Tax Reforms and the Underground Economy: A Simulation-Based Analysis*

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Abstract

This paper studies the effects of several tax reforms in an economy in which taxes are partially evaded by means of undeclared work. To this purpose, we consider a two-sector dynamic general equilibrium model calibrated to Italy which explicitly accounts for underground production and embodies a rich set of taxes. We construct various tax reform scenarios, such as deductibility of labor costs from business tax, ex-ante budget-neutral tax shifts from direct to indirect taxes, and various tax cuts financed by simultaneous or delayed decreases of government spending. We find the following results. First, neglecting the existence of the underground sector may lead to severely miscalculate the macroeconomic impact and the welfare effects of tax reforms. Second, partial deductibility of labor costs from the business tax base proves to be highly expansionary and highly detrimental to the size of the underground sector. Third, the dimension of the underground sector is permanently and considerably reduced by changes in the tax mix that diminish the labor tax wedge. Finally, all the considered tax reforms take the public-debt-to-output ratio to a prolonged downward path.

Keywords: DSGE, Underground Economy, Tax Reforms, Italy
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1 Introduction

During recent years most European economies have been experiencing feeble growth and increasing levels of public debt. Compliance with the Stability and Growth Pact, and in particular with the primary deficit clause, has required many governments to raise taxes to exceptional high levels, thus hindering business venture and economic recovery. These circumstances has led to a widespread consensus among policy makers on the need for tax reforms and, in particular, for lower taxes on labor. Lower tax wedges on labor, in fact, ought to lead to a significant rise in labor utilization and, thereby, to a higher level of economic activity. Similarly, alleviating the tax burden on business may stimulate investment in difficult economic circumstances. However, given the risk for public finance, lower labor and business taxes need to be compensated by increases in other sources of revenue, such as consumption taxes, or by public spending cuts.[1] Clearly, tax reforms should be carefully designed taking into account the existing tax system of the economies involved as well as their production structure. From this perspective the presence of a non-negligible share of underground production may substantially influence the effects of any reform aimed at reducing tax distortions. Indeed, that between a country's tax system and the size of its shadow economy is a two-way relationship. In fact, authors in the literature on the underground economy recognize that there exists a link between the dimension of the tax burden on economic activity and the size of the informal economy, and that the latter is likely to affect the outcome of fiscal policies. A positive relationship between the burden of taxes and the shadow economy has been documented by Kanniainen et al. (2004), who observe a substantial increase of the estimated size of the shadow economy in the 1990s in all of the OECD-countries included in their data, coherently with rising total tax rates in the OECD economies in that period. Such positive empirical relationship has also been found by Schneider (1997), Cebula (1997), Johnson et al. (1998), Giles et al. (2002), Dell'Anno et al. (2007), Buehn and Schneider (2012a), Giles and Caragata (2001), Tanzi (1999), Schneider and Enste (2000), and Feld and Schneider (2010). Higher tax rates clearly increase the agents' incentives to evade taxes.[2] On the other hand, just as the tax burden contributes to determine the size of the shadow economy, the latter affects the outcome of tax, and, more generally, of fiscal, reforms. In fact, strong reallocation effects between the underground and the formal sectors may be triggered by changes in the tax

[1] Recently many EU Member States have been attempting to strike the balance between economic recovery and fiscal soundness by reducing the tax burden on labor and by narrowing the tax base of corporate income taxation, while increasing consumption taxes. See European Commission (2014).

[2] In this respect, Ihrig and Moe (2004) combine a simple theoretical model with data on Sri Lanka to conclude that the size of underground production is much more sensitive to taxation, rather than to tax enforcement, while Lemieux et al. (1994) use micro data from a survey carried out in the metropolitan area of Quebec City, Canada, to asses the impact of taxes on the agents' decision to supply labor in the underground economy. They find that tax distortions are small for the average worker, but large for particular agents in the economy, such as welfare claimants (i.e., people at the low end of the income distribution).

structure, shaping the overall macroeconomic performance of tax reforms and the effects on fiscal variables. In this regard, Busato et al. (2012) show how tax evasion and the existence of underground economy mitigate tax distortions and attenuate the response of output to restrictive or expansionary tax changes, Fugazza and Jacques (2004) include the underground economy into a continuous-time search and matching model and show how the existence of an informal sector is likely to affect the impact of policy interventions, both on the labor force and on the government budget, and Turnovsky and Basher (2009) examine the role of the informal economy in limiting the ability of the government to raise tax revenues using a two-sector general equilibrium model for developing economies.

Starting from the work by Busato et al. (2012), the aim of this paper is to explore the effects of a richer set of tax reforms aimed at promoting growth, while preserving fiscal soundness, in an economy characterized by underground production and undeclared work. Despite most of the EU Member States in economic and fiscal distress, such as Greece, Italy, Portugal and Spain have high shares of shadow economies, as documented by Schneider (2012), this essential aspect of their production structure is overlooked in assessing the macroeconomic impact of changes in the tax and spending mix.[3] In this paper we use a two-sector dynamic general equilibrium model calibrated to Italy which explicitly accounts for underground production and embodies a rich set of taxes. Specifically, we carry out our analysis in an artificial economy where the underground sector includes "all market-based legal production of goods and services that are deliberately concealed from public authorities" to avoid payment of taxes and social security contributions or to escape certain legal market standards and administrative obligations (Schneider, 2012, p. 6). In particular, we start from the dynamic stochastic general equilibrium model of Orsi et al. (2014), which in turn is an adaptation of the model of Busato and Chiarini (2004), and incorporate nominal and real rigidities, which typically improve the empirical fit of a dynamic macroeconomic model and shape the transition dynamics, such as nominal rigidities, investments adjustment costs and habit persistence. We also introduce taxes on consumption, labor income, capital income, business as well as social security contributions (SSC) borne by employers and workers. We are so able to construct various tax reform scenarios, recently advocated in economic and policy circles as a means to promote growth, such as deductibility of labor costs from the business tax, and ex-ante budget-neutral tax shifts involving reductions of distortionary taxes on labor and business compensated by an increase in the consumption tax or counterbalanced by simultaneous or delayed decreases of government

[3] A laudable exception is given by the recent contribution of Pappa et al. (2015) who study the effects of fiscal consolidation accounting for the presence of tax evasion and corruption. In their analysis conducted for Greece, Italy, Portugal and Spain they unambiguously show that the recent consolidation plans introduced in these economies tend to increase tax evasion.

spending.[4] We will see that all these fiscal reforms give rise to a resource reallocation effect from underground to official production or vice versa and have rather different implications in terms of output, fiscal solvency and welfare.[5]

The interest of the present analysis on the Italian economy is motivated by two main reasons. In the first place, the Italian labor market is characterized by high tax wedges. In 2014 Italy recorded a total tax wedge as a percentage of labour costs of 48%, with the share of firms social security contributions accounting for more than 50% of this wedge. The average tax wedge for the OECD countries is about 36%.[6] At the moment several tax reforms are underway in Italy, aimed at reducing the tax wedge on labor and at stimulating economic activity, while preserving fiscal soundness. In this respect, our analysis attempts to quantify the potential gains for the economy from tax reforms acting in this direction. Furthermore, Italy is characterized by the existence of a sizeable underground sector. Most recent available estimates of the Italian National Institute for Statistics (ISTAT) point to the shadow economy being 20.6% of GDP,[7] Orsi et al. (2014) find that the share of the underground sector is about 23%, the estimates of Schneider (2013) indicate that the size of the shadow economy in Italy is 21.1% of GDP in 2013, while Ardizzi et al. (2014) estimate a quite lower, but still relevant, value (16.5% of GDP) using the currency demand approach.[8] This aspect is particularly significant when studying the effects of tax reforms able to change the incentives to supply and/or employ informal labor inputs.

Our main results can be summarized as follows. First, consistently with previous findings, we show that neglecting the existence of the underground sector may lead to severely miscalculate the macroeconomic impact and the welfare effects of tax reforms, especially during the transition toward the new long-run equilibrium. This result arises since a share of production or of worked hours, depending on the specific policy put in place, being kept secret to avoid taxation, is not directly affected by the tax reform. In addition, the existence of the underground sector offers households and firms the possibility of shifting from one sector to

[4] In doing so we enrich the analysis of Busato et al. (2012) who focus on the effects of tax reductions on labor and income, with public spending being determined endogenously so as to preserve the balance of the public budget constraint at all times.

[5] In this respect, through the use of a macroeconomic model embodying an underground sector, this paper contributes to the vast literature studying the effects of tax distortions (see the early contributions by Lucas 1990 and Cooley and Hansen 1992) and measuring the impact of tax reforms involving tax shifts or changes in public spending met by adjustments in taxes (see e.g. Baxter and King 1993, Mendoza and Tesar 1998, Leeper and Yang 2008, Uhlig 2010).

[6] See the OECD Tax Database available online at https://data.oecd.org/tax/tax-wedge.htm. The tax wedge is measured as the ratio between the amount of taxes paid by single worker at 100% of average earnings without children and the corresponding total labour cost borne by the employer.

[7] This value arises when considering only the market economy, that is excluding the non-market services provided by Public Administrations. When the latter are included, the estimate of the underground economy reduces to 17.5 percent of GDP. See ISTAT (2010).

[8] This discrepancy of estimates can be partly explained by the fact that different definitions of the shadow economy entail different measurements. For instance, Buehn and Schneider (2012b) claim that explicit shadow activities - that is, shadow activities from 'black' hours worked - only account for about one third of the shadow economy. See also Zizza (2002) for further details.

another in response to changes in the tax mix. Second, partial deductibility of labor costs from the business tax base is shown to be highly beneficial for output, detrimental to the size of the underground sector and strongly welfare improving. Third, the dimension of the underground sector is substantially decreased by fiscal interventions envisaging sizeable labor tax wedge reductions. Finally, all the considered tax reforms have positive effects on the fiscal consolidation process due to a combination of larger tax revenues and positive output growth. The remainder of the paper is organized as follows. Sections 2 presents the model with underground production. Section 3 provides details on model parametrization and solution. Section 4 describes the alternative fiscal reform scenarios and presents and discusses the results of the policy simulation analysis. Finally, Section 5 presents our conclusions.

2 The Model

We build a two-sector dynamic general equilibrium model with underground economy, a rich set of distortionary taxes, and sticky prices. Firms are divided into two types: (i) intermediate goods producers that engage in monopolistic competition, produce the goods either in the formal or in the underground sector, and face price rigidities; and (ii) competitive retailers that costlessly aggregate the intermediate goods into a final consumption good. The possibility that intermediate firms produce in the underground sector is motivated by the existence of tax distortions. In fact, informal production enables firms to keep transactions (and labor inputs) secret from fiscal authorities, thus eluding tax payments and raising profits. However, in each period intermediate firms face a positive probability, $p \in (0, 1)$, of being inspected and convicted to pay back the total amount evaded, increased by a surcharge factor, $s > 1$. In the household sector, agents can allocate their working time between formal and informal jobs, where the income derived from the latter remains unreported. Since underground production requires the usage of informal labor, we assume that firm inspections allow the fiscal authorities to simultaneously detect both irregularly produced output and irregularly employed workers. Thus, households and intermediate firms face the same probability of being detected. We also assume that the penalty to be paid if detected is the same. Finally, the government sector and a monetary authority complete the model setup.

2.1 Households

We consider an economy populated by a large number of identical, infinitely living, agents who seek to maximize the following objective function, which is separable in consumption and labor:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{\left(C_t - \eta \bar{C}_{t-1}\right)^{1-\sigma} - 1}{1-\sigma} - \Gamma_0 \frac{(H_t^m + H_t^u)^{1+\xi}}{1+\xi} - \Gamma_1 \frac{(H_t^u)^{1+\varphi}}{1+\varphi} \right\}. \tag{1}$$

In (1), the agents discount the stream of future utilities at the subjective rate $\beta \in (0,1)$, exhibit external consumption habit relative to the lagged aggregate consumption, where $\sigma > 0$ is the inverse of the intertemporal elasticity of substitution and $\eta \in (0,1)$ regulates the intensity of external habits in consumption, and obtain disutility from labor. In particular, the first negative term in (1) is the standard disutility of working activities - where the sum between hours spent working in the formal sector, H_t^m, and underground sector, H_t^u, represents the total amount of hours worked in the economy - which is regulated by the scale parameter $\Gamma_0 \geq 0$, while the second negative term represents the idiosyncratic cost of working in the underground sector, which is regulated by the scale parameter $\Gamma_1 \geq 0$.[9] Finally, $\xi > 0$ and $\varphi > 0$ are the inverse of the Frisch elasticities of labor supply. Households consume, supply labor per unit of time, own physical capital which they rent out to producing firms, pay taxes on consumption and labor income, and pay social security contributions. The stock of capital held by households, denoted by K_t, evolves according to the following law of motion:

$$K_{t+1} = (1-\delta)K_t + \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] I_t, \tag{2}$$

where $\delta \in (0,1)$ is the constant depreciation rate of capital, I_t denotes investment, and

$$S\left(\frac{I_t}{I_{t-1}}\right) = \frac{\phi_I}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2, \tag{3}$$

are convex investment adjustment costs, the intensity of which is regulated by the parameter $\phi_I > 0$. In addition, market completeness enables households to smooth their consumption through a complete set of nominal contingent claims. Thus, the households' period-by-period budget constraint is given by

$$\begin{aligned}(1+\tau_t^c)\, P_t C_t + E_t Q_{t,t+1} B_{t+1} + P_t I_t = B_t + (1 - \tau_t^h - \tau_t^{h,s}) W_t^m H_t^m + (1-\tau_t^k) R_t^k K_t + \\ + [1 - ps(\tau_t^h + \tau_t^{h,s})] W_t^u H_t^u + D_t + P_t T_t^{ls},\end{aligned} \tag{4}$$

