Chapter 6 in C. Amo-Yartley (Ed.), 2014, *Fiscal Policies: International Aspects, Short and Long-Term Challenges and Macroeconomic Effects*, Nova Publishers (forthcoming)

On the Long-Term Impact of a Fiscal Devaluation:
An Application to the Portuguese Case

Alfredo M. Pereira[1], Rui M. Pereira[1], and Pedro G. Rodrigues[2]

[1] Department of Economics, The College of William and Mary, VA 23187, United States

[2] School of Social and Political Sciences, Universidade de Lisboa, Portugal

Abstract. We use a dynamic general equilibrium model to quantify the likely long-term impact of a fiscal devaluation on the Portuguese economy. In a context of exogenous growth, and imposing an unchanged budget deficit to GDP ratio in the year the policy is enacted, we find that a tax swap worth 1 percent of steady-state GDP raises long-term income by as much as 1 percent, and still contributes towards fiscal consolidation, provided there are no cost of living adjustments. This permanent GDP gain is the result of a shift to a broader tax base, with fewer distortions, that then induces a faster accumulation of private capital. If all beneficiaries of public transfers and all civil servants are fully compensated for the increase in VAT, then a tax swap of the same magnitude raises long-term income by only 0.7 percent, and public indebtedness is not significantly altered. We also find that larger fiscal devaluations yield less-than-proportional GDP gains. The fact that fiscal devaluations are rather disappointing in raising the level of GDP can be traced back to a small net reduction in the overall labor tax wedge. This suggests that policymakers need to look elsewhere in their quest for efficient tax reforms.

1. Introduction

There is a growing sense that Europe is falling behind the United States, a feeling that is confirmed by statistics. The EU15's convergence to US productivity levels stalled in the late 1990s [see World Economic Forum (2012)], and relative GDP per head for the EU15 remains stubbornly stuck at just below 72 percent, a plateau it has sat on since 1992 [OECD (2014a)].

A lower income per head in Europe has been traced back to the fact that hours per person have fallen drastically in the past fifty years [see Gordon (2004)]. Even accounting for a greater preference for leisure in Europe, more than two-thirds of the gap in economic performance can be explained by a lower utilization of labor that is due to higher taxes [Lucas (2003), and Prescott (2004)]. Ohanian, Raffo, and Rogerson (2008) have found that differences in taxes explain much of the variation in hours worked, both over time and across countries. In fact, most of the trend reduction in the total number of hours worked in the economy is due to changes in taxes.

It is natural, then, to examine the overall labor tax wedge as a useful indicator that encapsulates the lackluster relative performance of the European economy. Various taxes that employers and employees have to pay – at effective rates of τ – create a wedge between the cost of labor to a firm and the consumption wage that the worker gets. It is this wedge between labor demand and labor supply that generates economic distortions that then translate into lower levels of employment. For a firm that hires someone, the total cost is not only the gross wage, w, but also the payroll taxes or Social Security contributions it has to pay as an employer (FSSC). For the employee, not only does he also have to contribute to Social

Security (WSSC) and pay personal income tax (PIT), but he is also subject to value-added and excise taxes (VATET) when he converts his net-of-all-contributions-and-income-tax wage into a bundle of goods and services. Clearly, it is this consumption wage that matters to him. Thus, the overall labor tax wedge is computed as:

$$1 - \frac{w(1-\tau_{PIT}-\tau_{WSSC})/(1+\tau_{VATET,C})}{w(1+\tau_{FSSC})} \qquad \textbf{(Equation 1)}.$$

An overall labor tax wedge of, say, 60 percent implies that the worker's consumption wage is only 40 percent of the total cost of labor.

Table I
The wedge between the total cost of labor for an employer and the worker's consumption wage in 2013 for a single, average worker

[percent of total labor costs]

Country/Region	Overall tax wedge on labor	Marginal firms' social security contributions rate (%)	Standard VAT/GST rate (%)
United States	**34.23**	**7.65**	**7.48**
EU15 (2013 GDP weights at PPP exchange rates)	**53.07**	**23.09**	**20.56**
Austria	58.04	21.63	20
Belgium	63.50	34.67	21
Denmark	52.79	-	25
Finland	54.98	22.80	24
France	57.35	40.93	19.60
Germany	57.68	10.95	19
Greece	49.74	28.56	23
Ireland	39.79	10.75	23
Italy	55.65	32.08	22
Luxembourg	51.12	12.31	15
Netherlands	49.32	10.15	21
Portugal	**50.13**	**23.75**	**23**
Spain	47.98	29.90	21
Sweden	54.86	31.42	25
United Kingdom	42.44	13.80	20

Source: Authors' calculations using Eurostat (2014: Table 82), OECD (2014b), the OECD Tax Database, the Tax Foundation and Bureau of Economic Analysis.

Table 1 presents data for 2013 on the overall labor tax wedge both in the United States and in the various member states that constitute the EU15. Instead of considering the whole EU, currently with twenty-eight member states, we have chosen to restrict our focus to the fifteen countries that have been in the European Union the longest because, as a whole, the EU now has very heterogeneous tax systems, with varied compositions. As is well known, the US does not have a VAT, so the 7.48 percent in Table 1 corresponds to an implicit tax rate on consumption that is computed by dividing Federal, State and Local excise and sales tax revenues by Final Household Consumption Expenditure, obtained from the Bureau of Economic Analysis.

There are a few striking facts in Table 1 that are worth highlighting. First, the overall labor tax wedge in the EU15 is almost 20 percentage points higher than in the US. This average encompasses a range of wedges from Ireland, the best performer, only 5.56 percentage points away, to Belgium, the worst performer, with a whopping 29.27 percentage points away. Germany has a wedge of 57.68 percent and sits

above the EU15 average, while Portugal has a wedge of 50.13 percent, below the EU15 average. It is also interesting to note that, in the US, FSSC and VATET are both at single-digit rates.

