Volume Title: Fiscal Policy after the Financial Crisis

Volume Author/Editor: Alberto Alesina and Francesco Giavazzi, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-01844-X, 978-0-226-01844-7 (cloth)

Volume URL: http://www.nber.org/books/ales11-1

Conference Date: December 12-13, 2011

Publication Date: June 2013

Chapter Title: How Do Laffer Curves Differ across Countries?

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Chapter URL: http://www.nber.org/chapters/c12638

Chapter pages in book: (p. 211 - 249)

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How Do Laffer Curves Differ across Countries?

Mathias Trabandt and Harald Uhlig

6.1 Introduction

We seek to understand how Laffer curves differ across countries in the United States and the EU-14. This provides insight into the limits of taxation. As an application, we analyze the consequences of recent increases in government spending and their fiscal consequences as well as the consequences for the permanent sustainability of current debt levels, when interest rates are permanently high, for example, due to default fears.

We build on the analysis in Trabandt and Uhlig (2011). There, we have characterized Laffer curves for labor and capital taxation for the United States, the EU-14, and individual European countries. In the analysis, a neoclassical growth model featuring constant Frisch elasticity (CFE) preferences are introduced and analyzed: we use the same preferences here. The results there suggest that the United States could increase tax revenues considerably more than the EU-14, and that conversely the degree of self-financing of tax cuts is much larger in the EU-14 than in the United States. While we have calculated results for individual European countries, the focus there

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We are grateful to Roel Beetsma and Jaume Ventura for useful discussions. Further, we are grateful to Alan Auerbach, Alberto Alesina, Axel Boersch-Supan, Francesco Giavazzi, Laurence Kotlikoff, and Valerie Ramey for useful comments and suggestions. The views expressed in this chapter are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System. For acknowledgments, sources of research support, and disclosure of the authors' material financial relationships, if any, please see http://www.nber.org/chapters/c12638.ack.

was directed toward a comparison of the United States and the aggregate EU-14 economy.

This chapter provides a more in-depth analysis of the cross-country comparison. Furthermore, we modify the analysis in two important dimensions. The model in Trabandt and Uhlig (2011) overstates total tax revenues to GDP compared to the data: in particular, labor tax revenues to GDP are too high. We introduce monopolistic competition to solve this: capital income now consists of rental rates to capital as well as pure profits, decreasing the share of labor income in the economy. With this change alone, the model now overpredicts the capital income tax revenue. We furthermore assume that only a fraction of pure profit income is actually reported to the tax authorities and therefore taxed. With these two changes, the fit to the data improves compared to the original version (see figure 6.2). In terms of the Laffer curves, this moves countries somewhat closer to the peak of the labor tax Laffer curve and somewhat farther away from the peak of the capital tax Laffer curve. For the cross-country comparison, we assume that all structural parameters for technologies and preferences are the same across countries. The differences between the Laffer curves therefore arise solely due to differences in fiscal policy—that is, the mix of distortionary taxes, government spending, and government debt. We find that labor income and consumption taxes are important for accounting for most of the cross-country differences.

We refine the methodology of Mendoza, Razin, and Tesar (1994) to calculate effective tax rates on labor and capital income. Broadly, we expand the measured labor tax base by including supplements to wages as well as a fraction of entrepreneurial income of households. As a result, the refinements imply a more reasonable labor share in line with the literature. More importantly, the average 1995 to 2010 labor income taxes turn out to be lower while capital income taxes are somewhat higher, as previously calculated in Trabandt and Uhlig (2011).

We update our analysis in Trabandt and Uhlig (2011) by including the additional years 2008 to 2010. This is particularly interesting, as it allows us to examine the implications of the recent substantial tax and revenue shocks. While recent fiscal policy changes were intended to be temporary, we examine the pessimistic scenario that they are permanent. To do so, we calibrate the model to the Laffer curves implied by the strained fiscal situation of 2010, and compare them to the Laffer curves of the average extended sample 1995 to 2010. We find that the 2010 calibration moves almost all countries closer to the peak of the labor tax Laffer curve, with the scope for additional labor tax increases cut by a third for most countries and by up to one-half for some countries. It is important, however, to keep the general equilibrium repercussions of raising taxes in mind: even though tax revenues may be increased by some limited amount, tax bases and thereby output fall when moving to the peak of the Laffer curve due to the negative incentive effects of higher taxes.

We then use these results to examine the scope for long-term sustainability of current debt levels, when interest rates are permanently higher due to, say, default fears. This helps to understand the more complex situation of an extended period with substantially increased interest rates due to, say, default fears. More precisely, we answer the following question: what is the maximum steady state interest rate on outstanding government debt that the government could afford without cutting government spending, based on a calibration to the fiscal situation in 2010? To do so, we calculate the implied peak of the Laffer curve and compute the maximum interest rate on outstanding government debt in 2010 that would still balance the government budget constraint in steady state. The results of our baseline model are in table 6.7: the most interesting column there may be the second one. We find that the United States can afford the highest interest rate if labor taxes are moved to the peak of the Laffer curve: depending on the debt measure used, a real interest rate of 12 to 15.5 percent is sustainable. Interestingly, Ireland can also afford the high rate of 11.2 percent when moving labor taxes only. By contrast, Austria, Belgium, Denmark, Finland, France, Greece, and Italy can only afford permanent real rates in the range of 4.4 to 7.1 percent, when financing the additional interest payments with higher labor tax rates alone, while, say, Germany, Portugal, and Spain can all afford an interest rate somewhere above 9 percent. The picture improves somewhat, but not much, when labor taxes and capital taxes can both be adjusted: notably, Belgium, Denmark, Finland, France, and Italy cannot permanently afford real interest rates above 6.5 percent. In the following we also examine the implications of human capital accumulation and show that the maximum interest rates may be even lower than suggested by our baseline model. It is worth emphasizing that we have not included the possibility of cutting government spending and/or transfers and that our analysis has focused on the most pessimistic scenario of a permanent shift.

In the baseline model, physical capital is the production factor that gets accumulated. It may be important, however, to allow for and consider human capital accumulation when examining the consequences of changing labor taxation. We build on the quantitative endogenous growth models introduced in Trabandt and Uhlig (2011), and provide a more detailed cross-country comparison. We find that the capital tax Laffer curve is affected only rather little across countries when human capital is introduced into the model. By contrast, the introduction of human capital has important effects for the labor income tax Laffer curve. Several countries are pushed on the slippery slope sides of their labor tax Laffer curves once human capital is accounted for. Intuitively, higher labor taxes lead to a faster reduction of the labor tax base since households work less and aquire less human capital, which in turn leads to lower labor income. We recalculate the implied maximum interest rates on government debt in 2010 when human capital accumulation is allowed for in the model. Table 6.9 contains the results: the United States may only afford a real interest rate between 5.8 to 6.6 percent in this case. Most of the European countries cluster between 4 and 4.9 percent except for Denmark, Finland, and Ireland, who can afford real interest rates between 5.9 and 9.5 percent.

We add a cross-country analysis on consumption taxes. In Trabandt and Uhlig (2011), we have shown that the consumption tax Laffer curve has no peak. Essentially, the difference between the labor tax Laffer curve and the consumption tax Laffer curve arises due to "accounting" reasons: the additional revenues are provided as transfers, and are used for consumption purchases to be taxed at the consumption tax rate. In Trabandt and Uhlig (2011), we only provided the analysis for the United States and the aggregate EU-14 economy. Here, we extend the consumption tax analysis to individual countries. The range of maximum additional tax revenues (in percent of GDP) in the baseline model is roughly 40 to 100 percent, while it shrinks to roughly 10 to 30 percent in the model with added human capital. Higher consumption taxes affect equilibrium labor via the labor wedge, similar to labor taxes. As before, human capital amplifies the reduction of the labor tax base triggered by the change in the labor wedge. Overall, maximum possible tax revenues due to consumption taxes are reduced massively, although at fairly high consumption tax rates.

The chapter is organized as follows. Section 6.2 provides the model. The calibration and parameterization of the model can be found in section 6.3. Section 6.4 provides and discusses the results. Section 6.5 discusses the extension of the model with human capital as well as the results for consumption taxation. Finally, section 6.6 concludes.

6.2 Model

We employ the baseline model in Trabandt and Uhlig (2011) and extend it by allowing for intermediate inputs, supplied by monopolistically competitive firms. Time is discrete, $t = 0.1, \ldots, \infty$. Households maximize

$$\max_{c_t, n_t, k_t, x_t, b_t} \quad E_0 \sum_{t=0}^{\infty} \beta^t [u(c_t, n_t) + \upsilon(g_t)]$$

subject to

$$(1) \qquad (1 + \tau_t^c)c_t + x_t + b_t = (1 - \tau_t^n)w_t n_t + (1 - \tau_t^k)[(d_t - \delta)k_{t-1} + \phi\Pi_t]$$
$$+ \delta k_{t-1} + R_t^b b_{t-1} + s_t + (1 - \phi)\Pi_t + m_t$$
$$k_t = (1 - \delta)k_{t-1} + x_t,$$

where c_t, n_t, k_t, x_t, b_t, m_t denote consumption, hours worked, capital, investment, government bonds, and an exogenous stream of payments. The household takes government consumption g_t, which provides utility, as given. Further, the household receives wages w_t, dividends d_t, and profits Π_t, from firms and asset payments m_t. The payments m_t are a stand-in for net imports, modeled here as exogenously given income from a "tree" (see Trabandt and Uhlig 2011 for further discussion). The household obtains interest earnings R_t^b and lump-sum transfers s_t from the government. It has to pay consumption taxes τ_t^c, labor income taxes τ_t^n, and capital income taxes τ_t^k on dividends and on a share ϕ of profits.[1]

As introduced and extensively discussed in Trabandt and Uhlig (2011), but also used in Hall (2009), Shimer (2009), and King and Rebelo (1999), we work with CFE preferences, given by

$$u(c, n) = \log(c) - \kappa n^{1+1/\varphi} \tag{2}$$

if $\eta = 1$, and by

$$u(c, n) = \frac{1}{1-\eta}(c^{1-\eta}(1 - \kappa(1-\eta)n^{1+1/\varphi})^{\eta} - 1) \tag{3}$$

if $\eta > 0, \eta \neq 1$, where $\kappa > 0$. These preferences are consistent with balanced growth and feature a constant Frisch elasticity of labor supply, given by φ, without constraining the intertemporal elasticity of substitution.

Competitive final good firms maximize profits

$$\max_{k_{t-1}, z_t} \quad y_t - d_t k_{t-1} - p_t z_t \tag{4}$$

subject to the Cobb-Douglas production technology, $y_t = \xi^t k_{t-1}^{\theta} z_t^{1-\theta}$, where ξ^t denotes the trend of total factor productivity, and p_t denotes the price of an homogenous input, z_t, which in turn is produced by competitive firms who maximize profits

$$\max_{z_{t,i}} \quad p_t z_t - \int p_{t,i} z_{t,i}\, di \tag{5}$$

subject to $z_t = (\int z_{t,i}^{1/\omega} di)^{\omega}$ with $\omega > 1$. Intermediate inputs, $z_{t,i}$, are produced by monopolistically competitive firms that maximize profits

$$\max_{p_{t,i}} \quad p_{t,i} z_{t,i} - w_t n_{t,i}$$

subject to their demand functions and production technologies:

$$z_{t,i} = \left(\frac{p_t}{p_{t,i}}\right)^{\omega/(\omega-1)} z_t$$

$$z_{t,i} = n_{t,i}.$$

1. We allow for partial profit taxation due to the various deductions and exemptions that are available for firms and households in this regard. Further, note that capital income taxes are levied on dividends net-of-depreciation as in Prescott (2002, 2004) and in line with Mendoza, Razin, and Tesar (1994).

In equilibrium, all firms set the same price, which is a markup over marginal costs. Formally, $p_{t,i} = p_t = \omega w_t$. Aggregate equilibrium profits are given by $\Pi_t = (\omega - 1)\, w_t n_t$.

The government faces the budget constraint,

$$g_t + s_t + R_t^b b_{t-1} = b_t + T_t \quad (6)$$

where government tax revenues are given by

$$T_t = \tau_t^c c_t + \tau_t^n w_t n_t + \tau_t^k [(d_t - \delta)k_{t-1} + \phi \Pi_t]. \quad (7)$$

It is the goal to analyze how the equilibrium shifts, as tax rates are shifted. More generally, the tax rates may be interpreted as wedges as in Chari, Kehoe, and McGrattan (2007), and some of the results in this chapter carry over to that more general interpretation. What is special to the tax rate interpretation and crucial to the analysis in this chapter, however, is the link between tax receipts and transfers (or government spending) via the government budget constraint.

The chapter focuses on the comparison of balanced growth paths. We assume that government debt and government spending, as well as net imports, do not deviate from their balanced growth paths; that is, we assume that $b_{t-1} = \psi^t \bar{b}$, $g_t = \psi^t \bar{g}$ as well as $m_t = \psi^t \bar{m}$, where ψ is the growth factor of aggregate output. We consider exogenously imposed shifts in tax rates or in returns on government debt. We assume that government transfers adjust according to the government budget constraint (6), rewritten as $s_t = \psi^t \bar{b} (\psi - R_t^b) + T_t - \psi^t \bar{g}$.