[9] As in Busato and Chiarini (2004), Busato et al. (2012) and Orsi et al. (2014), we assume that individuals face an additional cost of working in the underground sector. This specific cost can be justified by the lack of any social and health insurance, as well as by job insecurity.

where τ_t^c represents the tax rate on households' consumption, B_t is the quantity of bonds carried over from period $t-1$ and $Q_{t,t+1}$ is the stochastic discount factor between periods t and $t+1$ such that $E_t Q_{t,t+1} B_{t+1}$ is the value at time t of a random nominal payment in $t+1$.[10] Households earn a net salary $(1-\tau_t^h-\tau_t^{h,s})W_t^m$ for working one unit of time in the regular sector, where τ_t^h is the labor income tax rate, $\tau_t^{h,s}$ represents the workers' SSC, and W_t^m is the nominal wage of formal jobs, receive the amount $(1-\tau_t^k)R_t^k$ for each unit of capital they rent to producing firms, where R_t^k is the nominal rate of return on capital which is taxed at a rate τ_t^k, and obtain the nominal wage W_t^u for each hour they work in the underground sector. As previously discussed, the informal wage W_t^u is subject to the income and social contributions tax rates - increased by a penalty - only in probability, that is when the fiscal authorities detect the informal employment relationship between workers and firms. Finally, D_t denotes nominal (net-of-taxes) expected profits received by the representative household for the ownership of producing firms, and $P_t T_t^{ls}$ are nominal lump sum taxes flowing from the households to the government sector. The households' problem consists in choosing optimal contingent plans $\{C_t,\, H_t^m,\, H_t^u,\, B_{t+1},\, K_{t+1},\, I_t\}_{t=0}^{\infty}$ so as to maximize lifetime utility (1) subject to the sequence of constraints (2) and (4). Denoting with λ_t the Lagrange multiplier in front of the households' intertemporal budget constraint (4) - that is, the marginal utility of income - and with q_t the Tobin's q, the solution to this problem is characterized by the following set of first order conditions:

$$\lambda_t = \frac{\left(C_t - \eta \bar{C}_{t-1}\right)^{-\sigma}}{1+\tau_t^c}, \tag{5}$$

$$H_t^m + H_t^u = \lambda_t^{\frac{1}{\xi}} \left[\frac{(1-\tau_t^h-\tau_t^{h,s})W_t^m/P_t}{\Gamma_0}\right]^{\frac{1}{\xi}}, \tag{6}$$

$$H_t^u = \begin{cases} \lambda_t{}^{\frac{1}{\varphi}} \left(\frac{\left[1-ps(\tau_t^h+\tau_t^{h,s})\right]\frac{W_t^u}{P_t} - (1-\tau_t^h-\tau_t^{h,s})\frac{W_t^m}{P_t}}{\Gamma_1}\right)^{\frac{1}{\varphi}}, & \text{if} \quad \left[1-ps(\tau_t^h+\tau_t^{h,s})\right]\frac{W_t^u}{P_t} \geq (1-\tau_t^h-\tau_t^{s,h})\frac{W_t^m}{P_t}, \\ 0, & \text{otherwise} \end{cases} \tag{7}$$

$$E_t Q_{t,t+1} = \beta E_t \frac{\lambda_{t+1}}{\lambda_t}\frac{P_t}{P_{t+1}}, \tag{8}$$

$$q_t = \beta E_t \frac{\lambda_{t+1}}{\lambda_t}\left[(1-\tau_{t+1}^k)R_{t+1}^k + q_{t+1}(1-\delta)\right], \tag{9}$$

$$1 = q_t\left[1-\phi_I\left(\frac{I_t}{I_{t-1}}-1\right)\frac{I_t}{I_{t-1}} - \frac{\phi_I}{2}\left(\frac{I_t}{I_{t-1}}-1\right)^2\right] + \beta E_t q_{t+1}\frac{\lambda_{t+1}^h}{\lambda_t^h}\phi_I\left(\frac{I_{t+1}}{I_t}-1\right)\left(\frac{I_{t+1}}{I_t}\right)^2. \tag{10}$$

[10] Because of market completeness, the price at time t of a portfolio that pays one unit of currency in every state of the world at time $t+1$ has to be equal to the inverse of the risk-free nominal interest rate R_t, that is $E_t Q_{t,t+1} = R_t^{-1}$.

Equation (6) describes total labor supply, whereas equation (7) describes how households optimally allocate time to underground activities. Because of the additional disutility stemming from working in the underground sector, households supply informal labor as long as the after-tax wage differential between informal and formal wages is non-negative.[11] Equation (9) defines the Tobin's q as the marginal value of an additional unit of installed capital, measured in terms of the consumption goods. Equation (10) represents the marginal value of investments. Finally, equations (5) and (8) can be combined together to obtain the consumption Euler equation in the presence of external habits and consumption taxes:

$$\frac{1}{R_t} = \beta E_t \left(\frac{C_t - \eta \bar{C}_{t-1}}{C_{t+1} - \eta \bar{C}_t} \right)^{\sigma} \frac{1 + \tau_t^c}{1 + \tau_{t+1}^c} \frac{1}{\Pi_{t+1}}, \tag{11}$$

where $\Pi_{t+1} = P_{t+1}/P_t$ is the inflation rate between periods t and $t+1$.

2.2 Firms

As described above, the product market is characterized by a continuum of monopolistic competitive intermediate producers, indexed by $i \in [0, 1]$ and characterized by staggered price setting as described by Calvo (1983), that sell their differentiated output to competitive retailers. The latter aggregate intermediate goods into a final homogeneous consumption good, given the price set by intermediate producers.

2.2.1 Retailers

The final good market is competitive and the final good is produced combining a continuum of intermediate goods via the Dixit-Stiglitz aggregator function

$$Y_t = \left(\int_0^1 Y_{i,t}^{\frac{\varepsilon - 1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon - 1}}, \tag{12}$$

where $Y_{i,t}$ is the output of the intermediate producer, Y_t the final good output, and $\varepsilon > 1$ is the intratemporal elasticity of substitution between intermediate goods. Each period the final good producer solves a profit maximization problem subject to the aggregator (12), given the market price P_t and the price of each intermediate good $P_{i,t}$. The resulting demand for intermediate input i is then

$$Y_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\varepsilon} Y_t. \tag{13}$$

[11] From these two first-order conditions we notice the role played by parameters ξ and φ in this model, with the former determining the reactivity of total labor supply (legal and illegal) to changes in the net wage paid in the legal sector and the latter determining the reactivity of illegal labor supply to the net wage differentials between the two sectors.

Finally, the zero profit condition delivers the price index

$$P_t = \left(\int_0^1 P_{i,t}^{1-\varepsilon} di \right)^{\frac{1}{1-\varepsilon}}. \tag{14}$$

2.2.2 Intermediate Goods Sector with Underground Production

As firstly proposed by Busato and Chiarini (2004), and more recently by Orsi et al. (2014) and Pappa et al. (2015), firm i can produce the intermediate output with two different technologies:

$$Y_{i,t}^m = A_t^m \left(H_{i,t}^m \right)^{\alpha} K_{i,t}^{1-\alpha}, \tag{15}$$

$$Y_{i,t}^u = A_t^u \left(H_{i,t}^u \right)^{\alpha_u} K_{i,t}^{1-\alpha_u}, \tag{16}$$

where α, $\alpha_u \in (0,1)$, A_t^m and A_t^u denote total factor productivity (TFP) in the regular and in the irregular sectors. In order to reflect the fact that less skilled and educated people are more likely to work in the informal sector compared to those who attained higher education levels, and that the informal technology is labor intensive compared to the regular one,[12] we assume sector-specific TFPs and that $\alpha \neq \alpha_u$ - precisely, $\alpha_u > \alpha$ and $A^m > A^u$. Goods produced in the two sectors are homogeneous and indistinguishable. Denoting with $P_{i,t}^m$ and $P_{i,t}^u$ the price of good i produced, respectively, in the regular and informal market, this assumption implies that $P_{i,t}^m = P_{i,t}^u = P_{i,t}$, where $P_{i,t}$ is the price that the i-th intermediate producer charges to retailers. Therefore, total output produced by the intermediate firm i is simply given by

$$Y_{i,t} = Y_{i,t}^m + Y_{i,t}^u. \tag{17}$$

Clearly, equation (17) shows that $Y_{i,t}^m$ and $Y_{i,t}^u$ are perfect substitutes in production.[13] Moreover, (17) implies that firm i could stop using the informal technology without affecting its production capacity. In this perspective, the informal technology merely offers an additional channel along which firms maximize their profits by reducing the distortions generated by taxation, as it will become clear in a moment. Thus,

[12] For instance, Gallaway and Bernasek (2002) and Marcelli et al. (1999) show that, at least in urban settings, low skilled workers are more likely to work in the irregular sector compared to those workers who attained a higher level of education. Amaral and Quintin (2006) link the presence of low-skill workers in the underground sector to the fact that informal managers have access to less outside finance than their formal counterpart, and they substitute part of physical capital with low-skill workers. Also, Reyneri (2003) points out that a large share of workers employed in the irregular sector are migrants. This happens as in many advanced countries, although in presence of high unemployment rates, there is still unfilled demand for low-skilled, low-paid and less productive workers. Migrants are then attracted by these opportunities, but since many of them fail to obtain a residence visa, they are forced to work irregularly.

[13] This property, together with homogeneity and the fact that both $Y_{i,t}^m$ and $Y_{i,t}^u$ can be either consumed or invested with no additional costs, suggest that this model with underground economy could be more appropriately defined a *two-technology model* rather than a two-sector model.

the underground economy exists as it is optimal for firms to use both technologies. Given the existence of two technologies and taxation, firm i total expected revenues, $E_t\{\Lambda_{i,t}\}$, at time t are

$$E_t\{\Lambda_{i,t}\} = P_{i,t}\left[(1-\tau_t^y)Y_{i,t}^m + (1-ps\tau_t^y)Y_{i,t}^u\right], \tag{18}$$

where τ_t^y is a business tax on firms' revenues. Equation (18) implies that a necessary condition for the existence of underground production is that $1 - ps\tau_t^y > 0$, as firms have an incentive to use the informal technology as long as revenues from this activity are expected to be positive. To produce $Y_{i,t}$, firm i hires (regular and informal) workers and rents capital in competitive markets. Its total expected costs, $E_t\{\Phi_{i,t}\}$, at time t are then given by

$$E_t\{\Phi_{i,t}\} = (1+\tau_t^{f,s})W_t^m H_{i,t}^m + (1+ps\tau_t^{f,s})W_t^u H_{i,t}^u + R_t^k K_{i,t}, \tag{19}$$

where $\tau_t^{f,s}$ denotes social security contribution rate paid by employers. We define firm i nominal expected profits in period t, $D_{i,t}$ as the difference between (18) and (19):

$$D_{i,t} = E_t\{\Lambda_{i,t} - \Phi_{i,t}\}. \tag{20}$$

In order to derive the optimal demand for regular labor, informal labor, and capital, firm i chooses contingent plans $\{H_{i,t}^m, H_{i,t}^u, K_{i,t}\}_{t=0}^{\infty}$ that maximize the present discounted value of its future stream of profits subject to the demand for intermediate goods (13), technology constraints (15) and (16), the identity (17), and given the vector of prices $\{P_t, W_t^u, W_t^m, R_t^k\}_{t=0}^{\infty}$. The solution to this problem is characterized by the following set of first order conditions:

$$(1+\tau_t^{f,s})W_t^m = \frac{\alpha MC_{i,t}^N Y_{i,t}^m}{H_{i,t}^m}, \tag{21}$$

$$\begin{cases} (1+ps\tau_t^{f,s})W_t^u = \frac{\alpha_u MC_{i,t}^N Y_{i,t}^u}{H_{i,t}^u}, & \text{if } 1-ps\tau_t^y > 0 \\ H_{it}^u = 0, & \text{otherwise,} \end{cases} \tag{22}$$

$$R_t^k = MC_{i,t}^N\left[(1-\alpha)\frac{Y_{i,t}^m}{K_{i,t}} + (1-\alpha_u)\frac{Y_{i,t}^u}{K_{i,t}}\right], \tag{23}$$

where $MC_{i,t}^N$ represents firm i nominal marginal costs, that is the Lagrange multiplier in front of the constraint (17). Equations (21) and (22) respectively describe the demand for regular and informal labor. They state that intermediate producers demand labor in each sector until the marginal cost of labor equals the marginal

value of one additional hour worked. Equation (23) is the demand for capital, in which the marginal cost of one additional unit of capital has to be equal to its marginal value for the producing firm. Because of their market power, intermediate firms optimally choose the price of their output. However, during each period $t = 0, 1, 2...$ only a fraction $(1-\psi)$ of intermediate producers set a new price, while the remaining fraction ψ charge the previous period's price. The probability of changing price is constant over time and independent of each firm's price history. Thus, the typical firm able to reset its price in perdiod t will choose a price $P^*_{i,t}$ that maximizes its profits until the selected price remains effective, namely:

$$\max_{P^*_{i,t}} E_t \left\{ \sum_{j=0}^{\infty} \psi^j Q_{t,t+j} \left(\Lambda_{i,t} - MC^N_{i,t} Y_{i,t} \right) \right\}, \tag{24}$$

subject to the sequence of constraints (13) and (17). The first-order condition for this problem delivers the solution

$$\frac{P^*_{i,t}}{P_t} = \frac{\varepsilon}{\varepsilon - 1} \frac{E_t \left\{ \sum_{j=0}^{\infty} \psi^j Q^R_{t,t+j} MC_{i,t+j} \left(\frac{P_{t+j}}{P_t} \right)^{\varepsilon} Y_{t+j} \right\}}{E_t \left\{ \sum_{j=0}^{\infty} \psi^j Q^R_{t,t+j} \left[1 - \tau^y_{t+j} + \tau^y_{t+j} (1-ps) \frac{Y^u_{i,t}}{Y_{i,t}} \right] \left(\frac{P_{t+j}}{P_t} \right)^{\varepsilon - 1} Y_{t+j} \right\}}, \tag{25}$$

where $Q^R_{t,t+j} = \frac{P_{t+j}}{P_t} Q_{t,t+j}$ and $MC_{i,t+j} = \frac{MC^N_{i,t+j}}{P_{t+j}}$. Given price staggering, the aggregate price level $P_t = \left(\int_0^1 P^{1-\varepsilon}_{i,t} di \right)^{\frac{1}{1-\varepsilon}}$ evolves according to $P_t = \left[\psi P^{1-\varepsilon}_{t-1} + (1-\psi) P^{*1-\varepsilon}_t \right]^{1/(1-\varepsilon)}$, that is to say that the price level is just a weighted average of the last period's price level and the price set by firms adjusting in the current period. This equation can be rewritten as follows:

$$1 = \psi \Pi^{\varepsilon - 1}_t + (1-\psi) \left(p^*_t \right)^{1-\varepsilon}, \tag{26}$$

where $p^*_t = \frac{P^*_t}{P_t}$. Notice that in the deterministic steady state and in the absence of trend inflation (i.e. $\Pi = 1$), the optimal condition (25) collapses to:

$$P^* = P = \frac{\varepsilon}{\varepsilon - 1} \frac{MC^N}{1 - \tau^y + \tau^y (1-ps) \frac{Y^u}{Y}}. \tag{27}$$

