TAX REFORM IN THE CONTEXT OF BUDGETARY RESTRAINT: A NOTE ON THE PORTUGUESE CASE

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This note illustrates, in the framework of a dynamic general equilibrium analysis of tax reform in Portugal, the difficulties in the design of efficient tax reforms in a context of budgetary restraint.

1. Introduction

Tax reform is in the air in less developed EU countries, like Greece, Ireland, Portugal and Spain, and is on the horizon for the future Eastern European entrants. This is due mostly to a growing sense that there is a need not to fall behind in the process of real convergence to the EU standards of living. It is also due to the knowledge that, as the tax bases become increasingly mobile across EU countries, the ability of domestic authorities to use tax policy to give the country an edge in this process is quickly eroding.

In this setting, it is important to recognize that such reforms would have to occur in a context of significant budgetary restraint. The stringent public deficit targets of the Stability and Growth Programs place serious limitations on the use of either public deficits or reductions in public spending to finance tax reform in the less developed EU countries. In turn, the requirements of nominal convergence are expected to place equally stringent demands on the public finances of the new entrant economies.

Tax reform in such an environment of budgetary consolidation is, thus, inevitably reduced to an exercise in trading off distortionary tax margins. In this sense, a trade-off between GDP and welfare is a real possibility. When trading off distortionary tax margins one would expect the compensatory tax increases to either reduce labour demand, lower the net wage, or increase labour supply. Either way, after-tax labour income

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and disposable income will fall. Eventually, with the stimulus part of the package, capital income will increase and so will consumption. To the extent that investment is subject to adjustment costs, however, capital income adjusts only gradually. As a result, what happens to labour income and to the overall tax households pay will determine whether disposable income, and therefore private consumption, rises or falls in the short-run. Consumption levels will eventually be higher, but a long transition period can imply a welfare loss in a discounted sense. In such cases, finding a tax proposal that simultaneously enhances long-term GDP and private welfare may be a non-trivial task.

The objective of this note is to illustrate these points with a tax reform package currently under debate in Portugal. This tax shock was proposed initially in the spring of 1999 by Cavaco Silva, Portugal's Prime Minister from 1985 to 1995 and has served ever since as a central reference in the tax reform debate in Portugal. On the stimulus side, the corporate income tax rate would be reduced by 4pp, the employers' social security contribution rate by 4pp, and the personal income tax rate corresponding to the highest income bracket by 5pp. On the financing side, foregone revenues would be offset by additional revenues from a more effective combat to tax evasion as a result of prohibiting tax amnesties and abolishing banking secrecy for tax inspection purposes as well as a reduction of the wastefulness in public health care spending. If after these measures are implemented there is still a revenue shortfall then, to meet the budget deficit targets in the context of the Stability and Growth Pact, the general value-added tax rate would be increased, as needed, by up to 2pp.

To evaluate this tax reform package, we use a dynamic general-equilibrium model of the Portuguese economy. This model was originally developed by Pereira (1999) and has been used in the context of analysing the sustainability of the social security systems (see Pereira and Rodrigues 2002) as well as more general tax reform issues (see Pereira and Rodrigues 2001a, 2001b). This model shares with the computable general equilibrium literature the ability to consider the tax system in great detail and to analyse the effects of large and simultaneous changes in the tax parameters. Furthermore, it recognizes that a country's overall budgetary position depends on its macroeconomic performance. This is because, among other things, tax bases are endogenous and respond to changes in tax rates. On the other hand, it shares with the endogenous growth literature the fact that fiscal policy has the potential for affecting the fundamentals of long-term growth and not just for generating temporary

level effects. In this regard, two of the most relevant channels are public investment activities and changes in tax policy that motivate an increased demand for capital and labour. (See the above references for the fully-fledged pedigree of this model.)

2. The dynamic general equilibrium model

We consider a decentralized economy in a dynamic general equilibrium framework. With money absent, the model is framed in real terms. There are four sectors in the economy – the production sector, the household sector, the public sector and the foreign sector, which are interconnected through competitive market equilibrium conditions, the evolution of the stock variables and their relevant shadow prices. Economic agents are price-takers in all markets and are assumed to have perfect foresight. The intertemporal trajectory of the economy can be summarized by the optimal evolution of seven stock variables and three shadow price variables. These are private capital, public capital, and human capital and their respective shadow prices, as well as public debt, foreign debt, private financial wealth, and human wealth.