Our aim in this chapter is to determine the most likely long-term economic and budgetary effect of a fiscal devaluation on the Portuguese economy, in a context of exogenous growth and budget neutrality, where the main driver is the broadening of the tax base and the reduction of tax distortions, in addition to the extra capital accumulation that is induced by this policy. This is one of the three contributions this study makes to the literature on the general equilibrium effects of a fiscal devaluation. The second contribution we make is to determine how sensitive the long-term effect on GDP is to a cost of living adjustment (COLA), an element of any realistic tax package where the Government has to provide at least some compensation to those that would otherwise lose out through lower purchasing power. The COLAs we consider already incorporate the constraint of an unchanged budget deficit to GDP ratio. The third and last contribution we make is to investigate the existence and nature of nonlinear effects in the long-term impact of a fiscal devaluation.

From Equation 1 it is straightforward to see that a tax policy, such as fiscal devaluation, that trades off FSSC for VATET won't reduce the overall labor tax wedge by very much. If on one hand it lowers the employers' payroll tax rate in order to stimulate their demand for labor, on the other hand it lowers the employees' consumption wage which pulls down the labor supply. While it is true that, in a dynamic general equilibrium environment, over time, wages will rise and there will be benefits for everyone in shifting to a broader tax base, it is easy to see that we should anticipate a fiscal devaluation to be of limited use in significantly improving the performance of the labor market because, quantitatively, these induced effects will be of second-order importance.

Although Portugal is the focus of this study, this issue is of more than parochial interest. It extends far beyond the reality of peripheral economies of the euro area to the eleven member states that the Eurogroup recently flagged as having excessively-high overall labor tax wedges [revisit Table 1, as well as Eurogroup (2014)].

Previous versions of the dynamic general equilibrium model we use have, for example, evaluated the impact of tax policy [see Pereira and Rodrigues (2002, 2004)], public pension reform [see Pereira and Rodrigues (2007)], and, more recently, energy and climate policy [see Pereira and Pereira (2013, 2014a, 2014b, 2014c)]. The model features fully dynamic optimizing behavior for households, firms, and the public sector, and follows in the footsteps of computable general equilibrium modeling, bringing together various important strands of the taxation literature [see the above applications of this model for a detailed list of the references]. In addition, the model has two unique features. Not only is the public sector modeled in great detail, both on the spending and the revenue sides, but also all relevant tax bases are fully endogenous and adjust optimally to changes in policy. Capturing all these dynamic feedbacks is crucial for the goal of this chapter, because even ex-ante revenue-neutral tax policies end up affecting the budget balance, as the various macroeconomic aggregates that determine the tax bases reflect the sum of behavioral responses.

The rest of the chapter proceeds as follows. Section 2 explains what a fiscal devaluation is, and reviews the relevant literature. Section 3 presents a quick tour of the dynamic general-equilibrium model we use. Section 4 then explains how the simulations were designed, and discusses the results. Section 5 provides a few concluding remarks.

2. On the issue of a fiscal devaluation

The idea of a 'fiscal devaluation' has recently received a great deal of attention in policy circles in the wake of the European sovereign-debt crisis [see, for example, European Central Bank (2011a), Cavallo and Cottani (2010), and Keen and de Mooij (2012)], but it is far from new. Before we frame this chapter within the literature, however, it's worth spending a brief moment to define what this particular kind of tax policy is, so that we can then more easily understand why it has become so popular to the point that it is now at the forefront of the economic policy agenda in Europe [see Eurogroup (2014)].

A 'fiscal devaluation' is an ex-ante revenue-neutral tax swap that replaces an origin-based tax with a destination-based tax. In most policy circles, this is understood as a reduction in firms' Social Security contributions (FSSC) that is then compensated by an increase in consumption taxes – generally value-added taxes (VAT) – in such a way that, on impact, there is no net loss in tax revenues. Afterwards, as firms and households optimally change their economic decisions, given the new levels of taxes and contributions, tax bases adjust, and what was initially revenue neutral can end up affecting the budget deficit. This configuration of the tax swap – where labor taxes are replaced with consumption taxes – has prompted a wave of euphoria, especially throughout Europe, as many pundits view the shift in taxation from 'where it's produced' to 'where it's consumed' as panacea. A 'fiscal devaluation', they argue, has the capacity – in a single punch – to create new jobs, improve the trade balance, and reduce distortions in the tax system. We now turn to each of these three strands of the literature.

Europe is not only known for falling behind the US in terms of productivity and income per head, but also for exhibiting an average rate of unemployment that, over various business cycles, remains stubbornly elevated, far above its American counterpart. In this light, then, it is no surprise to find that in the midst of a recession, in the early 1990s, many European policymakers were already calling for lower rates for firms to contribute towards Social Security [see Commission of the European Communities (1993)], arguing that the high labor tax wedge was one of the culprits for the alarmingly-high rate of joblessness. In the words of Reis (2010), a payroll tax is a 'tax on jobs, a tax on production'. Despite these convincing arguments, the evidence in the literature is decidedly mixed on the causal link between reducing the payroll tax that firms pay (the FSSC rate) and a lower unemployment rate [see, for example, Hoon and Phelps (1996), Böhringer, Boeters, and Feil (2005), and Bach, Haan, Hoffmeister, and Steiner (2006)]. In fact, as proof of a weak link, Denmark is often mentioned, given that it now practically does not have a payroll tax, and the gains in terms of lower unemployment were not that significant since the tax shift from payroll to value-added taxes [Alogoskoufis, Bean, Bertola, Cohen, Dolado, and Saint-Paul (1995)]. The extent of frictions in the labor market, and the nature of the wage-setting process influence the transmission mechanism.

Another lesson one draws from the literature, and where there is much more consensus, is that FSSC reductions targeted at low-skilled workers are more effective in reducing the rate of joblessness, the reason being that these laborers not only exhibit a larger labor-supply elasticity with respect to the wage rate, but also because, for them, the rate of structural unemployment tends to be much higher [see, for example, Drèze and Malinvaud (1994), and Sørensen, Christiansen, and Dolado (1997) for two early accounts, arguing that minimum-wages ought to be exempt from payroll taxes paid by firms].

At the center of this discussion that calls for a tax swap seems to be a reluctance to scale back the welfare state in its current form. Not only do sometimes-overly-generous transfers discourage many low-skilled out of work of seeking a job because these compensating transfers effectively raise their reservation

wage, alarmingly-high taxes on labor (like in Belgium, for example) lead to low labor utilization. In this context, then, how did FSSCs get to be so high? One of the most convincing answers to this question, in our view, is that there seems to have been a high degree of illusion or even ignorance amongst the electorate with respect to the fact that the economic incidence of a contribution towards Social Security is largely independent of its legal incidence, i.e. who has the legal responsibility of paying this labor tax.