Clearly, in the absence of the business tax, the steady-state price markup will only depend on the elasticity of substitution between intermediate goods. In this case, instead, the price markup is shown to be increasing in the business tax rate, while the possibility of evading this tax through undeclared production is found to mitigate this effect. In this sense, market power gives producers the possibility of shifting the burden of the business tax toward consumers.

2.3 Public Sector

Each period the consolidated government faces an exogenous stream of expenditures, G_t. In order to finance these expenditures, the government issues one period risk-free bonds with nominal value B_t, and collects taxes in the amount $P_t T_t$. Hence, the government budget constraint in period t can be written in real terms as

$$R_t^{-1} b_{t+1} \Pi_{t+1} = b_t + G_t - T_t, \tag{28}$$

where $b_t = B_t/P_t$ denotes the stock of real public debt at time t. Equation (28) shows how primary deficit increases the value of real debt, whereas inflation reduces it. Because of the rich structure of taxes in this economy and the existence of underground production, tax revenues, T_t, are given by

$$\begin{aligned} T_t = {} & (\tau_t^h + \tau_t^{h,s} + \tau_t^{f,s}) w_t^m \int_0^1 H_{i,t}^m di + ps(\tau_t^h + \tau_t^{h,s} + \tau_t^{f,s}) w_t^u \int_0^1 H_{i,t}^u di + \tau_t^k r_t^k \int_0^1 K_{i,t} di \\ & + \tau_t^y \left(\int_0^1 Y_{i,t}^m di + ps \int_0^1 Y_{i,t}^u di \right) + T_t^{ls}, \end{aligned} \tag{29}$$

where T_t^{ls} denotes lump sum taxes. Finally, in order to be able to solve the model, we need to specify a fiscal rule which rules out the possibility of an explosive behavior of public debt in the long run and a monetary rule governing the behavior of the nominal interest rate. In particular, we assume that the government sets lump-sum taxes, T_t^{ls}, according to the following rule:

$$T_t^{ls} = T^{ls} + \tau^{ls}(b_t - \bar{b}), \tag{30}$$

where T^{ls} is the equilibrium value of lump sum taxes, $\bar{b}$ is the target level of public debt, and τ^{ls} is a parameter regulating the intensity of lump-sum tax adjustments to deviations of real debt from its target level. The monetary authority sets the one period nominal interest rate according to a standard Taylor rule of the form

$$\log\left(\frac{R_t}{R}\right) = \rho_R \log\left(\frac{R_{t-1}}{R}\right) + (1-\rho_R)\left[\rho_y \log\left(\frac{Y_t}{Y}\right) + \rho_\Pi \log\left(\frac{\Pi_t}{\Pi}\right)\right], \tag{31}$$

where R, Y and Π are the steady state values of the nominal interest rate, output and inflation, respectively, while ρ_R, ρ_y, ρ_Π are policy parameters. According to (31), the monetary authority gradually adjusts the nominal interest rate in response to deviations of output and inflation from their equilibrium values.

2.4 Aggregation and Market Clearing

As shown in Appendix A, the study of intermediate firms' marginal production costs points out that these are the same for all firms, meaning that all producers which are able to set their price optimally make the same price decision, that is, $P_{i,t}^* = P_t^*$. In equilibrium factor and good markets clear, hence the following conditions are satisfied for all t: $H_t^m = \int_0^1 H_{i,t}^m di$, $H_t^u = \int_0^1 H_{i,t}^u di$, $K_t = \int_0^1 K_{i,t} di$ and $Y_t^m \Delta_t = \int_0^1 Y_{i,t}^m di$, $Y_t^u \Delta_t = \int_0^1 Y_{i,t}^u di$, where $\Delta_t = \int_0^1 \left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon} di$ is a measure of price dispersion. It is easy to see that Δ_t evolves according to a non-linear first-order difference equation of the form:

$$\Delta_t = (1-\psi)\, p_t^{*-\varepsilon} + \psi \Pi_t^{\varepsilon} \Delta_{t-1}. \tag{32}$$

Aggregate production $Y_t = Y_t^m + Y_t^u$ is then found to be

$$Y_t = \Delta_t^{-1} \left[A_t^m \left(H_t^m\right)^{\alpha} K_t^{1-\alpha} + A_t^u \left(H_t^u\right)^{\alpha_u} K_t^{1-\alpha_u} \right], \tag{33}$$

where, clearly, price dispersion creates a wedge between aggregate output and production inputs, thus generating output dispersion that is increasing in the degree of price rigidity, ψ. Finally, the following aggregate resource constraint must hold:

$$Y_t = C_t + I_t + G_t. \tag{34}$$

All the equilibrium conditions describing the baseline model are summarized in Appendix B.

3 Calibration and Model Solution

The model is calibrated at quarterly frequency for the Italian economy. Given the lack of data for non-observable variables in the shadow economy, some parameters and variables are set according to the Bayesian estimates provided by Orsi et al. (2014). Precisely, we draw from their work the steady state share of irregular production to total output, Y^u/Y – i.e., the size of the underground economy – which is equal to 0.228, the inverse of the Frisch elasticities of total labor supply, ξ, and of informal labor supply, φ, equal to 1.1882 and 0.0559, respectively, and the output elasticities of labor in the regular technology, α, and in the underground technology, α_u, respectively equal to 0.6105 and 0.6537. The discount factor β is set to 0.99, which implies

an annual real (and nominal, given a zero steady state level of inflation, $\Pi = 1$) interest rate of 4%. The capital depreciation rate δ is set to 0.025, while the investment adjustment cost parameter, ϕ_I, is set to 2.48, as estimated by Christiano et al. (2005). The intertemporal elasticity of substitution σ is equal to 1, implying that the utility function is logarithmic in consumption. The parameter regulating the external consumption habit component is set to 0.7, in line with the existing literature.[14] Total hours worked in the economy, $H = H^m + H^u$, amount to 0.3. In order to assess the share of irregular to total hours, H^u/H, we rely on country-specific data provided the Euro Barometer 2007 Survey of Undeclared Work in the European Union, as reported by Andrews et al. (2011). According to this information, the share H^u/H is set to 0.26, which delivers $H^m = 0.2381$ and $H^u = 0.0619$. The price elasticity ε is set to 6 and the probability that firms do not revise their price, ψ – that is, the degree of price stickiness – is set to 0.85. The probability of a firm being inspected, p, is set to 3%, which is the value estimated by Busato and Chiarini (2004) using data on firm inspections released by the Italian Ministry of Labor; the penalty s that a tax evading firm is convicted to pay if detected is set to 30% of the total amount evaded, which is consistent with the current Italian Tax Law.[15] The equilibrium level of output Y is normalized to 1, and the debt-to-GDP and consumption-to-GDP ratios are set to 130% and 60.28 %, in line with the most recent data released by the Italian National Institute for Statistics. Tax rates are calibrated according to those prevailing in the Italian Tax System with reference to the taxes paid by single worker at 100% of average earnings without children: the consumption tax is set to 0.22; the personal labor income tax rate, τ_h, is set to 16.3%, embedding both a central and a local tax; the workers' SSC tax rate, $\tau^{h,s}$ is set to 7.19%; the tax rate on the capital return, τ^k is set to 20%; the business tax rate τ^y is set to 4.25% to reflect the average regional business tax that is levied on firms' revenues; and the employers' SSC tax rate is set to 24.29%.[16] Finally, this calibration delivers implicit values for public expenditure, and the scale parameters regulating labor disutilities in the agents' preferences, and total factor productivity in the production technologies. Precisely, public expenditure, G, results to be equal to 0.2229, the scale parameter measuring the disutility of aggregate labor, Γ_0, to 18.6014, the disutility scale parameter of irregular labor, Γ_1, to 4.8852, regular sector TFP, A^m, to 0.8699, and underground sector TFP, A^u, to 0.7174. In the public sector, the parameter regulating the response of lump-sum taxes to debt dynamics in the fiscal rule, τ^{ls}, is set to 1/2, while in the Taylor rule, the interest rate smoothing parameter, α_R, is set to 0.8, the interest rate response to output, α_y, to 0.08, and the interest rate response to inflation, α_y, to 2.04. However, as common practice in this kind of economic policy exercises, in order to isolate the effects of the

[14] For instance, Boldrin et al. (2001) find a point estimate of 0.7, while Christiano et al. (2005) estimate a value of 0.65.
[15] See Busato and Chiarini (2004); Orsi et al. (2014).
[16] See the OECD Tax Database.

tax experiments, we switch off any possible feedback channels coming from the tax rule and the Taylor rule. For each scenario, in fact, we consider a deterministic simulation of 1,000 quarters, where the fiscal rule (30) and the Taylor rule (31) are neutralized for the first 400 quarters.

Calibrated parameter values are reported in Table 1, while Table 2 summarizes the steady-state values of the main macroeconomic variables of our model. Using this parametrization, the non-linear version of the model is solved using a Newton-type algorithm. To conduct our simulation exercise, we treat all the tax rates and government spending as exogenous variables and examine the deterministic response of the economy to unexpected permanent changes in these variables occurring at the beginning of our simulation time horizon.[17] Clearly, the analysis of the effects of permanent shocks requires solving a two-point boundary-problem, specifying the initial conditions for the predetermined variables and the terminal conditions for the forward looking variables. To solve this problem for each scenario we have derived the new steady state of the model implied by the fiscal reform and used the theoretical equilibrium values as terminal conditions.

4 Tax Reform Scenarios

The simulation exercise quantifies the macroeconomic impact of a set of tax policy experiments partially inspired to the fiscal reform packages being undertaken or presently under consideration in Italy. However, the simulations hypotheses concerning the credibility and the size of the tax shifts, assumed in each case, are to some extent arbitrary. In particular, we design several scenarios in which a permanent reduction of one of the distortionary tax rates is met by a permanent change in another distortionary tax rate or by an immediate or a delayed government spending cut, so as to ensure that the fiscal reform is designed to be ex-ante budget neutral. In addition, we also construct a fiscal experiment regarding the business tax without envisaging any fiscal countermeasure to offset the initial effects on the budget balance. We will see, in fact, that business tax cuts are highly expansionary. The simulations are carried out under the assumption that all policy changes are unanticipated by agents and take place immediately. Forward looking agents adjust their behavior accordingly, anticipating the long-run effects of the tax reform put in place.[18] To make our analysis as much transparent as possible and uncover the role played by the existence of an illegal sector on the performance of different tax reforms, in what follows we carry out our experiments also for an economy with a small illegal sector, where we calibrate the size of the underground economy at 5%. Clearly, the

[17] Notably, deterministic simulations are carried out when studying the effects of structural and/or fiscal reforms involving permanent changes in some structural parameters and/or tax rates.

[18] Of course other assumptions are equally possible, such as providing economic agents with some information about the current or forthcoming policy change, namely, fiscal reform is announced some time before its implementation. On this aspect, see Yang (2005).

dimension of the illegal sector determines the size of the tax base involved by the tax change envisaged in each scenario.

