + \frac{d_{t+1}^h}{R_{t+1}} = (1-\theta_u-\theta_q)w_t + \frac{q_{t+1}^h}{R_{t+1}}$$

$$c_t^{h,e} = \frac{Q_t^h}{1+\beta}$$

$$d_{t+1}^{h,e} = \frac{\beta R_{t+1} Q_t^h}{1+\beta}$$

The capital market is in equilibrium

$$k_{t+1}^e = m_t s_t^{2,e} + (1-m_t)s_t^{1,e}$$

. The goods market equilibrium verifies

$$m_t c_t^{2,e} + (1-m_t)c_t^{1,e} + m_{t-1}d_t^{2,e} + (1-m_{t-1})d_t^{1,e} + k_{t+1}^e = y_t^e$$

where

$$c_t^{;e} + d_t^{;e} = \frac{m_t Q_{2,t} + (1-m_t)Q_{1,t}}{1+\beta} + \frac{\beta R_t(m_{t-1}Q_{2,t-1} + (1-m_{t-1})Q_{1,t-1})}{1+\beta}$$

and

$$k_{t+1}^e = (1-\theta_u-\theta_q)w_t^e - \frac{m_t Q_t^2}{1+\beta} - \frac{(1-m_t)Q_t^1}{1+\beta}$$

.

Above equation can be solved for $r_t^e + 1$ and $\tilde{w}_t^e$.

$$\begin{aligned}
\frac{\alpha\tilde{w}_t^e}{(r_t^e+1)(1-\alpha)} &= (1-\theta_u-\theta_q)w_{t-1}^e - \frac{m_{t-1}Q_{t-1}^2}{1+\beta} - \frac{(1-m_{t-1})Q_{t-1}^1}{1+\beta} \\
\frac{\tilde{w}_t^e}{1-\alpha} &= (1-\theta_u-\theta_q)w_t^e + \frac{\beta R_t(m_{t-1}Q_{t-1}^2 + (1-m_{t-1})Q_{t-1}^1)}{1+\beta}
\end{aligned}$$

Finaly, equilibrium wage and capital dynamics can be written as follows.

$$\begin{aligned}
w_t &= \left(\frac{\alpha\beta(1-\theta_u-\theta_q)g^{\frac{\alpha-1}{\alpha}}(1-\alpha)^{\frac{1}{\alpha}}}{(1+\alpha\beta)((\theta_u+\tau_w)m+\theta_q)+(1+\beta)\alpha(1-\theta_u-\theta_q)}\right)^{\alpha} w_{t-1}^{\alpha} \\
k_t &= \frac{\alpha(1-\alpha)\beta(1-\theta_u-\theta_q)}{(1+\alpha\beta)((\theta_u+\tau_w)m+\theta_q)+(1+\beta)\alpha(1-\theta_u-\theta_q)}(k_{t-1})^{\alpha}
\end{aligned}$$

7 Social welfare at steady state

At steady state, social welfare function becomes an infinite sum of constant lifetime welfare of all young generations plus welfare of the old generation alive at any period t:

$$\begin{aligned}
SW^* &= \tfrac{m}{2}\ln\tfrac{\beta RQ_2}{1+\beta} + \tfrac{1-m}{2}\ln\tfrac{\beta RQ_1}{1+\beta} + \tfrac{1}{1-\beta}\left(\tfrac{m}{2}\left(\ln\tfrac{Q_2}{1+\beta} + \beta\ln\tfrac{\beta RQ_2}{1+\beta}\right)\right. \\
&\qquad \left. + \tfrac{1-m}{2}\left(\ln\tfrac{Q_1}{1+\beta} + \beta\ln\tfrac{\beta RQ_1}{1+\beta}\right)\right) \\
SW^* &= \tfrac{1}{1-\beta}\left(m\ln Q_2 + (1-m)\ln Q_1 + \tfrac{1}{2}\ln R + \tfrac{1}{2}\ln\beta + \ln\tfrac{1}{1+\beta}\right)
\end{aligned}$$

