Society and Economy 35 (2013) 3, pp. 365–388
DOI: 10.1556/SocEc.2013.0002
First published online 15 March 2013

THE DESTABILIZING EFFECT OF COMPANY INCOME TAXATION

PETER A. SCHMID

School of Management, Catholic University Eichstätt-Ingolstadt
Email: peter.a.schmid@ku-eichstaett.de

This paper examines the effects of company income taxation. Therefore, a tax system is implemented in a dynamic, stochastic macroeconomic model with endogenous financial structure. In addition to the long-term level effects that are in line with the deterministic public economics literature, cyclical effects are identified. Besides insurance incidences, company income taxation implies amplifying effects. Depending on the model's frictions, the latter can dominate and lead to more volatile business cycles.

Keywords: company income taxation, tax incidences, DSGE modeling, business cycles

JEL-codes: E32, H22, H25

1. INTRODUCTION

Company income taxation plays a major role in all developed economies. Despite the trend of decreasing tax rates due to international tax competition, revenues from company income taxation remained stable or even increased (Auerbach 2006). Nevertheless, taxing income from companies is debated fiercely, especially in the United States. Opponents draw on the insights from Kaldor (1955) and others, e.g. Gordon et al. (2004), who postulate the substitution of income by consumption taxation due to efficiency reasons. Moreover, it is argued that company income taxation constrains the forces of growth and hinders future economic development (Asea – Turnovsky 1998). In the aftermath of the financial crisis fiscal stimuli, inlcuding lower taxation, were discussed (Freedman et al. 2009; Székely et al. 2011) and implemeneted. Today there is pressure for fiscal consolidation in many developed countries and consequently scope to minimize tax distortions (Sutherland et al. 2012). In addition, there is a debate over how lower taxes might be used for lowering public expenditures and, finally, public debt (Kumhof – Laxton 2010).

This paper intends to deepen the understanding of taxation's implications on economic dynamics and, thus, help in the fiscal policy debate. Therefore, policy conclusions can be drawn and the simulated tax incidences can be the basis for statistical empirical research. In particular, I show that current tax systems amplify the business cycle and relativize taxation's role as an automatic stabilizer (Auerbach – Feenberg 2000; De Mooji 2005). Different taxes however have differing quantitative implications, giving room to concrete recommendations with the aim of reducing the amplifying effects of taxation, reducing the economy's volatility and increasing welfare.

My model integrates a tax system in a stochastic general equilibrium framework and thus is connected to the production economy literature (e.g. Jermann 1998). Problems caused by endogenous labor are tackled by habit formation for leisure (Uhlig 2007) with memory (Jaccard 2007). This way habit formation embraces both consumption and leisure and may reach back several periods. An endogenous financial structure is established by the implementation of a trade-off between tax advantages and leverage cost of debt. The leverage cost constitutes a technical simplification of cost associated with the solvency risk of debt (Alessandrini 2003) and thus bypasses technical difficulties (Schmid 2011).

The heart of this paper, the analysis of company income taxation, builds on a wide spectrum of the public economics literature. Empirical research shows a negative correlation between debt finance and profits taxation that can be ascribed to debt tax shields (Gordon – Lee 2001; Dwenger – Steiner 2009). Moreover, Djankov et al. (2010) detect negative effects of profits taxation on investment and economic activitiy in general. These pure empirical results are backed by an evolved taxation theory in the deterministic dynamic general equilibrium modeling framework. Starting with Sinn (1985), it developed enormously and covers taxation's effects in detail (Osterberg 1989; Turnovsky 2000; Strulik 2003; Radulescu 2007; Stimmelmayr 2007).

The literature on taxation in a stochastic environment, however, is not yet comprehensive. This is partly owed to a strong focus on endogenous growth theory and taxation's influence on growth (e.g. Peretto 2007). Or, there is a focus on optimal fiscal policy from the viewpoint of government debt like in Kumhof and Yakadina (2007) who find that populist tax cuts, financed by additional government debt, can cause business cycle fluctuations. Among the few publications that focus on incidences of company taxation, Greenwood and Hufmann (1991), for example use a simplified model that accounts for production only through equalizing factor prices with their marginal products and find that labor and capital income taxation have both stabilizing and amplifying effects on business cycles. Kenc (2004) demonstrates in an Arrow-Romer growth model with the same tax types that higher capital income taxation can cause more volatile business cycles if the deterministic part of the return is taxed more heavily. The latest approach of Santoro and Wei (2011) is closer to this paper, as it also builds on a Jermann (1998) style production economy but uses a much simpler model with only company profits taxed and with less properties that cover reality's complexity. It shows that the equity risk premium increases with higher retained profits taxation due to amplifications of the business cycle and does not identify any effects for the taxation of distributed profits. This paper connects to these works, as its main finding is the cycle amplification mechanism of taxation. In contrast to Kenc (2004), it does not split up capital taxation into different rates for the components of the return on capital. Contrary to all, it accounts for a complete tax system with an elaborate set of parameters and for an endogenous financial structure. Moreover, it features endogenous labor in contrast to Greenwood and Hufmann (1991), as well as Santoro and Wei (2011).

Thus, this paper advances current research on tax incidences by integrating a complete tax system in a more elaborate stochastic general equilibrium framework. In chapter 2 I show how the tax system can be represented by parameters, in chapter 3 the model is presented, in chapter 4 the model's results are analyzed, in chapter 5 I give policy recommendations and in chapter 6 I conclude.

2. THE TAX SYSTEM

Tax systems are based on labor, as well as personal capital income, consumption, profits and capital stock taxation. Personal capital income taxation distinguishes between three sources of income: interest, dividends and capital gains. Moreover, tax rates can differ for distributed and retained profits. Therefore the following tax rates and tax factors (one minus the appropriate rates) are used:

τ_ω, θ_ω	tax rate, tax factor on labor income;
τ_ν	tax rate on consumption;
τ_i, θ_i	tax rate, tax factor on interest income;
τ_p, θ_p	tax rate, tax factor on dividends;
τ_c, θ_c	tax rate, tax factor on capital gains;
τ_d, θ_d	tax rate, tax factor on distributed profits;
τ_r, θ_r	tax rate, tax factor on retained profits;
τ_k	tax rate on capital stock.

Moreover, it is necessary to modify profits because of tax accounting rules to obtain the tax base. Therefore, the following parameters are used:

- α_1 share of deductible net investment (accelerated depreciation);
- α_2 share of deductible imputed equity interest;
- α_3 share of deductible debt interest.

Tax depreciation does not coincide with economic depreciation. As it is usually more favorable, the share α_1 of net investment can be deducted immediately (Sinn 1985).

3. THE MODEL

The model is composed of a representative household, a representative firm and the government.