The first fiscal reform scenario, S_1, envisages the introduction of partial deductibility of the legal labor cost component, $(1+\tau_t^{f,s})W_t^m H_{it}^m$, from the business tax. In particular we assume 70% deductibility of labor cost. We then consider three scenarios featuring tax swaps amounting to 0.1% of output (initial level), namely S_2 combines a reduction of the tax rate on business τ^y with an increase in the consumption tax τ^c, S_3 presents a tax shift from labor income to consumption and S_4 embodies a reduction of the employers' SSC rate, $\tau^{f,s}$, compensated by an increase in the consumption tax rate. We then consider 3 additional scenarios, S_5, S_6, S_7 in which the reductions of taxes envisaged in S_2, S_3 and S_4 are financed by immediate public spending cuts. Finally, in S_8 and S_9 the tax rate on wage income, τ^h, and the employers' SSC rate, $\tau^{f,s}$, are cut by 1 p.p.. These last two tax reductions are compensated by a delayed cut of public spending. Specifically, we suppose that the government wants to cut the tax wedge on labor today, finance this tax reduction by borrowing and then, after one year, restore the budget balance by cutting public spending. Table 3 summarizes the hypotheses made for each tax policy experiment in our benchmark economy (Y^u/Y=0.228) and in the economy with a small illegal sector (Y^u/Y=0.05). Table 4 reports,for each scenario, the overall labor tax-wedge, τ^{wedge}, measured as the difference between labour costs to the employer and the corresponding net take-home pay of the employee

$$\tau^{wedge} = 1 - \frac{1-\tau^h-\tau^{h,s}}{(1+\tau^c)(1+\tau^{f,s})}. \tag{35}$$

The overall tax wedge is commonly used as a summary measure of the distortions adversely affecting labor utilisation. In S_1, where we assume 70% deductibility of labor cost, the second term in (35) becomes $\frac{1-\tau^h-\tau^{h,s}}{(1+\tau^c)(1+\tau^{f,s})[0.7(1-\tau^y)+0.3]}$. Notice, that in some experiments the implied changes in the tax rates and/or in public spending, as well as the tax wedges, might differ in the two economies.[19] When this is the case we report in parentheses the corresponding changes in the tax rates and/or in public spending observed in the economy with a small underground sector.

[19]This is obviously the case in S_2, S_3, S_4 where the implied changes in the tax rates depend on the size of the tax bases involved by the reform. For the same reason, in S_5, S_6, S_7, S_8, S_9 the dimension of the immediate or delayed cut in public spending will be higher in the economy characterized by a small underground sector.

4.1 Transitionary Dynamics

In this section we illustrate the effects of all tax reforms showing the transitional dynamics for a 20-quarter time horizon. In particular, Figures 1-9 report the responses of the main macrovariables to the alternative tax reform scenarios illustrated in the previous section. All results are reported as percentage deviations from the initial steady-state, except for the share of the underground economy, Y^u/Y, and the annualized public-debt to output ratio, $B/4PY$, which are expressed as percentage point deviations. Continuous lines show the macroeconomic impact of the tax changes in the baseline economy, while dotted lines refer to the effects of the very same reforms undertaken in an economy characterized by a small underground sector.

4.1.1 Partial Deductibility of Labor Cost from the Business Tax

We start by examining the effects of making labor cost partially deductible from the tax base of the tax on businesses, according to the policy scenario S1. Figure 1 displays the transition path of the economy. Clearly the effects of this intervention are highly expansionary and considerably reduce the size of the underground sector. After five years, in fact, in the baseline economy the size of the underground sector is reduced by -0.8 percentage points, while undeclared labor falls by about 5%. The strong positive effects on output coupled with the reduction of the informal economy limit the long-run negative effects on total tax revenues. As a result, the public-debt to output ratio sharply declines. It should be noted that the expansionary effects are larger in the economy characterized by a smaller underground sector, while the de-shadowing of the informal economy is, as expected, much lower. This result arises as in this case a larger share of production is directly and positively affected by the reform. Overall, we notice how underestimating the dimension of the underground sector may lead to an overestimation of the beneficial effects on output and consumption of a tax reform of this kind, especially during the first 10 quarters, where adjustment costs, habit persistence and price stickiness play a major role in shaping the transition towards the long-run equilibrium. After an initial upward jump, in fact, all key macrovariables such as output consumption, investments and hours exhibit hump-shaped dynamics. The drop in the cost of labor, in the first place, induces firms to demand more regular labor inputs. This, in turn, generates an increase in the wage differential, so inducing households to increase their labor supply in the regular sector, while reducing the irregular component. At the same time, adjustment cost on investments and habit persistence prevent investments and consumption from reacting too strongly to the reform. In the first few quarters, after the implementation of the tax reform, a substitution effect tends to prevail, inducing households to increase even further worked hours. At later stages an income effect partially offsets the initial effects, while worked hours reduce and converge toward

the new steady-state level.

4.1.2 Shifting the Tax Burden from Business and Labor to Consumption

We now consider three fiscal experiments envisaging a shift from direct to indirect taxation. In particular, Figure 2 refers to the case in which we reduce the business tax by 0.1% of output and increase consumption tax so as to leave the budget balance unaltered, at least ex ante (S2). Figure 3 shows the results of a 0.1% reduction of the labor income tax combined with an increase in consumption taxes (S3), while Figure 4 reports the effects of a reduction in the SSC paid by the employers financed again by higher consumption taxes (S4).

From inspection of the results we observe what follows. First, as expected, in all the three scenarios we observe a positive effect on output, consumption, investment and tax revenues, and consequently, an improved fiscal position of the economy, as measured by the public debt to output ratio which significantly declines. In particular, in the first 10 quarters, the stronger effects on output are observed in S2, where the business tax is reduced, while after 20 quarters the major effects are observed in S3, where the labor income tax is cut. The smaller effects are, instead, observed in S4. This is because the permanent reduction in firms' SSC by reducing the effective cost of labour utilization induces a rise in labor demand, which, in turn, brings about an increase in the real wage. The increased real wage partially offsets the initial reduction of the labor cost, so dampening the overall effects on the level of output. Second, in S2 regular hours initially increase and then return to their initial level, while in S3 and S4 the positive effects persist also in the long run. This result immediately follows from the fact that in S3 and S4 the labor tax wedge is reduced (especially in S3), while in S2 is higher than its pre-reform level. This distortionary effect is sufficient, at least in the long run, to offset the positive effect on worked hours induced by the lower tax on business activity.[20] Third, the response of the irregular sector is mixed. In S3 and S4 where labor tax wedge reductions clearly have a deterrent effect on supplying and demanding irregular labor, we observe a reduction in irregular worked hours and in the share of the underground economy. On the contrary, in S2, the higher tax wedge, combined with the expansion of output due to a lower price markup, induces a temporary increase in the supply of irregular labor. Fourth, we notice that for these three policy experiments the baseline model and the model characterized by a small underground sector display very similar dynamics in terms of output, consumption and investments, especially after the first 10 quarters.

In general, we observe that still the underestimation of the size of the underground sector may lead to

[20] On the other hand, a lower tax on business tends to reduce the price markup.

overestimate the positive impact on all macrovariables, but in the context of tax shifts this miscalculation appears to be negligible. However, the positive effects on regular labor tend to be higher in the baseline model than in the model with a small underground sector in S3 and S4, where the labor tax wedge is reduced. Intuitively, being the labor tax base much larger in the economy with a lower share of underground economy, the beneficial effects induced by a cut in the labor income tax or in the labor cost are diluted across a larger share of labor than in an economy with a higher irregular sector. As shown in Table 3, in fact, a 0.1% of output reduction of taxes corresponds to higher changes in the tax and in the SSC rates in the sector with a higher underground sector.

4.1.3 Tax Cuts and Public Spending Reductions

In this section we examine an alternative financing scheme according to which the revenue loss due to the lowering of tax rates is financed by an immediate or a delayed reduction in government spending. Figures 5-7 display the response of the economy to tax cuts financed by immediate reductions of public spending as designed in S5, S6 and S7.

First, consider the case in which the decrease of the business tax is met by a public spending cut (S5). The results are qualitatively closer to those obtained in S2, where the tax reduction on the business tax was counterbalanced by an increase in the consumption tax rate. We still have an expansionary effect on output, consumption and investments, and, despite the overall reduction of tax revenues, the public-debt-to-output ratio falls. However, we notice that the expansionary effects are lower on output but magnified on consumption and investments. In this model, in fact, public spending is a pure waste that crowds out the private component of aggregate demand, therefore it comes as no surprise that a tax cut on business counterbalanced by a public spending reduction is highly beneficial for both consumption and investments. As in S2, we observe that both regular and irregular labor initially increase, but while regular labor returns to its pre-reform level, irregular worked hours stabilize below their initial level. As a result the underground sector shrinks.

We now turn our attention to the tax cuts reducing labor market distortions, operating through labor income and on labor cost, respectively. Also in this case we notice that the beneficial effects derived from a reduction of the labor tax wedge fosters economy activity and reduces the share of the underground sector. However, in these two scenarios the initial cut in public spending, and the consequent lower aggregate demand, causes output to fall on impact. Then when prices start to adjust, this negative effect on output is fully absorbed, and later the effects become positive, especially in S6. Further, it should be noted that also

in these two scenarios, the expansionary effects are larger when the underground sector is smaller.

Finally, we conclude our analysis by considering two additional scenarios, S8 and S9, where we reduce, in turn, the labor income tax rate and the firms' SSC are cut by 1 p.p. These tax cuts are initially financed by a temporary deficit and then, after one year, by a cut on public expenditure. Figures 8 and 9 show the transitional dynamics of the key-macrovariables. Clearly, the effects are expansionary in both cases, especially before the counterbalancing reduction of public spending. However, in these fiscal experiments a larger underground economy weakens the observed positive effects on output, consumption and investment, since a lower share of labor inputs is employed in the legal sector and take advantage from the reduction of the labor tax distortions. Nevertheless, these moderate tax cuts are still found to cause a sensitive reduction in the size of the underground sector.

4.2 Output Growth

In this section, we compare output growth rates arising from transitional dynamics generated by the considered tax reform scenarios. Output growth rates are computed for different time horizons, t, as percentage deviations from the initial (i.e., no policy) steady state level of output, Y_{ss}, namely as $\frac{Y_t - Y_{ss}}{Y_{ss}} \times 100$. Results are summarized in Table 5, where output growth rates observed in the economy with small underground sector are reported in parentheses. A close look at Table 5 leads us to notice what follows. First, with the exception of scenarios S6 and S7, all the envisaged tax reform scenarios generate positive output growth at any time horizon. In S1, this result naturally arises as the policy relieves firms' business tax burden, while in scenarios S2, S3, and S4 this is due to the fact that direct taxation creates more distortions compared to indirect taxation. Instead, as already discussed, the initial reduction of personal income taxes (S6) and employers' SSC rate (S7) do not immediately compensate the initial cut in public spending, causing output to fall on impact. However, this effect vanishes at later stages as resources freed by lower public spending are channeled into the reduction of the business tax (S5), or when the reduction in public spending is delayed (S8, S9). Second, the largest positive effects on output growth are observed when simulating 70% deductibility of labor costs from the business tax (S1). Precisely, output grows by approximately 1% on impact and 2% after one year in the baseline model. Moreover, this positive effects still remain there in the very long run - output is nearly 0.87% higher than its initial level after 20 years. Third, with the exception of S6, the observed hump-shaped dynamics of output in all of the envisaged policy experiments cause output growth to reach a peak one year after the implementation of the policy. Finally, the small underground sector economy always displays higher output growth compared to the baseline model, thus reinforcing our claim that the

underestimation of the size of the underground economy leads to miscalculate - precisely, to overestimate in the case of output - the beneficial effects of tax reforms.

4.3 Long-Run Effects on Fiscal Consolidation and on the Size of the Underground Economy

In this section we briefly explore the long-run impact of the alternative tax experiments considered above on fiscal consolidation and on the size of the underground economy. To this end we look at the changes in the public-debt-to-output ratio observed after 20 years since the implementation of each tax reform package, and examine the variations in the size of the underground economy. Table 6 reports the results for the 9 scenarios. The public-debt-to-output ratio and the share of the underground economy are reported as percentage point changes from the pre-reform values. As before, we are interested in the annualized debt-to-output ratio changes.

In terms of fiscal consolidation the major effects are observed in S_8 and S_9, where the labor tax distortions are significantly reduced. The major effects on output, coupled with substantial de-shadowing of the underground economy contribute to this result. Partial deductibility of labor cost has also strong effects on public-debt-to-output ratio, especially when the economy features a small underground sector. Among the scenarios envisaging tax shifts or immediate counterbalancing public spending cuts, the major effects on fiscal consolidation are observed in S_2 and S_5, where the business tax is lowered. Consider now the response of the underground economy to the tax policy changes. Major effects are observed in S_1, where the lower tax base implied by the fiscal reform have strong effects on the incentive to supply and employ legal labor inputs. Strong effects are also observed in S_8 and S_9, where tax rates are heavily reduced. When we compare the interventions compensated by either increase in consumption taxes or public spending cuts, then the major effects on the size of the underground economy are observed when the labor income tax rate is reduced. That is because, as it is clear from Table 4, lowering this tax rate induces major decreases of the tax wedge, which, in this context, triggers an additional resource allocation effect from the underground sector toward the legal sector. The lower wage differential due to the fiscal policy intervention, in fact, pushes households to reallocate their labor services from the illegal to the legal sector. The consequent lower real wage in this sector will then push firms to use more regular workers for their production activity.

4.4 Welfare Effects

This section provides a quantitative evaluation of the welfare gains or losses associated with each of the considered tax reform scenarios. As firstly proposed by Lucas (1987), welfare gains or losses associated with a specific policy are computed in terms of consumption equivalent units. That is, as it is shown in Appendix C, we compute the permanent change in consumption that leaves households indifferent between the utility derived by remaining in the pre-tax reform equilibrium and the utility obtained when the tax reform is adopted.