In the long-term, endogenous steady-state growth is possible because the production technology displays constant returns to scale in the factors that accumulate. Long-term endogenous growth is induced by the optimal accumulation of private capital as well as public capital and human capital. While the first is subject to private sector decisions, the last two are publicly provided. This implies that the command optimum for this economy cannot be replicated in a decentralized context in the absence of public intervention that is, itself, responsive to market incentives.

The model in presented in detail in Table 1. Here we present its basic outline. The reader is referred to Pereira and Rodrigues (2001b) for full details. Optimal production behaviour (see equations 1-7) consists in choosing the investment and labour demand levels that maximize the firms' market value, subject to the equation of motion for private capital accumulation, adjustment costs. Public capital and human capital are externalities in private sector production.

Table 1

The dynamic general equilibrium model

Equations of the Production Sector

$$Y_t = A(L_t^d HK_t)^{\theta_L} K_t^{\theta_K} KG_t^{1-\theta_L-\theta_K} \tag{1}$$

$$K_{t+1} = (1-\delta_K)K_t + I_t - \mu_I \frac{I_t^2}{K_t} \tag{2}$$

$$\begin{aligned} NCF_t = {} & Y_t - (1+\tau_{FSSC})W_t L_t^d HK_t - I_t - (1-\rho_I)\tau_{VATET,I} I_t - \\ & \tau_{CIT}\cdot[Y_t - (1+\tau_{FSSC})W_t L_t^d HK_t - \alpha I_t] + \tau_{ITC} I_t \end{aligned} \tag{3}$$

$$\alpha = [1-(1+g)^{-NDEP}]/NDEP[1-(1+g)^{-1}] \tag{4}$$

$$\theta_L Y_t = (1+\tau_{FSSC})W_t L_t^d HK_t \tag{5}$$

$$\frac{q_{t+1}^K}{1+r_{t+1}}\left(1-2\mu_I\frac{I_t}{K_t}\right) = 1 + (1-\rho_I)\tau_{VATET,I} - \alpha\tau_{CIT} - \tau_{ITC} \tag{6}$$

$$\frac{I_t}{K_t} = \frac{1}{2\mu_I} - [1+(1-\rho_I)\tau_{VATET,I} - \alpha\tau_{CIT} - \tau_{ITC}](2\mu_I q_{t+1}^K)^{-1}(1+r_{t+1}) \tag{6a}$$

$$q_t^K = (1-\tau_{CIT})\theta_K\frac{Y_t}{K_t} + \frac{q_{t+1}^K}{1+r_{t+1}}\left[1-\delta_K+\mu_I\left(\frac{I_t}{K_t}\right)^2\right] \tag{7}$$

Equations of the Household Sector

$$U_{a,t} = \frac{\sigma-1}{\sigma}\sum_{v=0}^{\infty}\gamma^v\beta^v\left(c_{a+v,t+v}^{\frac{\sigma-1}{\sigma}} + B\ell_{a+v,t+v}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{8}$$

$$\text{Consumption component of } U_t = \sum_{n=t_0}^{\infty}(\beta\gamma)^{n-t_0}C_n \tag{9}$$

$$\text{Leisure component of } U_t = \sum_{n=t_0}^{\infty}(\beta\gamma)^{n-t_0}\ell_n \tag{9a}$$

$$\sum_{v=0}^{\infty}\gamma^v[1+(1-\tau_r)r_{t+v}]^{-v}(1+\tau_{VATET,C})c_{a+v,t+v} \le TW_{a,t} \tag{10}$$

$$TW_{a,t} \equiv HW_{a,t} + FW_{a,t} + K_t \tag{11}$$

$$\begin{aligned} HW_{a,t} = {} & \sum_{m=0}^{\infty}\left(\frac{\gamma}{1+(1-\tau_r)r_{t+m}}\right)^m\cdot\{(1-\tau_{WSSC})(1-\tau_{PIT})\cdot \\ & [W_{t+m}HK_{t+m}(\bar{L}-\ell_{a+m,t+m})] + (1-\tau_{PIT})\cdot\varphi TR1_{t+m} + \\ & (1-\varphi)TR1_{t+m} + TR2_{t+m} + TR3_{t+m} + R_{t+m} - LST_{t+m}\} \end{aligned} \tag{12}$$

