The Non-Market Sector in Europe and in the United States: Underground Activities and Home Production*

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Abstract

This paper suggests that the "home production" and the "underground" sectors are two crucial phenomena for properly understanding the European and the United States business cycles. These sectors spell out the labor reallocation mechanism between market and non-market sectors, and rely upon two important and distinguishing aspects: a different degree of family institutionalization and the incentive for individuals and firms to seek tax-free income. The analysis is fruitfully carried out by reviewing two broad classes of multi-sector dynamic general equilibrium model incorporating different informal sectors. It is surprising, but the literature on the role of informal sectors in macromodels is not large, although their implications are extremely relevant.

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1 Introduction

In the industrialized countries, along with the official (market) activity sector, other informal activities often flourish. As a matter of fact, in the United States (US hereafter) economy the household sector is sizeable both in terms of input used in this sector and in terms of home-production output. The evidence for many European economies indicates large and increasing black markets for both labor forces and output. Despite these evidence, informal sectors have only recently been incorporated into macroeconomic models, and we are not aware of contributions drawing comparative implications.[1]

This is somewhat surprising, since the different structure of the European and the US non market sectors may represent one of the most important distinctive characteristics of their business cycles, and provide a more careful explanation of the unemployment experiences. In fact, several features characterizing the informal sector offers an additional explanation for the European and US labor market differentials (unemployment, wages, rigidities etc.).[2] The relation between market and underground activities deserve some attention, as well.

This paper compares the household production with the underground sector as two cases in point of non-market sectors. These two informal sectors provide useful insights concerning the inputs' allocation between the corresponding labor markets (the official and the unofficial). There are many candidate factors capable to enhance agents' willingness to shift resources out of market activity. The excess of tax burden and social security contributions is at the heart of both informal sectors. The tax policy and enforcement policies measure the opportunity cost of engaging in nonmarket activities and may generate a further distinction between United States and European economies in terms of labor market and business cycle features.

An informal sector is an important flexibility-enhancing instrument available in economies with high distortionary taxation. The paper reviews the literature comparing the characteristics and the performance of two classes of dynamic general equilibrium models of the

[1]Here we are not discussing whether informal sectors are a burden to society or, on the contrary, are a source of economic strength, nether we make effort to measure the social or welfare costs of these informal sectors. Moreover, we are concerned with the size of the underground economy as encompassing those activities which are otherwise legal but go unreported or unrecorded.

[2]Among the labor market features used by an extensive literature with different theoretical and empirical frameworks, to investigate on the differences between the US and European economies, we quote the role stressed for employment protection systems, benefit replacement rates and benefit duration, active labor market policies, union density and coverage; payroll tax rate, participation rates of marred women, the the hours worked and the employment rates of prime-age men. It is surprising that in general schemes as well as in the Europe versus North America analysis, which use the above arguments, the underground economy and home production are not involved in these frameworks.

US economy and European Economy (EE hereafter), where an explicit formalization of a nonmarket sector is included. The paper highlights the common features and the differences between underground activities and home production, and underlines the corresponding economic mechanisms by relying on numerical simulations.

Both the US and the EE are characterized by a remarkable burden of taxation and a large and increasing share of the informal economy. In this context agents reallocate resources from the market to either the home production sector or to the underground sector. The choice of the destination sector depends on the social structure and several institutional factors. The first aspect is related to the *stability of family* as an institution, while the *laws' enforceability* accounts for the second distinguishing element.[3] The family model is crucial since it characterizes the domestic allocation of labor between genders and, within the family, the willingness of its components to accept any kind of informal and temporal job. Informal activities are different whether the family context is highly institutionalized or not.

A key feature *common* to both the EE and US economies is that the non market sectors enhance the ability and willingness of agents to substitute into and out of market activity. In particular, there are more opportunities for for allocating labor services, for undertaking risk sharing (on the household side), and for smoothing production and profits (on the firms' side). Allocating their time between market and nonmarket activities, rather than simply between labor and leisure as in the canonical model, agents produce significant phenomena and business cycle issues that traditional schemes often time neglect.

Differences between these two classes of models concern the tradeability of the produced commodity, the source of the resources used for financing investments, and the cyclicality of labor services allocated to the two non market sectors. More precisely, there are five main differences: the response to economic policies, the commodities' number and their substitutability, the financing of capital investment, the insurance opportunities offered by the second sector, and the different cyclical properties between home production and underground activities.

The remainder of this paper is organized as follows. Section 2 reviews a set of stylized facts on the role and the features of the burden of taxation in US and European countries, and the characteristics of the informal sectors in the two economies. Section 3 reviews two dynamic general equilibrium models with, respectively, an underground sector and a home production sector. Section 4 reviews differences and similarities of the two model's solutions.

[3]The enforceability may be defined as a probability be forced to effectively pay the tax rates and a severe surcharge tax, after being discovered violating the law.

In Section 5, using taxation experiments, we show the reallocation mechanism generated by the models. Section 6 concludes the papers.

2 Stylized Facts

2.1 Burden of Taxation and Informal Sector's Size

The literature on the informal sector argues that the increase in taxation and social security contributions is responsible for the increase of the size of the informal sectors observed in US and European economies.[4] Here we review characteristics and sizes of the burden of taxation and document the size of the informal sectors in the two economies.

Although there may exist some methodological problem in comparing tax systems,[5] the following figures show a high level of tax burden as common characteristic between the two economies. They indicate, however, remarkable differences. As tax-to-GDP ratio, the burden of taxation in EE stood at almost 41% in 1999. About 11 percentage points higher than in the United States. If taxes are defined as income taxes and the social contributions over the labor cost, this percentage reaches 46.4% in Italy, 51.3% in Germany, 48.1 in France and 30.3% in United Kingdom. Between 1985 and 2002, the general government current tax receipts (which excludes capital receipts) for the EU ranges from 41.8 to 43.9 per cent of the nominal GDP. In the US in the same period, this percentage is between 28.7 to 30.8. The tax mix is also very different. Most EU countries rely heavily on social security contributions. In 1999 these are about 32% of total tax revenue whereas US social contribution reaches 24% of the total revenue. The average effective tax rate on labor in Europe is about 15 percentage points higher than in the US.