Table 7 summarizes results for each of the envisaged policy scenarios, where welfare effects are computed for different time horizons and positive numbers denote a gain in welfare. As usual, results in parentheses refer to the economy with a small underground sector. First, consider the scenario in which we allow for partial deductibility of legal labor costs from the business tax base (S1), that is the first row of Table 7. The reform makes households substantially better off, especially in the long run. In the short run, welfare is lower in the economy with a small underground sector as the expansionary effects of the reform are so strong that firms increase the demand for both labor types, while hours worked in the underground sector remain in the proximity of their steady state level in the baseline model. In the long run, this result is reversed as irregular hours decline in both models, while the positive effect on consumption is larger in the small underground sector economy. We now look at the three tax shifts, namely scenarios S2, S3, and S4. After a year, a 0.1 % of output tax shift from business to consumption generates negative welfare effects, while shifts from personal income and employers' SSC rate to consumption increase welfare. This is due to the fact that irregular hours increase in S2, as the expansionary effects of the reform are not combined with a reduction of the labor tax wedge. On the other hand, welfare effects are positive in scenarios S3 and S4, since the reforms trigger a substitution effect between underground and regular labor. As a result, the economy ends up with higher consumption, a lower legal labor tax wedge, and a smaller share of underground economy, whereas the total amount of hours worked is barely affected by the reform. Welfare gains are higher in S3 than in S4, as a reduction of the personal income tax rate, by directly affecting the demand side of the economy, raises consumption more than a decrease of employers' SSC rate. When the reduction of the business tax, personal income tax, and employers' SSC tax rates are financed through a cut in public spending - scenarios S5, S6, and S7, respectively - we observe positive welfare effects in all the three cases. The main difference between S2, where we observe a negative initial welfare effect, and S5, is that consumption is significantly higher in the latter scenario. This is due to the fact that this reform leaves the consumption tax unchanged, while public spending is a pure waste that crowds out private consumption. For the same reasons scenarios S6

and S7 deliver higher welfare gains compared to those where the same tax reductions are met by increasing consumption taxes (scenarios S3 and S4).

Finally, consider the cases in which 1 p.p. cuts in personal income (S8) and employers' SSC (S9) tax rates are financed by a delayed public spending reduction. Welfare effects are large and positive, and increasing in the long run. The increase in consumption and the substitution between irregular and regular hours overcome the increase in total hours worked. However, welfare gains are weakened by the existence of a large underground sector because of the additional disutility stemming from irregular labor and the lower level of consumption that households can afford when the reform targets a smaller number of individuals.

5 Conclusions

This paper has explored the macroeconomic impact of several tax reforms, designed to stimulate growth while preserving fiscal stability, in a dynamic general equilibrium model calibrated for the Italian economy where tax evasion and underground activities are explicitly incorporated. In particular, we consider various growth-friendly fiscal reforms advocated in academic and policy circles, such as the introduction of partial deductibility of labor costs from the business tax, ex-ante budget-neutral tax shifts from direct to indirect taxes, and tax cuts counterbalanced by contemporaneous or delayed decreases of government spending.

In summary, we find the following results. First, the size of the underground sector does play an important role in shaping the macroeconomic impact of tax reforms, especially during the transition toward the long-run equilibrium. Overall, we show that neglecting the existence of the underground sector and undeclared work may lead to severely miscalculate the macroeconomic impact and the welfare effects of tax reforms. Second, the deductibility of labor costs from the business tax base is highly expansionary and able to strongly reduce the size of the underground sector. Third, all the policy changes that lower the labor tax wedge permanently reduce the dimension of the underground sector. Finally, all the considered tax reforms positively contribute to the fiscal consolidation process.

To conclude, we argue that a carefully designed economic policy analysis of tax reforms should account for the reallocation effects between underground and formal sectors that the reforms themselves might generate. If the interplay between the size of underground sector and fiscal framework is not made explicit, policy recommendations may be misleading. From this perspective, our analysis prepares the ground for future explorations in this direction in the context of fully-fledged models designed for policy analysis.

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Appendixes

Appendix A: Firms' Marginal Costs of Production

This appendix derives the expression for firms' marginal costs in order to show that they are equal for all producing firms. To see this, take the intermediate producers' first order conditions with respect to regular labor, underground labor, and capital, respectively Eqs. (21), (22), and (23)[21]

$$(1+\tau_t^{f,s})W_t^m = \frac{\alpha MC_{i,t}^N Y_{i,t}^m}{H_{i,t}^m}, \tag{A-1}$$

$$(1+ps\tau_t^{f,s})W_t^u = \frac{\alpha_u MC_{i,t}^N Y_{i,t}^u}{H_{i,t}^u}, \tag{A-2}$$

$$R_t^k = MC_{i,t}^N \left[(1-\alpha)\frac{Y_{i,t}^m}{K_{i,t}} + (1-\alpha_u)\frac{Y_{i,t}^u}{K_{i,t}}\right], \tag{A-3}$$

and use the first two to substitute for $MC_{i,t}^N Y_{i,t}^m$ and $MC_{i,t}^N Y_{i,t}^u$ into (23), to obtain

$$R_t^k = \frac{1-\alpha}{\alpha}(1+\tau_t^{f,s})W_t^m \frac{H_{i,t}^m}{K_{i,t}} + \frac{1-\alpha_u}{\alpha_u}(1+ps\tau_t^{f,s})W_t^u \frac{H_{i,t}^u}{K_{i,t}}. \tag{A-4}$$

Now, use again Eqs. (21) and (22) after having substituted in them for $Y_{i,t}^m$ and $Y_{i,t}^m$ from Eqs. (15) and (16), respectively, and rearrange them as to have expressions for $\frac{H_{i,t}^m}{K_{i,t}}$ and $\frac{H_{i,t}^u}{K_{i,t}}$. By subtituting these two ratios into (A-4), we obtain

$$\begin{aligned} R_t^k = {} & \frac{1-\alpha}{\alpha}\left(\alpha A_t^m\right)^{\alpha-1}\left(MC_{i,t}^N\right)^{\alpha-1}\left[(1+\tau_t^{f,s})W_t^m\right]^{\frac{\alpha}{\alpha-1}} + \\ & + \frac{1-\alpha_u}{\alpha_u}\left(\alpha_u A_t^u\right)^{\alpha_u-1}\left(MC_{i,t}^N\right)^{\alpha_u-1}\left[(1+ps\tau_t^{f,s})W_t^u\right]^{\frac{\alpha_u}{\alpha_u-1}}, \end{aligned} \tag{A-5}$$

which solved for $MC_{i,t}^N$ show how the latter does not depend on firm specific variables, that is it is equal for all firms.

Appendix B: Complete Set of Equilibrium Conditions

$$K_{t+1} = (1-\delta)K_t + \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] I_t$$

[21] Given the parametrization of the model, the term $1 - ps\tau_t^y$ is always larger than zero. This rules out the possibility that $H_{i,t}^u = 0$.

$$\lambda_t = \frac{\left(C_t - \eta \bar{C}_{t-1}\right)^{-\sigma}}{1+\tau_t^c}$$

$$H_t^m + H_t^u = \lambda_t^{\frac{1}{\xi}} \left[\frac{(1-\tau_t^h - \tau_t^{h,s}) W_t^m / P_t}{\Gamma_0}\right]^{\frac{1}{\xi}}$$

$$H_t^u = \begin{cases} \lambda_t{}^{\frac{1}{\varphi}} \left(\frac{\left[1-ps(\tau_t^h+\tau_t^{h,s})\right]\frac{W_t^u}{P_t} - (1-\tau_t^h-\tau_t^{h,s})\frac{W_t^m}{P_t}}{\Gamma_1}\right)^{\frac{1}{\varphi}}, & \text{if} \quad \left[1-ps(\tau_t^h+\tau_t^{h,s})\right]\frac{W_t^u}{P_t} \geq (1-\tau_t^h-\tau_t^{s,h})\frac{W_t^m}{P_t}, \\ 0, & \text{otherwise} \end{cases}$$

$$E_t Q_{t,t+1} = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \frac{P_t}{P_{t+1}}$$

$$q_t = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \left[(1-\tau_{t+1}^k) R_{t+1}^k + q_{t+1}(1-\delta)\right]$$

$$1 = q_t \left[1 - \phi_I \left(\frac{I_t}{I_{t-1}} - 1\right) \frac{I_t}{I_{t-1}} - \frac{\phi_I}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2\right] + \beta E_t q_{t+1} \frac{\lambda_{t+1}^h}{\lambda_t^h} \phi_I \left(\frac{I_{t+1}}{I_t} - 1\right)\left(\frac{I_{t+1}}{I_t}\right)^2$$

$$Y_{i,t}^m = A_t^m \left(H_{i,t}^m\right)^{\alpha} K_{i,t}^{1-\alpha}$$

$$Y_{i,t}^u = A_t^u \left(H_{i,t}^u\right)_u^{\alpha} K_{i,t}^{1-\alpha_u}$$

$$Y_{i,t} = \Delta_t^{-1}\left(Y_{i,t}^m + Y_{i,t}^u\right)$$

$$(1+\tau_t^{f,s}) W_t^m = \frac{\alpha M C_{i,t}^N Y_{i,t}^m}{H_{i,t}^m}$$

$$\begin{cases} (1+ps\tau_t^{f,s}) W_t^u = \frac{\alpha_u M C_{i,t}^N Y_{i,t}^u}{H_{i,t}^u}, & \text{if } 1-ps\tau_t^y > 0 \\ H_{it}^u = 0, & \text{otherwise} \end{cases}$$

$$R_t^k = MC_{i,t}^N \left[(1-\alpha)\frac{Y_{i,t}^m}{K_{i,t}} + (1-\alpha_u)\frac{Y_{i,t}^u}{K_{i,t}}\right]$$

$$\frac{P_{i,t}^*}{P_t} = \frac{\varepsilon}{\varepsilon - 1} \frac{E_t \sum_{j=0}^{\infty} \psi^j Q_{t,t+j}^R MC_{i,t+j} \left(\frac{P_{t+j}}{P_t}\right)^{\varepsilon} Y_{t+j}}{E_t \sum_{j=0}^{\infty} \psi^j Q_{t,t+j}^R \left[(1-\tau_{t+j}^y) + \tau_{t+j}^y (1-ps)\frac{Y_{i,t}^u}{Y_{i,t}}\right]\left(\frac{P_{t+j}}{P_t}\right)^{\varepsilon-1} Y_{t+j}}$$

$$1 = \psi \Pi_t^{\varepsilon-1} + (1-\psi)\left(p_t^*\right)^{1-\varepsilon}$$

$$R_t^{-1} b_{t+1} \Pi_{t+1} = b_t + G_t - T_t$$

$$T_t = (\tau_t^h + \tau_t^{h,s} + \tau_t^{f,s}) w_t^m \int_0^1 H_{i,t}^m di + ps(\tau_t^h + \tau_t^{h,s} + \tau_t^{f,s}) w_t^u \int_0^1 H_{i,t}^u di + \tau_t^k r_t^k \int_0^1 K_{i,t} di$$
$$+ \tau_t^y \left(\int_0^1 Y_{i,t}^m di + ps \int_0^1 Y_{i,t}^u di \right) + T_t^{ls}$$

$$T_t^{ls} = T^{ls} + \tau^{ls}(b_t - \bar{b})$$

$$\log\left(\frac{R_t}{R}\right) = \rho_R \log\left(\frac{R_{t-1}}{R}\right) + (1-\rho_R)\left[\rho_y \log\left(\frac{Y_t}{Y}\right) + \rho_\Pi \log\left(\frac{\Pi_t}{\Pi}\right)\right]$$

$$\Delta_t = (1-\psi)\, p_t^{*-\varepsilon} + \psi \Pi_t^{\varepsilon} \Delta_{t-1}$$

$$Y_t = C_t + I_t + G_t$$

Appendix C: Welfare Computation

This appendix describes the welfare measure we us to evaluate the effects of the envisaged tax reform scenarios. Let a and b be two alternative generic policies that can be implemented by the government. Then, the present discounted value of the utility flow under policy a is:

$$V_T^a = \sum_{t=1}^{T} \beta^t U(C_t^a, H_t^{m,a}, H_t^{u,a}), \tag{C-1}$$

where C_t^a, $H_t^{m,a}$, and $H_t^{u,a}$ respectively denote consumption, regular hours, and irregular hours under policy a, and T is the time horizon we are interested in evaluating the welfare effects of the reform. Similarly, the present discounted value of the utility flow under policy b is:

$$V_T^b = \sum_{t=1}^{T} \beta^t U(C_t^b, H_t^{m,b}, H_t^{u,b}), \tag{C-2}$$

where, clearly, C_t^b, $H_t^{m,b}$, and $H_t^{u,b}$ respectively denote consumption, regular hours, and irregular hours under policy b. The welfare cost of adopting policy a instead of policy b is defined as the constant fraction of consumption, ω, that individuals have to give up under policy b in order to be indifferent between the two policies. Formally, ω represents the solution to the following identity:

$$V_T^a = \sum_{t=1}^{T} \beta^t U\left((1-\omega)C_t^b, H_t^{m,b}, H_t^{u,b}\right). \tag{C-3}$$

As we compare each reform with the utility households derive in the pre-tax reform equilibrium, and given the functional form of utility, Eq. (1), it is easy to see that the welfare cost of non-adopting the tax reform

is

$$\omega = 1 - \frac{exp\left(\ln((1-\eta)C) - \Gamma_0 \frac{(H^m+H^u)^{1+\xi}}{1+\xi} - \Gamma_1 \frac{(H^u)^{1+\varphi}}{1+\varphi}\right)}{exp\left(\frac{\sum_{t=1}^{T} \beta^t \left\{\ln(C_t - \eta \bar{C}_{t-1}) - \Gamma_0 \frac{(H_t^m+H_t^u)^{1+\xi}}{1+\xi} - \Gamma_1 \frac{(H_t^u)^{1+\varphi}}{1+\varphi}\right\}}{\sum_{t=1}^{T} \beta^t}\right)}. \tag{C-4}$$