A second strand of the literature that helps us understand why fiscal devaluations are now back in vogue argues that this kind of tax swap can help countries with chronic imbalances in their trade account, boosting exports and restricting imports, on account of the fact that the former are VAT exempt, while the latter are not. Although this literature is far too voluminous to quickly survey here, there are a few key ideas that are worth pointing out.

The idea of a 'fiscal devaluation' can be traced back to the times of the Gold Standard, when Keynes (1931) suggested that certain changes in taxes could be used as an alternative to a currency devaluation, where one was not an option [see Fahri, Gopinath, and Itskhoki (2014) who prove the equivalence in theory]. This was then echoed by Calmfors (1998) in the context of the euro area, a then-forthcoming currency union. More recently, in the early 2010s, in the wake of the European sovereign-debt crisis, many pundits prescribed the same solution to lowering the persistent current account deficits that, as a share of GDP, exceeded 10 percent in many peripheral economies of the euro area. Unfortunately, this a very complex issue, and there are several problems with this solution. First, it remains to be shown that a currency devaluation can be effective [see, for example, Krugman and Taylor (1978), and Thirlwall (1986) who argues that recurring devaluations make exporting firms lazy, favoring price-sensitive goods that tend to be low tech]. Furthermore, in practice, a fiscal devaluation is not a perfect substitute for a devalued exchange rate because labor costs are not equally significant across firms and across sectors. In fact, because the non-tradable sector is more labor intensive than the tradable sector, it will benefit more from a fiscal devaluation. Also, it is not irrefutable that the so-called PIGS (an acronym that refers to Portugal, Italy, Greece and Spain, the four main peripheral economies of the southern euro-area) all have a 'competitiveness problem'. For Portugal, at least, the case has been made that the persistent current account imbalances in the run up to the crisis were largely due to capital inflows and not due to significant trade deficits [see, for example, Jaumotte and Sodsriwiboon (2010), Reis (2013), and, more recently, Gabrisch and Staehr (2014)]. These capital inflows from Northern Europe to Southern-European countries such as Portugal, that later reversed as global liquidity suddenly seized up, were the result of 'hunting for higher yield', a natural outcome of introducing the euro that eliminated former exchange-rate risk. Finally, even if we concede that Portugal is 'not as competitive as Germany' [and there are serious measurement issues with the use of aggregate unit labor costs, as Felipe and Kumar (2011) point out], at best, a fiscal devaluation can only improve 'price and cost competitiveness'. In a context of growing globalization, where value chains are becoming increasingly global, and local labor costs are becoming less and less important [see Altomonte, Aquilante, and Ottaviano (2012)], there is a growing consensus that non-price competitiveness is even more important that cost competitiveness [see, for instance, European Central Bank (2013)].

Even more fundamentally, the once-dominant narrative that suggests that peripheral economies of Europe need to undergo an 'internal devaluation' to regain competitiveness [see, for example, Blanchard (2007), Thimann (2013), and Blanchard, Jaumotte, and Loungani (2014)] is beginning to show a few cracks. In addition to being a slow and painful route towards adjustment, plagued with high unemployment and generally-weak aggregate demand, with a backdrop of a growing consensus that price and cost

competitiveness are becoming less important in a global business arena, there are now concerns regarding debt overhang where deflation or even unexpectedly-low inflation, through the Fisher equation, increase debt payments in real terms [see, for example, Tressel, Wang, Kang and Shambaugh (2014)].

The third strand of literature that is relevant to a fiscal devaluation concerns the quest for an efficient tax reform, aimed at improving macroeconomic performance, in particular with respect to both GDP and employment [European Commission (2008), Prammer (2011), OECD (2014c), IMF (2010), and Mankiw, Weinzierl, and Yagan (2009), together, cover the most important issues]. The goal of improving economic performance at the aggregate level is to be achieved by changing the composition of the tax mix, without deteriorating public finances. To obtain the same tax revenue but with fewer economic distortions, the key idea is to broaden the tax base, getting more people to pay taxes. This can be done either by choosing to tax larger aggregates – tax consumption instead of labor income, for example – or by significantly reducing tax preferences that erode the tax base. That is the case of exemptions that effectively reduce tax revenues below what they would otherwise be. By taxing a broader base, the same tax revenue can be obtained with lower tax rates. This is crucial to improving economic performance, given that the deadweight loss is proportional to the square of the tax rate [see, for example, Auerbach (1985)]. Shifting taxes from labor to consumption offers at least two other advantages. On one hand, intertemporal choices such as saving are less distorted, allowing for faster capital accumulation and a rebalancing of the current account. On the other hand, in a context of projected aging of the population throughout most of the OECD where there seems to be a sizable imbalance in terms of generational accounting [see, for example, Auerbach, Gokhale, and Kotlikoff (1994)], many argue that the elderly should start to pay a larger share of the overall tax bill [European Commission (2008)].

3. The dynamic general-equilibrium model

Here we present a short account of the model used to simulate the economic impact of a fiscal devaluation in Portugal. We refer the reader to Pereira and Pereira (2012), which describes in full detail the model's equations, parameters, data, calibration, and numerical implementation in GAMS.

Consider a decentralized economy in a dynamic general equilibrium framework, where all agents are price takers and have perfect foresight. Money is absent, so the model is framed in real terms. There are four sectors in the economy–the production sector, the household sector, the public sector, and the foreign sector. In the model used for this chapter, public investment in human capital and in infrastructure is exogenous and, thus, only firms and households optimize. Nevertheless, all four sectors interconnect through competitive markets that clear and through the stock variables and their relevant shadow prices, which are fully endogenous in the model. Private capital, wind energy capital, public capital, human capital, and public debt–together with the shadow prices for these five capital stocks–and foreign debt, private financial wealth, and human wealth evolve optimally and describe the economy's trajectory over time. In the long term, the accumulation of private capital, combined with the accumulation of publicly-provided infrastructure and human capital, can determine the rate of economic growth.