The tax wedge on labor is one of the distinctive features. Labor income is heavily taxed in many European countries such as Italy, France, Belgium Austria. Moreover, as stressed recently from an Oecd study, both the average and marginal tax wedges on labor are high. In 2000, the EU area reported an *average effective* tax wedge on labor (personal income tax plus employee's social security contributions plus employer's social security contribution) of 40%. This figure in the United States is about 30%. An analogous picture is valid for the

[4]See Schneider and Enste (2000) and the papers quoted therein and McGrattan, Rogerson and Wright (1997). Of course, the informal sector may be explained also by institutional mechanisms such as labor market regulations, but the burden of taxation remain the main reason to push firms and workers to develop an informal sector.

[5]The sources are OECD (1999; 2001) and Joumard (2002).

marginal tax wedge on labor. These features, in particular the high marginal tax wedges on labor, affect the participation rate and the working hours and, as stressed by several studies,[6] in systems where taxes are levied on households, discourage the other family members from taking on a job.

This creates an incentive for many family members to stay outside the official labor market. This kind of behavior characterizes pensioners and older workers, unemployed young adults and spouses of low-income earners. **Table 1** reports the marginal effective tax rate on additional income for different family types. This is the amount of earnings which are taxed away via income taxes or mean testing procedures and cancellation of benefits.

Table 1: Marginal Effective Tax Rates on Additional Income

Principal E.	Full-time			Unemployed		Part-time
Secondary E.	Full-time	Part-time	NE	Full-time	Part-time*	NE
France	28	38	76	29	30	69
Germany	51	50	80	31	19	115
Italy	33	25	63	37	19	84
Spain	23	19	78	23	19	77
EU	35	31	77	38	38	107
US	19	11	68	20	0	102

Table 1. All numbers in the Table are in percentages; "Principal E": principal earner of wage income; "Secondary E": secondary earner of wage income; "NE": non-employed; (*) Employed without benefit entitlements. Source: Joumard (2002) and OECD (1999).

High marginal effective tax rates over a range of earnings imply a low incentive to earn in that range. This could reduce hour of work and earnings without affecting the net income. The effect on the official labor market of tax and benefit systems may be relevant, reducing the work incentives, preventing formal part-time work and thereby encouraging nonmarket labor supply and labor demand. Underground and home production phenomena may be an explanatory factor when the structure of social security contributions and income taxation produce an high marginal effective tax rate on the other family members earning.

This is particularly true when taxation is levied on couples rather than individual basis, though the family structure is much more complex in many of the EU countries. It is not a case that both many of the EU countries and the US have the joint as the unit of taxation (France; Germany; US; Spain; Portugal; Switzerland) and others (Italy; Netherlands; Denmark; Canada) with individual basis have full transfer of basic relief (tax paid by one partner

[6]See Joumard (2002) and the works quoted therein.

is dependent on the income of the other).[7] These aspects of tax structure and benefits are important in a policy area that has been completely neglected such as the nonmarket sector consequences.[8]

Finally, statutory rates on corporate profits are somewhat high and broadly the same in the major OECD countries. Effective corporate tax rate ranges from 37% of Italy to about 40% in Germany. A bit lower figure is imposed in the US. Of course the corporate tax follows alternative complicated approaches. The tax structure applied to net income may be graduated on income or may be a unique flat rate tax applied to net capital income. The important point here is that high rates encourage individuals and firms to seek tax-free income.

2.2 The Informal Sector in US and EE

2.2.1 The United States and the Size of Home Production

The US non market sector is characterized by a large home production, while underground activities account for a small share of GDP. In particular, Greenwood, Rogerson, and Wright (1995) document that investment in household capital is larger than that in market capital by about 15 percent. More importantly, household production generates a sizeable portion of aggregate output. For example, Eisner (1988) reports that home production constitutes between 20 and 50 percent of the value of gross national product, and Bonke (1992) estimates that the value of household production is around 40 to 50 percent of GNP in most western countries. In addition, several studies indicate that a typical North-American married couple allocates a large size of its discretionary time to work in household production activities.[9] This quantity is close to the time that it does working for paid compensation.[10]

A large body of literature introduce a household production sector into a stochastic growth model, mainly for the US economy. Benhabib, Rogerson, and Wright (1991), Greenwood and Hercowitz (1991), and Greenwood, Rogerson, and Wright (1995) find that introducing a household production sector into an otherwise standard closed economy business cycle model, improves the ability of the model to explain the volatility of output, the rela-

[7] See OECD (1997).

[8] On the contrary, the importance between marginal tax rates and poverty trap, in-work benefit, and family taxation have been extensively investigated. See, OECD (1997).

[9] In particular, Juster and Stafford (1991) find that a typical married US couple spends 25 percent of their time working at home while allocating 33 percent of their time on market activities.

[10] Benhabib, Rogerson and Wright (1991) indicate that the output of the household sector may be as much as half that of the market sector.

tive volatilities of output, consumption, investment, and hours, the correlation between hours and productivity, and the correlation between the investments in home and market capital. Einarsson and Marquis (1997)resolve some drawbacks of the canonical home production model. They demonstrate that casting the home production mechanism into an endogenous growth model, it is possible to generate comovement between employment and output across the market and the home sectors, even with a single technology shock to market production. McGrattan, Rogerson, and Wright (1997) estimate a model with a household production sector to study the impact of different types of fiscal policies. Their results suggest that the model has considerably different implications for fiscal policies than those of the standard model. Rupert, Rogerson and Wright (2000) include home production into the standard life cycle model, and show that there exist a downward bias in the estimates of the intertemporal substitution elasticities obtained with the standard model and Baxter and Jermann (1999) use home production to solve the excess sensitivity of consumption puzzle. Gomme, Kydland and Rupert (2001) introduce home production in a time-to-build technology, improving the ability of the model in matching the comovement of sectoral investments. Perli (1998) presents a business cycle model with the home production, showing that this provides an indeterminate equilibrium. In this case, cycles may be driven by self-fulfilling expectations.

Canova and Uribe (1997) construct an international business cycle model with a household production sector and show that the model can generate some important features of the data as household production provides important channels for transmitting business cycles between countries. The main focus was to examine the ability of dynamic equilibrium models to account for the business cycle behavior of the labor market, while augmented with an household production sector.[11] In this context, a non-market sector appears to be a relevant *shock absorber*, for it is able to influence the ability and willingness of individuals to substitute into and out of market activity.