3.1. Household

The household maximizes its expected utility

$$E_0\left\{\sum_{t=0}^{\infty}\beta^t u(C_t, L_t^s, H_{t-1})\right\} \tag{1a}$$

by decisions on consumption, as well as labor streams, i.e. $\{C_t\}$ and $\{L_t^s\}$ and in case of internal habit formation also on habit stock streams $\{H_{t-1}\}$ subject to its intertemporal budget

$$\begin{gathered}\theta_\omega \omega_t L_t^s + \\ \theta_p Div_t S_{t-1}^d + \theta_c (P_t - P_{t-1}) S_{t-1}^d + \theta_i r_{t-1}^d B_{t-1}^d + \\ Csc_t + Tr_t = \\ C_t(1-\tau_v) + (P_t S_t^d - P_{t-1} S_{t-1}^d) + (B_t^d - B_{t-1}^d)\end{gathered} \tag{1b}$$

and the habit stock's equation of motion

$$H_t = h(H_{t-1}, C_t, L_t^s). \tag{1c}$$

In case of external habit formation the habit stocks are considered as an exogenous variable in the optimization.

Main sources of the household's income are after-tax labor and capital income. The first results from labor's renumeration ω_t multiplied by labor supply L_t^s and the tax factor θ_ω (first line of (1b)). The latter consists of (1) dividends per stock Div_t multiplied by the number of stocks S_{t-1}^d and the tax factor θ_p, (2) capital gains resulting from price changes $P_t - P_{t-1}$ per stock multiplied by the number of stocks and the tax factor θ_c and (3) interest income on debt given by the product of the debt interest rate r_{t-1}^d, the debt level B_{t-1}^d and the tax factor θ_i (second line of (1b)). In addition (third line of (1b)), the household realizes financial structure adjustment cost income and receives/pays governmental income transfers or lump-sum taxes Tr_t. The financial structure adjustment cost arises from corporate finance rearrangements in the firm sector and is obtained by the household sector as both equity and debt holder. In the case of income transfers (lump-sum taxes) Tr_t is postive (negative).

The household's revenues are spent on consumption $C_t(1+\tau_v)$, including the value added tax, and used for financial investments. The latter are split into equity, given by the difference of previous and current equity $P_t S_t^d - P_{t-1} S_{t-1}^d$, and debt increases, given by $B_t^d - B_{t-1}^d$.

Utility's dependence on the habit stock constitutes an important model friction that strengthens the household's intertemporal smoothing preferences. My specification also allows for a habit memory accounting for the full history of consumption and leisure streams, as opposed to only the last period, by making the previous habit stock H_{t-1} an argument in the habits stock's equation of motion.

3.2. Firm

The representative firm maximizes its equity value for its shareholders

$$V_0 = E_0 \sum_{t=1}^{\infty} \frac{\theta_p / \theta_c Div_t}{\prod_{i=0}^{t} [(m_i - 1)/\theta_c + 1]} \tag{2a}$$

by decisions on investment $\{I_t\}$, labor input $\{L_t^d\}$ and debt $\{B_t^s\}$ streams subject to its financing constraint

$$\frac{\theta_r}{\theta_d} Div_t = \theta_r [Z_t f(K_{t-1}, A_t L_t^d) - \omega_t L_t^d - l(B_{t-1}^s / K_{t-1}, F_t) B_{t-1}^s - \kappa(B_{t-1}^s)]$$

$$+\tau_r [\delta K_{t-1} + \alpha_1 (I_t - \delta K_{t-1}) + \alpha_2 r_t^e (K_{t-1} - B_{t-1}^s) + \alpha_3 r_{t-1}^d B_{t-1}^s] \quad (2b)$$

$$+[B_t^s - (1 + r_{t-1}^d) B_{t-1}^s - I_t - \tau_k L_{t-1}]$$

and the capital stock's equation of motion

$$K_t = \Theta\left(\frac{I_t}{K_{t-1}}\right) K_{t-1} + (1-\delta) K_{t-1}. \quad (2c)$$

The stochastic discount factor *m* is exogenous for the firm and derived from the household's preferences by the fraction of two consecutive marginal utilities of consumption (Cochrane 2005). There is an exogenous trend growth rate implemented by the labor productivity variable *A* with $A_{t+1} = aA_t$ and $a > 1$. Moreover, there are two exogenous shocks. First, the total factor productivity *Z* follows an exogenous auto-regressive process of first order with $Z_t = Z_{t-1}^{\rho^z} e^{\varepsilon_t^z}$ and $\varepsilon_t^z \in N(0, \sigma_z^2)$. Second, the debt financing conditions *F* are also characterized by a first-order auto-regressive process with $F_t = F_{t-1}^{\rho^F} e^{\varepsilon_t^F}$ and $\varepsilon_t^F \in N(0, \sigma_F^2)$.

The firm's financing constraint states that dividends are nourished by:

- company profits multiplied by the tax rate for retained profits, i.e. the first line of the right hand side of (2b),
- tax reductions yielded by tax accounting rules, i.e. the second line of the right hand side (2b), and the
- net increase in debt, less investment and taxes on the capital stock, i.e. the third line of the right hand side (2b).

Thus, retained profits and new debt are the only sources of finance. New capital issuances are not taken into consideration. The multiplier θ_r/θ_d before Div_t is necessary to account for the possibility of differing tax rates on retained and distributed profits; it becomes 1 in case of a single tax rate.

Profits result from:

- revenues obtained by production $Z_t f(\cdot)$,
- less the renumeration for labor $\omega_t L_t^d$,
- less leverage cost driven by the leverage cost function $l(\cdot)$ depending on the debt ratio and stochastic debt financing conditions and
- less financial structure adjustment cost resulting from $\kappa(\cdot)$.

Tax accounting rules resulting in a narrower tax base are accounted for in the second line of the right hand side of (2b). The firm sector is characterized by three frictions:

- Capital adjustment cost are implemented in capital's equation of motion (2c) by the function $\Theta(\cdot)$. They capture the cost arising from the transfer of consumption into investment goods (Hayashi 1982).
- The leverage cost $l(\cdot)B^s_{t-1}$, which are convex in debt, ensure an endogenous financial structure in the sense of a "trade-off theory". They are widely used in the public economics literature (Osterberg 1989; Strulik 2003) and are connected to the microfounded endogenous financial structure theory as proposed by Carlstrom and Fuerst (1997), Bernanke et al. (1999) or Christiano et al. (2009). They might be seen as a shortcut to the solution of the agency problem, as in Amdur (2009), who accounts for monitoring cost in the household sector to implement an endogenous financial structure.
- The financial structure adjustment cost $\kappa(\cdot)$ restricts fluctuations of debt due to transaction cost and the desire to avoid large and frequent changes of the financial structure.