3.1. The production sector

A Constant Elasticity of Substitution (CES) technology produces aggregate output, and links value added with primary energy demand. Value added is produced according to a Cobb-Douglas technology that

exhibits constant returns to scale in the reproducible inputs – effective labor, private capital, and public capital. The firm only controls its demand for labor and its stock of private capital, meaning that, without public investment, decreasing returns set in. In this setting, public infrastructure and the economy-wide stock of knowledge are two positive externalities that are publicly financed. A CES technology using crude-oil inputs and sources of energy that are not meant for transportation produces primary energy demand. A Cobb–Douglas technology using coal, natural gas and wind energy inputs produces non-transportation energy.

Private capital accumulates and depreciates according to a dynamic equation of motion. Gross investment is dynamic, and incorporates adjustment costs that reflect rigidities in the accumulation of capital toward its optimal level. These adjustment costs, which we assume to be quadratic in investment per unit of installed capital, are internal to the firm, as learning and installation imply a loss in capital accumulation.

Revenues from sales minus wage payments, energy expenditure and investment spending yield a firm's net cash flow before taxes. Its financial position after paying taxes reflects private investment and investment tax credits, taxes on corporate profits, and social security contributions paid by firms on their gross wage bill. The cost of labor is thus the sum of gross wages and employers' contributions to social security.

Buildings are a fraction of private investment expenditure. Only this fraction is subject to value-added taxes; the remainder is exempt. The corporate income tax base is computed as sales revenues minus total labor costs and minus fiscal depreciation allowances over past and present capital investments. We use a straight-line method to compute the fiscal depreciation allowances, and we assume that investment is a constant share of output. This way, depreciation allowances are proportional to the difference between two infinite geometric sums.

Optimizing firms choose the levels of investment and labor that maximize the present value of their net cash flows, subject to the equation of motion that dictates how private capital accumulates. The demands for labor and for investment are obtained from the current-value Hamiltonian function, where the shadow price of private capital evolves according to the respective co-state equation. Regarding the financial link of the firms with the rest of the economy, we assume that at the end of each operating period the net cash flow is transferred to the households.

The energy sector is an integral part of the firm's optimal decisions. We consider primary energy demand for crude oil, coal, natural gas and wind energy, i.e. energy sources that have not been subject to conversion or transformation processes. A CES technology produces aggregate primary energy demand. While petroleum products dominate in the demand for transportation energy, alternatives in industry and electric-power generation include coal, natural gas and, to a lesser extent, wind energy. This justifies using a Cobb-Douglas technology to produce non-transportation fuels, where substitution is potentially greater. While coal, natural gas and crude oil are imported, the firm chooses how much to invest in wind energy. Similar to private investment, wind energy infrastructure accumulates and depreciates according to a dynamic equation of motion, and gross investment in wind turbines is also subject to adjustment costs.

The optimizing firm chooses the level of primary energy demand that maximizes the present value of its net cash flow. Its demands for coal and natural gas are the solution to a nested dual problem of minimizing energy costs, given the production function and the optimal demand for these energy vectors in

electric power and industry. By differentiating the Hamiltonian with respect to the investment in wind energy and its stock, we obtain the variational condition for wind-energy investment, as well as the equation of motion for its shadow price.

3.2. The households

We adopt an overlapping-generations (OLG) specification in which households plan over a finite horizon, albeit one that is not deterministic. The 'perpetual youth' assumption implies that, in each period, there is a probability of survival that is constant over time and across age cohorts. Without loss of generality, we normalize the population to one.

The household chooses streams of consumption and leisure to maximize subjectively-discounted lifetime expected utility, subject to a consolidated budget constraint. We assume CES preferences that are additively separable in consumption and leisure. A higher probability of survival increases the effective discount factor, making the household relatively more patient about the future.

The budget constraint incorporates an effective value-added and excise tax on private consumption, and imposes that the present value of the household's expenditure stream, discounted in real terms at the after-tax market interest rate, cannot exceed its total wealth. Reflecting a non-zero probability of death, the loan rate at which households borrow and lend among themselves is greater than the after-tax interest rate.

Total wealth is age-specific and is composed of human wealth, net financial worth, and the present value of the firm. Human wealth represents the present discounted value of the household's future labor income stream, net of personal income taxes and employees' social security contributions. The household's wage income is the result of its endogenous decision of how many hours of labor to supply out of a total time endowment, given the stock of human capital that is augmented by public investment in education. Labor earnings have to be discounted at a higher rate, reflecting a non-zero probability of death in each period.

A household's income is augmented by net interest payments received on public debt, profits distributed by corporations, international transfers, and public transfers. On the spending side, debts to foreigners are serviced, taxes are paid, and consumption expenditures are made. Income net of spending adds to net financial wealth. As we assume that there are no bequests, households are born without any financial wealth. In general, total wealth is age-specific because both labor supplies and consumption streams are age-specific.