6.2.1 Equilibrium

In equilibrium the household chooses plans to maximize its utility, the firm solves its maximization problem, and the government sets policies that satisfy its budget constraint. In what follows, key balanced growth relationships of the model that are necessary for computing Laffer curves are summarized. Except for hours worked, interest rates, and taxes, all other variables grow at a constant rate $\psi = \xi^{1/(1-\theta)}$. For CFE preferences, the balanced growth after-tax return on any asset is $\bar{R} = \psi^{\eta}/\beta$. It is assumed throughout that $\xi \geq 1$ and that parameters are such that $\bar{R} > 1$, but β is not necessarily restricted to be less than one. Let $\overline{k/y}$ denote the balanced growth path value of the capital-output ratio k_{t-1}/y_t. In the model, it is given by

$$\overline{k/y} = \left(\frac{\bar{R} - 1}{\theta(1 - \tau^k)} + \frac{\delta}{\theta} \right)^{-1}. \quad (8)$$

Labor productivity and the before-tax wage level are given by

$$\frac{y_t}{\bar{n}} = \psi^t \left(\overline{k/y}\right)^{\theta/(1-\theta)} \quad \text{and} \quad w_t = \frac{(1-\theta)}{\omega} \frac{y_t}{\bar{n}}.$$

The level of equilibrium labor remains to be solved for. Let $\overline{c/y}$ denote the balanced growth path ratio c_t/y_t. With the CFE preference specification and along the balanced growth path, the first-order conditions of the household and the firm imply

(9) $$(\eta\kappa\bar{n}^{1+1/\varphi})^{-1} + 1 - \frac{1}{\eta} = \alpha\overline{c/y}$$

where $\alpha = \omega(1+\tau^c)/(1-\tau^n)(1+1/\varphi)/(1-\theta)$ depends on tax rates, the labor share, the Frisch elasticity of labor supply, and the markup.

In this chapter, we shall concentrate on the case when transfers $\bar{s}$ are varied and government spending $\bar{g}$ is fixed. Then, the feasibility constraint implies

(10) $$\overline{c/y} = \chi + \gamma\frac{1}{\bar{n}},$$

where $\chi = 1-(\psi - 1 + \delta)\overline{k/y}$ and $\gamma = (\bar{m}-\bar{g})(\overline{k/y})^{-\theta/(1-\theta)}$. Substituting equation (10) into (9) therefore yields a one-dimensional nonlinear equation in $\bar{n}$, which can be solved numerically, given values for preference parameters, production parameters, tax rates, and the levels of $\bar{b}$, $\bar{g}$, and $\bar{m}$.

After some straightforward algebra, total tax revenues along a balanced growth path can be calculated as

(11) $$T = \left[\tau^c\overline{c/y} + \tau^n\frac{(1-\theta)}{\omega} + \tau^k\left(\theta - \delta\overline{k/y} + \phi(1-\theta)\frac{\omega-1}{\omega}\right)\right]\bar{y}$$

and equilibrium transfers are given by

(12) $$\bar{s} = (\psi - R^b)\,\bar{b} - \bar{g} + \bar{T}.$$

6.3 Data, Calibration, and Parameterization

The model is calibrated to annual postwar data of the United States, the aggregate EU-14 economy, and individual European countries. An overview of the calibration is in tables 6.1 and 6.2.

We refine the methodology of Mendoza, Razin, and Tesar (1994) to calculate effective tax rates on labor and capital income. Broadly, we expand the measured labor tax base by including supplements to wages as well as a fraction of entrepreneurial income of households. As a result, the refinements imply a more reasonable labor share in line with the empirical literature. More importantly, the average 1995 to 2010 labor income taxes turn out to be lower while capital income taxes are higher, as previously calculated in Trabandt and Uhlig (2011). Appendix A provides the new tax rates across countries over time and appendix B contains the details on the calculations with further discussion of the implications for the Laffer curves, among others.

There are two new key parameters compared to Trabandt and Uhlig (2011). The first parameter is ω, the gross markup, due to monopolistic competition. We set $\omega = 1.1$, which appears to be a reasonable number, given the literature.

The second parameter is ϕ, the share of monopolistic-competition profits that are subject to capital taxes. We set this parameter equal to the capital share, that is, to 0.36. While we could have explored specific evidence to help us pin down this parameter, we have chosen this value rather arbitrarily and with an eye toward the fit of the model to the data instead.

The sample covered in Trabandt and Uhlig (2011) is 1995 to 2007. Here we extend the sample to 2010 using the same data sources. We update all data up to 2010, except for taxes and tax revenues, which we can update only to 2009 due to data availability reasons. For most of the analysis in this chapter, we assume that the 2010 observation for taxes and revenues are the same as in 2009. We also pursue an alternative approach for tax rates for the year 2010 (see subsection 6.3.2 for the details).

We also refine the calculation of transfers in the data compared to Trabandt and Uhlig (2011). In the data, there is a nonneglible difference between government tax revenues and government revenues. This difference is mostly due to "other government revenue" and "government sales." We subtract these two items from the measure of transfers defined in Trabandt and Uhlig (2011).

The US and aggregate EU-14 tax rates, government expenditures, and government debt are set according to the upper part of table 6.1. We also calibrate the model to individual EU-14 country data for tax rates, government spending, and government debt as provided in table 6.2. Although we allow fiscal policy to be different across countries, we restrict the analysis to identical parameters across countries for preferences and technology (see the lower part of table 6.1 for the details).[2]

Finally, the empirical measure of government debt for the United States as well as the EU-14 area provided by the AMECO (annual macroeconomic) database is nominal general government consolidated gross debt (excessive deficit procedure, based on the European System of Accounts [ESA] 1995), which is divided by nominal GDP. For the United States, the gross debt to GDP ratio is 66.2 percent in the sample. For checking purposes, we also examine the implications if we use an alternative measure of US government debt: debt held by the public. See tables 6.1 and 6.2 for the differences. However, given that, to our knowledge, data on "debt held by the public" is not available for European countries, we shall proceed by using gross debt as a benchmark if not otherwise noted. Where appropriate, we shall perform a sensitivity analysis with respect to the measure of US government debt.

6.3.1 Model Fit and Sensitivity

The structural parameters are set such that model-implied steady states are close to the data. In particular, figure 6.1 provides a comparison of the

2. See Trabandt and Uhlig (2011) for the differences with respect to Laffer curves when parameters for technology and preferences are assumed to be identical or country-specific.

Table 6.1 **Baseline calibration and parameterization**

Variable	US	EU-14	Description	Restriction
			Fiscal policy	
τ^n	22.1	34.2	Labor tax rate	Data
τ^k	41.1	36.8	Capital tax rate	Data
τ^c	4.6	16.7	Consumption tax rate	Data
$\overline{g/y}$	18.0	23.1	Gov. consumption + invest. to GDP	Data
			Gross government debt	
$\overline{b/y}$	66.2	67.3	Government gross debt to GDP	Data
$\overline{s/y}$	4.3	11.1	Government transfers to GDP	Implied
		Sensitivity:	*Government debt held by the public*	
$\overline{b/y}$	42.4	—	Government debt held by public to GDP	Data
$\overline{s/y}$	4.9	—	Government transfers to GDP	Implied
			Trade	
$\overline{m/y}$	3.6	–1.2	Net imports to GDP	Data
			Technology	
ψ	1.5	1.5	Annual balanced growth rate	Data
θ	0.36	0.36	Capital share in production	Data
δ	0.07	0.07	Annual depreciation rate of capital	Data
$\bar{R}-1$	4	4	Annual real interest rate	Data
ω	1.1	1.1	Gross markup	Data
ϕ	0.36	0.36	Share of profits subject to capital taxes	Data
			CFE preferences	
η	2	2	Inverse of IES	Data
φ	1	1	Frisch labor supply elasticity	Data
κ	3.30	3.30	Weight of labor	$\bar{n}_{us} = 0.25$

Notes: Baseline calibration and parameterization for the US and EU-14 benchmark model. Numbers expressed in percent where applicable. Sample: 1995–2010. IES denotes intertemporal elasticity of substitution; CFE refers to constant Frisch elasticity preferences; $\bar{n}_{us}$ denotes balanced growth labor in the United States, which is set to 25 percent of total time.

data versus model fit for key great ratios, hours as well as transfers and tax revenues.[3] Overall, the fit is remarkable given the relatively simple model in which country differences are entirely due to fiscal policy.[4]

Most of the structural parameter values in the lower part of table 6.1 are standard and perhaps uncontroversial (see, e.g., Cooley and Prescott 1995; Prescott 2002, 2004, 2006; and Kimball and Shapiro 2008).

3. We assume a mapping of data and model in the literal sense, that is, the one based on the definitions of the national income and product accounts and the revenues statistics. For work that takes an alternative perspective and emphasizes the general relativity of fiscal language, see Green and Kotlikoff (2009).

4. The present chapter, and in particular the comparison of data versus model hours, is closely related to Prescott (2002, 2004) and subsequent contributions by, for example, Blanchard (2004); Alesina, Glaeser, and Sacerdote (2006); Ljungqvist and Sargent (2007); Rogerson (2007); and Pissarides and Ngai (2009).

Table 6.2 **Calibration of the model to individual countries**

	τ^n			τ^c		τ^k		$\overline{b/y}$		$\overline{m/y}$		$\overline{g/y}$		$\overline{s/y}$	
	∅	2010[a]	2010[b]	∅	2010	∅	2010	∅	2010	∅	2010	∅	2010	∅	2010
US	22	20	28	5	4	41	38	66	92	4	4	18	20	4	4
US[c]	22	20	28	5	4	41	38	42	64	4	4	18	20	5	5
EU-14	34	35	40	17	15	37	36	67	83	–1	–1	23	25	11	11
GER	34	35	35	16	17	25	27	64	83	–3	–5	21	21	10	10
FRA	39	39	43	18	16	43	43	63	82	–0	2	27	28	12	12
ITA	36	39	39	14	13	41	45	111	119	–1	2	22	23	13	13
GBR	24	25	36	15	13	52	50	48	80	2	3	22	26	11	11
AUT	43	43	45	20	20	26	24	66	72	–3	–5	21	21	18	18
BEL	39	38	43	17	17	51	50	104	97	–4	–3	24	26	16	16
DNK	43	44	50	34	31	49	56	49	44	–5	–6	28	32	22	22
FIN	44	41	51	26	23	31	30	45	48	–6	–3	25	27	17	17
GRE	29	28	35	15	13	19	17	105	143	10	8	21	21	6	6
IRL	25	24	40	24	19	17	16	48	96	–13	–19	19	23	7	7
NET	36	38	50	19	19	32	23	58	63	–7	–8	27	32	6	6
PRT	22	24	30	19	16	32	34	61	93	9	7	23	24	7	7
ESP	30	30	42	14	10	31	24	54	60	3	2	22	24	8	8
SWE	50	46	43	26	26	40	52	54	40	–7	–6	30	31	16	16

Notes: Individual country calibration of the benchmark model for the average (∅) sample from 1995 to 2010 and for the year 2010. Country codes: Germany (GER), France (FRA), Italy (ITA), United Kingdom (GBR), Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), Greece (GRE), Ireland (IRL), Netherlands (NET), Portugal (PRT), Spain (ESP), and Sweden (SWE). See table 6.1 for abbreviations of variables. All numbers are expressed in percent.

[a]Due to data availability reasons, the year 2009 value for tax rates has been assumed to remain in 2010 for most of the analysis in this chapter.

[b]We deviate from *a* in subsection 6.3.2 by letting labor taxes in 2010 adjust to balance the 2010 government budget. More precisely, we calculate the 2010 labor tax given government debt and consumption in 2010 as well as average 1995–2010 model implied transfers.

[c]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

The new parameters here compared to Trabandt and Uhlig (2011) are the gross markup, $\omega = 1.1$, and the share of monopolistic-competition profits subject to capital taxation, $\phi = \theta = 0.36$. Figure 6.2 contains a sensitivity analysis for ω and ϕ. When $\omega \rightarrow 1$, the model overstates labor tax revenues and understates capital tax revenues (see the crosses in figure 6.2).[5] In the adapted model with intermediate inputs, a gross markup $\omega > 1$ reduces the labor tax base. At the same time, profits increase the capital tax base, but too much if profits are fully subject to capital taxation (i.e., $\phi = 1$); see the triangles in figure 6.2. Overall, the fit improves considerably if we set the share of profits subject to capital taxes, $\phi = \theta = 0.36$. The fit is not sensitive

5. Note that in this case, the value of ϕ becomes immaterial since equilibrium profits are zero.

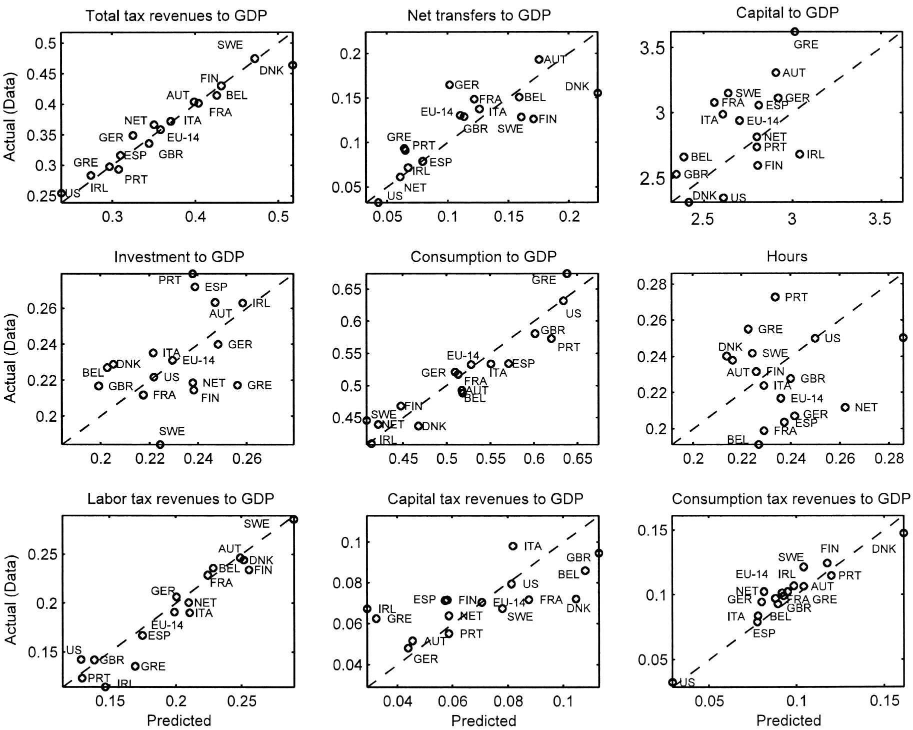

Fig. 6.1 Comparison of "actual" versus "predicted" variables

Notes: "Actual" refers to data sample averages for 1995–2010. "Predicted" refers to model implied steady state (balanced growth path) variables when the model is calibrated as in table 6.2 (gross US debt). Parameters for technology and preferences are set as in table 6.1 (gross debt).

to ϕ: all values in $\phi \in [0.3, 0.4]$ work practically just as well in terms of the fit, for example.