In the US the shadow economy constituted between only 3.6 and 4.2 percent of GNP in 1970. In 1990 this share reached about 7 percent and, in 1998 it was estimated to about 8 percent. Although it may appear relevant, these estimates represent the smallest hidden economy size in the OECD countries. [12]

[11]Quoting Gronau (1986), "the greatest contribution of the theory of home production in the past decade was in its service to the better understanding of consumption behavior and changes in labor supply over the business cycle".

[12]See, Schneider and Schneider and Enste (2000).

2.2.2 The European Economies and the Size of Underground Economy

In the **EE**, the picture is different. Household production sector appears relatively smaller in size (in terms of hours allocated to household activities) compared to the US. This appearance is due to a different degree of institutionalization of the family in US and EE. The EE home production is as sizeable as the US, but its cost for the family is lower than US. In the United States, there exists a high degree of de-institutionalization of the traditional family model: this means that the family model is characterized by high divorce rates, high proportion of live births outside marriage, while unemployed young adults do not remain close to their families. In the majority of the couples both spouses have jobs.

On the contrary, in many European countries, in particular in Southern Europe (Greece, Italy, Spain and France) the family model is more traditional, with a domestic division of labor between genders and within the family. Adult children (who often continue to live with their parents) and older parents are taken care of within the same home. These countries share in common a lower rate both of divorce and birth of births outside marriage. In more than half of all couples only the husband has a job while pensioners, women and young adults have a high willingness to accept any kind of temporary and informal job.

One of the main difference between these two household (society) models seems to be the work/job sharing arrangement between spouses. Both members have a regular job in the North-American society, while only one (usually the husband) has a regular job in more than half of southern European couples. Hence young pensioners, women and young unemployed have a high willingness to accept any kind of informal and temporary job. Underground or informal activities are more relevant, in this context, than home production activities.[13]

We may draw two implications. First, home production is quite costly in the US where both components of a couple work in the majority of marriages. In this case, under certain conditions, it may pay to substitute market with nonmarket jobs. Conversely, in EE where a large share of families only the husband works, the home production is much cheaper. The second implication from the different family structure is the high degree of EE family institutionalization, which tends to tie together several members, along with higher average and marginal effective tax rates, make many of them prone to look for black jobs.

In the EE countries, there exist a pernicious effect, because under the current tax system, the probability to be detected is negligible for a firm. This means that firms have a strong incentive to shift a part of their labor demand on the shadow economy. European

[13]See, Jurado Guerrero and Naldini (1997) and Gallie and Paugam (2000).

non-market sector is determined by underground activities, which represent a large part of GNP. Schneider and Enste (2000), show that the size of underground economic activity is quite large and increasing in many countries. In particular, several Southern European countries have underground economies almost one-third as large as officially measured GNP. For instance, Greece has a share of the hidden economy of official GNP of about 27-30 percent. Estimations for Italy range from 20 to 27 percent while for Spain this range is 16-23 percent and Belgium of 21-23 percent of GNP. The importance of the hidden activities is shown also for several northern countries such as Norway, Sweden and Denmark (about 17-18 percent), but also France and Germany report relevant estimation (close to 15 percent).

The literature demonstrates that there can be interesting interactions between underground and market activity and that these interactions cannot be neglected in analyzing the European countries. Loayza (1996) and Sarte (2000) model the connection between the informal sector and the formal one, drawing interesting macroeconomic implications using AK growth models. Ihrig and Moe (2001) develop a dynamic model of a representative agent's decision to accumulate capital and to work in both the sectors with the aim of studying the role of government taxation policies on the underground sector. These authors, simulating their simple dynamic model, show that lowering tax rates as opposed to increasing the enforcement of tax policies, play a larger role in determining a country's standard of living. The results support the view of the informal sector as an important source of subsistence and as a relatively easy way to expand employment during recessions. These works refer to developing countries but they are interesting also for many developed countries with a sizeable underground sector. Busato and Chiarini (2004) incorporating an underground sector in a dynamic general equilibrium model, improve the fit of the model to the Italian data, especially along several important labor market dimensions. They show that underground activities offer risk sharing opportunities by allowing households to smooth income through a proper labor allocation between the two sectors. Conesa, Diaz-Moreno and Galdon-Sanchez (2001) analyze the role of underground activities as an explanation of differences in registered aggregate fluctuations. The quantitative implications of the model show a substantial improvement in capturing the cyclical behavior of the economy.

3 Non-Market Sector in Dynamic Equilibrium Models

3.1 The Underground Economy

In order to describe the working of the reallocation mechanism, this section reviews an underground economy model set up by Busato and Chiarini (2004). In this model there exist three agents: the firm, the consumer-worker-investor, and the government.[14] In addition there are two sectors: the market and the underground sector, and there is a homogenous consumption good. In this context, agents are subject to distortionary taxation, but they can use the underground sector to evade taxes, while optimally allocating labor across sectors. In addition, the consumer-worker-investor is consistent with the traditional family model suitable to represent many European countries cases.

Each firm $i \in [0,1]$ produces final output by using two different technologies, one associated with the market, y^i_{mt}, and the other with the non-market sector, y^i_{ut}.[15]

$$y^i_{mt} = \lambda^m_t \left(k^i_t\right)^{\alpha} \left(\theta^i_t n^i_t\right)^{1-\alpha} \quad \text{and} \quad y^i_{ut} = \lambda^u_t (1-\theta^i_t) n^i_t, \tag{1}$$

where the market output, y^i_{mt}, is the result of capital, k^i_t, and market labor, $n^i_{mt} \equiv \theta^i_t n^i_t$, applied to a Cobb-Douglas technology. Next, θ^i_t $(0 < \theta^i_t < 1)$ denotes the share of labor demand allocated by $i-th$ firm to the market sector. The non-market output, y^i_{ut}, is produced with a production function which uses only non-market labor, $n^i_{ut} \equiv (1-\theta^i_t) n^i_t$.[16] Finally, λ^m_t and λ^u_t denote sectoral stochastic productivity shocks.

Following Prescott and Mehra (1980), we assume that each firm solves a myopic profit maximization problem, on a period-by-period basis, subject to a technological constraint, and to the possibility that it may be discovered producing in the unofficial economy, convicted of tax evasion and subject to a penalty surcharge.