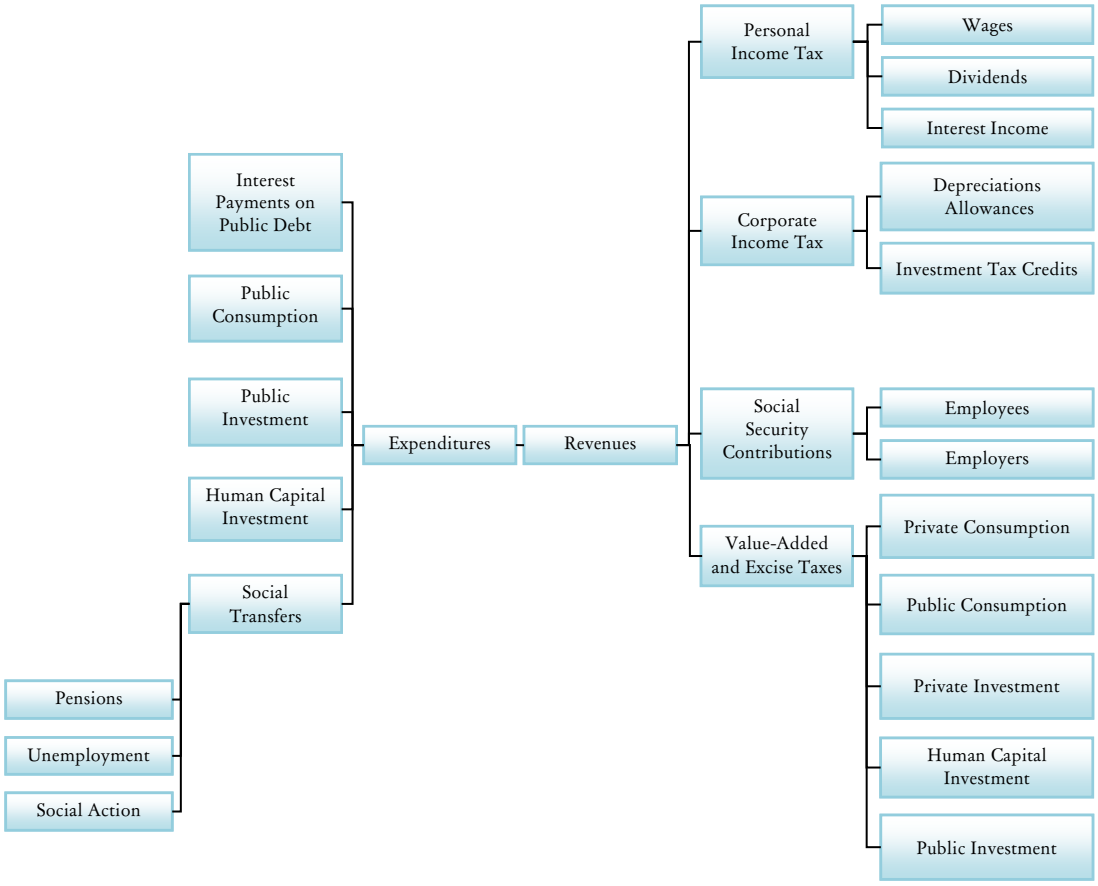
With a real interest rate that we assume to be constant over time, the marginal propensity to consume out of total wealth is age-independent, and aggregation over age cohorts is greatly simplified. This allows us to write the aggregate demand for leisure as a function of aggregate consumption.

3.3. The public sector

An equation of motion governs the stock of public debt. Every time public spending exceeds tax revenues, further public debt needs to be issued to finance this shortfall. Total tax revenues include personal income taxes, corporate income taxes, value-added and excise taxes, and social security contributions that both employers and employees have to pay (see Figure 1). All of these are levied on tax bases that

are fully endogenous to the model. We assume than any residual taxes are of a lump sum nature, and we keep them constant as a share of GDP.

Figure 1
Overview of the public sector.



The public sector pays interest on public debt, and the households receive old-age, disability and survivors' pensions, unemployment subsidies, and social benefits. In the variant of the model used for this chapter, we assume that all welfare spending is a constant share of GDP. In addition to public consumption, the public sector carries out public investment activities both in infrastructure and in human capital (again, see Figure 1). For this chapter, because we assume that economic growth is exogenous, these two flows of public investment are constant shares of GDP. This way, public sector behavior still affects both the level and the rate of growth of GDP in the long run, but it does so in a passive and accommodating form, as opposed to actively pursuing long-term economic growth through endogenous changes in public spending. This is a formulation that is more in keeping with the current terms of the policy debate in Portugal, where budgetary concerns prevent a more pro-active approach on the part of the public sector.

The two stocks of public capital–human capital and infrastructure–accumulate and depreciate, taking into account adjustment costs that we assume to be quadratic and that are a fraction of the respective levels of investment. Effective labor is the product of embodied human capital and the number of hours

worked. Given that there are rigidities in the accumulation of human capital toward its optimal level, the quantity of labor that firms demand is also subject to adjustment costs.

In the variant of the model used for this chapter, the public sector chooses a trajectory of public consumption to maximize social welfare. This objective function is the net present value of the future stream of utility that benefits households. Public consumption, private consumption and leisure all contribute to that utility. The optimal choice is subject to three constraints: the equations of motion of the stock of public debt, the stock of public capital, and the stock of human capital. Optimal conditions are defined for public debt and for public consumption, and the best possible trajectory depends on the shadow prices of public debt, public capital, and human capital stocks.

3.4. The foreign sector

An equation of motion for foreign financing describes in a stylized way the balance of payments. Domestic spending and exports absorb the goods and services produced in Portugal and those imported from abroad. Net imports include payments by firms for fossil fuels, and these are financed by foreigners through transfers and borrowing. We assume that foreign transfers grow at an exogenous rate. Portugal is modeled as a small, open economy that obtains the desired level of foreign financing at a rate which is determined on international financial markets.

3.5. The intertemporal market equilibrium

The behavioral equations, the equations of motion of the stock and shadow-price variables, and the market equilibrium conditions jointly describe the intertemporal path of the economy. The condition that clears the labor market incorporates a rate of structural unemployment, which we assume to be exogenous. The product market clears when the supply and the demand for output are equal. Being a small open economy, foreign production satisfies part of domestic demand. Finally, for the financial market to clear, we impose that private capital formation and further public indebtedness are financed from savings that are accumulated both by Portuguese households and by foreigners.

The steady-state growth path is an intertemporal-equilibrium trajectory, where all flow and stock variables grow at rate g, while market prices and shadow prices remain constant. There are three types of restrictions that a steady state imposes. First, it determines the value of critical production parameters, like adjustment costs and rates of depreciation, given the initial stocks of capital. These stocks, in turn, are determined by assuming that the observed levels of each type of investment are such that the ratios of capital to GDP are unchanged in the steady state. Second, so that public debt- and foreign debt-to-GDP ratios are kept constant, the budget deficit and the current account deficit in the steady state have to be a fraction g of the respective stocks of debt. Finally, the exogenous variables, such as welfare benefits or international transfers, also grow at the rate at which the economy grows in the steady state.

3.6. Numerical implementation

Although we conceived the model with an infinite horizon, it is implemented numerically and, as such, we have to truncate it to a finite horizon. Upon implementation, we impose terminal conditions that require the model to achieve a steady-state trajectory by the truncation date, which we set fifty years into the future.

The model is implemented numerically in GAMS, using the MINOS non-linear optimization algorithm. We code the optimality conditions for each kind of agent in an implicit manner. The equilibrium conditions, as well as the optimal equations of motion for the stock variables and variational conditions, are set as constraints of a large-scale and highly non-linear optimization problem, with an objective function that is artificial and fixed. This setting ensures that the algorithm we use is very quick to find the unique intertemporal solution to our problem, which also happens to be the only feasible solution to the artificial constrained-optimization problem we set up.