6.3.2 The Year 2010

At the end of our sample, government spending and government debt have risen substantially as a fallout of the financial crisis (see table 6.2). We are particularly interested in characterizing Laffer curves for the year 2010. While there is no tax rate data for the year 2010 at the time of this writing, we do have data for government spending and debt in 2010. We wish to consider the pessimistic scenario of a steady state, in which these changes are permanent. We therefore use the government budget constraint of the model to infer the labor tax rate; that is, we calculate the implied labor tax given government debt and government consump-

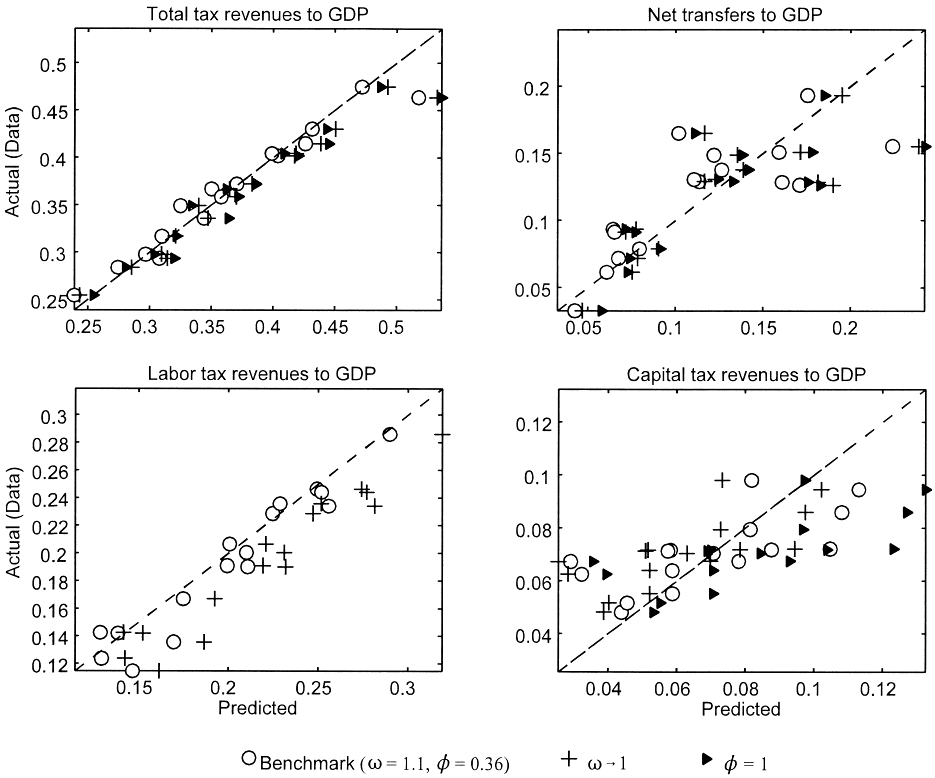

Fig. 6.2 Sensitivity of "actual" versus "predicted" tax revenues and government transfers

Notes: "Actual" refers to data sample averages for 1995–2010. "Predicted" refers to model implied steady state (balanced growth path). Three cases are examined. The benchmark case is the model used in the chapter, and as in figure 6.1. The case $\omega \rightarrow 1$ obtains, when there is no market power by intermediate goods producers: this is our previously used model in Trabandt and Uhlig (2011). Finally, there is the intermediate case with monopolistic competition, but where profits are fully subject to capital taxation, $\phi = 1$. Note that all other variables plotted in figure 6.1 are unaffected by the sensitivity analysis, except for hours. However, the impact on hours is small and therefore omitted here. All other parameters and steady states are as in tables 6.1 and 6.2 (gross US debt).

tion in 2010, as well as average 1995 to 2010 model-implied government transfers.

Table 6.2 contains the resulting labor tax rates across countries. According to the model, in the United States and EU-14 labor taxes need to be 5 to 8 percentage points higher to balance the government budget in 2010 compared to the sample average. There is substantial country-specific variation. While, for example, labor taxes in Germany and Italy remain unchanged,

Table 6.3 **Maximum additional tax revenues (in % of baseline GDP)**

		Start with US and impose country calibration for . . .					
	Baseline	τ^n	τ^k	τ^c	$\overline{b/y}$	$\overline{g/y}$	$\overline{m/y}$
US	9.0	9.0	9.0	9.0	9.0	9.0	9.0
US[a]	9.0	9.0	9.0	9.0	9.0	9.0	9.0
EU-14	4.3	4.9	9.3	6.6	9.0	9.6	9.6
GER	5.0	4.8	10.2	6.7	9.0	9.3	9.9
FRA	2.9	3.6	8.8	6.3	9.0	10.2	9.5
ITA	3.6	4.3	9.0	7.0	9.0	9.4	9.6
GBR	6.0	8.4	8.0	6.8	9.0	9.5	9.2
AUT	2.1	2.5	10.1	5.9	9.0	9.3	9.8
BEL	2.4	3.4	8.2	6.4	9.0	9.8	10.0
DNK	0.7	2.4	8.3	3.7	9.0	10.4	10.1
FIN	1.8	2.2	9.7	4.9	9.0	9.9	10.4
GRE	5.6	6.5	10.6	6.9	9.0	9.3	8.3
IRL	9.0	7.9	10.7	5.3	9.0	9.2	11.8
NET	5.2	4.3	9.7	6.1	9.0	10.3	10.4
PRT	6.7	8.9	9.7	6.1	9.0	9.6	8.4
ESP	5.7	6.2	9.7	7.1	9.0	9.5	9.1
SWE	0.9	1.0	9.1	5.0	9.0	10.7	10.5

Notes: Labor tax Laffer curve: sources of differences across countries.The table provides maximal additional tax revenues (in percent of baseline GDP) if labor taxes are varied. "Baseline" refers to the results when the model is calibrated to country-specific averages of 1995–2010 (see table 6.2). Parameters for technology and preferences are set as in table 6.1. All other columns report results if in the US calibration, fiscal instruments are set to country-specific values (each at a time).

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

those in the United Kingdom, Ireland, Spain, and the Netherlands increase by 10 or more percentage points.

6.4 Results

6.4.1 Sources of Differences of Laffer Curves

What accounts for the differences between the US Laffer curves and (individual) EU-14 Laffer curves? To answer this question, we proceed as follows. As before, we calibrate the model to country-specific averages of 1995 to 2010 (see table 6.2), keeping structural parameters as in table 6.1. Next, we compute Laffer curves.

Results are in the "Baseline" column of tables 6.3 and 6.4. All other columns report results if, in the US calibration, fiscal instruments are set to European country-specific values, one at a time. It appears that labor income

Table 6.4 **Maximum additional tax revenues (in % of baseline GDP)**

		Start with US and impose country calibration for . . .					
	Baseline	τ^n	τ^k	τ^c	$\overline{b/y}$	$\overline{g/y}$	$\overline{m/y}$
US	2.6	2.6	2.6	2.6	2.6	2.6	2.6
US[a]	2.6	2.6	2.6	2.6	2.6	2.6	2.6
EU-14	1.2	1.2	3.1	1.4	2.6	2.8	2.8
GER	2.2	1.2	4.5	1.5	2.6	2.7	3.0
FRA	0.4	0.9	2.3	1.3	2.6	3.1	2.8
ITA	0.8	1.1	2.5	1.6	2.6	2.8	2.8
GBR	0.6	2.4	1.3	1.5	2.6	2.8	2.7
AUT	1.1	0.6	4.4	1.1	2.6	2.7	2.9
BEL	0.1	0.8	1.5	1.4	2.6	2.9	3.0
DNK	0.0	0.6	1.6	0.4	2.6	3.2	3.0
FIN	0.7	0.5	3.7	0.8	2.6	3.0	3.2
GRE	2.7	1.7	5.1	1.5	2.6	2.7	2.3
IRL	4.1	2.2	5.3	0.9	2.6	2.6	3.7
NET	1.9	1.1	3.7	1.2	2.6	3.1	3.2
PRT	2.0	2.6	3.7	1.2	2.6	2.8	2.4
ESP	2.0	1.7	3.7	1.6	2.6	2.8	2.6
SWE	0.2	0.2	2.7	0.8	2.6	3.3	3.2

Notes: Capital tax Laffer curve: sources of differences across countries. The table provides maximal additional tax revenues (in percent of baseline GDP) if capital taxes are varied. "Baseline" refers to the results when the model is calibrated to country-specific averages of 1995–2010 (see table 6.2). Parameters for technology and preferences are set as in table 6.1. All other columns report results if in the US calibration, fiscal instruments are set to country-specific values (each at a time).

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

and consumption taxes are most important for accounting for cross-country differences.

Imposing country-specific debt-to-GDP ratios has no effect in our calculations, due to Ricardian equivalence: a different debt-to-GDP ratio, holding taxes and government consumption fixed, results in different transfers along the equilibrium path.

Finally, note that compared to Trabandt and Uhlig (2011), intermediate inputs and profit taxation in the present chapter move countries somewhat closer to the peak of the labor tax Laffer curve and somewhat farther away from the peak of the capital tax Laffer curve.

6.4.2 Laffer Curves: Average 1995 to 2010 versus 2010

To compute Laffer curves, we trace out tax revenues across balanced growth paths, as we change either labor tax rates or capital tax rates, and compute the resulting changes in transfers. When changing both tax rates, we obtain a "Laffer hill." We compute Laffer curves and the Laffer hill for a 1995 to 2010 versus 2010 calibration; that is, when the model is calibrated in terms of fiscal policy either to the average of 1995 to 2010 or to the year 2010 (see table 6.2). Structural parameters are set as in table 6.1.

Figure 6.3 shows the resulting Laffer curves for all countries for the average 1995 to 2010 calibration. Figure 6.4 provides a comparison of Laffer curves for the 1995 to 2010 versus 2010 calibration for the US and aggregate EU-14 economy. Further cross-country results in this respect are available in table 6.5 and in figure 6.5. The latter figure shows how far each country is from its peak, given its own tax rate: perhaps not surprisingly, the points line up pretty well. In the figure, we compare it to the benchmark of performing the same calculation for the United States, given by the dash-dotted line: there, we change, say, the labor tax rate, and, for each new labor tax rate, recalculate κ as well as $\bar{g}$, $\bar{m}$, and $\bar{b}$ to obtain the same $\bar{n}$ and $\overline{g/y}$, $\overline{b/y}$, and $\overline{m/y}$ as in table 6.1. We then recalculate $\bar{s}$ and $\overline{s/y}$ to balance the government budget and calculate the distance to the peak of the Laffer curve. One would expect this exercise to result in a line with a slope close to –1, and indeed, this is what the figure shows. The points for the individual countries line up close to this line, though not perfectly: in particular, for the capital tax rate, the distance can be considerable, and is largely explained by the cross-country variation in labor taxes and consumption taxes.

According to the results, the vast majority of countries have moved closer to the peaks of their labor and capital income tax Laffer curves and Laffer hills, respectively. The movements to the peaks are sizable for some countries such as, for example, the United Kingdom, the Netherlands, and Ireland for labor taxes. As before and for the average 1995 to 2010 sample, it does not matter whether "gross US debt" or "US debt held by the public" is used. For the year 2010, however, small differences arise since transfers are kept at the model average for 1995 to 2010.