$$\begin{aligned} FW_{a,t} = {} & [1+(1-\tau_r)r_{t-1}^{PD}]PD_{t-1} + (1-\tau_\pi)NCF_{t-1} - \\ & (1+r_{t-1}^{FD})FD_{t-1} + (1-\tau_{PIT})[(1-\tau_{WSSC})W_{t-1}HK_{t-1}\cdot \\ & (\bar{L}-\ell_{a-1,t-1}) + \varphi TR1_{t-1}] + (1-\varphi)TR1_{t-1} + TR2_{t-1} + TR3_{t-1} + \\ & R_{t-1} - (1+\tau_{VATET,C})C_{a-1,t-1} - LST_{t-1} \end{aligned} \tag{13}$$

$$(1+\tau_{VATET,C})C_t = \{1-[1+(1-\tau_r)r]^{\sigma-1}\gamma\beta^\sigma\}[HW_t + (PD_t - FD_t) + K_t] \tag{14}$$

$$\ell_t = \left(\frac{B(1+\tau_{VATET,C})}{(1-\tau_{WSSC})(1-\tau_{PIT})W_t(1-UR_t)HK_t}\right)^\sigma C_t \tag{15}$$

Table 1 (continued)

Equations of the Public Sector

$$PD_{t+1} = (1 + r_t^{PD})PD_t + (1 + \tau_{VATET,CG})CG_t + (1 + \tau_{VATET,IG})IG_t + (1 + \tau_{VATET,IH})IH_t + TR_t - T_t \quad (16)$$

$$\begin{aligned} T_t &= PIT_t + CIT_t + VATET_t + WSSC_t + FSSC_t + LST_t \\ &= \tau_{PIT}[(1 - \tau_{WSSC})W_t HK_t(\bar{L} - \ell_t) + \varphi TR1_t] + \tau_r r_t^{PD} PD_t + \\ &\quad \tau_\pi NCF_t + \tau_{CIT}[Y_t - (1 + \tau_{FSSC})W_t HK_t(\bar{L} - \ell_t) - \alpha I_t] - \\ &\quad \tau_{ITC} I_t + \tau_{VATET,C} C_t + (1 - \rho_I)\tau_{VATET,I} I_t + \tau_{VATET,IH} IH_t + \\ &\quad \tau_{VATET,IG} IG_t + \tau_{WSSC} W_t HK_t(\bar{L} - \ell_t) + \\ &\quad \tau_{FSSC} W_t HK_t(\bar{L} - \ell_t) + LST_t \end{aligned} \quad (17)$$

$$TR_t = TR1_t + TR2_t + TR3_t + TR4_t \quad (18)$$

$$KG_{t+1} = (1 - \delta_{KG})KG_t + IG_t - \mu_{IG}\frac{IG_t^2}{KG_t} \quad (19)$$

$$HK_{t+1} = (1 - \delta_{HK})HK_t + IH_t - \mu_{IH}\frac{IH_t^2}{HK_t} \quad (20)$$

$$\frac{q_{t+1}^{PD}}{1+(1-\tau_r)r_{t+1}^{PD}} = \frac{q_t^{PD}}{1+(1-\tau_r)r_t^{PD}} \quad (21)$$

$$-q_{t+1}^{PD} = q_{t+1}^{KG}(1 - 2\mu_{IG}\frac{IG_t}{KG_t}) \quad (22)$$

$$\begin{aligned} q_t^{KG} &= [-\tfrac{\partial T_t}{\partial KG_t}q_{t+1}^{PD} + q_{t+1}^{KG}(1 - \delta_{KG} + \mu_{IG}\left(\tfrac{IG_t}{KG_t}\right)^2)]/[1 + (1 - \tau_r)r_{t+1}^{PD}] \\ &\quad + \tfrac{(1-\theta_L-\theta_K)Y_t}{KG_t} \end{aligned} \quad (23)$$

$$\frac{\partial T_t}{\partial KG_t} = [\tau_\pi(1 - \tau_{CIT}) + \tau_{CIT}](1 - \theta_L - \theta_K)Y_t/KG_t \quad (24)$$