3.7. Data set, parameter specification, and calibration

The model is implemented numerically using detailed sets of both data and parameters. Data are extracted from a variety of sources that include the Statistical Annex of the European Community [European Commission (2012)], Ministério das Finanças e da Administração Pública (2012), and Ministério do Ambiente, Ordenamento do Território e Energia (2012). The decomposition of the aggregate variables follows the average for the period 2000-2013 for all macroeconomic data. This period was chosen to reflect the most recent available information and to cover several business cycles, thereby reflecting the long-term nature of the model. Public debt and foreign debt, as well as the stocks of capital, reflect the most recent available data.

Parameter values are specified in different ways. Whenever possible, parameter values are taken from the available data sources or the literature. This is the case, for example, of the population growth rate, the probability of survival, the share of private consumption in private spending, and the different effective tax rates.

All the other parameters are obtained by calibration; i.e., in a way that the trends of the economy for the period 2000-2013 are extrapolated as the steady-state trajectory. These calibration parameters assume two different roles. In some cases, they are chosen freely in that they are not implied by the state-state restrictions. Although free, these parameters have to be carefully chosen since their values affect the value of the remaining calibration parameters. Accordingly, they were chosen either using central values or using available data as guidance. The remaining calibration parameters are obtained using the steady-state restrictions.

As a common practice in the literature, it is worth highlighting that the dynamic general-equilibrium model we use is fundamentally a long-term model. By design, it captures the long-term trends of the economy. Hence, we choose all parameters so that the model replicates exactly the average performance of the Portuguese economy over the period 2000-2013. Furthermore, and also by construction, the results that the model produces are not affected by business-cycle effects.

4. Simulation results

Our objective is to determine the likely long-term effect of a fiscal devaluation on the Portuguese economy, in a context of exogenous growth and budget neutrality, where the main driver is the broadening of the tax base and the reduction of tax distortions, in addition to the extra capital accumulation that is induced by this policy. In this section we explain the specifics behind the design of the simulations, and then we discuss the results.

4.1. Designing the simulations

We start off with a baseline, where there are no policy changes, and all economic aggregates grow according to a steady-state path. We then measure the impact of the tax swap in terms of deviations to that baseline. For most variables, the deviations are measured in terms of percent changes; for variables that are expressed as ratios to GDP, the deviations are measured in terms of percentage-point changes.

In addition to investigating the permanent effects of a fiscal devaluation, one of the main contributions of this research to the literature is to determine how the macroeconomic and budgetary impact of the tax swap change when the Government offers a cost of living adjustment to compensate all those who would otherwise suffer a loss of purchasing power as a result of the increase in VAT. As such, we consider three cases. In our central case, Case 1, where there is still no cost of living adjustment, we simulate the effects of a fiscal devaluation worth 1 percent of steady-state GDP. We choose an impulse of this magnitude so that our results are more easily compared with those of other major studies. We then consider two counterfactual cases, Case 2 and Case 3, with a full and a partial cost of living adjustment, respectively. It is interesting to note that, if Portugal wanted to reach the same marginal firms' Social Security contributions rate as in Germany, then it would have to implement a fiscal devaluation with an impulse of just over 2 percent of steady-state GDP.

For all three cases, we impose an unchanged budget deficit to GDP ratio in 2015, the year the tax swap is implemented. The reason why we need budget neutrality instead of simple revenue neutrality is that cost of living adjustments in Portugal are not tax expenditures, and therefore they increase public spending. Value-added tax revenues are raised by 1 percent of steady-state GDP. Then, if there is a COLA, part of the extra public resources is used to finance it. And, finally, the effective payroll tax rate that firms pay towards Social Security is reduced in a residual fashion to ensure that the budget deficit to GDP ratio remains unchanged.

Table 2
Summary of the results: deviations from steady state by 2050, of a fiscal devaluation in 2015, worth 1% of steady-state GDP

[percent deviations, unless otherwise indicated]

Variable	Case 1 No COLA	Case 2 Full COLA	Case 3 Partial COLA
COLA for public pensions, unemployment benefits, social transfers, and civil servants' wages and salaries	0.00	1.41	0.70
GDP	1.03	0.71	0.88
Employment	0.37	0.11	0.25
Wage	2.16	1.60	1.88
Labor cost	0.20	0.23	0.21
Effective firms' Social Security contributions rate (percentage-points deviation)	−2.22	−1.56	−1.89
Statutory firms' Social Security contributions rate (percentage-points deviation)	−6.05	−4.25	−5.15
Overall labor tax wedge (percentage-points deviation)	−0.27	0.02	−0.12
Private consumption	0.70	0.42	0.56
Consumption wage	0.75	0.18	0.46
Effective value-added and excise tax rate (percentage-points deviation)	1.65	1.66	1.66
Statutory general VAT rate (percentage-points deviation)	3.47	3.47	3.47

4.2. The gist of the results

The simulation output of a dynamic general equilibrium model can be quite overwhelming. A full account of all results appears in the next three subsections; for now it is useful to examine a summary table of the results of the long-term effects of the tax swap by 2050 (see Table 2).

A fiscal devaluation worth 1 percent of steady-state GDP that finances lower firms' Social Security contributions with higher VAT revenues has the capacity to permanently raise long-term income by 1.03 percent by 2050, provided there are no cost of living adjustments to compensate beneficiaries of public transfers and civil servants for a loss in purchasing power. Without an increase in public spending as a percent of GDP, Case 1 effectively imposes revenue neutrality in 2015. In this case, the statutory rate at which firms contribute towards Social Security is lowered from 23.75 percent to 17.7 percent, while the general VAT rate rises from 23 percent to 26.47 percent.

With respect to the performance of the labor market, employment is 0.37 percent higher by 2050, which is equivalent to around 16 000 new jobs. These gains are obtained through firms demanding more labor as a result of a 2.22 percentage-points drop in the effective rate they pay towards Social Security. Despite the 1.65 percentage-points increase in the effective value-added and excise tax rate that all household pay, the consumption wage is 0.75 percent higher by 2050 because the gross real wage is 2.16 percent higher by then. Crucially, the overall labor tax wedge is lowered by a mere 0.27 percentage points, from 50.13 to 49.86 percent.