Finally, table 6.6 provides the output losses associated with moving to the peak of the Laffer curve. According to the model, US and EU-14 output falls by about 27 and 14 percent, respectively, when labor taxes are moved to the peak of the Laffer curve. The magnitudes for the case of capital taxes are similar. There is considerable country-specific variation among European countries: Denmark loses 4 percent while Ireland loses 24 percent of output at the labor tax Laffer curve peak. Clearly, if a country is already close to its Laffer curve peak in terms of tax rates, the output losses associated with increasing taxes a little more to attain the peak are more muted than in a country that has more scope to increase tax revenues. Nevertheless, the table highlights the general equilibrium repercussions of raising taxes: even though tax revenues may be increased by some limited amount, tax bases and thereby output fall when moving to the peak of the Laffer curve due to the negative incentive effects of higher taxes.

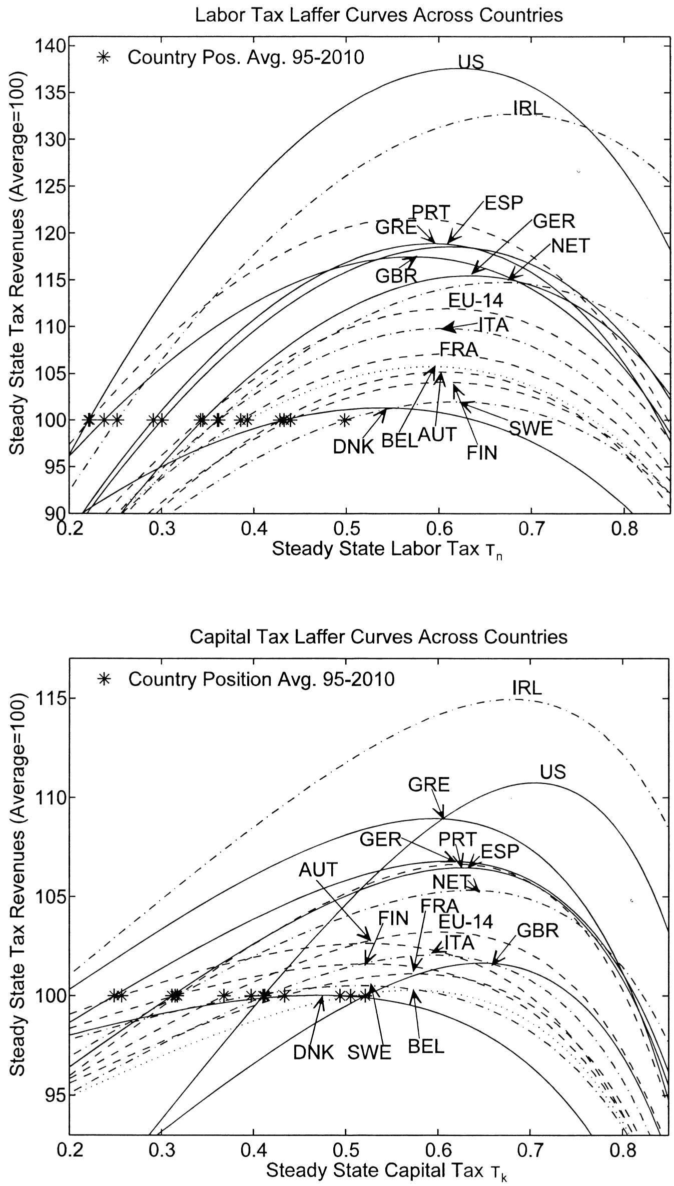

Fig. 6.3 Labor and capital tax Laffer curves across all countries

Notes: The model is calibrated to the average of 1995–2010, see table 6.2 (gross US debt). Parameters for technology and preferences are set as in table 6.1 (gross US debt). Shown are steady state (balanced growth path) total tax revenues when labor taxes (upper panel) or capital taxes (lower panel) are varied between 0 and 100 percent. All other taxes and parameters are held constant. Total tax revenues at the average 1995–2010 tax rates are normalized to 100. Stars indicate positions of respective countries on their Laffer curves. In cases without an arrow, the first letter of each country name indicates the peak of the respective Laffer curve.

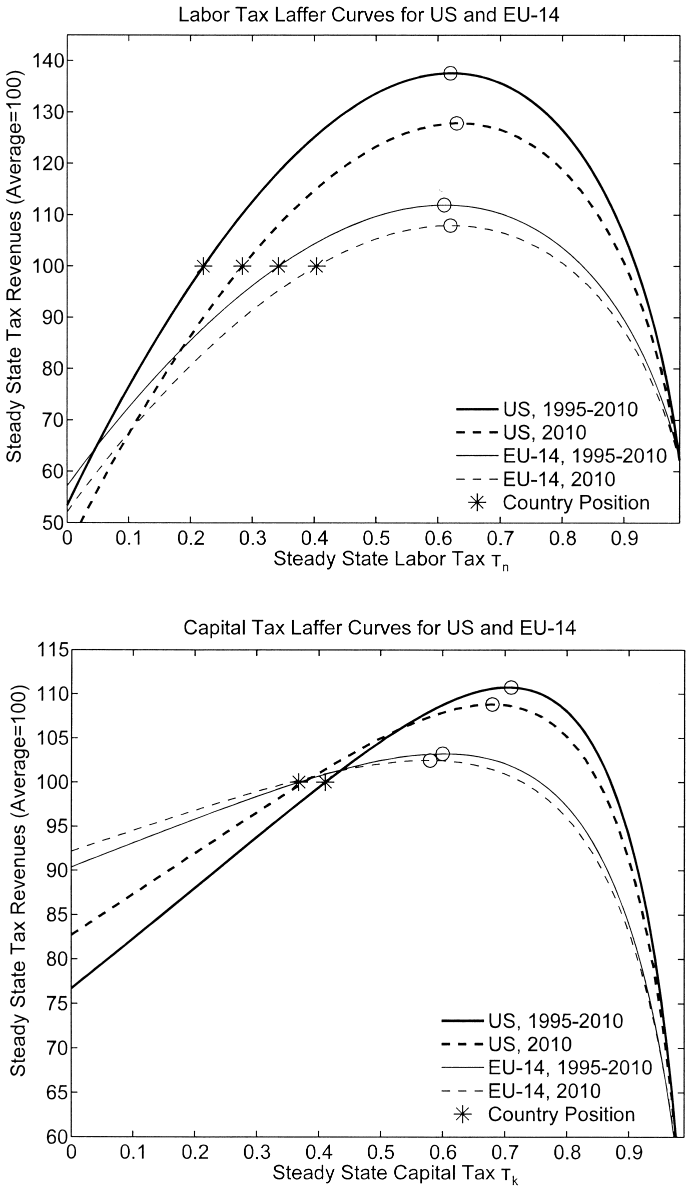

Fig. 6.4 Comparing the US and the EU-14 labor and capital tax Laffer curve

Notes: The model is either calibrated to the average of 1995–2010 or to 2010, see table 6.2 (gross US debt). Parameters for technology and preferences are set as in table 6.1 (gross US debt). Shown are steady state (balanced growth path) total tax revenues when labor taxes (upper panel) or capital taxes (lower panel) are varied between 0 and 100 percent. All other taxes and parameters are held constant. Total tax revenues at the average 1995–2010 or at the year 2010 tax rates are normalized to 100. Stars indicate positions of respective countries on their Laffer curves.

Table 6.5 **Maximum additional tax revenues (in %): Average 1995–2010 versus year 2010**

	Vary labor taxes, τ^n $\Delta\bar{T}_{\text{Max}}$		Vary capital taxes, τ^k $\Delta\bar{T}_{\text{Max}}$		Vary τ^n and τ^k jointly $\Delta\bar{T}_{\text{Max}}$	
	∅	2010	∅	2010	∅	2010
US	37.6	27.9	10.7	8.8	37.6	28.1
US[a]	37.6	28.2	10.7	8.9	37.6	28.4
EU-14	11.9	7.9	3.2	2.5	12.1	8.2
GER	15.4	14.9	6.8	6.1	16.4	15.7
FRA	7.1	4.6	1.1	0.7	7.1	4.6
ITA	9.8	7.3	2.1	1.1	9.9	7.3
GBR	17.5	8.6	1.7	0.7	17.9	8.8
AUT	5.2	4.7	2.6	2.8	5.8	5.5
BEL	5.7	4.0	0.3	0.1	5.9	4.1
DNK	1.3	0.3	0.0	0.4	1.6	1.0
FIN	4.1	1.6	1.6	1.0	4.4	1.9
GRE	18.9	14.2	8.9	7.8	19.9	15.6
IRL	32.7	21.5	14.9	12.2	35.4	25.9
NET	14.7	6.6	5.3	4.6	15.6	8.6
PRT	21.6	15.4	6.6	4.6	21.8	15.6
ESP	18.5	10.3	6.5	5.4	19.0	11.4
SWE	2.0	3.3	0.5	0.0	2.1	3.5

Notes: Laffer curves and Laffer hill for 1995 to 2010 versus 2010 calibration. The model is either calibrated to the average of 1995–2010 or to 2010 (see table 6.2). Parameters are set as in table 6.1. $\Delta\bar{T}_{\text{Max}}$ denotes the maximum additional tax revenues (in percent) that results from moving to the peak of the Laffer curve.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

6.4.3 Laffer Curve and Interest Rates

What is the maximum interest rate on outstanding government debt that the government could afford without cutting government spending? Put differently, how high can interest rates on government debt be due to, say, default fears (and not due to generally higher discounting by households), so that fiscal sustainability is still preserved if countries move to the peak of their Laffer curves?

To answer this question we pursue the following experiment. We calibrate the model in terms of fiscal policy to the year 2010 (see table 6.2). Structural parameters are set as in table 6.1. We calculate Laffer curves for labor and capital taxation as well as the Laffer hill for joint variations of capital and labor taxes. Keeping model-implied government transfers and government consumption to GDP ratios at their 2010 levels, we calcuate the interest rate that balances the government budget at maximal tax revenues.

For the calcuations, we focus on balanced growth relationships ignor-

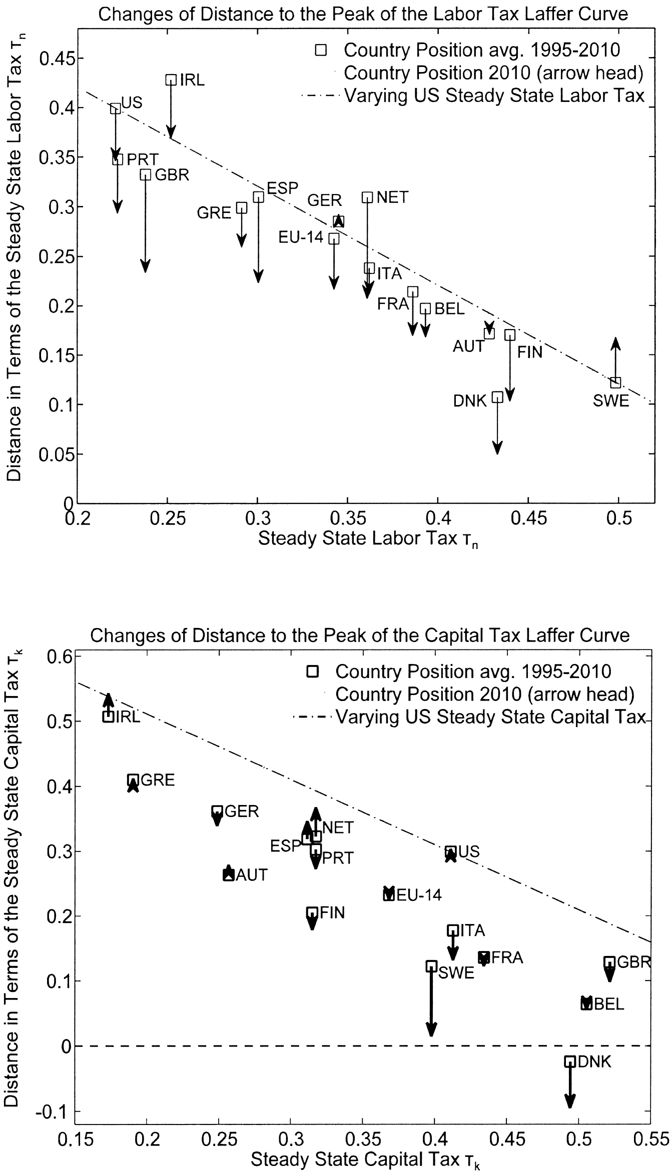

Fig. 6.5 Distance to the peak of Laffer curves for average 1995–2010 versus 2010 calibration

Notes: The model is either calibrated to the average of 1995–2010 or to 2010, see table 6.2 (gross US debt). Parameters for technology and preferences are set as in table 6.1 (gross US debt). Horizontal axis shows calibrated tax rates. Vertical axis shows distance to the peak in terms of tax rates. The dashed-dotted line shows the distance to the peak for the United States when the initial steady state tax is varied and the model is recalibrated for each assumed tax rate.