Firms are subject to distortionary taxation, which is partially evaded by allocating resource to the underground (and untaxed by definition) sector. Market-produced revenues,

[14] The model presented here resembles that in Busato and Chiarini (2004).

[15] This technology specification is equivalent to a more general set-up where both production functions use capital and labor, for example $y^i_{mt} = M_t \left(k^i_t\right)^{\alpha} \left(n^i_{mt}\right)^{1-\alpha}$ and $y^i_{ut} = Z_t \left(k^i_{ut}\right)^{\beta} \left(n^i_{ut}\right)^{1-\beta}$. From Uzawa (1965) and Lucas (1988) if $\beta < \alpha$ we can set the smaller elasticity to zero without loss of any generality. Since underground activities are labor intensive, we can simplify the model, and preserving the main economic intuition, by assuming that underground sector produces using only labor. We anticipate that in a Rational Expectations Equilibrium (REE) firms use both technologies (for a formal proof see Busato and Chiarini (2004))

[16] We could imagine that the same firm produces in the market economy in the day, while in the underground economy by night.

$q_t^m(1-t_t)y_{mt}^i$, are taxed at the stochastic corporate rate t_t, where q_t^m denotes the price of market-produced good. Firms do not pay taxes on non-market produced revenues, $q_t^u y_{ut}^i$, where q_t^u is the price of non-market-produced commodity. Firms, however, may be discovered evading, with probability $p \in (0,1)$, and forced to pay the stochastic tax rate, t_t, increased by a surcharge factor, $s > 1$, applied to the standard tax rate. Note that since the market-produced and the non-market produced goods are identical, in a REE they must have the same price.

Since $q_t = 1$ holds in the equilibrium, we can impose it along the solution. In the first case (firm is discovered,with probability p), revenues, denoted as $y_{D,t}^i$, are:

$$y_{D,t}^i = (1-t_t)y_{mt}^i + (1-st_t)y_{ut}^i$$

In the second case (firm is not discovered, with probability $1-p$), revenues equal:

$$y_{ND,t}^i = (1-t_t)y_{mt}^i + y_{ut}^i$$

To compute total expected revenues, we apply linear projection, and we have $E\left(y_t^i|\mathcal{I}_t\right) = py_{D,t}^i + (1-p)\, y_{ND,t}^i$, where E denotes an expectation operator conditional on information set $\mathcal{I}_t$. Simplifying, we rewrite $E\left(y_t^i|\mathcal{I}_t\right) = (1-t_t)y_{mt}^i + (1-pst_t)y_{ut}^i$, where $(1-pst_t) > 0$ ensures that a firm cannot go bankrupt.

The cost of renting capital equals its marginal productivity r_t, net of capital depreciation, δ. The cost of market labor is represented by the wage paid for hours worked, augmented by social security stochastic tax rate, t_t, which, for simplicity, is assumed equal to social security tax rate. We denote the former as $w_t^m = (1+t_t)w_t$, where w_t is pre-tax wage, while the cost of non-market labor equals the pre-tax wage, i.e. $w_t^u = w_t$.

To introduce a traditional family model, with a domestic division of labor between genders and within the family, we suppose that the economy is populated by a continuum of consumers, uniformly distributed over the unit interval. Each consumer works in only one of the two sectors. They receive incomes that are functions of the sectoral, idiosyncratic, shocks. Within the economy there exist extended families, exogenously determined and of fixed size. We assume that family members have perfect information concerning each other's idiosyncratic shocks to each sector. For simplicity suppose there exists one family, which is composed by two working individuals, Mr. κ and Miss. l[17]. Without loss of generality, we assume that Mr. κ works in market sector, while Miss. l works in the non-market sector.

[17]We choose to restrict the analysis to one family to keep notation simple. The size and the number of the extended family can easily be enlarged.

Since Mr. κ and Miss. l belong to the same family, it is sensible to assume that their preferences do not differ significantly. We assume therefore, that they have the same utility function for consumption. The heterogeneity, however, concerns their labor supply, which is consistent with the fact they work in different sectors. This theoretical family structure is a reasonable approximation of a traditional family with a high degree of institutionalization. To model their preferences for consumption and labor, we generalize the structure presented by Busato and Chiarini (2004), which derives from Cho and Rogerson's (1988) extended family labor supply model. Precisely, we specify instantaneous utility function as follows:

$$U(c_t^\kappa, c_t^l, l_t^\kappa, l_t^l) = \varphi u(c_t^\kappa) + (1-\varphi)u(c_t^l) - v\left(l_t^\kappa\right) l_t^l - \mu(l_t^l) \tag{2}$$

where $u(c_t^\kappa)$ and $u(c_t^l)$ represent utility from Mr. κ and Miss l consumption, and $v(l_t^\kappa)l_t^l$ describes the disutility of working in both sectors. We interpret the last term, $\mu(l_t^l)$, as reflecting the idiosyncratic cost of working in the non-market sector. This cost may be associated in particular with the lack of any social and health insurance in the non-market sector. Finally, φ and $(1-\varphi)$ denote the relative weights of Mr. κ and Miss l utility function.

An aspect of primary interest in our labor market is workers' labor supply in the two sectors of the economy. Mr. κ, which works in the market sector, supplies l_t^κ, and receive a wage $w_t^\kappa = w_t(1-\tau)$, where τ is the tax rate on wage income. Miss l, who works in the other sector, offers l_t^l, and earns a wage $w_t^l = w_t$. The family budget constraint is

$$w_t(1-\tau)l_t^\kappa + w_t l_t^l + R_t K_t^{tot} = C_t^{tot} + X_t^{tot} \tag{3}$$

where $C_t^{tot} = c_t^\kappa + c_t^l$ and X_t^{tot} represents total consumption and total investment by the family, respectively. Eventually they pool their savings together, and rent the grand total, X_t^{tot}, to the firms, which capital stock evolves according to a standard capital accumulation constraint, $K_{t+1}^{tot} = (1-\delta)K_t^{tot} + X_t^{tot}$, where δ denotes the exogenous and constant depreciation rate.

In this context we introduce a Risk Sharing Contract, defined as follows.