Table 1: Parametrization

Parameter	Description	Value
α	Regular technology parameter	0.6105
α_u	Underground technology parameter	0.6537
β	Discount factor	0.99
η	Consumption habit parameter	0.7
δ	Capital depreciation rate	0.025
ϕ_I	Investment adjustment cost	2.48
σ	Intertemporal elasticity of substitution	1
ε	Price elasticity	6
ψ	Calvo's price parameter for nominal rigidities	0.85
ξ	Inverse of Frish elasticity of total labor supply	1.1882
φ	Inverse of Frish elasticity of underground labor supply	0.0559
Γ_0	Disutility of aggregate labor	18.6014
Γ_1	Disutility of underground labor	4.8852
A^m	Regular technology total factor productivity	0.8699
A^u	Underground technology total factor productivity	0.7174
p	Probability of a firm being inspected	0.03
s	Penalty rate for tax evading firms	1.3
τ^{ls}	Response of lump sum taxes to debt	0.5
α_R	Taylor rule: Interest smoothing	0.8
α_y	Taylor rule: Output coefficient	0.08
α_Π	Taylor rule: Inflation coefficient	2.04
τ^c	Consumption tax rate	0.22
τ^h	Households' labor income tax rate	0.163
$\tau^{h,s}$	Workers' social security contribution tax rate	0.0719
$\tau^{h,f}$	Employers' social security contribution tax rate	0.2429
τ^k	Capital tax rate	0.2
τ^y	Business tax rate	0.0425

Table 2: Deterministic Steady State of the Main Variables

Variable	**Description**	**Value**
Y	Output	1
Y^u/Y	Share of underground economy	0.228
C	Consumption	0.6028
I	Investments	0.1743
H	Total hours worked	0.3
H^u/H	Fraction of total hours in undeclared work	0.2063
B	Stock of public debt	5.2
G	Public expenditure	0.2229

Table 3: Tax Policy Experiments (%)

Scenario		τ^y	τ^h	$\tau^{f,s}$	τ^c	$\Delta G/G$
Baseline		4.25	16.30	24.29	22	0
S_1	70% deductibility of legal labor cost from business tax	4.25	16.30	24.29	22	0
S_2	0.1% of output tax shift from business to consumption	4.12 (4.14)	16.30	24.29	22.17	0
S_3	0.1% of output tax shift from labor income to consumption	4.25	15.98 (16.03)	24.29	22.17	0
S_4	0.1% of output tax shift from employers' SSC to consumption	4.25	16.30	23.97 (24.02)	22.17	0
S_5	0.1% of output cut in the business tax financed by public spending reduction	4.12 (4.14)	16.30	24.29	22	-0.449 (-0.453)
S_6	0.1% of output cut in the labor income tax financed by public spending reduction	4.25	15.98 (16.03)	24.29	22	-0.449 (-0.453)
S_7	0.1% of output cut in the employers' SSC financed by public spending reduction	4.25	16.30	23.97 (24.02)	22	-0.449 (-0.453)
S_8	1 p.p. cut in the labor income tax financed by a delayed public spending reduction	4.25	15.30	24.29	22	-1.448 (-1.765)
S_9	1 p.p. cut in the employers' SSC rate financed by a delayed public spending reduction	4.25	15.30	23.29	22	-1.448 (-1.765)

Table 4: Tax Wedge Implied by Tax Policy

	Scenario		**Tax Wedge**
	Baseline		0.4954 (0.4954)
Experiments	S_1	70% deductibility of legal labor cost from business tax	0.4800 (0.4800)
	S_2	0.1% of output tax shift from business to consumption	0.4961 (0.4961)
	S_3	0.1% of output tax shift from labor income to consumption	0.4940 (0.4944)
	S_4	0.1% of output tax shift from employers' SSC to consumption	0.4948 (0.4950)
	S_5	0.1% of output cut in the business tax financed by public spending reduction	0.4954 (0.4954)
	S_6	0.1% of output cut in the labor income tax financed by public spending reduction	0.4933 (0.4937)
	S_7	0.1% of output cut in the employers' SSC financed by public spending reduction	0.4941 (0.4943)
	S_8	1 p.p. cut in the labor income tax financed by a delayed public spending reduction	0.4888 (0.4888)
	S_9	1 p.p. cut in the employers' SSC rate financed by a delayed public spending reduction	0.4913 (0.4913)

Table 5: Output Growth Rates Arising from Tax Policy Experiments (%)

Scenario		Impact	1 year	5 years	10 years	20 years
S_1	70% deductibility of legal labor cost from business tax	1.0357 (1.5832)	1.9304 (2.8374)	0.8243 (1.0410)	0.8673 (1.1184)	0.8674 (1.1191)
S_2	0.1% of output tax shift from business to consumption	0.1364 (0.1528)	0.2301 (0.2504)	0.0473 (0.0509)	0.0522 (0.0558)	0.0522 (0.0558)
S_3	0.1% of output tax shift from labor income to consumption	0.0722 (0.0825)	0.1345 (0.1513)	0.0629 (0.0725)	0.0650 (0.0747)	0.0650 (0.0747)
S_4	0.1% of output tax shift from employers' SSC to consumption	0.0230 (0.0285)	0.0422 (0.0521)	0.0183 (0.0248)	0.0189 (0.0255)	0.0189 (0.0255)
S_5	0.1% of output cut in the business tax financed by public spending reduction	0.0463 (0.0614)	0.1756 (0.1955)	0.0354 (0.0395)	0.0397 (0.0439)	0.0396 (0.0439)
S_6	0.1% of output cut in the labor income tax financed by public spending reduction	-0.0174 (-0.0080)	0.0810 (0.0977)	0.0509 (0.0612)	0.0525 (0.0629)	0.0525 (0.0629)
S_7	0.1% of output cut in the employers' SSC financed by public spending reduction	-0.0663 (-0.0618)	-0.0109 (-0.0011)	0.0062 (0.0133)	0.0064 (0.0137)	0.0064 (0.0137)
S_8	1 p.p. cut in the labor income tax financed by a delayed public spending reduction	0.2850 (0.3861)	0.5683 (0.7533)	0.1498 (0.2169)	0.1549 (0.2238)	0.1549 (0.2238)
S_9	1 p.p. cut in the employers' SSC rate financed by a delayed public spending reduction	0.1316 (0.1792)	0.2809 (0.3755)	0.0136 (0.0414)	0.0140 (0.0422)	0.0140 (0.0422)

Table 6: Effects on Fiscal Consolidation and on the Size of the Underground Economy

Scenario		$\Delta(B/4PY)$	$\Delta(Y^u/Y)$
Baseline		0	0
S_1	70% deductibility of legal labor cost from business tax	-3.8814(-7.7260)	-0.7245(-0.1955)
S_2	0.1% of output tax shift from business to consumption	-2.7571(-3.3242)	-0.0051(-0.0014)
S_3	0.1% of output tax shift from labor income to consumption	-2.2586(-2.0680)	-0.1070(-0.0244)
S_4	0.1% of output tax shift from employers' SSC to consumption	-2.1029(-1.9399)	-0.0682(-0.0157)
S_5	0.1% of output cut in the business tax financed by public spending reduction	-2.9928(-3.4844)	-0.0071(-0.0019)
S_6	0.1% of output cut in the labor income tax financed by public spending reduction	-2.5024(-2.2414)	-0.1090(-0.0249)
S_7	0.1% of output cut in the employers' SSC financed by public spending reduction	-2.3515(-2.1200)	-0.0701(-0.0162)
S_8	1 p.p. cut in the labor income tax financed by a delayed public spending reduction	-7.9499(-9.0102)	-0.3362(-0.0927)
S_9	1 p.p. cut in the employers' SSC rate financed by a delayed public spending reduction	-7.4946(-8.4918)	-0.2184(-0.0609)

Table 7: Welfare Effects Arising from Tax Policy Experiments

Scenario		**1 year**	**5 years**	**10 years**	**20 years**
S_1	70% deductibility of legal labor cost from business tax	0.0064 (0.0026)	0.0208 (0.0205)	0.0268 (0.0276)	0.0296 (0.0309)
S_2	0.1% of output tax shift from business to consumption	-0.0014 (-0.0003)	-0.0001 (0.0004)	0.0007 (0.0010)	0.0011 (0.0012)
S_3	0.1% of output tax shift from labor income to consumption	0.0015 (0.0011)	0.0024 (0.0019)	0.0028 (0.0022)	0.0030 (0.0024)
S_4	0.1% of output tax shift from employers' SSC to consumption	0.0009 (0.0005)	0.0012 (0.0007)	0.0013 (0.0009)	0.0014 (0.0009)
S_5	0.1% of output cut in the business tax financed by public spending reduction	0.0030 (0.0037)	0.0049 (0.0052)	0.0057 (0.0059)	0.0061 (0.0063)
S_6	0.1% of output cut in the labor income tax financed by public spending reduction	0.0059 (0.0051)	0.0074 (0.0067)	0.0079 (0.0072)	0.0081 (0.0074)
S_7	0.1% of output cut in the employers' SSC financed by public spending reduction	0.0053 (0.0045)	0.0061 (0.0056)	0.0064 (0.0058)	0.0065 (0.0060)
S_8	1 p.p. cut in the labor income tax financed by a delayed public spending reduction	0.0090 (0.0097)	0.0209 (0.0231)	0.0232 (0.0257)	0.0244 (0.0270)
S_9	1 p.p. cut in the employers' SSC rate financed by a delayed public spending reduction	0.0073 (0.0079)	0.0173 (0.0192)	0.0188 (0.0210)	0.0195 (0.0219)