In Case 1 there is no cost of living adjustment, while Cases 2 and 3 consider a 100 and 50 percent indexation, respectively, of public pensions, social transfers, unemployment benefits and civil servants' wages and salaries to the increase in the Consumer Price Index that results from the higher general VAT rate. Compared to Case 1, with a full cost of living adjustment of 1.41 percent (see Case 2 in Table 2), long-term GDP is only 0.7 percent higher than the baseline by 2050, and fewer than 30 percent of the extra jobs are created. The reason behind this insignificant result is that the overall labor tax wedge is practically unchanged (it is 0.02 percentage points higher), despite a reduction of the statutory rate at which firms contribute towards Social Security from 23.75 percent to 19.5 percent. In contrast, with a 50 percent cost of living adjustment that translates into a one-time permanent increase of 0.7 percent of all public pensions, social transfers, unemployment benefits and civil servants' wages and salaries (see Case 3 in Table 2), by 2050, long-term GDP and employment are 0.88 and 0.25 percent higher than in the baseline. This corresponds to little more than 11 000 new jobs. In this case, the statutory rate at which firms contribute towards Social Security is cut from 23.75 percent to 18.6 percent.

4.3. On the effects of the tax swap without a cost of living adjustment

To fully evaluate the effects of a fiscal devaluation on the Portuguese economy, we group the simulation results according to their impact on the labor market, on national accounts, on the foreign account, and finally on the public-sector account. This way we capture all the relevant macroeconomic and budgetary effects of the tax swap.

Table 3 presents, in full detail, the simulation results for Case 1, where there is still no cost of living adjustment. In a context of exogenous growth, the permanent gain of 1.03 percent in GDP by 2050 can be traced back to a shift that primarily broadens the tax base and lowers the effective tax burden. Lower tax

distortions then accelerate capital accumulation to the point that the flow of private investment is 1.34 percent higher than the baseline.

Table 3
Simulation results for Case 1: The impact of a fiscal devaluation, with an unchanged budget deficit to GDP ratio in 2015, and no cost of living adjustment
[percentage-point deviations from steady-state ratios to GDP, unless otherwise indicated]

	2020	2025	2030	2040	2050
Labor market (percent change)					
Employment	0.12	0.18	0.22	0.31	0.37
Wage	2.04	2.08	2.11	2.15	2.16
National accounts (percent change)					
GDP	0.26	0.41	0.55	0.80	1.03
Private consumption	0.53	0.56	0.58	0.64	0.70
Private investment	0.69	0.81	0.93	1.13	1.34
Foreign account					
Foreign debt	0.12	1.49	2.65	4.44	5.56
Public-sector accounts					
Public debt	−1.88	−2.31	−2.73	−3.51	−4.27
Total tax revenues	0.58	0.67	0.76	0.95	1.16
Personal income tax	0.05	0.06	0.07	0.09	0.11
Corporate income tax	0.00	0.01	0.01	0.03	0.04
Value-added and excise taxes	1.02	1.08	1.14	1.27	1.42
Firms' Social Security contributions	−0.80	−0.83	−0.86	−0.93	−1.01
Workers' Social Security contributions	0.16	0.18	0.20	0.24	0.28

Without compromising public finances, the ratio of total tax revenues to GDP is up to 1.16 percentage points higher by 2050. It is interesting to note that the endogenous adjustment of the various tax bases in response to a better performance of the macroeconomic aggregates allows for higher workers' Social Security contributions, as well as higher personal income tax and VAT and excise tax revenues. This is due to a 0.7 percent expansion in private consumption, and a 2.54 percent increase in wage income, that can be decoupled as a 2.16 percent increase in gross real wages and a 0.37 percent increase in employment. This corresponds to the creation of around 16 000 new jobs. With stable public spending patterns over the projection horizon, the stock of public debt as a share of GDP falls and is 4.27 percentage points lower by 2050. Thus, in addition to permanently increasing the level of GDP and creating more jobs, a fiscal devaluation worth 1 percent of steady-state GDP endogenously generates additional fiscal space that, over time, allows for a moderate budgetary consolidation.

Unfortunately, this good news does not extend to the foreign account, where the stock of net foreign liabilities as a share of GDP is 5.56 percentage points higher by 2050 because of the tax swap. This negative long-term impact is a feature of the model that extrapolates structural trends of the Portuguese economy, where capital inflow has traditionally been strong, and import demand is highly responsive to income and tends to more than offset a positive export performance. A high ratio of private consumption to GDP both reflects the availability of foreign credit and increases the stock of net foreign liabilities over time. Given this and the fact that consumer durables and leisure are complements, it seems that Portugal could benefit from having a significantly lower overall labor tax wedge, in that a greater utilization of labor would not only increase long-term GDP but also help to reduce net foreign liabilities. Our interpretation of the simulation results is, thus, that the reduction in the overall labor tax wedge is too small to lower the ratio of foreign debt to GDP. In any case, it is true that our aggregate one-sector

long-term model with an exogenous interest rate paid on foreign debt is not equipped to capture the ongoing shift of resources from non-tradables to tradables that is key to assessing sustainable improvements in the current account.

4.4. On the effects of the tax swap with a cost of living adjustment

Table 4 presents, in full detail, the simulation results for Case 2, where the Government provides a one-time permanent increase of of all public pensions, social transfers, unemployment benefits and civil servants' wages and salaries to fully compensate for the loss in purchasing power that results from increasing the general VAT rate. This is a 'compensating variation', in the sense that the economic agent is compensated to make the initial consumption bundle still affordable at the new prices that already reflect the higher VAT. While private-sector workers benefit from the higher consumption wages that result from a greater demand for labor by firms, all those with fixed incomes such as public transfers, or who work in the public sector, would suffer a loss of purchasing power if there was no cost of living adjustment. Cases 2 and 3 therefore represent more realistic scenarios where the Government responds to political pressures to compensate those who lose with a fiscal devaluation. In both cases the COLA increases public spending and thus partially crowds out the reduction in the effective payroll tax that firms pay, because of the restriction of an unchanged budget deficit as a percentage of GDP.