3.3. Government and equilibrium

The government finances its expenses G_t by tax revenues from taxing consumption, labor, personal capital income, the capital stock and company profits. The gap between revenues and expenses is closed by transfer income to, or lump-sum taxes from, the houshold Tr_t. Public debt is not considered because of Ricardo-equivalence (Strulik 2003). As a result the government budget is given by

$$G_t + Tr_t = \tau_v C_t + \tau_\omega \omega_t L^s_t + \tau_p Div_t S^d_{t-1} + \tau_i r^d_{t-1} B^d_{t-1} + \tau_c (P_t - P_{t-1}) S^d_{t-1} + \tau_k K_{t-1} + Tax^f_t \quad (3a)$$

with

$$\begin{aligned} Tax^f_t &= \tau_d \frac{Div_t}{\theta_d} \\ &+ \tau_r \{ Z_t f(K_{t-1}, A_t L^d_t) - \omega_t L^d_t - dK_{t-1} - l(B^s_{t-1}/K_{t-1}, F_t) B^s_{t-1} - \kappa(B^s_{t-1}/K_{t-1}) \quad (3b) \\ &- \alpha_1 (I_t - \delta K_{t-1}) - \alpha_2 r^e_t (K_{t-1} - B^s_{t-1}) - \alpha_3 r^d_{t-1} B^s_{t-1} - \frac{Div_t}{q_d} \}. \end{aligned}$$

Profit taxes Tax_t^f consist, on the one hand, of the tax on distributed profits $\tau_d Div_t / \theta_d$; please note that Div_t are the distributions after profit taxation, which is why they have to be levered by $1/\theta_d$. On the other hand, there is the tax on retained earnings which is given by the product of the tax rate τ_r and the tax base shown in the curly brackets on the right hand side of (3b). The tax base is yielded by the difference of profits, deductible expenses resulting from tax accounting rules and distributed profits.

The model is closed by the market equilibria for product, labor, debt and equity markets:

$$Z_t f(K_{t-1}, A_t L_t^d) = C_t + I_t + G_t + l(B_{t-1} / K_{t-1}, F_t) B_{t-1}, \quad (4a)$$

$$L_t^s = L_t^d \equiv L_t, \quad (4b)$$

$$B_t^s = B_t^d \equiv B_t, \quad (4c)$$

$$S_t^d \equiv 1. \quad (4d)$$

As no new capital issuances are considered, the number of stocks S_t^d is normalized to 1.

4. SIMULATION RESULTS[1]

4.1. Parametrization

The model is calibrated for the United States and Germany. The model's functions are parametrized in the following way. The household's utility function is given by:

$$u(C_t, L_t) = \frac{[C_t (1 - L_t)^{\xi} - H_{t-1}]^{(1-\eta)}}{1 - \eta}. \quad (5a)$$

The habit stock's equation of motion follows:

$$H_t = habita \cdot H_{t-1} + habitb \cdot C_t (1 - L_t^s)^{\xi} \text{ with } habita, habitb \geq 0. \quad (5b)$$

As long as $habita > 0$ there is habit memory, i.e. the household considers its complete history of consumption and leisure streams in its habit formation. Here, the

[1] All quantitative results can be obtained from the author upon request.

household has discretion over the habit stock such that internal habit formation is pursued. As in Jermann (1998), I generally use internal habit formation but also make a robustness check for external habits. For comparison, the tax incidence results of the model with external habits are reported in *Appendix C*.

The production function is Cobb-Douglas with constant returns to scale and labor-augmenting technical porgress:

$$f(K_{t-1}, A_t L_t) = K_{t-1}^{\alpha} (A_t L_t)^{1-\alpha} \text{ with } \alpha > 0. \tag{6a}$$

Capital's equation of motion, the leverage cost function and financial structure adjustment cost are given by:

$$K_t = \left[1 - \delta + \frac{j_1}{1-\zeta} \left(\frac{I_t}{K_{t-1}} \right)^{1-\varsigma} + j_2 \right] K_{t-1} \text{ with } \varsigma \geq 0, \tag{6b}$$

$$l(B_{t-1} / K_{t-1}, F_t) = lev_1 + lev_2 F_t^{-1} \cdot (B_{t-1} / K_{t-1})^{\gamma} \text{ with } lev_2 \geq 0 \text{ and } \gamma \geq 1, \tag{6c}$$

$$\kappa(B_{t-1}) = \frac{c^b}{A_t} (B_{t-1} - \overline{B})^2 \text{ with } c^b \geq 0 \text{ and } \overline{B} \text{ equal to the long-term debt level.} \tag{6d}$$

The capital adjustment cost parameters j_1 and j_2 are constructed in such a way that there are no costs in the long-term deterministic steady state (Heer – Maußner 2009). The leverage cost function's parameters lev_1, lev_2 and γ are chosen so that a one percent increase of the tax rate on retained profits augments the debt ratio by half a percentage point (Strulik 2003).

The tax parameters are given by law. The parameters $\alpha, \beta, \delta, \eta, \rho^Z, \rho^F, \sigma_Z$ and σ_F are chosen in the style of previous publications. The parameters α and φ ensure that the long-term trend growth rates are met and that in the long-run eight hours a day are worked, respectively. All other parameters (c^b, *habita, habitb* and ς) are chosen by minimizing the sum of squared and weighted deviations of the model's results from empirical observations for macroeconomic fluctuations and the risk premium under the restriction that a positive correlation of labor and production is generated. Details are provided in *Appendix A*.

4.2. Effects of the tax system

The model's results are generated by second order perturbation methods with Dynare. The complete list of equations and the code can be obtained from the author.