Figure 1: 70% Deductibility of Legal Labor Cost from Business Tax

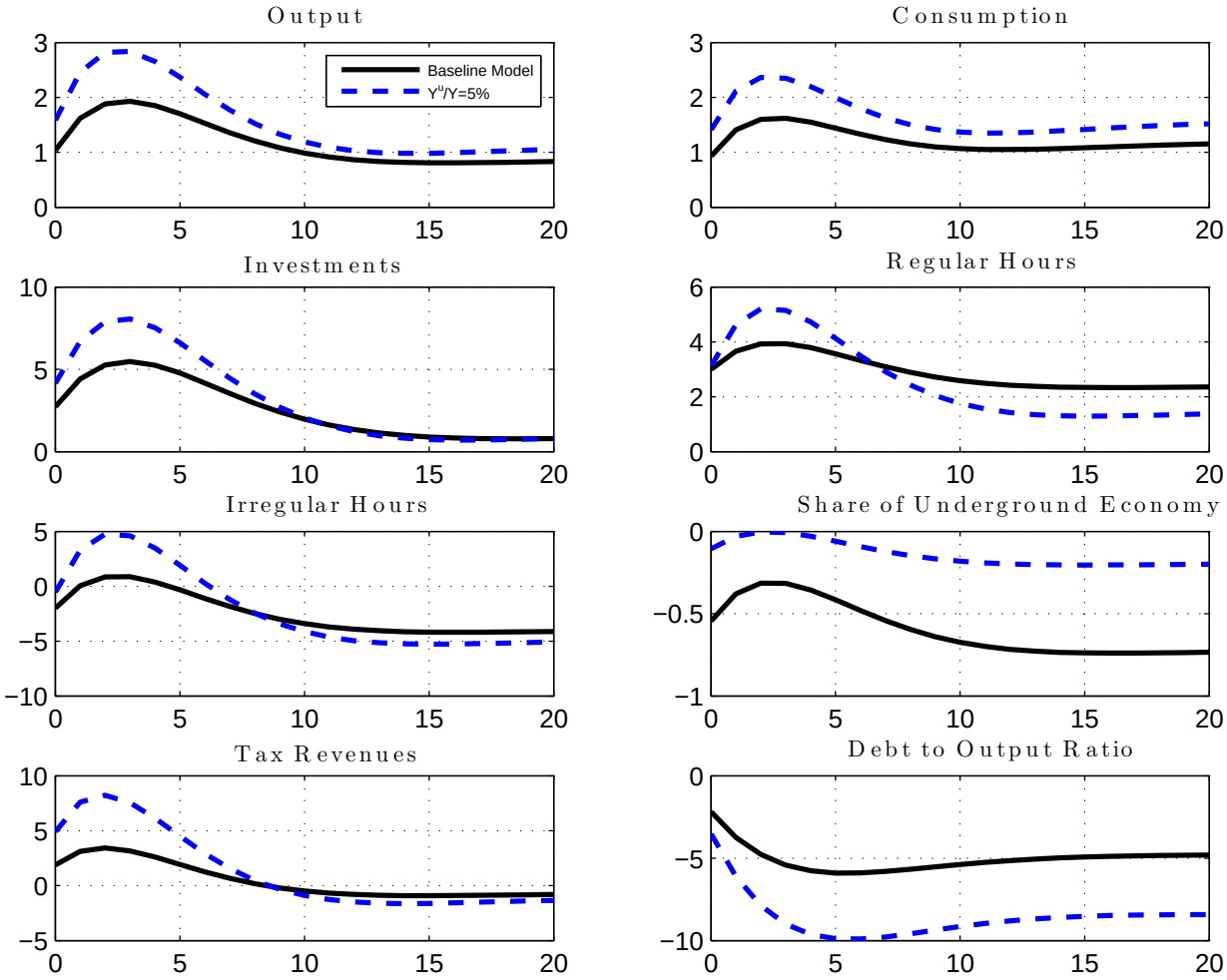

Figure 2: 0.1% of Output Tax Shift from Business to Consumption

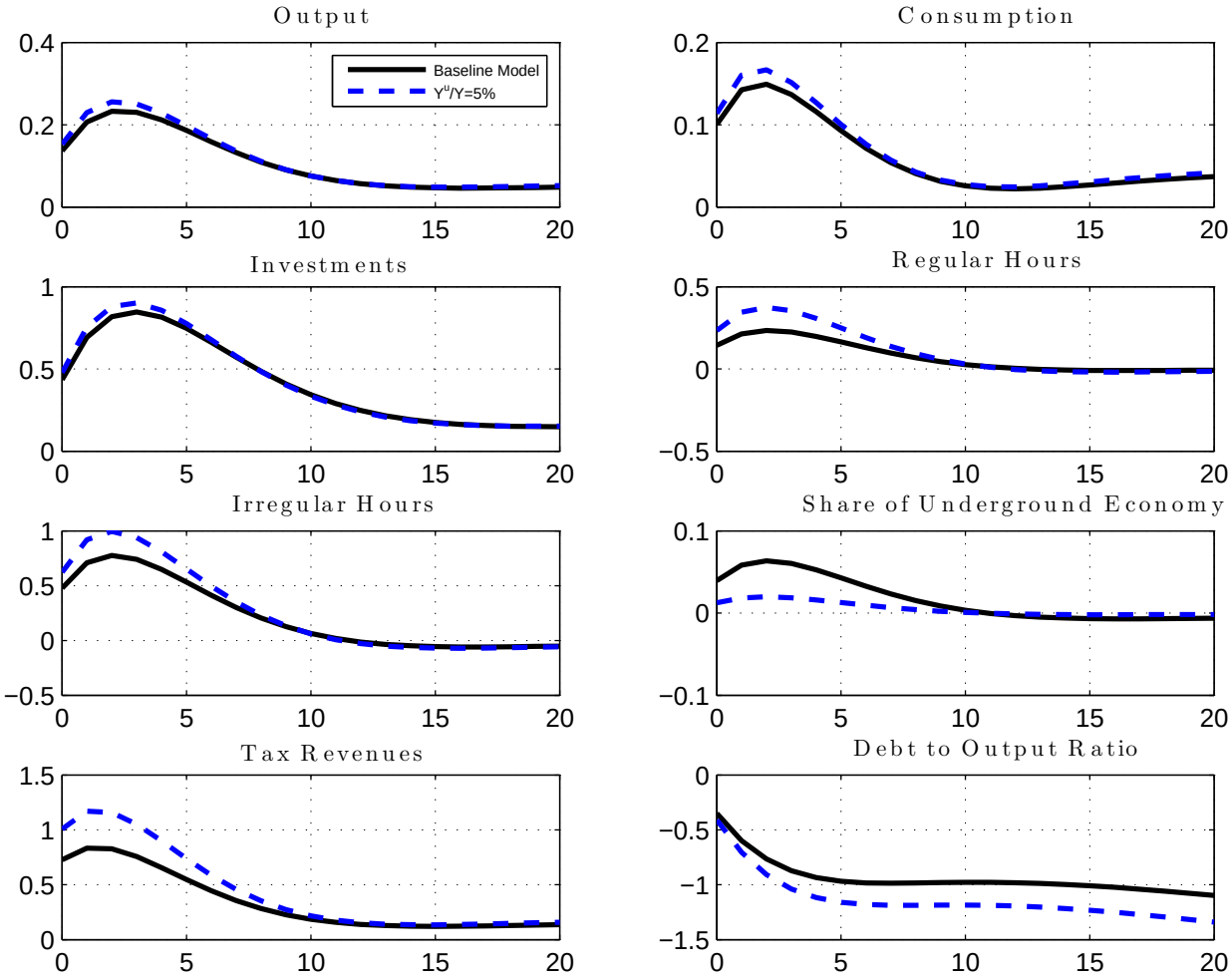

Figure 3: 0.1% of Output Tax Shift from Labor Income to Consumption

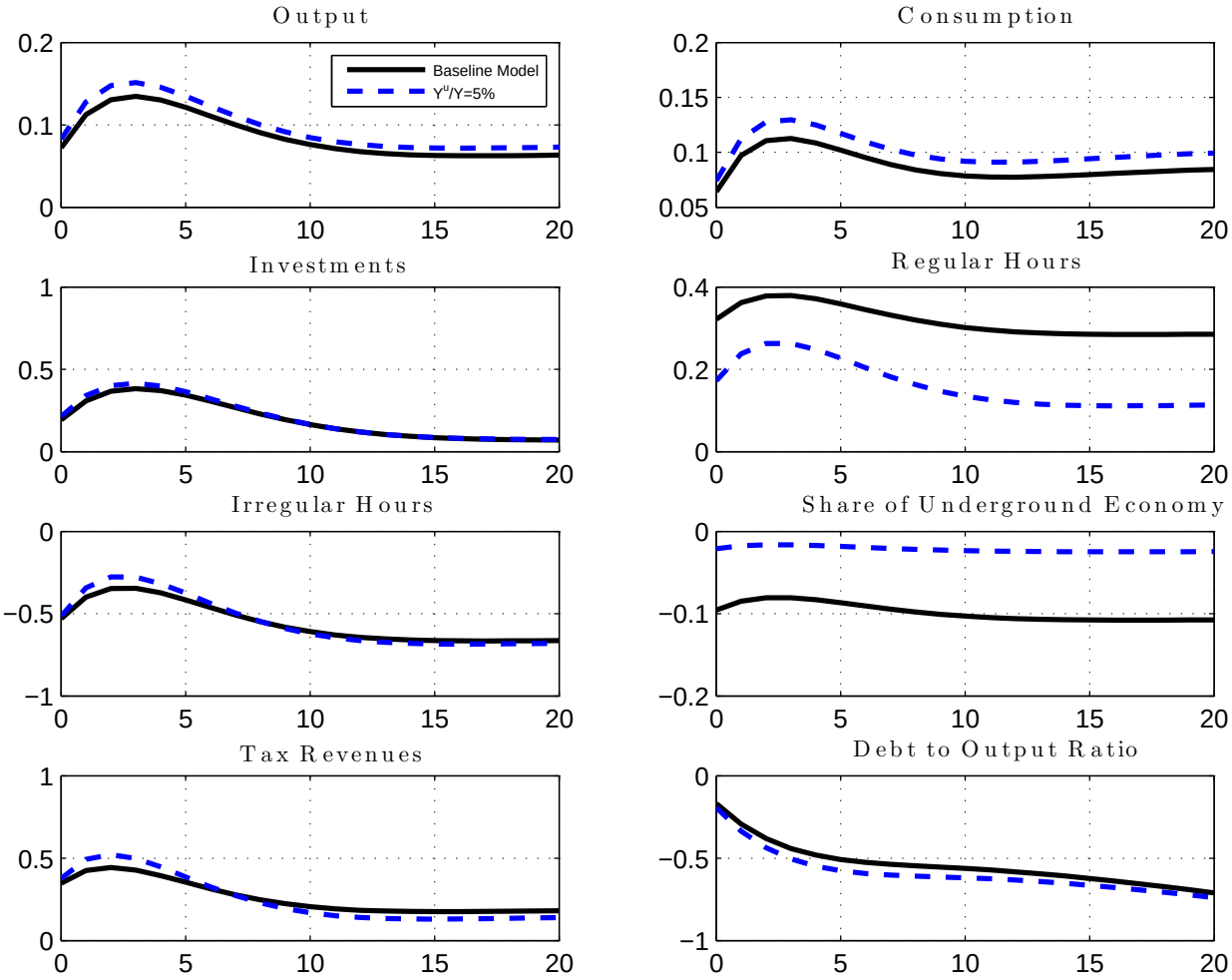

Figure 4: 0.1% of Output Tax Shift from employers' SSC to Consumption

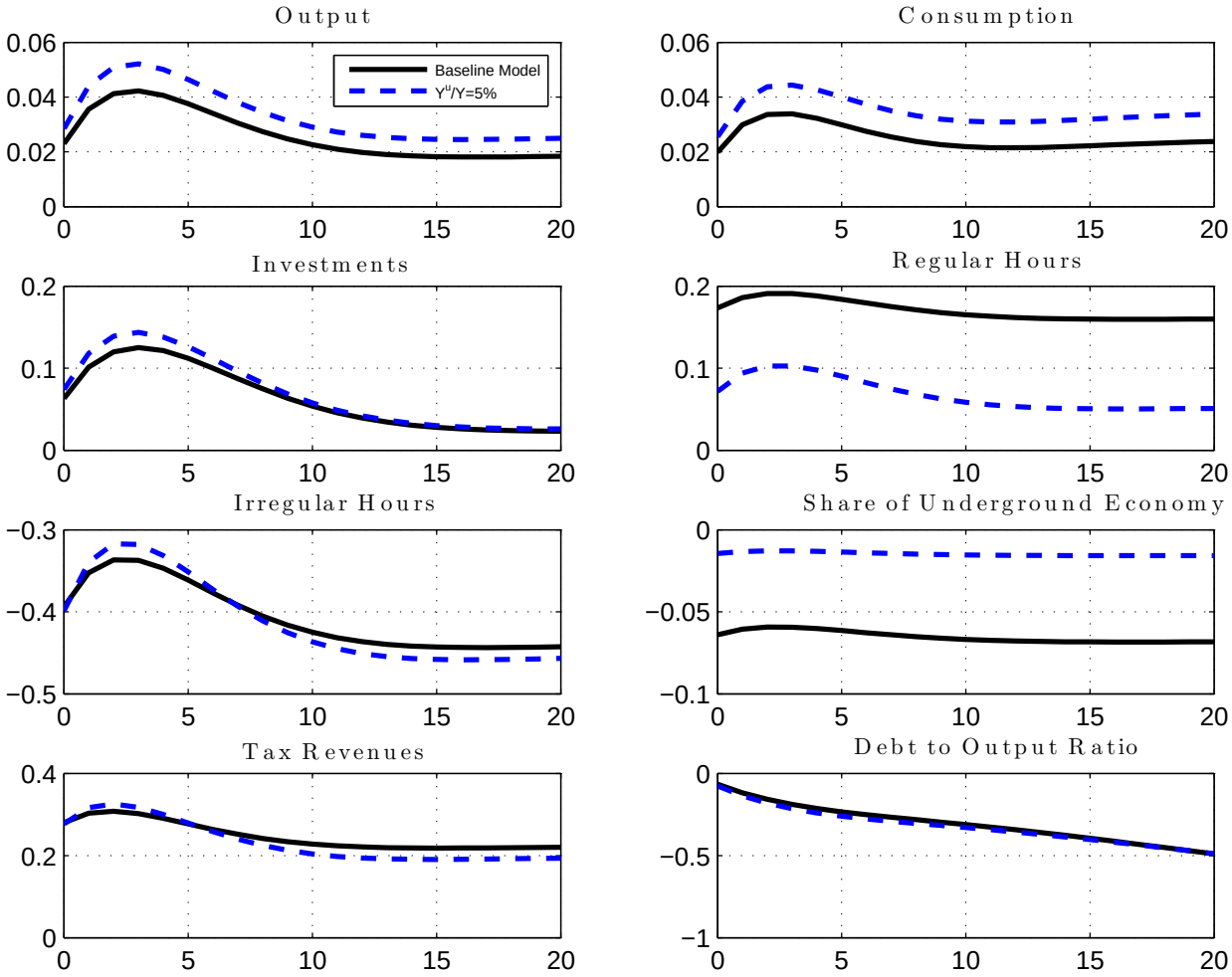

Figure 5: 0.1% of Output Cut in the Business Tax Financed by Public Spending Reduction

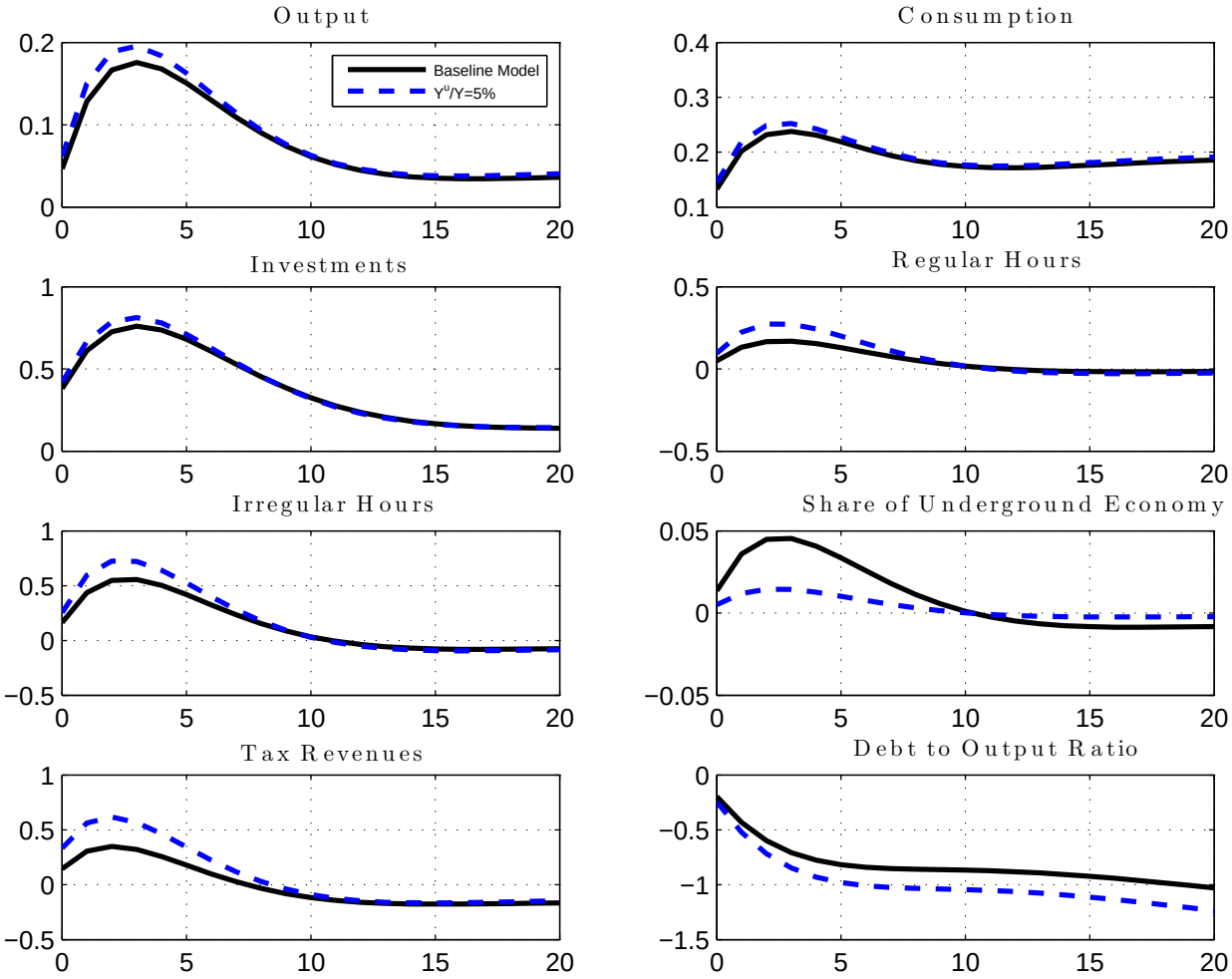

Figure 6: 0.1% of Output Cut in the Labor Income Tax Financed by Public Spending Reduction