$$\begin{aligned}
\frac{\partial SW^*}{\partial\theta_q} &= \frac{1}{1-\beta}\left(m\frac{-w + (1-\theta_u-\theta_q)\frac{\partial w}{\partial\theta_q} + (\theta_u+\tau)\frac{\partial w/R}{\partial\theta_q}}{(1-\theta_u-\theta_q)w + \frac{(\theta_u+\tau)w}{R}}\right. \\
&\quad \left. + (1-m)\frac{-w + (1-\theta_u-\theta_q)\frac{\partial w}{\partial\theta_q} + \frac{w}{(1-m)R} + \frac{\theta_q}{1-m}\frac{\partial w/R}{\partial\theta_q}}{(1-\theta_u-\theta_q)w + \frac{\theta_q w}{(1-m)R}} + \frac{1}{2R}\frac{\partial R}{\partial\theta_q}\right)
\end{aligned}$$

We can analyse the sign of the derivative of social welfare with respect to private transfer rate to have an insight on the graph of social welfare. We refer to the value of R and w with respect to private transfer rate at $\theta_q = 1-\theta_u$ as R_1 and w_1.

$$\begin{aligned}
\left.\frac{\partial SW^*}{\partial\theta_q}\right|_{\theta_q=1-\theta_u} &= \frac{1}{1-\beta}\left(\frac{m(-w_1 + (\theta_u+\tau)\left.\frac{\partial w/R}{\partial\theta_q}\right|_{\theta_q=1-\theta_u})}{\frac{(\theta_u+\tau)w_1}{R_1}}\right. \\
&\quad \left. + \frac{(1-m)(-w_1 + \frac{w_1}{(1-m)R_1} + \frac{1-\theta_u}{1-m}\left.\frac{\partial w/R}{\partial\theta_q}\right|_{\theta_q=1-\theta_u})}{\frac{(1-\theta_u)w_1}{(1-m)R_1}} + \frac{1}{2R_1}\left.\frac{\partial R}{\partial\theta_q}\right|_{\theta_q=1-\theta_u}\right) \\
\left.\frac{\partial SW^*}{\partial\theta_q}\right|_{\theta_q=1-\theta_u} &= \frac{R_1}{1-\beta}\left(-\frac{m}{\theta_u+\tau} + \frac{(1-m)(1-(1-m)R_1)}{(1-\theta_u)R_1} + \left.\frac{R_1\partial w}{w_1\partial\theta_q}\right|_{\theta_q=1-\theta_u}\right. \\
&\quad \left. - \left.\frac{\partial R}{R_1^2\partial\theta_q}\right|_{\theta_q=1-\theta_u}\right) < 0
\end{aligned}$$

Since the derivative is negative at the upper limit of private transfers, the sufficient condition for the existence of a maximum in the interval $[0, 1-\theta_u)$ is $\left.\frac{\partial SW^*}{\partial\theta_q}\right|_{\theta_q=0} > 0$.

8 Determination of private transfers

8.A Existence

Agents working informally will determine $\theta_q^{1,*}$ where $\xi_{\theta_q}^{\frac{w}{R}} = -(1-f)$. Agents working formally choose $\theta_q^{2,*} = 0$ as these transfers decrease only income when young and do not generate any effect on lifetime utility and income when retired. As $\xi_{\theta_q}^{\frac{w}{R}} = \frac{\partial(\frac{w}{R})}{\partial\theta_q}\frac{\theta_q}{\frac{w}{R}}$, we have $\xi_{\theta_q}^{\frac{w}{R}} = -\frac{1}{1-\alpha}\frac{\theta_q}{R}\frac{\partial R}{\partial\theta_q}$. $\theta_q^{1,*}$ will be the solution of the following equation: $-\frac{1}{1-\alpha}\left.\frac{\theta_q}{R}\frac{\partial R}{\partial\theta_q}\right|_{\theta_q=\theta_q^{1,*}} = -(1-f)$. By arranging terms of this equation, we obtain the following equation of second degree: $A(\theta_q^{1,*})^2+B\theta_q^{1,*}+C = 0$ where $A=(1-\alpha)^2(1-f)$, $B=-(2(1-f)(1-\alpha)^2(1-\theta_u)-(1+\alpha\beta)((\theta_u+\tau)m+1-\theta_u)((1-f)(1-\alpha)+1))$ and $C=-(1-f)(1-\alpha)(1-\theta_u)((1+\alpha\beta)((\theta_u+\tau)m+1-\theta_u)-(1-\alpha)(1-\theta_u))$ with $A>0$ and $C<0$. Remember that $\theta_q^* = (1-m)\theta_q^{1,*}$, so if $\theta_q^{1,*}$ is the root of the previous second order equation and $f(x) = Ax^2 + B(1-m)x + C(1-m)^2$ then θ_q^* will be the root of $f(x)=0$. The product of roots of this equation $\frac{C(1-m)^2}{A}$ is negative so that there is one negative and one positive root and the value of $f(x)$ at $x=1$ is positive, so there exists one positive root such that $\theta_q^* < 1$.