Table 1

Results for Germany and the United Sates

Expected values (levels)									
	E(y)	*E(c/y)*	*E(i/y)*[2]	*E(k/y)*	*E(L/y)*	$E(r^e – r^d)$			
Germany									
(1)	1.869	0.754	0.246	8.422	0.301	0.006			
(2)	0.984	0.803	0.197	6.707	0.342	0.014			
(3)	1.058	0.783	0.217	7.400	0.323	0.031			
(4)	1.017	0.808	0.2092	7.136	0.330	0.022			
U.S.A.									
(1)	1.499	0.756	0.244	8.228	0.305	0.006			
(2)	0.892	0.831	0.169	5.648	0.376	0.014			
(3)	0.971	0.810	0.190	6.369	0.352	0.035			
(4)	0.934	0.8272	0.1842	6.152	0.359	0.022			
Relative standard deviations									
	σ_y	σ_c/σ_y	σ_i/σ_y	σ_k/σ_y	σ_L/σ_y	σ_{re}	σ_{rd}	$\sigma_{div/y}$	σ_b
Germany									
(1)	1.139	0.429	2.950	0.300	0.287	6.672	0.745	4.913	–
(2)	1.315	0.407	3.839	0.385	0.485	10.709	1.906	9.565	–
(3)	1.299	0.412	3.501	0.347	0.480	21.323	2.194	71.498	0.451
(4)	1.321	0.402	3.646	0.367	0.487	16.684	1.754	58.639	0.772
U.S.A.									
(1)	1.181	0.455	2.853	0.295	0.335	6.699	0.760	4.751	–
(2)	1.276	0.464	4.079	0.414	0.434	10.896	1.899	9.515	–
(3)	1.259	0.472	3.643	0.364	0.427	22.100	2.339	72.205	0.459
(4)	1.271	0.469	3.898	0.402	0.434	16.646	1.596	86.272	2.088
Correlations with production									
	c	*i*	*k*	*L*	r^e	r^d	*div/y*	*b*	
Germany									
(1)	0.894	0.980	0.431	0.955	0.261	–0.955	–0.955	–	
(2)	0.819	0.969	0.477	0.946	0.238	–0.942	–0.944	–	
(3)	0.819	0.970	0.473	0.944	0.308	–0.942	0.704	0.473	
(4)	0.813	0.972	0.464	0.946	0.298	–0.952	0.345	–0.932	
U.S.A.									
(1)	0.921	0.981	0.426	0.957	0.264	–0.957	–0.957	–	
(2)	0.875	0.963	0.499	0.937	0.230	–0.934	–0.936	–	
(3)	0.875	0.964	0.496	0.934	0.295	–0.933	0.708	0.496	
(4)	0.868	0.969	0.476	0.932	0.294	–0.950	0.035	–0.943	

Source: calculations of the author.

[2] Please note that the leverage cost enters the product market equilibrium so that the shares of investment and of consumption do not add up to 1 in version (4).

The results from the model variations

(1) model without taxes and with full equity finance;
(2) model with taxes and full equity finance;
(3) model with taxes and a fixed (exogenous) financial structure;
(4) model with taxes and an endogenous financial structure

are summarized in *Table 1*. These are quarterly values. Small letters indicate variables adjusted by trend growth, e.g. c is consumption adjusted by trend growth.

The results document the model's ability to capture basic characteristics of business cycles (Rebelo 2005) and meet empirical requirements. First, production volatility is more than double of that exhibited by consumption, and likewise investment volatility is more than twice as high as production volatility. Second, labor is procyclical. Third, there is a realistic risk premium despite a reasonable volatility of the riskfree rate. In addition, the current tax systems have a destabilizing effect on the business cycle. In detail, there are the following effects:

– The introduction of the tax system from variation (1) to variation (2) implies enormous implications for economic dynamics. Product and labor market become volatile. In addition, the risk premium increases. Thus, the current tax systems do not serve the role of an automatic stabilizer.
– The introduction of fixed debt from variation (2) to variation (3) increases the risk premium further due to the leverage effect. Moreover, the debt tax shield implies real effects with lower fluctuations of production and investment. The incidences on consumption are very small and labor fluctuates slightly less.
– The introduction of endogenous debt from variaton (3) to variation (4) implies an amplifcation of production and investment volatilities and stronger labor fluctuations. The effects on consumption are again very small.

The tax incidences of the single parameters are summarized in *Table 2a* and *Table 2b*. A positive (negative) sign means that a hike of the specific tax parameter increases (decreases) the stated variable; a question-mark is used in the cases where the effects for Germany and the United States differ.

The taxation of dividends and distributed profits does not show any real or financial effects, except for the implications of dividend taxation on the equity return. The latter and the risk premium increase with dividend taxation because the equity return is measured before this specific tax. The lack of real effects is due to the fact that the firm's investment is financed by retained profits and new debt. As new equity is not accounted for in the model there cannot be any real effects of dividends and distributed profits taxation.

Table 2a

Level effects of taxation

	$\tau_w\uparrow\tau_v\uparrow$	$\tau_i\uparrow$	$\tau_p\uparrow\tau_d\uparrow$	$\tau_c\uparrow\tau_r\uparrow\tau_k\uparrow$	$\alpha_1\uparrow\alpha_2\uparrow\alpha_3\uparrow$
$E(y)$	–	–	0	–	+
$E(c)$	–	–	0	–	+
$E(i)$	–	–	0	–	+
$E(i/y)$	+	–	0	–	+
$E(L/k)$	–	+	0	+	–
$E(b/k)$	–	–	0	+,+,–	+,–,+
$E(r^e – r^d)$	+	–	+, 0	+	–,–,?

Source: calculations of the author.

Table 2b

Cyclical effects of taxation

	$\tau_w\uparrow\tau_v\uparrow$	$\tau_i\uparrow$	$\tau_p\uparrow\tau_d\uparrow$	$\tau_c\uparrow\tau_r\uparrow\tau_k\uparrow$	$\alpha_1\uparrow\alpha_2\uparrow\alpha_3\uparrow$
σ_y	+	+	0	?,–,+	–,+,–
σ_c	+	–	0	+	–,–,+
σ_i	+	+	0	+	–
σ_c/σ_y	–	–	0	+	–,–,+
σ_i/σ_y	+	+	0	+	–
σ_L	+	+	0	?,–?	?,+,–
σ_L/σ_k	+	?	0	–	+,+,?
σ_b/σ_k	+	–	0	+	–,+,+
σ_λ	+	?	0	?,+,+	–,–,?

Source: calculations of the author.

Labor and consumption taxations' effects are qualitatively equal as every labor taxation can be converted (non-revenue-neutrally) into a consumption tax. By making labor more expensive, the labor-capital-relation is reduced below its former optimal level. Consequently, lower production, consumption and investment (macroeconomic aggregates) and a cyclical destabilization are yielded. The higher uncertainty is also shown in a higher risk premium. The debt ratio, although not affected in a deterministic model, decreases slightly. The economic destabilization is also seen in the impulse response functions for investment, consumption and labor to a shock equal to one standard deviation σ_Z to total factor productivity *(Figure 1).*

Interest taxation also leads to lower macroeconomic aggregates by discouraging capital formation through the debt channel by a decreased debt ratio. Investment becomes less important as a share of production and the labor-capital-relation increases. The cyclical consequences are mixed. While production, investment and labor become more volatile, consumption stabilizes. The effects on the