Definition 1 (Risk Sharing Contract) *The contract has three features:*

1. $l_t^\kappa = \theta_t L_t$ *and* $l_t^l = (1-\theta_t)\, L_t$. *Mr.* κ *and Miss.* l *pool together their labor supplies,* L_t, *then they allocate a share* θ_t *to market sector, and the remaining* $1-\theta_t$ *to non-market sector.*

2. *The extended family chooses total consumption* C_t^{tot}*.Then Mr.* κ *and Miss.* l *consumption*

will be $c_t^{\kappa} = \omega C_t^{tot}$ *and* $c_t^{l} = (1-\omega) C_t^{tot}$.[18]

3. *We assume that agents accept the contract, that it holds for each period in time, and that it is incentive compatible and perfectly enforceable*[19].

Readers unfamiliar with Contract Theory would call it a "marriage" contract. Since we are not interested in studying consumption reallocation, we assume that family member undertake a Perfect Risk Sharing scheme that allows each consumer to have the same consumption profile.

Definition 2 (Perfect Risk Sharing) *After entering the contract, consumers agree on a perfect risk sharing scheme, in the sense that they set ratio between marginal utilities equal to a constant, i.e.* $\frac{u_{\kappa}^{'}(C_{\kappa,t})}{u_{l}^{'}(C_{l,t})} = \frac{\phi_{\kappa}}{\phi_{l}}$.*Since* $u_{\kappa}^{'}(c_t^{\kappa}) = u_{l}^{'}(c_t^{\kappa}) = u'(C_t)$, *we have* $c_t^{\kappa} = \frac{\phi_{\kappa}}{\phi_{l}} c_t^{l}$. *Assuming, that both consumers have the same weight within the family, we can set* $\phi_{\kappa} = \phi_{l}$, *and therefore* $c_t^{\kappa} = c_t^{l}$. *The PRS is defined in the sense of the two consumers enjoying the same consumption profile, smoothed on period by period basis. In terms of total consumption, we have* $c_t^{\kappa} = c_t^{l} = \frac{1}{2} C_t^{j}$, *where* C_t^{j} *represents consumption chosen by j-th household at time t.*

The contract has the simple goal to pool together labor supply, and income insuring the family against idiosyncratic shocks.[20]

To complete the description of extended family behavior, we specify the functional forms for (2), consistent with the Risk Sharing Contract and the Perfect Risk Sharing scheme. In particular, preferences of j-th consumer or family, are described by the following function, where total labor supply is normalized to unity ($n_t = 1$):

$$\mathcal{U}^{j} = \sum_{t=0}^{\infty} \beta^{t} u^{j}(c_t^{j}, n_{mt}^{j}, n_{ut}^{j}).$$

[18] In this way individual consumption is disentangled from individual income. It may be interesting to note that this is the argument behind the risk sharing and consumption literature (see Deaton, 1992 for a survey). In that context, optimal risk sharing is induces by financial market completeness. In our model, the insurance comes from the real sector.

[19] By definition, an implicit contract will need to be sustained as an equilibrium in the interaction between the parties (Salanie', 1997). The contract we present in this model has the very simple goal to provide insurance against production idiosyncratic risk. For this reasons we assume that agents accept the contract.

[20] Note that in this paper we do not consider strategic interaction among agents. It is clear, however, that this would be a natural development of the structure presented here.

In particular, the instantaneous utility function (separable between consumption and labor) is specified as follows:

$$u^j(c_t^j, n_{mt}^j, n_{ut}^j) \equiv \frac{(c_t^j)^{1-q} - 1}{1-q} - h\frac{(\theta_t^j)^{1+\gamma}}{1+\gamma}(1-\theta_t^j) - f\frac{(1-\theta_t^j)^{1-\eta}}{1-\eta}, \tag{4}$$

where c_t^j denotes consumption profile of consumer j, θ_t^j her market labor supply, and $1-\theta_t^j$ her non-market labor supply.[21] The second term, $h\frac{(\theta_t^j)^{1+\gamma}}{1+\gamma}(1-\theta_t^j)$, represents the overall disutility of working, while the last term, $f\frac{(1-\theta_t^j)^{1-\eta}}{1-\eta}$, reflects the idiosyncratic cost of working in the underground sector. In particular, this cost may be associated with the lack of any social and health insurance in the underground sector. To have a well behaved utility function, we assume that $h, f \geq 0$, $\gamma, \eta > -1$, that all the parts of the momentary utility function are well behaved[22].

The representative household, next, faces the following budget constraint:

$$w_t(1-\tau_t)\theta_t^j + w_t(1-\theta_t^j) + R_t k_t^j = c_t^j + x_t^j,$$

where x_t denotes investment at time t. Notice that in this model capital stock is not taxed. If it were, it should be necessary to allow for the possibility of deducing depreciated capital from taxable income, since this in one of the reasons behind the existence of an underground sector. Finally, investment increases the capital stock according to a standard state equation:

$$k_{t+1} = (1-\delta)k_t + x_t.$$

3.2 The Household Production Economy

Enforcement of tax policies plays a large role in determining resources reallocation. The enforceability rules in the EE are weak. This has led us to introduce a tax-evasion model into the general equilibrium economy described above. Enforceability in US economy is stronger than in the European economy and we stylize this fact, assuming that the probability to be detected in US is equal to one. In this case, the expected revenues $(1-p)\, y_{ND,t}^i = 0$. In the following model for the US economy we, therefore, do not specify an underground sector.

[21] To represent consumer behavior in this environment, we refer to Cho and Cooley (1994) family labor supply model. They distinguish labor supply with regard to an intensive (the hours worked), and an extensive margin (the employment margin). In our model we reinterpret these two dimensions as representing worker's labor supply in the regular and in the underground sectors

[22] Restriction on the utility function to make the inter-temporal optimization problem well defined are derived in Busato and Chiarini (2004).

As well as underground activities, household production is a large part of the economic activity.[23] More importantly, the addition of household production influences the ability and willingness of individuals to substitute into and out of market activities.[24] In this sense home production is similar to underground activities, even though movitations for shifting resources to one or the other sector are different, and are detailed below. To carry out a consistent comparison between these two nonmarket activities, it is necessary to present a home production model augmented with distortionary taxation. This section reviews a home production model such as that of McGrattan, Rogerson and Wrigth (1997).