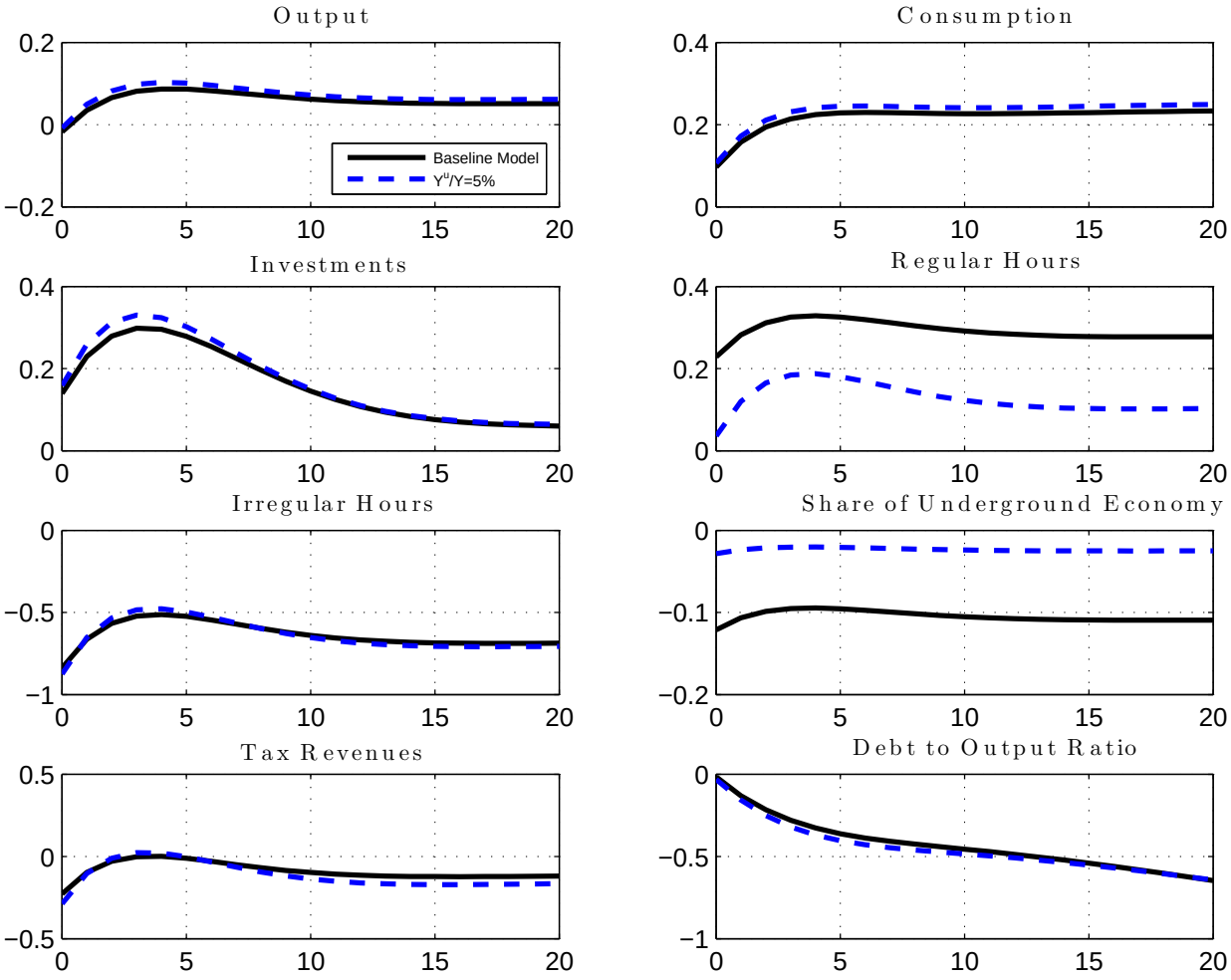

Figure 7: 0.1% of Output Cut in the Employers' SSC Financed by Public Spending Reduction

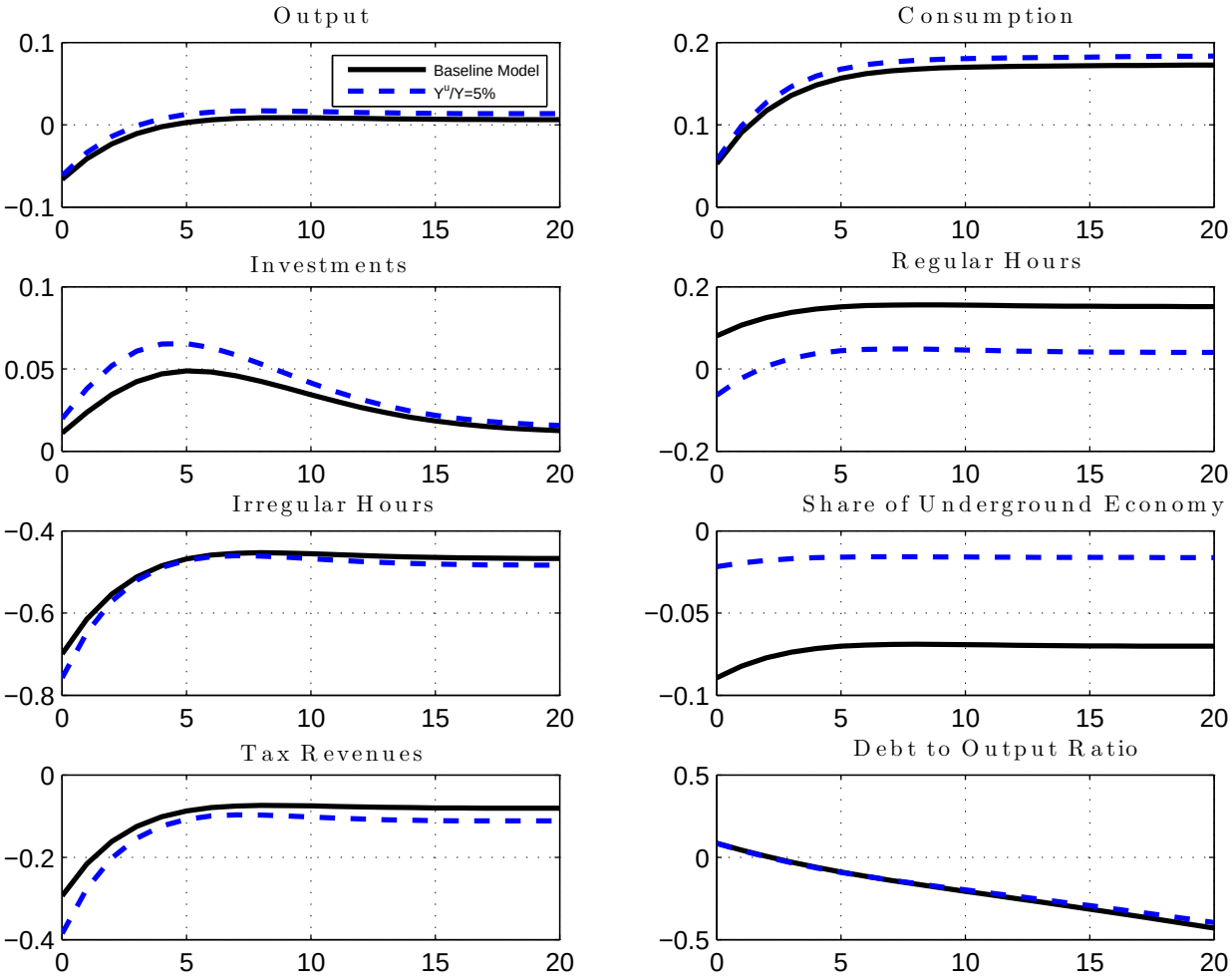

Figure 8: 1 p.p. Cut in the Labor Income Tax Financed by a Delayed Public Spending Reduction

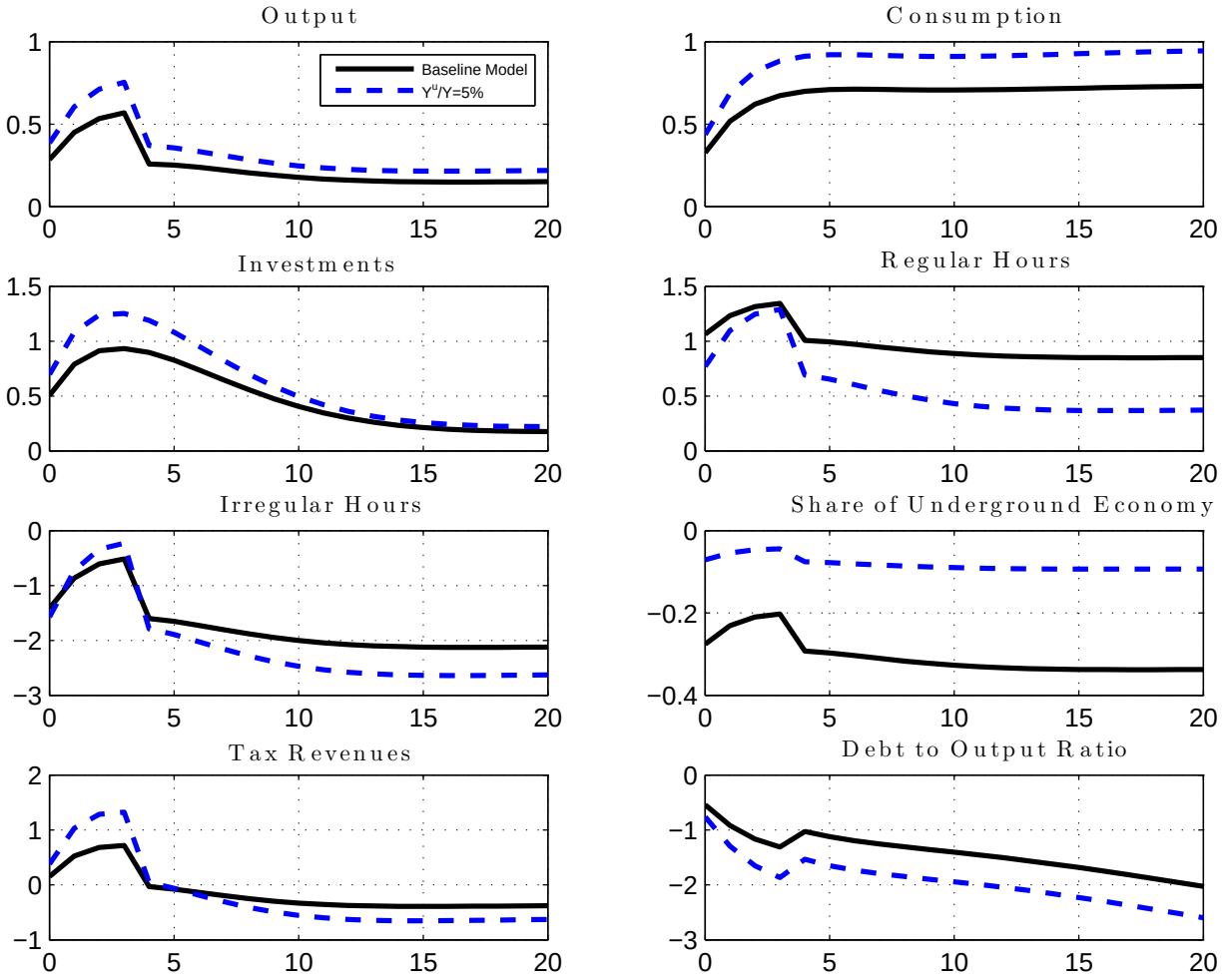

Figure 9: 1 p.p. Cut in the Employers' SSC Rate Financed by a Delayed Public Spending Reduction