$$-q_{t+1}^{PD} = q_{t+1}^{HK}(1 - 2\mu_{IH}\frac{IH_t}{HK_t}) \quad (25)$$

$$\begin{aligned} q_t^{HK} &= [-\tfrac{\partial T_t}{\partial HK_t}q_{t+1}^{PD} + q_{t+1}^{HK}(1 - \delta_{HK} + \mu_{IH}\left(\tfrac{IH_t}{HK_t}\right)^2)]/[1 + (1 - \tau_r)r_{t+1}^{PD}] \\ &\quad + \tfrac{\theta_L Y_t}{HK_t} \end{aligned} \quad (26)$$

$$\frac{\partial T_t}{\partial HK_t} = \frac{\theta_L Y_t}{HK_t}[\tau_{PIT}(1 - \tau_{FSSC}) - (1 - \tau_\pi)(1 + \tau_{CIT})\tau_{FSSC} + \tau_{WSSC}] \quad (27)$$

Conditions for Market Equilibrium

$$L_t^d = (1 - UR_t)(\bar{L} - \ell_t) \quad (28)$$

$$FW_t = PD_t - FD_t \quad (29)$$

$$Y_t = C_t + CG_t + I_t + IG_t + IH_t + NX_t \quad (30)$$

$$FD_{t+1} = (1 + r_t^{FD})FD_t + C_t + I_t + CG_t + IG_t + IH_t - Y_t - R_t \quad (31)$$

Table 2

Data set

Variable	Description	Value
	Domestic spending data (% of Y_0)	
Y_0	GDP at market prices in 1999 (10^{12} PTEs)	20.36300
g	GDP growth rate	2.65000
C_0	Private consumption	64.90000
I_0	Private investment	21.50000
CG_0	Public consumption	11.10000
IG_0	Public investment in infrastructure	3.80000
IH_0	Public investment in human capital	6.50000
	Foreign Account data (% of Y_0)	
TB_0	Trade deficit	7.80000
$r_0^f FD_0$	Interest payments	0.70875
R_0	Unilateral transfers	7.26420
CAD_0	Current account deficit (+) (CAL)	0.505119
FD_0	Foreign debt in 1999	13.50000
	Population and employment data	
POP_0	Population in 1999	9,979,450
$PARTRA_0$	Participation rate of those aged 15-64	72.47210
$PARTRE_0$	Participation rate of those aged 65+	11.23917
UR_0	Unemployment rate	5.70000
	Capital stocks (% of Y_0)	
K_0	Private capital stock (CAL)	204.21222
KG_0	Public capital stock (CAL)	53.70281
HK_0	Human capital stock (CAL)	341.10706
	Public Account data (% of Y_0)	
TR_0	Total public transfers	14.20069
T_0	Total tax revenues	36.33026
PIT_0	Personal income tax revenues	6.10000
CIT_0	Corp. income tax revenues (incl. *derramas*)	3.24781
$derramas_0$	Municipal corporate income tax revenues	0.24781
$VATET_0$	Value-added and excise tax revenues	14.20000
$VATET, C_0$	on private consumption expenditure	11.41600
$VATET, I_0$	on private investment expenditure	1.84100
$VATET, CG_0$	on public consumption expenditure	0.47100
$VATET, IG_0$	on public investment in infrastructure	0.38000
$VATET, IH_0$	on public investment in human capital	0.09200
$FSSC_0$	Firms' social security contribution revenues	4.46074
$TrCGA_0$	Transfers to the CGA included in CG_0	2.51000
$WSSC_0$	Workers' social security contribution revenues	3.99042
$WSSC1_0$	on private sector workers	2.97383
$WSSC2_0$	on public sector employees	1.05659
LST_0	Lump sum tax revenues (CAL)	4.33128
$r_0^{PD} PD_0$	Interest payments on public debt	2.96625
DEF_0	Public deficit (+) (CAL)	1.49725
PD_0	Public debt in 1999	56.50000

Note: All values are 1990-1998 averages unless otherwise stated.