Consider first the corporate sector. The i-th firm, $i \in [0,1]$, is characterized by production technologies for the market and the non-market sectors that display constant returns to scale, and which are specified as follows:

$$y_{mt}^i = \lambda_t^m \left(k_{mt}^i\right)^{\alpha} \left(n_{mt}^i\right)^{1-\alpha} \quad \text{and} \quad y_{ht}^i = \lambda_t^h \left(k_{ht}^i\right)^{\beta} \left(n_{ht}^i\right)^{1-\beta}, \tag{5}$$

where employment supplied to the market n_m^i and the capital stock k_m^i produce market output y_m^i, whereas employment supplied in the home sector n_h^i and home capital sector k_h^i produce home output y_h^i. Maximization implies factor prices equal marginal product because of the constant returns to scale.

Next, assume that consumers are infinitely lived and homogenous, and total population is normalized to unity. The $j \in [0,1]$ household has preferences over stochastic processes for aggregate consumption flow, c_t^j, and leisure, ℓ_t^j, described by the following utility function:

$$\mathcal{U}^j = \sum_{t=0}^{\infty} \beta^t u^j(c_t^j, \ell_t),$$

where the instantaneous utility is assumed to be a constant relative risk aversion transformation of a Cobb-Douglas function,

$$u^j(c_t^j, \ell_t^j) \equiv \frac{\left(c_t^q \ell_t^{1-q}\right)^{1-\rho} - 1}{1-\rho},$$

where leisure in this context is an aggregate of total available time normalized to unity,

[23] Home production has been part of standard labor paradigm. Fundamental references include Becker (1965), Pollak and Watcher (1975), and Gronau (1986)). Only recently has been introduced into macro models. However, the literature is quite large: see Benhabib, Rogerson and Wright (1991) for a survey, or among the many Rios Rull (1993), McGrattan, Rogerson and Wright (1992), Fisher (1992), Fung (1992), Perli (1998), Gomme, Kydland and Rupert (2001).

[24] As reported in Greenwood, Rogerson and Wrigth (1993), a typical family spends almost as much time in production activities such as cooking, cleaning, and so on, as it does working for salary.

market hours n_{mt}, and non-market hours n_{ht}: $\ell_t^j = 1 - n_{mt}^j - n_{ht}^j$. Consumption, next, is an aggregate of private consumption c_{pt}^j, and government consumption c_{gt}^j:

$$c_t = \left\{ \phi_1 (c_{pt}^j)^{e_1} + (1 - \phi_1)(c_{gt}^j)^{e_1} \right\}^{\frac{1}{e_1}}, \tag{6}$$

where $\phi_1 \in (0, 1)$, and the parameter $e_1 \leqq 1$ is the household willingness to substitute between the two types of consumption goods. Private consumption itself is an aggregate of market consumption c_{mt}^j, and non-market consumption c_{ht}^j:

$$c_{pt} = \left\{ \phi_2 (c_{mt}^j)^{e_2} + (1 - \phi_2)(c_{ht}^j)^{e_2} \right\}^{\frac{1}{e_2}}, \tag{7}$$

where notation is analogous to that of (6). Next, feasibility in the market sector is ensured by the following equation:

$$c_{mt} + x_t = (1 - \tau_{ht})\, w_t h_{mt} + (1 - \tau_{kt})\, r_t k_{mt} + \delta \tau_{kt} k_{mt} + T_t, \tag{8}$$

where τ_{ht} and τ_{kt} are the stochastic taxes on capital and labor, w_t and r_t are the marginal prices for capital and labor, and T_t is a lump-sum transfer. Following McGrattan, Rogerson and Wright (*1997*) we assume that the depreciated capital is tax deducible, for which reason it is added up to the income side of previous equation.

The fiscal authority faces a budget constraint:

$$c_{gt} = h_{mt} \tau_{ht} w_t + \tau_{kt} r_t k_{mt} - \delta \tau_{kt} k_{mt} - T_t.$$

Notice that the transfer T_t ensures that the government balances its budget in each point in time, given realization of stochastic tax rates (τ_{ht} and τ_{kt}) and of ν_t (defined below). In addition, notice that the home capital stock is not subject to taxation, at least in the basic formulation of the model.[25] Finally, it is assumed that government consumption is a stochastic process given by:

$$c_{gt} = \nu_t y_t,$$

where ν_t is a random variable and y_t is the aggregate output.

Finally, let aggregate capital stock, k_t, evolving according the following:

$$k_{t+1} = (1 - \delta) k_t + x_t,$$

[25] In a policy experiment presented below the possibility of taxing home capital stock is taken into account.

where $k_t = k_{mt} + k_{ht}$.

4 Two Mechanisms for Risk Hedging and Optimal Labor Allocation

First notice that, technically speaking, both the home production model and the underground economy model, are characterized by three agents: a large number of myopic firms, a large number of identical infinitely-lived and forward looking households, and the government. In addition there are two sectors: the market and the nonmarket sector. Differences between these two classes of models concern, however, the tradeability of the produced commodity, the origin of resources used for financing investments, and the cyclicality of labor services allocated to the two non market sectors. We outline five issues: the reaction to policy distortions, the commodities' number and their substitutability, the financing of capital investment, the insurance opportunities offered by the second sector, and the different cyclical properties between home production and underground activities.

4.1 Risk Sharing and Labor Flexibility

In both the models, agents are more willing to shift resources out of market activity in response to policy distortions. Thus, in home production and underground economy models, policies do not affect only total hours worked but also how hours are allocated between the market and the nonmarket sectors.[26] In these models there exist a high degree of *flexibility* of the labor inputs. However, whereas in the home production labor flexibility involves the labor supply, in the underground economy it is a key feature of both firms' labor demand and households' labor supply.

4.2 Consumption Goods and their Substitutability

In the home production class of models there exist two goods, denoted as market and nonmarket commodities, each of which is produced with a sector specific technology. In addition, the preference specification allows for different degrees of substitutability between market

[26]This aspect has also important development implications. In fact as agents change their allocation of time spent in market and nonmarket work, differences in output per person will be due to both differences in capital and in market hours per worker. See Parente, Rogerson and Wright (1999).

and non-market goods.[27]

In the model with underground sector there exists only one homogenous good, which is produced using two different technologies: one associated with market sector, and the other with underground sector. In this environment it is natural to focus on the case of perfect substitutability between market-produced final output and underground-produced one. This latter issue, however, can be generalized, developing underground models with two goods and relative prices.