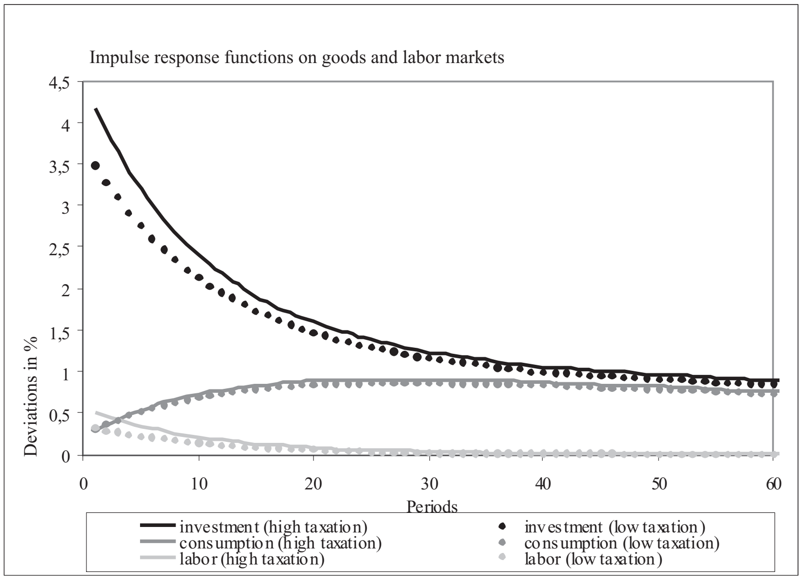

Figure 1. Impulse response functions for Germany for different labor taxation regimes, i.e. high (τ_ω = 0.5090) and low (τ_ω = 0.1) taxation

Source: calculations of the author.

co-state variable λ for the household's intertemporal budget are different for Germany and the United States. Nevertheless, a possible increasing effect on the risk premium by higher economic uncertainty is not strong enough for counteracting the negative leverage effect by the lower debt ratio. Consequently, the risk premium decreases.

Capital gains, capital stock and retained profits taxation can be grouped together. By cutting marginal revenus of capital they lead to lower capital formation and macroeconomic aggregates, a lower share of investment in production and a higher labor-capital-relation. The fluctuations of investment and consumption increase. Although both investment and consumption become more volatile, production's volatility may become smaller due to investment's smaller share in production. With respect to labor's volatility, the three taxes differ in their implications. While labor stabilizes in the case of retained profits taxation, the effects for capital gains and stock taxation are different for Germany and the United States. Nevertheless, the ratio of labor and capital volatilities decreases for all tax rates which can be interpreted as a relative stabilization of labor. The cyclical effects of retained profits taxation can also be seen in the respective impulse response functions for investment, consumption and labor to a shock equal to σ_Z to total factor productivity *(Figure 2)*.

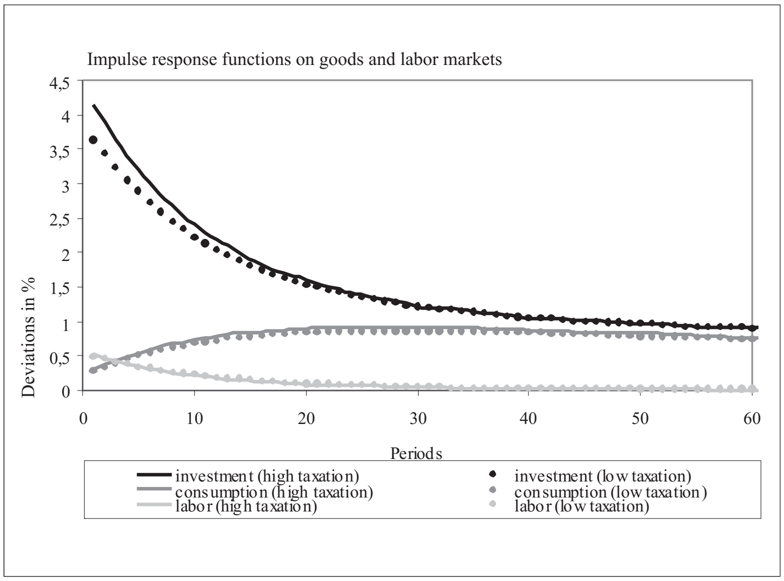

Figure 2. Impulse response functions for Germany for different retained profits taxation regimes, i.e. high ($\tau_r = 0.3661$) and low ($\tau_r = 0.05$) taxation

Source: calculations of the author.

λ's volatility increases in the case of retained profits and capital stock taxation, which leads to a higher risk premium manifesting the economy's higher uncertainty. For the capital gains taxation the effects on the co-state variable λ are uncertain but, due to a postive leverage effect, the risk premium increases as well. With respect to the debt ratio the three taxes have differing effects. While capial gains and retained profits taxation increase the debt ratio, capital stock taxation leads to a slightly lower debt ratio.

Accelerated depreciation and deductible imputed equity interest have smoothing real effects as they constrain retained profits taxation. Deductible debt interest only has smoothing effects with respect to macroeconomic levels and has unclear cyclical effects and differing incidences on the risk premium in both countries.

4.3. Frictions, insurance and amplification

The model's frictions influence its results considerably. First, debt finance allows pro-cyclical dividends (see *Table 1* from variation (2) to variation (3)). Second, taxation becomes effective through the debt channel by altering the optimal debt ratio. Third, debt volatility spills over to the real economy (see *Table 1* from variation (3) to (4)). Moreover, reducing financial structure adjustment costs results in higher volatilities of debt and product markets, but a decreasing labor volatility. Consequently, there are spill-over effects from the financial to the real economy. Financial shocks, however, do not play a significant role, and influence the model's results only to a very small extent.

Most importantly, the fricitions are decisive for the cyclical effects of taxation on the real economy, which are summarized in *Table 3*.

Table 3

Real cyclical effects of taxation

	$\tau_w \uparrow \tau_v \uparrow$	$\tau_i \uparrow$	$\tau_p \uparrow \tau_d \uparrow$	$\tau_c \uparrow \tau_r \uparrow \tau_k \uparrow$	$\alpha_1 \uparrow \alpha_2 \uparrow \alpha_3 \uparrow$
σ_i	+	+	0	+	–
σ_c	+	–	0	+	–,–,+
σ_l	+	+	0	?,–?	?,+,–
E[cl/(cl + i)][3]	+	+	0	+	–

Source: calculations of the author.

The taxation of dividends and distributed profits lack real economic effects as new capital issuances are not considered as a financing source. All other taxes have real cyclical effects. Investment's volatility is increased by the tax rate and dampened by the tax accounting parameters. This is due to the more important long-term role of the mixed good $c(1-L)^{\xi}$ compared to investment, as shown in the last line of *Table 3*. By developing Santoro and Wei (2011) further, investment must react stronger to stochastic shocks as the household sector has strong preferences for smoothing consumption and leisure due to habit persistence with memory. As capital adjustment costs limit investment's reactions, however, consumption and labor can also vary stronger in the presence of taxes. All in all, there are two counteracting effects. First, taxation results in insurance and thus has a stabilizing effect. But second, there are looping effects in the general equilibirum via the stochastic discount that can be destabilizing due the model's frictions. Here the destabilizing effect dominates for many tax parameters and yields real cyclical destabilization. The effects are illustrated by the following impulse response functions for investment for the case of retained profits taxation to a shock equal to σ_Z to total factor productivity *(Figure 3)*.