Table 6.6 **Output changes (in %) from moving to the Laffer curve peak**

	Vary labor taxes, τ^n $\Delta\bar{y}$ at $\Delta\bar{T}_{\text{Max}}$	Vary capital taxes, τ^k $\Delta\bar{y}$ at $\Delta\bar{T}_{\text{Max}}$	Vary τ^n and τ^k jointly $\Delta\bar{y}$ at $\Delta\bar{T}_{\text{Max}}$
US	–27.2	–21.1	–29.6
US[a]	–27.3	–21.1	–29.7
EU-14	–17.5	–12.8	–20.1
GER	–22.0	–17.7	–26.5
FRA	–14.2	–7.5	–14.3
ITA	–17.6	–8.8	–16.7
GBR	–18.5	–7.3	–15.8
AUT	–14.6	–13.0	–18.9
BEL	–13.6	–3.8	–11.2
DNK	–3.9	6.0	2.2
FIN	–9.0	–8.3	–12.5
GRE	–22.3	–20.3	–27.5
IRL	–23.6	–23.6	–34.6
NET	–15.9	–16.1	–23.7
PRT	–22.6	–16.5	–24.5
ESP	–19.3	–17.7	–24.8
SWE	–12.3	–1.0	–8.5

Notes: Output changes (in %) when moving to the Laffer curve peak. The model is calibrated to the year 2010 (see table 6.2). Parameters are set as in table 6.1. $\Delta\bar{y}$ is the change of balanced growth output in the model from moving from the status quo equilibrium to the peak of the Laffer curve. $\Delta\bar{T}_{\text{Max}}$ denotes the maximum additional tax revenues (in percent) that results from moving to the peak of the Laffer curve.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

ing transition issues for simplicity. Consider the scaled government budget constraint along the balanced growth path:

$$(13) \qquad \left(\overline{s/y}\right)_{2010} + \left(\overline{g/y}\right)_{2010} = \left(\overline{b/y}\right)_{2010} (\psi - \bar{R}_{\text{Max}}) + \left(\overline{T/y}\right)_{\text{Max}},$$

where $(\overline{T/y})_{\text{Max}}$ denotes the maximum additional tax revenues (expressed in percent of baseline GDP) that results from moving from the 2010 status quo to the peak of the Laffer curve. We solve for $\bar{R}_{\text{Max}} = 1 + \bar{r}_{\text{Max}}$ that balances the above government budget constraint.

Table 6.7 contains the baseline model results. For each of the three tax experiments (adjusting only labor taxes, adjusting only capital taxes, and adjusting both), the table lists the maximal additional obtainable revenue as a share of GDP as well as the maximal sustainable interest rate that can be sustained with these revenues. For comparison, the last two columns of the table also contain real long-term interest rates for 2010 downloaded from the European Commission AMECO database. These are nominal ten years government bond interest rates minus inflation—either using the GDP deflator (ILRV, first column) or the consumption deflator (ILRC, second

Table 6.7 Baseline model: Maximum real interest rates on government debt (in %)

	Vary labor taxes, τ^n		Vary capital taxes, τ^k		Vary τ^n and τ^k jointly		Data: Long-term interest rates[b]	
	$\overline{\Delta T/y}_{\text{Max}}$	$\bar{r}_{\text{Max}}$	$\overline{\Delta T/y}_{\text{Max}}$	$\bar{r}_{\text{Max}}$	$\overline{\Delta T/y}_{\text{Max}}$	$\bar{r}_{\text{Max}}$		
US	7.3	12.0	2.3	6.5	7.4	12.0	2.0	1.4
US[a]	7.4	15.5	2.3	7.7	7.4	15.6	2.0	1.4
EU-14	3.0	7.6	0.9	5.1	3.1	7.7	2.4	1.5
GER	5.0	10.0	2.0	6.4	5.2	10.3	2.1	0.8
FRA	1.9	6.4	0.3	4.4	1.9	6.4	2.3	1.9
ITA	2.8	6.4	0.4	4.3	2.8	6.4	3.7	2.5
GBR	3.4	8.2	0.3	4.3	3.4	8.3	0.5	–0.4
AUT	1.9	6.6	1.1	5.6	2.2	7.1	1.4	1.1
BEL	1.8	5.8	0.1	4.1	1.8	5.9	1.6	1.6
DNK	0.2	4.4	0.2	4.5	0.6	5.3	–0.5	0.4
FIN	0.7	5.5	0.5	5.0	0.9	5.8	2.6	1.1
GRE	4.4	7.1	2.4	5.7	4.8	7.4	7.3	4.4
IRL	6.9	11.2	3.9	8.1	8.3	12.7	8.4	8.0
NET	2.6	8.2	1.8	6.9	3.4	9.4	1.7	1.5
PRT	5.1	9.5	1.5	5.6	5.2	9.5	4.3	3.7
ESP	3.5	9.8	1.8	7.0	3.9	10.5	3.8	1.8
SWE	1.6	8.0	0.0	4.0	1.7	8.2	1.6	1.6

Notes: Maximum additional tax revenue and interest rates for the labor and capital tax of Laffer curve and Laffer hill, respectively. The model is calibrated to the year 2010 (see table 6.2). Parameters are set as in table 6.1. $\overline{\Delta T/y}_{\text{Max}}$ denotes the maximum additional tax revenues (expressed in percent of baseline GDP) that results from moving from the 2010 status quo to the peak of the Laffer curve. $\bar{r}_{\text{Max}}$ is the maximum net real interest rate that the government could afford on outstanding debt in the year 2010 if all additional tax revenue is spent on interest rate payments.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

[b]Real long-term interest rates for 2010 downloaded from the European Commission AMECO database. These are nominal ten years government bond interest rates minus inflation—either using the GDP deflator (ILRV, first column) or the consumption deflator (ILRC, second column). EU-14 value is the real GDP weighted average of European countries. All numbers in the table in percent.

column). The value for the aggregate EU-14 is the real GDP weighted average of individual European countries.

The most interesting column in table 6.7 may be the second one. We find that the United States can afford the highest interest rate if labor taxes are moved to the peak of the Laffer curve: depending on the debt measure used, a real interest rate of of 12 to 15.5 percent is sustainable. Interestingly, Ireland can also afford the high rate of 11.2 percent when moving labor taxes only. By contrast, Austria, Belgium, Denmark, Finland, France, Greece, and Italy can only afford permanent real rates in the range of 4.4 to 7.1 percent when financing the additional interest payments with higher labor tax rates alone, while, say, Germany, Portugal, and Spain can all afford an interest rate somewhere above 9 percent. The picture improves somewhat, but not much, when labor taxes and capital taxes can both be adjusted: notably, Belgium, Denmark, Finland, France, and Italy cannot permanently afford real interest rates above 6.5 percent.

Note that now, the comparison of "US gross government debt" versus "US debt held by the public" matters for the results since government spending is kept constant. Indeed, the United States could afford higher interest rates if "US debt held by the public" is considered.

Interestingly, in the next section, we also examine the implications of human capital accumulation and show that the maximum interest rates may be even lower than suggested by our baseline model.

For the above analysis, some caveats should be kept in mind. The interest rate on outstanding government debt deviates from the one on private capital but does not crowd out private investment. In other words, it is implicitly assumed that the interest rate payments due to the higher interest rate are paid lump-sum to the households and thereby do not affect household consumption, hours, or investment, and that it does not affect the rate at which firms can borrow privately.[6]

Note that the steady state safe real interest rate is calibrated to equal 4 percent and therefore represents the lower bound for $\bar{r}_{\text{Max}}$: our analysis on sustainable rates may therefore be too optimistic, keeping in mind that the interest rates are real interest rates, not nominal interest rates. It is worth emphasizing that we have not included the possibility of cutting government spending and/or transfers and that our analysis has focused on the most pessimistic scenario of a permanent shift.

6.5 Extensions: Human Capital, Consumption Taxes

6.5.1 Baseline Model versus Human Capital Accumulation

We compare the distance to the peak of Laffer curves for the above baseline model and the above baseline model with added human capital accumulation (see table 6.8). More specifically, we assume that human capital is accumulated following the second-generation case considered in Trabandt and Uhlig (2011).[7]

In particular, we assume that human capital can be accumulated by both learning-by-doing as well as schooling, following Lucas (1998) and Uzawa

6. For related work, see, for example, Bi (2011) and Bi, Leeper, and Leith (2010).

7. See Jones (2001), Barro and Sala-i-Martin (2003), or Acemoglu (2008) for textbook treatments of models with endogenous growth and human capital accumulation. While first-generation endogenous growth models have stressed the endogeneity of the overall long-run growth rate, second-generation growth models have stressed potentially large level effects, without affecting the long-run growth rate. We shall focus on the second-generation case here since little evidence has been found that taxation impacts on the long-run growth rate; see, for example, Levine and Renelt (1992).

Table 6.8 **Distance to peak in terms of tax rates (in %)**

	Vary labor taxes, τ^n		Vary capital taxes, τ^k	
	Baseline	Human capital	Baseline	Human capital
US	39.9	20.9	29.9	27.9
US[a]	39.9	20.9	29.9	27.9
EU-14	26.8	7.8	23.2	22.2
GER	28.5	11.5	36.1	36.1
FRA	21.4	1.4	13.6	12.6
ITA	23.8	3.8	17.7	15.7
GBR	33.2	11.2	12.9	9.9
AUT	17.2	–3.8	26.3	22.3
BEL	19.7	–1.3	6.5	4.5
DNK	10.7	–15.3	–2.4	–5.4
FIN	17.0	–4.0	20.5	20.5
GRE	29.9	7.9	41.0	34.0
IRL	42.8	34.8	50.7	56.7
NET	30.9	17.9	32.3	36.3
PRT	34.8	12.8	30.3	26.3
ESP	31.0	12.0	31.9	28.9
SWE	12.2	–8.8	12.2	13.2

Notes: Distance to the peak of Laffer curves for baseline model and baseline model with added human capital accumulation (second generation, see the main text and Trabandt and Uhlig 2011 for details). Distance is measured in terms of tax rates. All numbers are expressed in percent. The model is calibrated to the average of 1995–2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1. Parameters for human capital accumulation are set as in the main text and Trabandt and Uhlig (2011). All numbers in the table in percent.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

(1965). The agent splits total nonleisure time n_t, into workplace labor $q_t n_t$, and schooling time $(1 - q_t)n_t$, where $0 \leq q_t \leq 1$. Agents accumulate human capital according to

$$h_t = (Aq_t n_t + B(1 - q_t)n_t)^{\nu} h_{t-1}^{1-\nu} + (1 - \delta_h)h_{t-1}, \tag{14}$$

where $A \geq 0$ and $B > A$ parameterize the effectiveness of learning-by-doing and schooling, respectively, and where $0 < \delta_h \leq 1$ is the depreciation rate of human capital. Wages are paid per unit of labor and human capital so that the after-tax labor income is given by $(1 - \tau_t^n)w_t h_{t-1} q_t n_t$. Given this, the adaptions of the model on the parts of firms is straightforward so that we shall leave them out here.

The model is calibrated to the average of 1995 to 2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1. Parameters for human capital accumulation are set as in Trabandt and Uhlig (2011). More precisely, the same calibration strategy for the initial steady state is applied as in the above baseline model, except assuming now $\bar{q}\bar{n}_{\mathrm{US}} = 0.25$.

Further, $v = 0.5$ and $\delta_h = \delta$ are set for simplicity. Parameter A is set such that initial $\bar{q}_{US} = 0.8$. Moreover, B is set to have $h_{US} = 1$ initially.

Figure 6.6 shows the comparison for the United States and the EU-14. Further cross-country results are contained in figure 6.7. Interestingly, the capital tax Laffer curve is affected only very little across countries when human capital is introduced. By contrast, the introduction of human capital has important effects for the labor income tax Laffer curve. Several countries are pushed on the slippery slope sides of their labor tax Laffer curves. This result is due to two effects. First, human capital turns labor into a stock variable rather than a flow variable as in the baseline model. Higher labor taxes induce households to work less and to aquire less human capital which in turn leads to lower labor income. Consequently, the labor tax base shrinks much more quickly when labor taxes are raised. Second, the introduction of intermediate inputs moves countries closer to the peaks of their labor tax Laffer curves already in the baseline model compared to Trabandt and Uhlig (2011). This effect is reinforced when human capital is introduced.

Finally, we recalculate the implied maximum interest rates on government debt in 2010 when human capital accumulation is allowed for in the model. Table 6.9 contains the results: the United States may only afford a real interest rate between 5.8 to 6.6 percent in this case. Most of the European countries cluster between 4 and 4.9 percent except for Denmark, Finland, and Ireland, who can afford real interest rates between 5.9 and 9.5 percent.

6.5.2 Consumption Taxes

We compute maximum additional tax revenues that are possible from increasing consumption taxes (see table 6.10). We do this in the previous baseline model and in the model with added human capital accumulation, as in the previous subsection. The model is calibrated to the average of 1995 to 2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1. Parameters for human capital accumulation are set as in the previous subsection.

The upper panel of figure 6.8 shows the comparison for the United States and EU-14. Further cross-country results are shown in the lower panel of the same figure. As documented and examined in Trabandt and Uhlig (2011), the consumption tax Laffer curve has no peak. However, the introduction of human capital has important quantitative effects across countries. The range of maximum additional tax revenues (in percent of GDP) in the above baseline model is roughly 40 to 100 percent, while it shrinks to roughly 10 to 30 percent in the model with added human capital. Higher consumption taxes affect equilibrium labor via the labor wedge, similar to labor taxes. Human capital amplifies the reduction of the labor tax base triggered by the change in the labor wedge by the same argument as in the previous subsection. Overall, maximum possible tax revenues due to consumption taxes are reduced massively, although at fairly high consumption tax rates.