4.3 Investments Financing

The home production model shows that only market-produced goods can be consumed and invested, either into market capital or into non-market capital. There are no uses for home production output other than consumption - it cannot be sold or transformed into capital, for example, the way that market-produced output can. In the underground economy model, however, there exists only one capital stock (invested in the market sector), but market and non-market-produced output can be transformed into market capital and, in our simple version, without any adjustment cost. The underground sector offers an additional channel for financing capital stock accumulation, and an additional dimension along which firms can employ the available labor supply.[28] While home production model is a legitimate two sector model, the underground economy model could be more appropriately defined as a *two technology model*, since the same good is produced using two different technologies.

Notice that, when households shift working time in the home sector, in general they decrease the marginal product of capital in the market sector, thereby causing a change in the desired allocation of capital across the two sectors: agents will invest more in the home sector. In the model of underground economy presented above, when agents draw working time out of market sector to the underground economy the product of capital falls but there is not change in the capital allocation across sectors.

4.4 Production and Consumption Smoothing

Notice that an underground sector offers profit smoothing opportunities for firms, and insurance opportunities for consumers. More precisely, firms can smooth their profits by a proper

[27]It is customary, in this literature, to consider the version with perfect substitutability as the benchmark simulated economy.

[28]Technically speaking, the specification of consumer intertemporal feasibility constraint, equation (3), incorporates this feature.

allocation of labor demand between the two sectors, on a period by period base. In addition, consumers can smooth not only consumption, by substituting over time consumption and investments, but they can also smooth income, by allocating their labor supply across sectors, on a period by period base. In the model with underground sector consumers have two sources of income, which, being countercyclical, offer insurance against bad times. This mechanism is absent in models with home production.

4.5 Cyclical Properties of Labor Services

Finally, Ingram, Kocherlakota and Savin (1997) find that hours spent in home production are acyclical whereas other studies find that home hours are countercyclical.[29] It is important to notice that this implies that during recessions home production models predict that workers may adjust by switching into leisure, whereas a model with underground activities predicts a switch into underground activities. Difference is that in our class of model, non-market income increases during recessions, mitigating slumps, by offering insurance opportunities to household. Again this mechanism is not present in home production models.

5 The Reallocation Mechanism: A Fiscal Policy Experiment

RBC models with fiscal policy do a good job in matching some observed comovements in the data. In the set up considered by this model taxes affect labor and consumption allocations, and stimulate production and labor demand in the informal sector. Because it seems that government taxation plays a relevant role in the allocation of output and labor input between these sectors, our interest in this analysis is motivated by the desire to assess its empirical implications in term of resource reallocation in economies with an informal sector. In particular, we investigate how changes in corporate and personal income taxes affects production and labor allocation between the market and the non-market sector.

5.1 Calibration

The underground-activity model is calibrated for the Italian economy though the analysis can be generalized to a large number of European countries which present a sizeable underground

[29] Benhabib, Rogerson and Wright (1991), Greenwood, Rogerson, Wright (1995), Canova and Ubide (1997), Blankenau and Ayhan Kose (2002).

sector.[30] The calibration is based on the seasonally adjusted ISTAT series from 1970:1 to 1996:4, expressed in constant 1995 prices, and on a set of underground output estimations provided by Bovi (1999). More details are presented in Busato and Chiarini (2004). For convenience, calibrated parameters are presented in **Table 2**.

Table 2: Underground Activity Model

q	η	h	f	γ	α	δ
1.0	0.62	6.0	1.0	2.0	.36	.025
s	p	β	t, τ	$\bar{\theta}$	ρ_m, ρ_z	σ_m, σ_z
1.30	.03	0.98	.275	.735	.95	.712

Table 2. According to the Italian Tax Law (Legislative Decree 471/97, Section 13, paragraph 1) the surcharge s equals 30 or 200 percent of the statutory tax rate. We present results just for the first value. The standard deviations of innovation, σ_m, σ_z, are defined as percentages.

The home production model is, instead, calibrated for the US economy. The parameters' estimated are taken from McGrattan, Rogerson and Wright (1997), with use procedure presented in McGrattan (1994). Parameters are included in **Table 3**.[31]

Table 3: Home Production Model

q	e_1	e_2	b	b_1	b_2	b_3	b_4
5.27	0.62	6.0	.448	0.00	.385	.020	.525
a_1	a_2	a_3	a_4	τ_k	τ_n	δ	
1.00	.485	0.21	.234	0.57	0.23	0.22	

Table 3. Source: McGrattan, Rogerson and Wright (1997).

5.2 Taxation and Household Production

To have an idea of the dimension of the taxation impact on the relationship between the household production and the market sector, we may imagine to eliminate distortionary taxation in the US market sector, setting in the home production model of Section 6, $\tau_{ht} = \tau_{kt} = 0$. A further experiment is accomplished introducing taxation over non-market activities.

According to McGrattan, Rogerson and Wright estimates, the effect of eliminating dis-

[30] Countries like Belgium, Denmark, Greece , Portugal and Spain have a large share of the underground sector. See, Schneider and Enste (2000).

[31] There is an important difference between the two calibrations. Busato and Chiarini (2004) calibrate tax rate relying on the statutory tax rates, while McGrattan Rogerson and Wright (1997) use effective tax rates.

tortionary taxation in the market sector is quite remarkable: output increases by 43 percent, market consumption increases by 47 percent, market investment increases by 87 percent, market hours increase by 22 percent, and the stock market capital more than double. In the home sector, however, the picture is reversed for all variables but capital, which increases by 34 percent. In other words, there is a shift in labor from the home sector to the market sector, while capital stock increases in both sectors.[32]

The second experiment concerns the introduction of a tax on the home production capital. In order to do this, the feasibility constraint (6) should be rewritten as follows:

$$c_{mt} + x_t = (1 - \tau_{ht})\, w_t h_{mt} + (1 - \tau_{kt})\, r_t k_{mt} + \delta \tau_{kt} k_{mt} + T_t - \tau_p k_n, \tag{9}$$

where τ_p can be interpreted as a residential "property tax". When τ_p is set different from zero, all variables are lower with the exception of market consumption. With respect to the base case ($\tau_p = 0$),the latter rise ranges from 3 to 7 per cent, whereas home production and (since home capital is produced in the market) market production fall from 1.2 to 2 per cent. Of course home capital stock, being the taxed factor, falls. However, since a property tax does not affect labor/leisure choice, market capital/labor ratio does not change. Moreover, the reduction of capital stock is associated to a large reduction in investment, and, by this end, there is an increase in market consumption. The labor input reduces slightly in home production sector while in the market sector the fall ranges from 1.24 to 2 per cent. The simulations show that in this economy there may be frequent and relevant opportunities from substituting between market and home goods.