There are great differences in the impulse response functions. First, a lack of habit persistance leads to a weaker response of investment in cases of stronger retained profits taxation as they are better absorbed by consumption and leisure.

[3] *cl* is the mixed good of the household, i.e. $cl \equiv c(1-L)^{\xi}$.

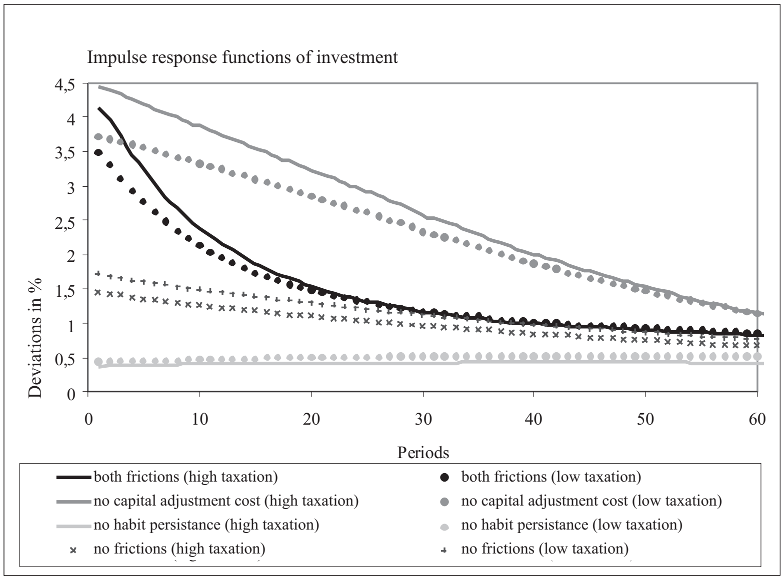

Figure 3. Impulse response functions of investment for the United States in dependence of different friction designs for high (τ_r = 0.4070) and low (τ_r = 0.05) retained profits taxation

Source: calculations of the author.

Habit persistance with memory, however, deables this mechanism with the result of amplifying investment's response. Capital adjustment costs play a role, too, as they dampen a much stronger response of investment and yield an amplification of consumption's response in the case of retained profits, labor and consumption taxation, for example. Thus, these two frictions determine taxation's incidence on the business cycle by ensuring that the destabilization effect dominates taxation's insurance aspect.

5. POLICY RECOMMENDATION: THE CASE FOR CONSUMPTION TAXATION

Policy recommendations can be deducted from the simulation of tax reforms. In *Table 4,* I show the effects of revenue-neutral tax reforms where the effects of higher consumption taxation and simultaneous reductions of the other tax parameters are shown.

Although labor and consumption taxation have the same qualitative tax incidences, the latter produces less distortions. Labor taxation results in a stronger decrease of macroeconomic aggregates, higher fluctuations on product and labor markets and a higher risk premium. Higher consumption taxation in favor of less interest income and capital gains taxation also has positive level effects. The cyclical effects are not the same for both tax reforms, but the overall tendency is a stabilization of at least the product markets.

Lowering retained profits by higher consumption taxation shows positive welfare effects, too. The macroeconomic aggregates and investment's share of production increase, product markets stabilize and the risk premium decreases. Only

Table 4

Tax incidences in case of consumption tax reforms

	$E(y)$	$E(c)$	$E(i)$	$E(i/y)$	$E(L/k)$	$E(b/k)$	$E(r^e – r^d)$	
$\tau_\omega \downarrow$	+	+	+	–	+	+	–	
$\tau_i \downarrow$	+	+	+	+	–	+	+	
$\tau_p \downarrow$	–	–	–	+	–	–	–	
$\tau_c \downarrow$	+	+	+	+	–	–	–	
$\tau_r \downarrow$	+	+	+	+	–	–	–	
$\tau_d \downarrow$	–	–	–	+	–	–	+	
$\alpha_1 \downarrow$	–	–	–	–	+	–	+	
$\alpha_2 \downarrow$	–	–	–	–	+	+	+	
$\alpha_3 \downarrow$	–	–	–	–	+	–	–	
$\tau_k \downarrow$	+	+	+	+	–	+	–	
	σ_y	σ_c	σ_i	σ_c/σ_y	σ_i/σ_y	σ_L/σ_k	σ_b/σ_k	σ_λ
$\tau_\omega \downarrow$	–	–	–	+	–	–	–	–
$\tau_i \downarrow$	–	+	–	+	–	?	+	+
$\tau_p \downarrow$	+	+	+	–	+	+	+	+
$\tau_c \downarrow$	+	–	–	–	–	+	–	?
$\tau_r \downarrow$	+	–	–	–	–	+	–	–
$\tau_d \downarrow$	+	+	+	–	+	+	+	+
$\alpha_1 \downarrow$	?	+	+	+	+	–	+	+
$\alpha_2 \downarrow$	–	+	+	+	+	–	–	+
$\alpha_3 \downarrow$	+	–	+	–	+	?	–	–
$\tau_k \downarrow$	+	–	–	–	–	+	–	–

Source: calculations of the author.

labor fluctuates more. Comparing the quantitative results with the effects of lower interest income and capital gains, taxation emphasizes the relatively high positive welfare effects that can be realized by a lower retained profits taxation.

Capital stock taxation also displays higher negative level and cyclical effects than consumption taxation. Thus, higher macroeconomic aggregates and investment share in production, as well as a stabilization of product markets, and a lower risk premium can be generated by lowering this tax type by increasing consumption taxation. As with retained profits taxation, only labor becomes more volatile.

By contrast, increasing consumption taxation in favor of lower rates on dividends and distributed profits has negative effects as these two tax types do not show any real economic effects due to the absence of new capital issuances as a financing source.

All in all, it is recommendable for policymakers to think about stronger consumption taxation in the light of not only yielding level effects but also due to stabilizing effects on the business cycle.

6. CONCLUSION

Summarizing, my model extends current research and contributes to a better understanding of tax incidences in a stochastic environment. First, the long-term level effects of taxation in deterministic models (Strulik 2003) are affirmed in the stochastic environment. Second, it shows that taxation can accelerate business cycles like the current tax systems in Germany and the United States. This main finding is of interest for policy makers who should be aware not only of level effects of taxation but its effects on fluctuations as well. Moreover, the incidences of taxation are split up to different tax types and incidences identified. These insights should be considered in future tax reforms. The model can be used for the derivation of more concrete policy recommendations by identifying the effects of tax reforms. For this end, not only consumption taxation as a possible starting point but all tax types should be considered, especially for the identification of an optimal tax mix. For the consideration of dividends and distributed profits taxation, the model must be extended with new capital issuances as financing source such that these two tax types have real economic effects as well. Moreover, international capital movements might be implemented by enriching the model by a foreign world sector. Fiscal policy shocks might also be implemented in the model as they evidently play an important role for business cycles (McGrattan 1994). Another field of research might be pure empirical research for which the findings of this article can be used for hypotheses formulation.