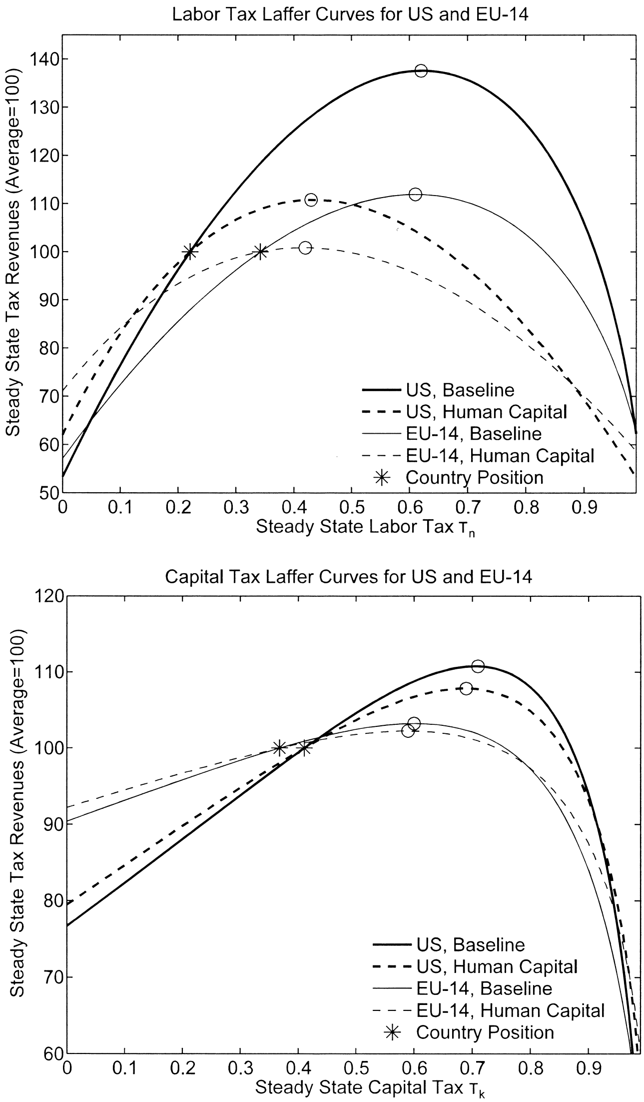

Fig. 6.6 Labor and capital tax Laffer curves: The impact of endogenous human capital accumulation

Notes: Shown are steady state (balanced growth path) total tax revenues when labor taxes are varied between 0 and 100 percent in the United States and EU-14. All other taxes and parameters are held constant. Total tax revenues at the average tax rates are normalized to 100. Two cases are examined. First, the benchmark model with exogenous growth. Second, the benchmark model with a second-generation version of endogenous human capital accumulation (see the main text and Trabandt and Uhlig 2011 for details). The model is calibrated to the average of 1995–2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1 (gross US debt). Parameters for human capital accumulation are set as in the main text and Trabandt and Uhlig (2011).

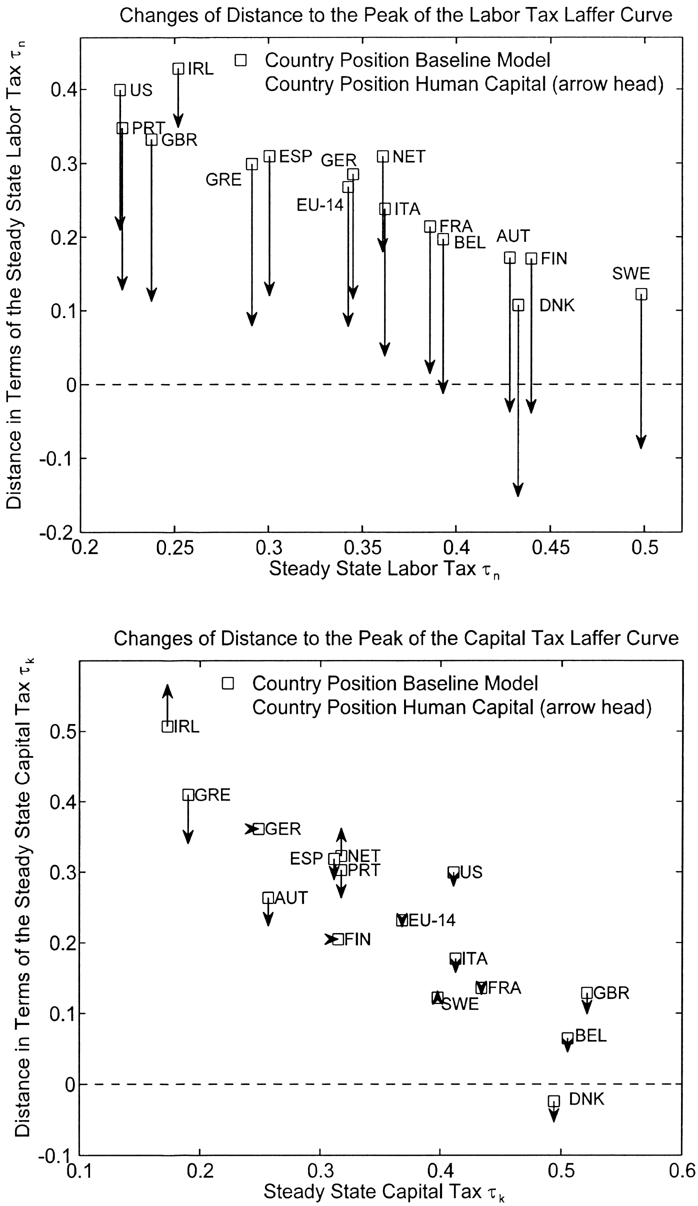

Fig. 6.7 Distance to the peak of Laffer curves for baseline model and baseline model with added human capital accumulation

Notes: Second generation, see the main text and Trabandt and Uhlig (2011) for details. The model is calibrated to the average of 1995–2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1 (gross US debt). Parameters for human capital accumulation are set as in the main text and Trabandt and Uhlig (2011). Horizontal axis shows calibrated tax rates. Vertical axis shows distance to the peak in terms of tax rates.

Table 6.9 **Model with human capital: Maximum real interest rates on government debt (in %)**

	Vary labor taxes, τ^n		Vary capital taxes, τ^k		Data: Long-term interest rates[b]	
	$\Delta\overline{T/y}_{Max}$	$\bar{r}_{Max}$	$\Delta\overline{T/y}_{Max}$	$\bar{r}_{Max}$		
US	1.7	5.8	1.7	5.8	2.0	1.4
US[a]	1.7	6.6	1.7	6.6	2.0	1.4
EU-14	0.0	4.0	0.6	4.8	2.4	1.5
GER	0.8	4.9	1.7	6.0	2.1	0.8
FRA	0.1	4.1	0.1	4.2	2.3	1.9
ITA	0.0	4.0	0.2	4.1	3.7	2.5
GBR	0.0	4.0	0.1	4.1	0.5	–0.4
AUT	0.1	4.1	0.7	5.0	1.4	1.1
BEL	0.1	4.1	0.0	4.0	1.6	1.6
DNK	2.4	9.5	0.2	4.5	–0.5	0.4
FIN	0.9	5.9	0.3	4.6	2.6	1.1
GRE	0.2	4.1	1.3	4.9	7.3	4.4
IRL	4.0	8.1	4.8	9.0	8.4	8.0
NET	0.3	4.5	2.2	7.5	1.7	1.5
PRT	0.4	4.4	0.9	4.9	4.3	3.7
ESP	0.1	4.2	1.3	6.1	3.8	1.8
SWE	0.1	4.3	0.0	4.0	1.6	1.6

Notes: Model with human capital: maximum additional tax revenue and interest rates for the labor and capital tax Laffer curves. Second-generation model with human capital accumulation, see the main text and Trabandt and Uhlig (2011) for details. The model is calibrated to the year 2010, see table 6.2. Parameters are set as in table 6.1. For human capital accumulation parameters see the main text and Trabandt and Uhlig (2011). $\Delta\overline{T/y}_{Max}$ denotes the maximum additional tax revenues (expressed in percent of baseline GDP) that results from moving from the 2010 status quo to the peak of the Laffer curve. $\bar{r}_{Max}$ is the maximum net real interest rate that the government could afford on outstanding debt in the year 2010 if all additional tax revenue is spent on interest rate payments. All numbers in the table in percent.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

[b]Real long-term interest rates for 2010 downloaded from the European Commission AMECO database. These are nominal ten years government bond interest rates minus inflation—either using the GDP deflator (ILRV, first column) or the consumption deflator (ILRC, second column). EU-14 value is the real GDP weighted average of European countries. All numbers in the table in percent.

6.6 Conclusion

We have studied how Laffer curves differ across countries in the United States and the EU-14. This provides insight into the limits of taxation. To that end, we extended the analysis in Trabandt and Uhlig (2011) to include monopolistic competition as well as partial taxation of the monopolistic-competition profits: we have shown that this improves the fit to the data considerably. We have also provided refined data for effective labor and capital income taxes across countries. For the cross-country comparison, we assume

Table 6.10 **Vary consumption taxes: Distance to peak in terms of tax revenues (in % of GDP)**

	Baseline	Human capital
US	90.7	27.2
US[a]	90.7	27.2
EU-14	63.9	19.9
GER	61.7	20.2
FRA	58.7	17.9
ITA	67.8	20.0
GBR	79.7	23.5
AUT	62.6	18.5
BEL	58.2	17.3
DNK	48.9	14.4
FIN	47.0	15.2
GRE	97.8	27.3
IRL	44.2	18.1
NET	42.3	15.8
PRT	91.2	26.8
ESP	76.0	23.2
SWE	37.8	12.5

Notes: Maximum additional tax revenues due to consumption taxes. Baseline model versus baseline model with added human capital accumulation (second-generation human capital accumulation growth model, see the main text and Trabandt and Uhlig 2011 for details). Additional tax revenues are measured in percent of baseline GDP. The model is calibrated to the average of 1995–2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1. Parameters for human capital accumulation are set as in the main text and Trabandt and Uhlig (2011). All numbers in the table in percent.

[a]Results when "debt held by the public" is used for the United States rather than the harmonized cross-country measure of gross government debt provided by the AMECO database.

that all structural parameters for technologies and preferences are the same across countries. The differences between the Laffer curves therefore arise solely due to differences in fiscal policy; that is, the mix of distortionary taxes, government spending, and government debt. We find that labor income and consumption taxes are important for accounting for most of the cross-country differences.

To examine recent developments, we calibrate the steady state of the model to the Laffer curves implied by the strained fiscal situation of 2010, and compare them to the Laffer curves of the average extended sample 1995 to 2010. We find that the 2010 calibration moves all countries considerably closer to the peak of the labor tax Laffer curve, with the scope for additional labor tax increases cut by a third for most countries and by up to one-half for some countries. In this context, we show that it is important to keep the general equilibrium repercussions of raising taxes in mind: even though tax revenues may be increased by some limited amount, tax bases and thereby

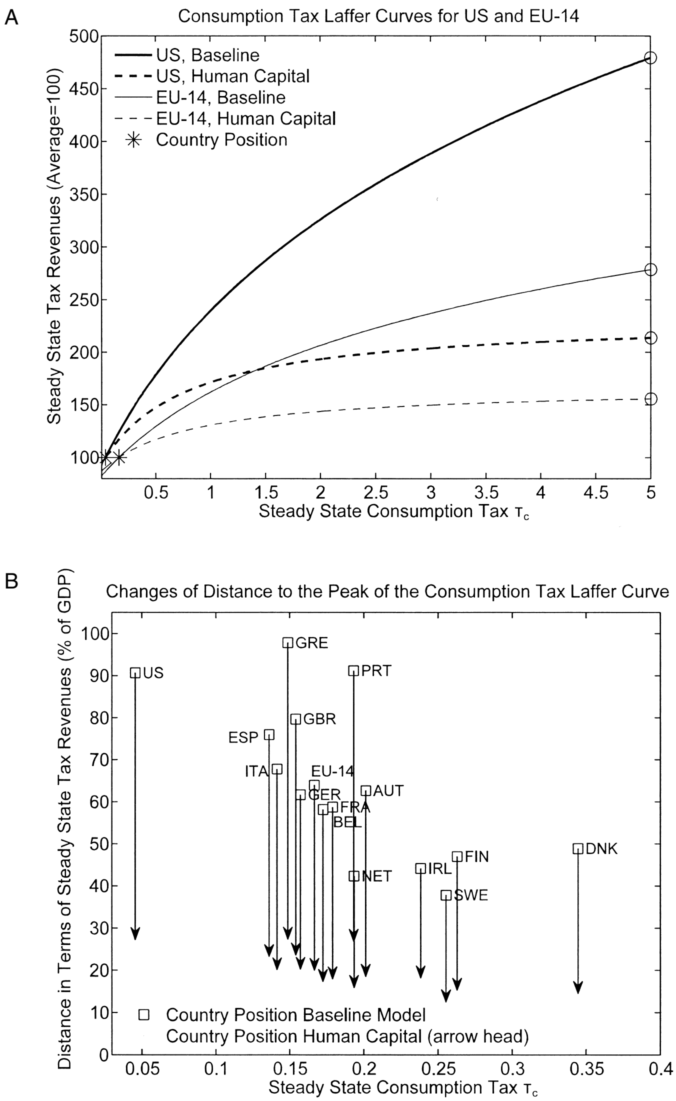

Fig. 6.8 ***A*, Consumption tax Laffer curve in the United States and EU-14: The impact of endogenous human capital accumulation; *B*, Distance to the peak of Laffer curves for baseline model and baseline model with added human capital accumulation**

Notes: Shown are steady state (balanced growth path) total tax revenues when consumption taxes are varied between 0 and 500 percent. All other taxes and parameters are held constant. Total tax revenues at the average consumption tax rate are normalized to 100. Two cases are examined. First, the benchmark model with exogenous growth. Second, the benchmark model with a second-generation version of endogenous human capital accumulation (see the main text and Trabandt and Uhlig 2011 for details). The model is calibrated to the average of 1995–2010 for fiscal variables. Standard parameters for technology and preferences are set as in table 6.1 (gross US debt). Parameters for human capital accumulation are set as in the main text and Trabandt and Uhlig (2011). Horizontal axis shows calibrated tax rates. Vertical axis shows distance to the peak in terms of tax revenues (in percent of GDP).

output fall when moving to the peak of the Laffer curve due to the negative incentive effects of higher taxes.