Table 3

Structural parameters

Symbol	Description	Type	Value
	Household parameters		
β	Discount factor	CAL	0.97705
	Discount rate	CAL	0.02349
γ	Probability of survival	DAT	0.97449
$gPOP$	Population growth rate	DAT	0.00000
σ	Elasticity of substitution	ARB	1.00000
σ^{Social}	Social elasticity of substitution	ARB	1.00000
	Production parameters		
θ_L	Labour share	DAT	0.47500
θ_K	Capital share	DAT	0.37500
$1-\theta_L-\theta_K$	Public capital externality	CAL	0.15000
δ_K	Private capital's depreciation rate	CAL	0.05866
μ_I	Adjust. cost coefficient	CAL	2.20037
AC_I	Adjust. cost as a % of private investment	CAL	0.25000
$\dot{A}/A$	Exogenous rate of technological progress	ARB	0.00000
	Public sector - outlays parameters		
δ_{KG}	Public infrastructure's depreciation rate	CAL	0.02997
μ_{KG}	Adjust. cost coefficient	CAL	3.32028
AC_{IG}	Adjust. cost as a % of public investment	CAL	0.25000
δ_{HK}	Human capital's depreciation rate	CAL	0.01000
μ_{HK}	Adjust. cost coefficient	CAL	11.36713
AC_{IH}	Adjust. cost as a % of hum. capital inv.	CAL	0.25000
	Real interest rates		
r	Basic real interest rate	DAT	0.05250
r^{FD}	Real interest rate on foreign debt	DAT	0.05250
r^{PD}	Real interest rate on public debt	DAT	0.05250
	Public sector - tax parameters		
τ_{PIT}	Effective personal income tax rate	DAT	0.09964
φ	Fraction of pensions taxed	DAT	0.07500
τ_π	Effective distributed profits tax rate	DAT	0.10000
τ_r	Eff. (and Stat.) interest income tax rate	DAT	0.20000
τ_{CITd}	Eff. corp. income tax and *derramas* rate	DAT	0.10449
$NDEP$	Time for fiscal deprec. of inv. (years)	DAT	16.0000
ρ_I	Frac. of priv. inv. that is VAT exempt	DAT	0.68000
τ_{ITC}	Effective investment tax credit rate	DAT	0.00446
τ_{VATET}	Eff. value-added and excise taxes rate	DAT	0.15171
$\tau_{VATET,C}$	VAT and excise taxes on priv. cons.	DAT	0.21344
$\tau_{VATET,I}$	*idem* on private investment	DAT	0.09365
$\tau_{VATET,CG}$	*idem* on public consumption	DAT	0.04431
$\tau_{VATET,IG}$	*idem* on public inv. in infrastructure	DAT	0.11111
$\tau_{VATET,IH}$	*idem* on public inv. in human capital	DAT	0.01438
τ_{FSSC}	Firms' effective SS contributions rate	DAT	0.13984
τ_{WSSC}	Workers' effective SS contributions rate	DAT	0.11467
$gLST$	Growth of lump sum taxes	CAL	0.02650

Key: ARB - arbitrary; CAL - calibrated; DAT - data.

On the household side (see equations 8-15), we follow a Blanchard-Yaari overlapping generations specification, in which households have finite but non-deterministic planning horizons. Under conventional simplifying assumptions the marginal propensity to consume out of total wealth is age-independent and aggregation over all age cohorts is a simple matter. Aggregate consumption is a function of the economy-wide stock of total wealth while the aggregate supply of labour is, itself, a function of aggregate consumption.

Public investment in human capital and infrastructure are determined in an optimal fashion by the fiscal authorities (see equations 16-27). The public investment decisions are determined by the maximization of the present value of the future stream of GDP subject to the respective equations of motion, including adjustment costs, as well as the equation of motion for public debt. The choice of GDP as the objective for the public sector was suggested by the terms of the policy debate in Portugal. In fact, since the late 1980s, the public investment decisions in coordination with the EU structural policy programs seem to be clearly dictated by the goal of real convergence to EU standards of living as measured by GDP per capita

Different agents contribute differently to the overall economy-wide equilibrium (see equation 29-31). Households demand consumption goods and financial securities, and supply labour. Firms supply output and securities and demand investment goods and labour. Finally, the public sector supplies public debt securities and demands goods for different consumption and investment purposes. Given the open nature of the economy, part of the demand is satisfied through the recourse to foreign production. Finally, the financial market equilibrium reflects the fact that, household savings and foreign financing finance private capital formation and public indebtedness.

The model is implemented numerically using detailed data and parameter sets. The data set is reported in Table 2 and reflects the GDP and stock variable values in 1999. In addition, the decomposition of the aggregate variables follows the average for the period 1990-98. This period was chosen to reflect the most recent available information and to cover a complete business cycle. The choice of averages for the decomposition of the aggregate variables reflects the nature of this model, which captures the behaviour of the economy around a smooth trend but does not capture the fluctuations of the business cycle.