APPENDIX A. PARAMETRIZATION

Table A1

Non-tax parameters

Parameter	Ger-many	U.S.A.	Source
a	1.0040	1.0045	Own calculations
c^b	0.0500	0.0500	Own calculations
habita	0.1600	0.1600	Own calculations
habitb	0.8100	0.8100	Own calculations
lev_1	–0.0150	–0.0095	Own calculations
lev_2	0.0271	0.0307	Own calculations
α	0.3600	0.3600	Boldrin et al. (2001)
β	0.9900	0.9900	Heer – Maußner (2009)
g	2.0000	2.0000	Own calculations
d	0.0250	0.0250	King et al. (1988); McGrattan (1994)
η	2.0000	2.0000	Heer – Maußner (2009)
ξ	0.6589	1.0160	Own calculations
ρ^Z	0.9900	0.9900	Jermann (1998)
σ_Z	0.0072	0.0072	Heer – Maußner (2009)
ς	2.5000	2.5000	Own calculations
ρ^F	0.9500	0.9500	Jermann – Quadrini (2009)
σ_F	0.0100	0.0100	Jermann – Quadrini (2009)

Table A2

Tax parameters

Parameter	Ger-many	U.S.A.	Source
τ_ω	0.5090	0.2940	OECD 2010 (OECD Tax Database, Table I.5)
τ_ν	0.1679	0.0680	Own calculations, The Sales Tax Clearinghouse 2010
τ_i	0.2638	0.2100	Own calculations, OECD Tax Database, Table I.5
τ_p	0.1570	0.0701	Own calculations, OECD Tax Database, Table II.4
τ_c	0.0392	0.0194	Own calculations; OECD Tax Database, Table II.4
τ_d	0.3661	0.4070	Own calculations; OECD Tax Database, Tables I.7 & II.1
τ_r	0.3661	0.4070	Own calculations; OECD Tax Database, Tables I.7 & II.1
α_1	0.0800	0.0865	Stimmelmayr (2007); Own calculations
α_2	0.0000	0.0000	Own calculations
α_3	0.8714	1.0000	Own calculations
τ_k	0.0013	0.0052	Own calculations

APPENDIX B. LIST OF VARIABLES

Latin letters

a	Exogenous trend growth rate
A	Productivity variable
B^d, B^s	Demand, supply of debt
C	Consumption
c^b	Parameter in financial structure adjustment cost function
Csc	Financial structure adjustment cost
Div	Dividends
$E(x)$	Expected value of the variable
F	Debt financing conditions
H	Habit stock
I	Investment
j_1	Parameter in capital adjustment cost function
j_2	Parameter in capital adjustment cost function
K	Capital stock
L^d, L^s	Labor demand, supply
lev_1	Parameter in leverage cost function
lev_2	Parameter in leverage cost function
m	Stochastic discount
P	Stock price
r^d	Debt interest
r^e	Imputed equity interest
RP	Risk premium
S^d	Stock demand
Tax^f	Revenues from profit taxation
Tr	Transfer income or lump-sum taxes
Z	Total factor productivity

Greek letters

α	Capital share in production function
α_1	Share of deductible net investment
α_2	Share of deductible imputed equity interest
α_3	Share of deductible debt interest
β	Time preference rate
γ	Parameter in leverage cost function
η	Parameter in the utility function
δ	Rate of economic depreciation
ε^F	Shock on debt financing conditions

ε^Z	Shock on total factor productivity
λ	Co-state variable (adjusted for trend growth) for the household's intertemporal budget
ρ^F	Parameter for AR process of debt financing conditions
ρ^Z	Parameter for AR process of the total factor productivity
σ_x	Volatility of the variable x
σ_F	Standard deviation of εF
σ_Z	Standard deviation of εZ
ς	Parameter in capital adjustment cost function
τ_c, θ_c	Tax rate, tax factor on capital gains
τ_i, θ_i	Tax rate, tax factor on debt interest
τ_p, θ_p	Tax rate, tax factor on dividends
τ_d, θ_d	Tax rate, tax factor on distributed profits
τ_r, θ_r	Tax rate, tax factor on retained profits
τ_k	Tax rate on capital stock
τ_v	Tax rate on consumption
$\tau_\omega, \theta_\omega$	Tax rate, tax factor on labor income
ξ	Parameter in utility function
ω	Wage rate

APPENDIX C

For a robustness check the tax incidences for the case of external habits are given in *Table C1* and *Table C2*. For the levels only the incidence of deductible debt interest on the risk premium differs. For the cyclical incidences there are some changes for interest, capital gains and capital stock taxation as well as the tax accounting parameters. The overall finding of cyclical destabilization, however, re-

Table C1

Level effects of taxation in the case of external habits

	$\tau_w\uparrow \tau_v\uparrow$	$\tau_i\uparrow$	$\tau_p\uparrow \tau_d\uparrow$	$\tau_c\uparrow \tau_r\uparrow \tau_k\uparrow$	$\alpha_1\uparrow \alpha_2\uparrow \alpha_3\uparrow$
E(y)	–	–	0	–	+
E(c)	–	–	0	–	+
E(i)	–	–	0	–	+
E(i/y)	+	–	0	–	+
E(L/k)	–	+	0	+	–
E(b/k)	–	–	0	+,+,–	+,–,+
$E(r^e – r^d)$	+	–	+, 0	+	–,–,+

Source: calculations of the author.

mains unchallenged. Only interest taxation on its own might have stabilizing effects; the destabilizing incidences of capital gains, retained profits and capital stock taxation is evident.

Table C2

Cyclical effects of taxation in the case of external habits

	$\tau_w \uparrow \tau_v \uparrow$	$\tau_i \uparrow$	$\tau_p \uparrow \tau_d \uparrow$	$\tau_c \uparrow \tau_r \uparrow \tau_k \uparrow$	$\alpha_1 \uparrow \alpha_2 \uparrow \alpha_3 \uparrow$
σ_y	+	+	0	–,–,–	+,+,–
σ_c	+	–	0	?,+,+	–,–,+
σ_i	+	?	0	+	–,–,?
σ_c/σ_y	–	–	0	?,+,+	–,–,+
σ_i/σ_y	+	?	0	+	–,–,?
σ_L	+	+	0	+,–,–	+,+,–
σ_L/σ_k	+	?	0	–	+,+,–
σ_b/σ_k	+	–	0	+	–,+,+
σ_λ	+	–	0	+,+,+	–,–,+

Source: calculations of the author.

REFERENCES

Alessandrini, F. (2003): Introducing Capital Structure in a Production Economy: Implications for Investment, Debt and Dividends. FINRISK: *Working Paper* No. 47.