We calculate the implications for the long-term sustainability of current debt levels by calculating the maximal permanently sustainable interest rate. We calculated that the United States can afford the highest interest rate if only labor taxes are adjusted to service the additional debt burden: depending on the debt measure used, a real interest rate of of 12 to 15.5 percent is sustainable. Interestingly, Ireland can also afford the high rate of 11.2 percent when moving labor taxes only. By contrast, Austria, Belgium, Denmark, Finland, France, Greece, and Italy can only afford permanent real rates in the range of 4.4 to 7.1 percent, when financing the additional interest payments with higher labor tax rates alone, while, say, Germany, Portugal, and Spain can all afford an interest rate somewhere above 9 percent. The picture improves somewhat, but not much, when labor taxes and capital taxes can both be adjusted: notably, Belgium, Denmark, Finland, France, and Italy cannot permanently afford real interest rates above 6.5 percent.

We have shown that the introduction of human capital has important effects for the labor income tax Laffer curve across countries. Several countries are pushed on the slippery slope sides of their labor tax Laffer curves once human capital is accounted for. We recalculated the implied maximum interest rates on government debt in 2010 when human capital accumulation is allowed for in the model. In this case, the United States may only afford a real interest rate between 5.8 to 6.6 percent. Most of the European countries cluster between 4 and 4.9 percent except for Denmark, Finland, and Ireland, who can afford real interest rates between 5.9 and 9.5 percent.

We have performed a cross-country analysis on consumption taxes. We document that the range of maximum additional tax revenues (in percent of GDP) in the baseline model is roughly 40 to 100 percent, while it shrinks to roughly 10 to 30 percent in the model with added human capital, although the underlying consumption taxes are fairly high in both cases.

Appendix A

Tax Rate Tables

Table 6A.1 **Labor income taxes in percent across countries and time**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010[a]
US	22.2	22.8	23.3	23.5	23.8	24.1	23.8	21.7	20.7	20.6	21.6	21.9	22.3	21.4	20.0	20.0
EU-14	34.9	35.0	34.9	34.3	34.7	33.8	33.6	33.2	33.5	33.4	33.7	34.1	34.3	34.8	34.8	34.8
GER	35.2	34.4	34.6	35.0	35.1	34.9	35.2	34.4	34.0	33.5	33.2	33.7	34.1	34.3	35.2	35.2
FRA	38.7	39.2	39.2	38.3	38.9	38.5	37.9	37.7	38.3	38.0	39.1	39.1	38.7	38.7	38.6	38.6
ITA	33.7	36.3	37.6	34.8	35.4	34.9	34.8	35.0	35.5	35.7	35.8	36.0	37.4	38.4	39.0	39.0
GBR	22.7	21.9	21.6	22.6	23.2	23.6	23.6	23.1	23.3	24.2	24.6	25.2	25.7	25.8	24.8	24.8
AUT	40.8	41.8	42.8	43.0	42.9	42.4	43.8	43.8	43.7	43.4	42.6	42.4	42.3	43.0	43.4	43.4
BEL	39.0	39.0	39.6	39.7	39.5	39.2	39.1	40.0	40.3	40.6	39.7	38.8	38.6	38.8	38.5	38.5
DNK	42.0	42.3	43.0	42.2	44.7	44.9	44.2	43.3	43.3	42.4	42.4	42.1	43.4	43.3	44.4	44.4
FIN	47.4	48.2	46.0	45.7	44.7	44.9	44.4	44.0	42.7	41.8	42.7	43.2	42.8	42.3	41.4	41.4
GRE	NaN	NaN	NaN	NaN	NaN	26.8	28.3	29.7	30.5	29.7	29.5	29.2	29.3	30.3	28.5	28.5
IRL	NaN	NaN	NaN	NaN	NaN	NaN	NaN	23.8	24.4	25.8	25.9	27.0	26.7	24.3	24.4	24.4
NET	40.7	38.0	38.3	34.2	35.5	35.6	32.9	33.1	33.2	33.5	34.2	36.9	36.6	38.4	38.1	38.1
PRT	20.9	21.1	21.3	21.2	21.2	21.7	22.4	22.4	22.7	22.0	22.1	22.7	23.4	23.4	23.6	23.6
ESP	NaN	NaN	NaN	NaN	NaN	28.9	29.5	29.7	29.8	29.8	30.2	30.7	31.3	30.6	30.0	30.0
SWE	48.5	50.0	52.0	53.6	55.3	51.5	49.8	48.4	49.8	50.2	50.2	50.2	48.2	47.6	45.9	45.9

Note: Country codes: Germany (GER), France (FRA), Italy (ITA), United Kingdom (GBR), Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), Greece (GRE), Ireland (IRL), Netherlands (NET), Portugal (PRT), Spain (ESP), and Sweden (SWE).

NaN = not available number (no numeric data available).

[a] Due to data availability reasons, 2010 tax rates are assumed to be the same as in 2009. For an alternative, see subsection 6.3.2 in the main text.

Table 6A.2 **Capital income taxes in percent across countries and time**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010[a]
US	44.0	42.6	41.7	42.6	41.9	43.2	39.9	37.4	38.7	38.7	40.9	42.1	45.6	42.6	37.6	37.6
EU-14	33.4	35.6	37.7	38.2	40.3	39.8	37.9	35.3	34.1	34.6	36.7	39.0	38.3	37.1	35.5	35.5
GER	22.9	23.6	23.8	25.1	27.8	29.4	20.9	21.7	23.5	22.9	24.2	25.9	25.7	26.3	27.1	27.1
FRA	34.6	38.5	40.7	42.0	44.8	44.0	45.9	44.1	41.9	44.5	44.4	48.6	46.5	48.4	42.8	42.8
ITA	41.1	43.0	45.8	39.1	41.9	37.0	39.0	38.0	35.8	36.0	37.6	44.1	46.1	46.1	44.8	44.8
GBR	47.3	46.2	50.3	54.7	55.6	61.6	62.7	52.4	48.0	48.0	52.1	54.9	50.1	49.7	50.2	50.2
AUT	22.0	26.0	27.9	27.6	26.2	25.9	32.1	25.3	25.4	25.3	24.5	23.5	24.6	26.4	24.1	24.1
BEL	44.8	48.5	50.0	54.2	54.6	53.2	56.6	52.4	47.9	45.1	49.0	50.5	48.6	52.4	50.4	50.4
DNK	40.0	41.4	41.7	50.9	44.0	42.8	46.7	47.4	48.5	49.4	55.1	58.7	57.1	56.0	55.5	55.5
FIN	26.1	30.8	32.0	33.8	34.1	40.6	32.0	31.7	30.1	30.4	30.8	30.1	30.4	30.7	30.1	30.1
GRE	NaN	NaN	NaN	NaN	NaN	27.3	20.6	20.3	17.9	17.5	19.0	17.2	18.6	17.3	16.8	16.8
IRL	NaN	NaN	NaN	NaN	NaN	NaN	NaN	15.2	16.4	17.7	18.1	20.4	18.8	17.6	15.7	15.7
NET	31.6	35.7	35.9	36.9	37.3	35.4	36.5	33.4	29.8	30.5	33.1	29.1	28.8	27.4	23.3	23.3
PRT	25.0	27.1	27.5	26.9	30.7	33.7	30.1	32.1	31.3	30.2	33.7	34.8	37.0	40.3	33.8	33.8
ESP	NaN	NaN	NaN	NaN	NaN	28.7	27.1	29.0	29.7	32.5	37.3	40.1	41.3	28.1	24.4	24.4
SWE	27.3	34.2	36.4	36.6	38.0	48.3	44.4	37.6	34.8	35.8	40.1	38.0	39.9	40.2	52.5	52.5

Note: Country codes: Germany (GER), France (FRA), Italy (ITA), United Kingdom (GBR), Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), Greece (GRE), Ireland (IRL), Netherlands (NET), Portugal (PRT), Spain (ESP), and Sweden (SWE). NaN = not available number (no numeric data available).

[a]Due to data availability reasons, 2010 tax rates are assumed to be the same as in 2009.

Table 6A.3 **Consumption taxes in percent across countries and time**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010[a]
US	5.1	5.1	5.0	5.0	4.9	4.7	4.6	4.5	4.4	4.4	4.5	4.5	4.3	4.1	4.0	4.0
EU-14	17.0	17.1	17.1	17.3	17.6	17.4	16.9	16.8	16.7	16.6	16.5	16.6	16.7	16.1	15.2	15.2
GER	15.4	15.3	15.0	15.2	16.0	16.0	15.6	15.5	15.7	15.3	15.1	15.3	16.7	16.6	16.7	16.7
FRA	18.6	19.4	19.6	19.6	19.8	18.8	18.1	18.0	17.5	17.6	17.5	17.4	17.1	16.5	15.6	15.6
ITA	15.4	14.4	14.2	15.1	14.7	15.6	14.9	14.6	14.1	13.7	13.7	14.2	14.0	13.1	12.5	12.5
GBR	16.7	16.9	16.7	16.7	16.7	16.3	15.7	15.5	15.6	15.6	15.0	14.8	14.7	14.1	13.0	13.0
AUT	19.3	20.0	21.0	21.0	21.6	20.5	20.2	20.7	20.2	20.2	20.0	19.2	19.6	19.6	19.5	19.5
BEL	16.5	16.8	17.1	17.0	18.0	17.9	16.8	17.2	17.0	17.8	18.2	18.3	17.8	16.8	16.5	16.5
DNK	32.4	33.9	34.2	35.4	36.4	35.7	35.8	35.7	35.0	34.8	35.6	36.0	35.3	33.1	31.0	31.0
FIN	26.5	26.4	28.9	28.5	28.9	28.1	26.8	26.7	27.2	26.2	26.1	25.8	24.8	23.9	22.9	22.9
GRE	15.7	15.8	16.3	15.6	15.8	15.1	15.7	15.6	14.9	14.5	14.2	14.4	14.8	14.1	12.8	12.8
IRL	24.1	24.4	24.8	26.0	26.5	25.4	22.3	23.5	23.3	25.0	26.0	25.9	24.5	21.1	19.3	19.3
NET	17.9	18.4	18.5	18.7	19.5	19.3	19.9	19.1	19.2	19.8	20.7	20.5	20.5	20.2	18.7	18.7
PRT	19.2	19.8	19.5	20.6	20.6	19.4	19.5	20.2	20.0	19.7	20.5	20.7	19.6	18.4	15.9	15.9
ESP	12.8	13.1	13.5	14.3	15.0	14.7	14.2	14.3	14.7	14.7	14.9	14.9	14.3	12.4	10.2	10.2
SWE	26.8	25.4	25.2	25.5	25.0	24.7	25.1	25.1	25.1	25.3	25.7	25.8	26.1	26.3	25.8	25.8

Note: Country codes: Germany (GER), France (FRA), Italy (ITA), United Kingdom (GBR), Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), Greece (GRE), Ireland (IRL), Netherlands (NET), Portugal (PRT), Spain (ESP), and Sweden (SWE).

[a] Due to data availability reasons, 2010 tax rates are assumed to be the same as in 2009.

Appendix B
Calculation of Tax Rates

We use the same data sources as in Trabandt and Uhlig (2011); that is, the AMECO database of the European Commission, the Organization for Economic Cooperation and Development (OECD) revenue statistics database and the national income and product accounts (NIPA) database of the Bureau of Economic Analysis (BEA).

In this chapter, we refine the methodology of Mendoza, Razin, and Tesar (1994) to calculate effective tax rates on labor and capital income. Broadly, we expand the measured labor tax base by including supplements to wages as well as a fraction of entrepreneurial income of households. Supplements to wages beyond employers' Social Security contributions account for about 7 percent of US GDP. Also, entrepreneurial income of households is sizable as a fraction of GDP but entirely accounted for as capital income in Mendoza, Razin, and Tesar (1994). We argue that at least a fraction, say α, of this income ought to be attributed to labor income. As a result, the refinements imply a more reasonable labor share in line with the empirical literature. More importantly, the average 1995 to 2010 labor income taxes turn out to be lower while capital income taxes are higher, as previously calculated in Trabandt and Uhlig (2011). Appendix table 6B.1 provides an overview of the refinements.[8] The following list explains the abbreviations used in appendix table 6B.1.