5.3 Taxation and Underground Activities

In Figure 1 (Tax Cuts on the Income and the Corporate Tax Rates) the square line represents market output, the line with circles denotes total output, the line with triangles represents non-market output, and the dotted line represents the tax rate profile.

Here we give a brief insight of the allocation mechanism in the underground model of Section 5 performing an impulse-response analysis cutting income and corporate tax rates. A cut in the corporate tax rates, remarkably increases production and labor input in the market sector ($\frac{\Delta y_m}{y_m} = +8\%$), while reduces labor and production in the underground sector. In particular, production activity in the underground economy falls by more than six percent

[32]Notice that a model that ignores the home production sector has different production. See for example the contribution of McGRattan (1994), where market sector fluctuations are much larger that in a model augmented with an household production sector.

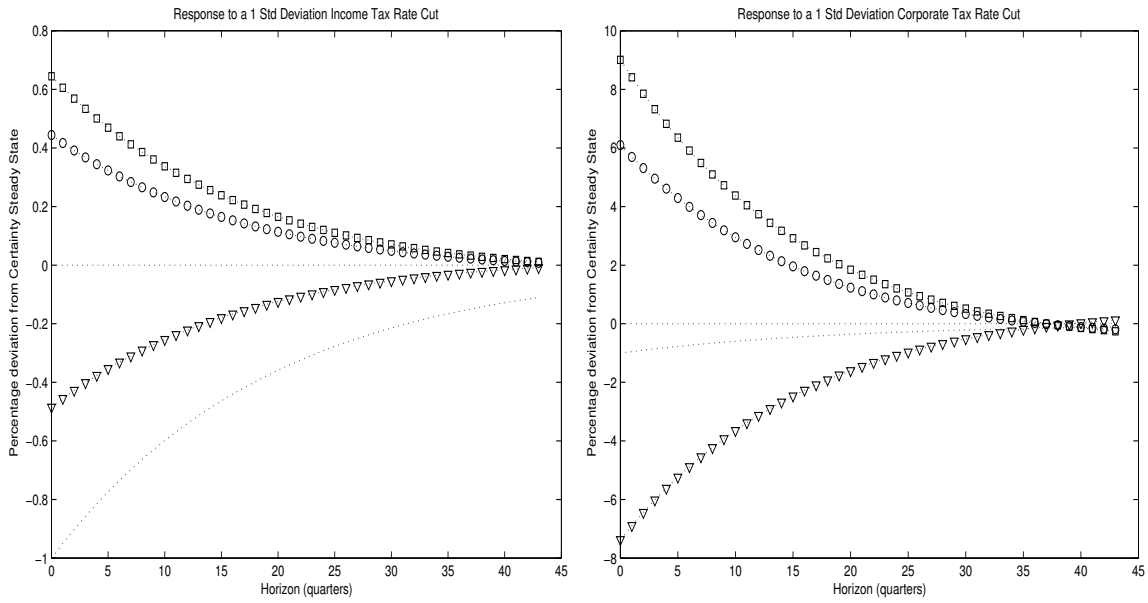

Figure 1:

($\frac{\Delta y_u}{y_u} = -6.5\%$). Notice, however, that the fall in the unreported activities thwarts to some degree the expansion effects of the tax cut. The positive impact on output and income taxation induces firms and households to work less in the underground sector highlighting a strong reallocation effect between the two economies.

The reaction of the economic system is diminished when the model is subject to a cut to personal income taxes. In particular, we have that $\frac{\Delta y_m}{y_m} = -0.5\%$ and $\frac{\Delta y_u}{y_u} = +0.6\%$. Both impact responses are smaller than those of standard RBC models without the underground sector. That is because the consumers can reallocate consumption and labor intra-temporally within the two sectors, reducing the loss generated by the fiscal policy. More precisely, they shift resources from the underground to the market sector.

While taxes causes a distortion in the formal sector in both the US and European economies, driving a remarkable reallocations of inputs and outputs between sectors, the existence of different informal sectors have an equally important effects on the labor market and the economy. These effects, possibly, create different cyclical and welfare implications. These models can be extended in different directions but, if one wishes to study the labor market structure and the cyclical properties of these economies and perform comparative analysis, the informal sectors cannot be neglected.

6 Conclusions

This paper suggests that home production and underground sectors are two crucial phenomena for properly understanding the European and United States economies. These sectors spell out the mechanism of reallocation of the labor input and production between market and nonmarket sector and rely upon two important and distinguishing aspects: a different degree of family institutionalization and the incentive for individuals and firms to seek tax-free income. This is fruitfully done reviewing two dynamic general equilibrium models incorporating different informal sectors and attributing their differences to the EE and US economies tax enforceability rules and family features. It is surprising, but the literature on the role of informal sectors in macromodels is not large, although their implications are extremely relevant.

The review of these models provide important policy implications. **First**, our analysis support the long-held view that the rise of the tax and social security burdens is the most important cause of the increase of informal activity. Experiments carried out in McGrattan, Rogerson and Wright (1997) and Busato and Chiarini (2004) provide empirical support to this analysis. Taxes distort production and labor choices stimulating production and labor supply in the untaxed sector of the economy. **Second**, the effects of these reallocation mechanisms may hamper, to some degree, the effectiveness of a fiscal contraction policy. This happens because the underground and the home production sectors offer to the agents a channel through which they may reallocate their resources, avoiding (at least partially) the fiscal policy effects.**Third**, since the size of unrecorded activity is relevant, it may distort our understanding of the business cycle, raising difficulties for policy analysis. **Fourth**, the informal sectors are features of the labor markets that may help to understand many of their dynamic phenomena.

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