Amdur, D. (2009): Capital Structure over the Business Cycle. Georgetown University: *Working Paper.*

Asea, P. K. – Turnovsky, S. J. (1998): Capital Income Taxation and Risk Taking in a Small Open Economy. *Journal of Public Economics* 68: 55–90.

Auerbach, A. J. (2006): The Future of Capital Income Taxation. *Fiscal Studies* 27: 399–420.

Auerbach, A. J. – Feenberg, D. (2000): The Significance of Federal Taxes as Automatic Stabilizers. *Journal of Economic Perspectives* 14(3): 37–56.

Bernanke, B. – Gertler, M. – Gilchrist, S. (1999): The Financial Accelerator in a Quantitative Business Cycle Framework. In: Taylor, J. – Woodford, M. (eds.): *Handbook of Macroeconomics Volume 1C*. Amsterdam: Elsevier.

Boldrin, M. – Christiano, L. J. – Fisher, J. D. M. (2001): Habit Persistence, Asset Returns, and the Business Cycle. *The American Economic Review* 91(1): 149–166.

Carlstrom, C. – Fuerst, T. (1997): Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis. *The American Economic Review* 87(5): 893–910.

Christiano, L. J. – Motto, R. – Rostagno, M. (2009): Financial Factors in Economic Fluctuations (Preliminary). Northwestern University: *Working Paper*.

Cochrane, J. (2005): *Asset Pricing, Revised Edition.* Princeton: Princeton University Press.

De Mooij, R. (2005): Will Corporate Income Taxation Survive? *The Economist* 153: 277–301.

Djankov, S. – Ganser, T. – McLiesh, C. – Ramalho, R. – Shleifer, A. (2010): The Effect of Corporate Taxes on Investment and Entrepreneurship. *American Economic Journal: Macroeconomics* 2(3): 31-64.

Dwenger, N. – Steiner, V. (2009): Financial Leverage and Corporate Taxation: Evidence from German Corporate Tax Return Data. DIW: *Discussion Paper* No. 855.
Freedman, C. – Kumhof, M. – Laxton, D. – Lee, J. (2009): The Case for Global Fiscal Stimulus. *IMF Staff Position Note,* SPN/09/03.
Gordon, R. – Kalambokidis, L. – Slemrod, J. (2004): Do We Now Collect Any Revenue from Taxing Capital Income? *Journal of Public Economics* 88: 981–1009.
Gordon, R. H., – Lee, Y. (2001): Do Taxes Affect Corporate Debt Policy? Evidence from U.S. Corporate Tax Return Data. *Journal of Public Economics* 82: 195–224.
Greenwood, J. – Huffmann, G. (1991): Tax Analysis in a Real-business-cycle Model – On Measuring Harberger Triangles and Okun Gaps. *Journal of Monetary Economics* 27: 167–190.
Hayashi, F. (1982): Tobin's Marginal q and Average q: A Neoclassical Interpretation. *Econometrica* 50: 213–224.
Heer, B. – Maußner, A. (2009): *Dynamic General Equilibrium Modeling: Computational Methods and Applications*. Berlin, Heidelberg: Springer.
Jaccard, I. (2007): Asset Pricing, Habit Memory, and the Labor Market. FINRISK: *Working Paper* No. 410.
Jermann, U. J. (1998): Asset Pricing in Production Economies. *Journal of Monetary Economics* 41: 257–275.
Jermann, U. J. – Quadrini, V. (2009): Macroeconomic Effects of Financial Shocks. Wharton School of the University of Pennsylvania: *Working Paper*.
Kaldor, N. (1955): *An Expenditure Tax*. London: George Allen & Unwin.
Kenc, T. (2004): Taxation, Risk-taking and Growth: A Continuous-time Stochastic General Equilibrium Analysis with Labor-leisure Choice. *Journal of Economic Dynamics & Control* 28: 1511–1539.
King, R. G. – Plosser, C. I. – Rebelo, S. T. (1988): Production, Growth and Business Cycles: I. The Basic Neoclassical Model. *Journal of Monetary Economics* 21: 195–232.
Kumhof, M. – Laxton, D. (2010): To Starve or not to Starve the Beast. *IMF Working Paper Series* WP/10/199.
Kumhof, M. – Yakadina, I. (2007): Politically Optimal Fiscal Policy. *IMF Working Paper Series* WP/07/68.
McGrattan, E. R. (1994): The Macroeconomic Effects of Distortionary Taxation. *Journal of Monetary Economics* 33: 573–601.
OECD (2010): *Taxing Wages: 2008–2009*. Paris: OECD Publishing.
Osterberg, W. P. (1989): Tobin's q, Investment and the Endogenous Adjustment of Financial Structure. *Journal of Public Economics* 40: 293–318.
Peretto, P. (2007): Corporate Taxes, Growth and Welfare in a Schumpeterian Economy. *Journal of Economic Theory* 137: 353–382.
Radulescu, D. (2007): *CGE Models and Capital Income Tax Reforms: The Case of a Dual Income Tax for Germany*. Berlin, Heidelberg: Springer.
Rebelo, S. (2005): Real Business Cycle Models: Past, Present and Future. *The Scandinavian Journal of Economics* 107: 217–238.
Santoro, M. – Wei, C. (2011): Taxation, Investment and Asset Pricing. *Review of Economic Dynamics* : 14: 443–454.
Schmid, P. A. (2011): *Investitionen, Finanzierung und Steuern: Eine Analyse in einer stochastischen Umwelt*. Hamburg: Dr. Kovač.
Sinn, H.-W. (1985): *Kapitaleinkommensbesteuerung. Eine Analyse der intertemporalen, internationalen und intersektoralen Allokationswirkungen*. Tübingen: J.C.B. Mohr.
Stimmelmayr, M. (2007): *Fundamental Capital Income Tax Reforms*. Tübingen: Mohr Siebeck.

Strulik, H. (2003): Capital Tax Reform, Corporate Finance, and Economic Growth and Welfare. *Journal of Economic Dynamics & Control* 28: 595–615.
Sutherland, D. – Hoeller, P. – Merola, R. (2012): How Much, How Fast and by What Means? *OECD Economic Policy Papers*: No. 1/2012.
Székely, I. – Roeger, W. – In 't Veld, J. (2011): Fiscal Policy in the EU in the Crisis: A Model-based Approach with Application to New EU Member States. *Society and Economy* 33: 595–618.
The Sales Tax Clearinghouse (2011): Frequently Asked Questions. http://thestc.com/FAQ.stm., accessed 02/08/2011.
Turnovsky, S. J. (2000): *Methods of Macroeconomic Dynamics.* Cambridge, London: MIT Press.
Uhlig, H. (2007): Explaining Asset Prices with External Habits and Wage Rigidities in a DSGE Model. *The American Economic Review* 97(2): 239–243