1100: Income, profit, and capital gains taxes of individuals, revenue statistics (OECD).
1200: Income, profit, and capital gains taxes of corporations, revenue statistics (OECD).
2000: Social Security contributions, revenue statistics (OECD).
2200: Social Security contributions of employers, revenue statistics (OECD).
3000: Payroll taxes, revenue statistics (OECD).
4000: Property taxes, revenue statistics (OECD).
4100: Recurrent taxes on immovable property, revenue statistics (OECD).
4400: Taxes on financial and capital transactions, revenue statistics (OECD).
OS: Net operating surplus: total economy (AMECO, NIPA).
W: Gross wages and salaries: households and nonprofit institutions serving households. (NPISH) (AMECO, NIPA).
OSPUE+PEI: Gross operating surplus minus consumption of fixed capital plus mixed income plus net property income: households and NPISH (AMECO).

8. Note that we retain the assumption in Mendoza, Razin, and Tesar (1994) that, implicitly, income from capital and labor is taxed at the same rate. In future research, it would be interesting to take differences in the taxation of labor and capital income explicitly into account when calculating tax rates.

Table 6B.1 Calculations of effective tax rates: Mendoza, Razin, and Tesar (1994) as used in Trabandt and Uhlig (2011) versus this chapter

Income tax	Mendoza, Razin, and Tesar (1994)	This chapter
Personal:	$\tau^h = \frac{1100}{\text{OSPUE} + \text{PEI} + W}$	$\tau^h = \frac{1100}{(1 - \alpha + \alpha)(\text{OSPUE} + \text{PEI}) + W + W^{\text{suppl}}}$
Labor:	$\tau^n = \frac{\tau^h W + 2000 + 3000}{W + 2200}$	$\tau^n = \frac{\tau^h[W + W^{\text{suppl}} + \alpha(\text{OSPUE} + \text{PEI})] + 2000 + 3000}{W + W^{\text{suppl}} + \alpha(\text{OSPUE} + \text{PEI}) + 2200}$
Capital:	$\tau^k = \frac{\tau^h(\text{OSPUE} + \text{PEI}) + 1200 + 4100 + 4400}{OS}$	$\tau^k = \frac{\tau^h(1 - \alpha)(\text{OSPUE} + \text{PEI}) + 1200 + 4100 + 4400}{OS - \alpha(\text{OSPUE} + \text{PEI})}$

Table 6B.2 **Comparison of effective tax rates**

	Labor taxes, τ^n		Capital taxes, τ^k		Labor share	
	TU (2011)	This chapter	TU (2011)	This chapter	TU (2011)	This chapter
US	0.27	0.22	0.35	0.41	0.50	0.64
EU-14	0.41	0.34	0.32	0.37	0.48	0.58
GER	0.41	0.34	0.22	0.25	0.49	0.60
FRA	0.45	0.39	0.35	0.43	0.50	0.59
ITA	0.47	0.36	0.34	0.41	0.38	0.52
GBR	0.28	0.24	0.44	0.52	0.50	0.60
AUT	0.50	0.43	0.24	0.26	0.48	0.57
BEL	0.48	0.39	0.43	0.51	0.48	0.60
DNK	0.48	0.43	0.50	0.49	0.50	0.56
FIN	0.48	0.44	0.32	0.31	0.48	0.53
GRE	0.41	0.29	0.17	0.19	0.32	0.46
IRL	0.27	0.25	0.17	0.17	0.42	0.45
NET	0.44	0.36	0.28	0.32	0.45	0.55
PRT	0.28	0.22	0.27	0.32	0.44	0.56
ESP	0.35	0.30	0.27	0.31	0.46	0.55
SWE	0.56	0.50	0.39	0.40	0.51	0.57

Notes: "TU (2011)" stands for Trabandt and Uhlig (2011), who use the methodology proposed by Mendoza, Razin, and Tesar (1994). The table shows the implications of the refined calculations of effective tax rates as well as the implied labor share. See appendix B for details.

W^{suppl}: Supplements to wages: households and NPISH. Calculated as the residual of compensation of employees minus wages and salaries minus Social Security contributions of employers.

We select a value for α such that the average 1995 to 2010 labor share, that is, $[W + W^{\text{suppl}} + \alpha(\text{OSPUE} + \text{PEI}) + 2200]/\text{GDP}$, equals 64 percent in the United States. It turns out that we need to set $\alpha = 0.35$. We keep the same value for α for all other countries.

Appendix table 6B.2 shows the resulting effective tax rates across countries and compares them to those when the standard Mendoza, Razin, and Tesar (1994) methodology is applied as used, for example, in Trabandt and Uhlig (2011). It turns out, that due to the broader labor tax base, effective labor taxes are somewhat smaller while effective capital taxes are higher.

Finally, appendix table 6B.3 provides maximum additional tax revenues that result from moving from the peak of the Laffer curve when either the standard Mendoza, Razin, and Tesar (1994) tax rates or the refined version proposed in this chapter are used. Further, the table also shows the implications of imperfect versus perfect competition. The introduction of imperfect competition reduces the effective labor tax base and thus less additional tax revenues are attainable when varying labor taxes. By contrast, profits arising from market power increase maximum additional tax revenues when capital

Table 6B.3 **Laffer curves for the 1995–2010 calibration**

	Vary labor taxes, τ^n $\Delta\bar{T}_{\text{Max}}$			Vary capital taxes, τ^k $\Delta\bar{T}_{\text{Max}}$		
	This chapter		TU (2011)	This chapter		TU (2011)
	$\omega = 1.1$	$\omega \to 1$	$\omega \to 1$	$\omega = 1.1$	$\omega \to 1$	$\omega \to 1$
US	37.6	42.5	33.3	10.7	8.2	7.3
EU-14	11.9	13.9	8.4	3.2	1.6	1.0
GER	15.4	17.3	10.1	6.8	3.9	2.3
FRA	7.1	8.6	4.9	1.1	0.3	0.3
ITA	9.8	11.6	4.2	2.1	0.9	0.3
GBR	17.5	21.0	18.7	1.7	0.9	1.6
AUT	5.2	6.1	2.0	2.6	1.0	0.3
BEL	5.7	7.2	3.0	0.3	0.0	0.0
DNK	1.3	2.1	0.6	0.0	0.4	0.9
FIN	4.1	5.1	2.9	1.6	0.4	0.2
GRE	18.9	21.0	8.2	8.9	5.6	2.1
IRL	32.7	36.3	32.3	14.9	10.7	9.4
NET	14.7	16.9	8.7	5.3	3.0	1.6
PRT	21.6	25.1	18.6	6.6	4.5	3.6
ESP	18.5	21.0	15.0	6.5	4.0	3.1
SWE	2.0	2.7	0.7	0.5	0.0	0.0

Notes: $\Delta\bar{T}_{\text{Max}}$ denotes the maximum additional tax revenues (in percent) that results from moving from to the peak of the Laffer curve. Results are shown for the standard Mendoza, Razin, and Tesar (1994) taxes used in Trabandt and Uhlig (2011), "TU," as well as for the refined tax rate calculations discussed in appendix B. Further, the case of imperfect competition with a gross markup $\omega = 1.1$ is compared to the case of perfect competition (i.e., $\omega \to 1$).

taxes are varied. The third column shows the results when the standard Mendoza tax rates are used in the analysis and are essentially those obtained by Trabandt and Uhlig (2011). In this case, higher effective labor taxes at the status quo equlibrium reduce the scope for more tax revenues when labor and capital taxes are varied.

References

Acemoglu, D. 2008. *Introduction to Modern Economic Growth,* 1st ed. Princeton, NJ: Princeton University Press.

Alesina, A., E. Glaeser, and B. Sacerdote. 2006. "Work and Leisure in the US and Europe: Why So Different?" In *NBER Macroeconomics Annual 2005,* vol. 20, edited by Mark Gertler and Kenneth Rogoff, 1–100. Cambridge, MA: MIT Press.

Barro, R. J., and X. Sala-i-Martin. 2003. *Economic Growth,* 2nd ed. Cambridge, MA: MIT Press.

Bi, H. 2011. "Sovereign Default Risk Premia, Fiscal Limits, and Fiscal Policy." Bank of Canada Working Paper 2011-10, March.

Bi, H., E. M. Leeper, and C. Leith. 2010. "Stabilization versus Sustainability: Macroeconomic Policy Tradeoffs.." Prepared for the European Central Bank's Conference on Monetary and Fiscal Policy Challenges in Times of Financial Stress. December 2–3.

Blanchard, O. 2004. "The Economic Future of Europe." *Journal of Economic Perspectives* 18 (4): 3–26.

Chari, V. V., P. J. Kehoe, and E. R. McGrattan. 2007. "Business Cycle Accounting." *Econometrica* 75 (3): 781–836.

Cooley, T. F., and E. Prescott. 1995. "Economic Growth and Business Cycles." In *Frontiers of Business Cycle Research,* edited by T. F. Cooley, 1–38. Princeton, NJ: Princeton University Press.

Green, J., and L. J. Kotlikoff. 2009. "On the General Relativity of Fiscal Language." *Key Issues in Public Finance—A Conference in Memory of David Bradford,* edited by Alan J. Auerbach and Daniel Shaviro, 241–56. Cambridge, MA: Harvard University Press.

Hall, R. E. 2009. "Reconciling Cyclical Movements in the Marginal Value of Time and the Marginal Product of Labor." *Journal of Political Economy* 117 (2): 281–323.

Jones, C. I. 2001. *Introduction to Economic Growth,* 2nd ed. New York: Norton.

Kimball, M. S., and M. D. Shapiro. 2008. "Labor Supply: Are the Income and Substitution Effects Both Large or Both Small?" NBER Working Paper no. 14208. Cambridge, MA: National Bureau of Economic Research.

King, R. G., and S. T. Rebelo. 1999. "Resuscitating Real Business Cycles." In *Handbook of Macroeconomics,* edited by J. B. Taylor and M. Woodford, 927–1007. Amsterdam: Elsevier.

Levine, R., and D. Renelt. 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review* 82 (4): 942–63.

Ljungqvist, L., and T. J. Sargent. 2007. "Do Taxes Explain European Employment? Indivisible Labor, Human Capital, Lotteries, and Savings." In *NBER Macroeconomics Annual 2006,* vol. 21, edited by D. Acemoglu, K. Rogoff, and M. Woodford, 181–224. Cambridge, MA: MIT Press.

Lucas, R. E. 1988. "On the Mechanics of Economic Development." *Journal of Monetary Economics* 22:3–42.

Mendoza, E. G., A. Razin, and L. L. Tesar. 1994. "Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption." *Journal of Monetary Economics* 34:297–323.

Pissarides, C., and L. R. Ngai. 2009. "Welfare Policy and the Sectoral Distribution of Employment." Center for Structual Econometrics Discussion Paper no. 09/04. London: London School of Economics.

Prescott, E. C. 2002. "Prosperity and Depression." *American Economic Review* 92:1–15.

———. 2004. "Why Do Americans Work So Much More Than Europeans?" *Quarterly Review, Federal Reserve Bank of Minneapolis* 28:2–13.

———. 2006. "Nobel Lecture: The Transformation of Macroeconomic Policy and Research." *Journal of Political Economy* 114 (2): 203–35.

Rogerson, R. 2007. "Taxation and Market Work: Is Scandinavia an Outlier?" *Economic Theory* 32 (1): 59–85.

Shimer, R. 2009. "Convergence in Macroeconomics: The Labor Wedge." *American Economic Journal: Macroeconomics* 1 (1): 280–97.

Trabandt, M., and H. Uhlig. 2011. "The Laffer Curve Revisited." *Journal of Monetary Economics* 58 (4): 305–27.

Uzawa, H. 1965. "Optimum Technical Change in an Aggregative Model of Economic Growth." *International Economic Review* 6:18–31.

Comment Jaume Ventura

In their chapter, Trabandt and Uhlig compute Laffer curves for the United States and fourteen European countries. Their goal is to assess the limits of taxation in these countries and its implications for government deficit and the sustainability of current debt levels. Overall, I think this is a very interesting research project and a most welcome contribution to the current debate on fiscal policy in Europe and elsewhere. Undoubtedly, the estimates provided by the authors are subject to a number of important critiques, some of which I detail following. Despite this, we desperately need quantitative estimates of the effects of fiscal policy and the methodology developed by the authors can help us obtain those.

In this short comment, I first review the authors' methodology and highlight its basic strengths and weaknesses. This takes up the majority of these comments. After doing this, I briefly describe the main results and add some general remarks on them.

The methodology used by the authors can be summarized in five steps or assumptions. I describe next these steps or assumptions using a simplified version of the model that does not take into account monopolistic competition or human capital accumulation. These extensions are important from a quantitative perspective, but are not central when it comes to explaining and commenting on Trabandt and Uhlig's methodology.

The first step is to assume that aggregate production in the United States and the fourteen European countries can be well described by a Cobb-Douglas technology of the following sort:

$$y_t = \xi^t \cdot k_t^{\theta} \cdot n_t^{1-\theta} = \xi^{t/(1/\theta)} \cdot \left(\frac{k_t}{y_t}\right)^{\theta/(1-\theta)} \cdot n_t, \tag{1}$$

where I use the same notation as the authors. In particular, y_t is output; k_t and n_t are the stocks of capital and labor; ξ^t denotes the trend in total factor productivity; and θ is a parameter such that $\theta \in (0, 1)$. This is routinely assumed in macroeconomics. But still I cannot resist mentioning here again that this might be a poor assumption when one goes beyond building theo-

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For acknowledgments, sources of research support, and disclosure of the author's material financial relationships, if any, please see http://www.nber.org/chapters/c12639.ack.