Parameter values are reported in Table 3 and are specified in different ways. Whenever possible, parameter values are obtained from the available data sources or the literature or as implied by the conditions for the existence of a steady-state equilibrium. All of the other parameter values are obtained by calibration, i.e., in such a way that the data for 1999 was exactly replicated and the trajectory of the economy for the period 1990-98 was exactly extrapolated as the steady-state trajectory into the future. This trajectory is slightly modified in the baseline scenario to accommodate the public deficit targets of the Stability and Growth Program for Portugal.

3. On the implementation of the tax shock

The stimulus component of the tax package is amenable to direct quantification. Naturally, the tax changes are phrased in statutory terms. Pereira and Rodrigues (2001c, 2001d) present estimates for the Portuguese economy of the effective tax rates at the most important tax margins as well as estimates on how changes in the statutory tax rates translate into changes in the effective tax rates. Using this information, Table 4 reports on how the effective tax rates at the various tax margins would be affected by the tax shock.

Table 4

How the tax shock changes statutory and effective tax rates

Statutory change	Effective impact	From	To
$\Delta t_{CIT} = -4$pp	$\Delta\tau_{CITd} = -0.04 \cdot 0.30734$	0.10449	0.09219
$\Delta t_{FSSC} = -4$pp	$\Delta\tau_{FSSC} = -0.04 \cdot 0.54656$	0.13984	0.11797
$\Delta t_{PIT,4} = -5$pp	$\Delta\tau_{PIT} = -0.05 \cdot 0.07100$	0.09964	0.09609
$\Delta t_{VAT,5} = +2$pp	$\Delta\tau_{VATET,C} = +0.02 \cdot 0.67402$	0.21344	0.22692

Sources: Cavaco Silva (1999) and Pereira and Rodrigues (2001c, 2001d).

Key – CIT - corporate income tax; CITd - CIT including *derramas*; FSSC - Firms' social security contributions; PIT,4 - personal income tax corresponding to the highest income bracket; VAT,5 - general value-added tax; VAT-ET, C - value-added and excise taxes on private consumption.

The financing component of the tax reform package is more vague and there are some crucial uncertainties. Because of the current environment of budgetary restraint, a mere reduction in tax revenues, implicitly financed by public deficits, is not a realistic option. This means that the stimulus component of the tax shock has to be matched by offsetting increases in tax revenues at other margins or by a decrease in public spending. Indeed, the tax reform package considers increased tax revenue from more effective control of tax evasion and reductions in public spending as the offsetting mechanisms. They are not, however, explicitly quantified since it is exceedingly difficult to evaluate the revenue effects of fighting tax evasion or saving on wasteful public expenditures.

4. On the effects of the tax shock

In our simulations we consider different scenarios depending on the financing mechanisms used to offset the proposed tax reductions. We start by considering the case of lump-sum tax financing. Admittedly, this is an

Table 5

Effects of the tax shock – A summary table

Case	Y	TW	TW_C	TW_ℓ
Effects of the stimulus component under lump sum tax financing				
Effects of reducing the CIT rate	+0.94	−0.23	−0.14	−0.09
Effects of reducing the FSSC rate	+1.02	+0.49	+0.75	−0.25
Effects of reducing the PIT rate	+1.15	−0.55	−0.36	−0.17
The full stimulus component financed by...				
Lump sum tax	+2.91	−0.18	+0.33	−0.49
Corporate income tax	+0.95	−0.27	+0.12	−0.35
Personal income tax	+0.72	−0.99	−1.04	+0.07
Value-added and excise taxes	+2.77	−0.91	−0.55	−0.32
Public consumption	+2.56	+0.90	+1.24	−0.30

Key – Y GDP in 2050, TW Total welfare, TW_C Consumption component, and TW_ℓ Leisure component.

unrealistic scenario. It is, however, a clear benchmark case. It yields the best possible scenario in that it minimizes the distortion induced by offsetting tax increases. Simulation results suggest that under lump-sum financing the tax shock would increase GDP in the long-term by 2.91%.

The shock affects capital accumulation positively as well as employment and after-tax wages. Accordingly, the consumption component of private welfare is 0.33% higher. The leisure component, however, shows a long-term decline. The overall private welfare indicator reflects this decline and shows a long-term loss of 0.18%.