8.B Comparison of $\bar{\theta}_q$ and θ_q^*

As far as $\bar{\theta}_q$ is concerned, we can use $g(x) = \frac{1}{1-\alpha}\left.\frac{\theta_q}{R}\frac{\partial R}{\partial\theta_q}\right|_{\theta_q=x} - (1-f)$ ($\theta_q^{1,*}$ is the root of $g(x)=0$) to compare θ_q^* with $\bar{\theta}_q$ as if $\theta_q^* = \frac{(1-\theta_u)(1-m)(\theta_u+\tau_w)}{1+\tau_w}$ then $\theta_q^{1,*} = \frac{(1-\theta_u)(\theta_u+\tau_w)}{1+\tau_w}$. We need to evaluate $g(x)$ at $x = \frac{(1-\theta_u)(\theta_u+\tau_w)}{1+\tau_w}$. The function $g(x)$ is increasing with x such that if $g(\frac{\bar{\theta}_q}{1-m}) > 0$ we will have $\theta_q^{1,*} < \frac{\bar{\theta}_q}{1-m} \Rightarrow \theta_q^* < \bar{\theta}_q$. We can introduce a new variable γ to define penalties as a function of contribution rates such that $\phi = (\tau_w+\theta_u)\gamma$[6]. This will simplify the analysis as well. $g(\frac{\bar{\theta}_q}{1-m})$ can be expressed as a function of γ where

$$g(\frac{\bar{\theta}_q}{1-m}) = \frac{1}{1-\alpha}\frac{1+\frac{\theta_u+\tau}{1-\theta_u}(1-\frac{(1+2\gamma)}{2(1+\gamma)}\sqrt{\frac{\chi}{(\tau_w+\theta_u)\gamma}})}{1-\frac{(1+2\gamma)}{2(1+\gamma)}\sqrt{\frac{\chi}{(\tau_w+\theta_u)\gamma}}+\frac{(1-\theta_u)(-(1-\alpha)(1-\theta_u)+(1+\alpha\beta)(1+\tau_w))}{(\theta_u+\tau_w)(1+\beta\alpha)(1+\tau_w)}} - \frac{(1+2\gamma)}{2(1+\gamma)}$$

This condition is met if $\chi > \bar{\chi}$ where

$$\bar{\chi} = \frac{(1-\alpha)\frac{(1+2\gamma)}{2(1+\gamma)}(1+\frac{(1-\theta_u)(-(1-\alpha)(1-\theta_u)+(1+\alpha\beta)(1+\tau))}{(\theta_u+\tau)(1+\beta\alpha)(1+\tau)}) - 1 - \frac{\theta_u+\tau}{1-\theta_u}}{(1-\alpha)\frac{(1+2\gamma)}{2(1+\gamma)} - \frac{\theta_u+\tau}{1-\theta_u}}$$

This means that there is a lower bound for efficiency of auditing activity.

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[6] $z = \frac{1}{2(1+\gamma)}\sqrt{\frac{(\tau_w+\theta_u)\gamma}{\chi}}$, $f = \frac{1}{2(1+\gamma)}$ and $m = 1-\frac{(1+2\gamma)}{2(1+\gamma)}\sqrt{\frac{\chi}{(\tau_w+\theta_u)\gamma}}$.

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