The next two scenarios consider the possibility of the stimulus component of the package being financed by increases in either corporate income or personal income tax revenues. These correspond to the idea of increased tax revenues due to a more effective combat against tax evasion. Ultimately, these scenarios require tax changes, which are in themselves distortionary.

Simulation results suggest that under corporate income tax financing of the tax shock the statutory tax rate would have to increase by between 6.64 and 8.63 pp. The effective tax rate would have to be 0.125 up from 0.105. Under this scenario, the gains in GDP performance are reduced by as much as 67.4% compared to the lump-sum financing scenario. Indeed, in the long-term GDP is only 0.95% higher than in the baseline scenario. Naturally, the private capital stock is lower as a result of tax policy change. Nevertheless, because employment and the after-tax wage still show some increase there is a long-term gain of 0.12% in the consumption component of the private welfare indicator. Overall, however, welfare declines by 0.27% reflecting a decline in the leisure component of welfare.

In turn, if the tax shock were to be financed by changes in personal income taxation, the effective personal income tax rate would have to rise by around 34% from 0.099 to 0.134. In this scenario, GDP in the long-term is only 0.72% higher than in the baseline, a 75.3% reduction compared to gains under lump-sum financing. In this scenario capital accumulation is lower than under lump-sum financing, employment rises only marginally and the after-tax wage declines as a result of higher personal income taxes. Naturally, despite the long-term gain in GDP, the consumption component of the private welfare indicator is 1.04% lower and the overall decline on 0.99% in public welfare reflects this fact.

The next scenario considers the case of value-added tax financing. Indeed, the tax proposal suggests that if there were a revenue shortfall as a result of the tax shock, the VAT tax rate would be temporarily increased by up to 2 pp. Simulation results suggest that, if no other means were available to finance the stimulus component then the general statutory VAT rate would have to increase by between 2.59 and 3.35 pp, a permanent increase that is somewhat higher than the maximum increase allowed in the tax proposal. Under this scenario, the current effective tax rate would have to be 0.236 up from 0.213. Under VAT financing, the tax shock would yield a long-term increase in GDP of 2.77%, which is comparable to the gains under lump-sum financing. Capital accumulation responds positively to the tax shock, as do employment and the after-tax wage. The consumption component of the private welfare indicator declines by 0.55%. This is because the increase in the VAT rate penalizes consumption. Furthermore, with leisure being a complement of consumption, households naturally increase their supply of labour and the leisure component of welfare declines as well. Under such a setting, in spite of higher corporate profits down the road, we should not be surprised that the GDP welfare trade-off makes its appearance once more. Indeed, in the long-term private welfare declines by 0.91%.

The final scenario considers the case of public consumption financing. Simulation results suggest to finance the tax shock an additional permanent decrease of 1.05 pp of GDP would be required. This is in addition to the 1.30 pp reduction required under the current Stability and Growth Programs. Under this financing scenario the tax shock would yield a long-term GDP increase of 2.56%. In this scenario the public sector is doing the required saving to finance the tax shock and private consumption needn't fall as much. With leisure being a normal good that is also a complement of consumption, households choose to supply less labour. For this reason, the after-tax wage rises the most of all scenarios. Naturally then, consumption is always higher and the respective component of private welfare increases 1.24%. Overall private welfare increases by 0.90%.

5. Concluding remarks

The critical aspect of our results is that the effects of the tax shock, both the magnitude of its positive effects on GDP and the sign of its *welfare effects depend critically on how the shock is financed.* Among the

scenarios based on tax financing, the cases of lump-sum and VAT financing yield the largest positive GDP effects while the case of lump-sum and corporate tax financing yield the lowest welfare losses. Interestingly, only in the case of public spending financing would the tax shock yield simultaneously positive GDP and welfare effects. This is not particularly good news in that this is not a very realistic scenario. This is because any reductions in public spending to finance the tax shock would have to be in addition to the already stringent reductions required under the Stability and Growth Program.

These considerations place at the centre of the tax reform debate the idea that all realistic changes have to be in the form of trading off distortionary tax margins. In this case, a *fundamental trade-off between the GDP and the welfare effects of tax reform seem to be difficult to avoid.* This trade-off can be traced to the effects of the tax changes on employment, after-tax wages, and disposable income, in particular, in the presence of adjustment costs.

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