With respect to Case 2 that includes the full cost of living adjustment (see Table 4), on account of the overall labor tax wedge that is almost unchanged (see Case 2 in Table 2), employment also shows practically no deviation with respect to the baseline. In this case, because the fiscal space that in Case 1 was allocated towards budgetary consolidation is now used to finance the full cost of living adjustment, the gains that result from a broader tax base and lower tax distortions show up in the form of moderately higher GDP and private consumption, and not in the form of more jobs. Given that the foreign account deteriorates, the public debt to GDP ratio does not fall, and there are no significant gains in terms of employment, the policy implication is that providing a full cost of living adjustment is a bad idea.

Table 4
Simulation results for Case 2: The impact of a fiscal devaluation, with an unchanged budget deficit to GDP ratio in 2015, and a full cost of living adjustment
[percentage-point deviations from steady-state ratios to GDP, unless otherwise indicated]

	2020	2025	2030	2040	2050
Labor market (percent change)					
Employment	−0.10	−0.06	−0.02	0.05	0.11
Wage	1.52	1.54	1.56	1.59	1.60
National accounts (percent change)					
GDP	0.09	0.21	0.32	0.52	0.71
Private consumption	0.30	0.32	0.34	0.38	0.42
Private investment	0.38	0.51	0.61	0.80	0.98
Foreign account					
Foreign debt	−0.04	1.14	2.19	3.90	5.08
Public-sector account					
Public debt	−0.99	−0.87	−0.71	−0.24	0.41
Total tax revenues	0.69	0.77	0.86	1.05	1.26
Personal income tax	0.04	0.05	0.06	0.08	0.11
Corporate income tax	0.00	0.00	0.01	0.02	0.03
Value-added and excise taxes	0.99	1.05	1.11	1.23	1.37
Firms' Social Security contributions	−0.57	−0.59	−0.61	−0.66	−0.71
Workers' Social Security contributions	0.10	0.12	0.13	0.16	0.20

Table 5

Simulation results for Case 3: The impact of a fiscal devaluation, with an unchanged budget deficit to GDP ratio in 2015, and a 50 percent cost of living adjustment

[percentage-point deviations from steady-state ratios to GDP, unless otherwise indicated]

	2020	2025	2030	2040	2050
Labor market (percent change)					
Employment	0.01	0.06	0.10	0.18	0.24
Wage	1.78	1.81	1.84	1.87	1.88
National accounts (percent change)					
GDP	0.18	0.31	0.44	0.66	0.87
Private consumption	0.42	0.44	0.46	0.51	0.56
Private investment	0.54	0.66	0.77	0.97	1.16
Foreign account					
Foreign debt	0.04	1.31	2.42	4.17	5.32
Public-sector account					
Public debt	−1.43	−1.59	−1.72	−1.88	−1.94
Total tax revenues	0.64	0.72	0.81	1.00	1.21
Personal income tax	0.05	0.06	0.07	0.09	0.11
Corporate income tax	0.00	0.00	0.01	0.02	0.03
Value-added and excise taxes	1.01	1.06	1.12	1.25	1.40
Firms' Social Security contributions	−0.68	−0.71	−0.73	−0.79	−0.86
Workers' Social Security contributions	0.13	0.15	0.16	0.20	0.24

Table 5 presents the simulation results for Case 3, where only a 50 percent cost of living adjustment is given, and thus only half the crowding out takes place. While Case 2 clearly represents an upper bound for how generous a COLA may be if the Government gives in to all protests, it is reasonable to argue that a cost of living adjustment that fully compensates economic agents for lost purchasing power need not go so far. That is because everyone stands to benefit from a shift to a less distortionary tax system, although it is true that the elderly have fewer years to live, and thus will benefit relatively less. This line of reasoning suggests that, if a COLA is given then, at least, pensioners ought to be compensated.

Case 3, with a 50 percent cost of living adjustment, therefore represents an indicative scenario, given that the exact COLA that ought to be provided is hard to determine. In this case that we consider to be more realistic, in the long-term, GDP and the level of employment are 0.88 and 0.25 percent higher than in the baseline. As one would expect, these gains lie in between the results obtained in Cases 1 and 2.

4.5. Investigating possible nonlinear effects of the tax swap

In addition to measuring the permanent effects of a fiscal devaluation and how sensitive the results are to the introduction of adjustments aimed at preserving the cost of living, another contribution of this study to the literature is to investigate the existence of nonlinear effects.

Table 6 presents the results for simulations that replicate Cases 1 and 2, but with fiscal devaluations of varying magnitudes, ranging from 0.5 to 5 percent of steady-state GDP.

The main conclusion from this set of simulations, taken as a group, is that a fiscal devaluation is a tax policy that is subject to diminishing returns. For example, compared to Cases 1 and 2, a tax swap worth 3 percent of steady-state GDP yields less than three times the increase in GDP. This means that larger fiscal devaluations yield less-than-proportional GDP gains. Recall that a tax swap worth just over 2 percent of steady-state GDP would be required to lower the the statutory rate at which firms in Portugal contribute towards Social Security from the current 23.75 to the 10.95 percent in Germany. We thus cannot endorse a fiscal devaluation more ambitious than that, as it would quickly run into diminishing returns.

Table 6
Long-term effects, by 2050, of a fiscal devaluation under different scenarios

[percent-point deviations from steady-state ratios to GDP, unless otherwise indicated]

Impulse (as a percent of steady-state GDP)	0.5%	1%	2%	3%	5%
With no cost of living adjustment					
GDP (percent change)	0.52	1.03	1.99	2.90	4.56
Employment (percent change)	0.19	0.37	0.72	1.06	1.67
Foreign debt	2.93	5.56	9.98	13.40	17.55
Public debt	−2.17	−4.27	−8.23	−11.93	−18.59
With a full cost of living adjustment					
GDP (percent change)	0.36	0.71	1.39	2.02	3.18
Employment (percent change)	0.06	0.11	0.21	0.29	0.43
Foreign debt	2.64	5.08	9.34	12.87	17.95
Public debt	0.18	0.41	0.97	1.69	3.55

4.6. How our results compare with the literature

The simulations we ran suggest that a fiscal devaluation worth 1 percent of steady-state GDP can increase income in the long run by between 0.7 and 1 percent above the baseline. We chose to simulate the effects of an impulse of this magnitude to make this study easy to compare with others in the literature.

Table 7 helps to put our results in perspective, and a few interesting lessons can be drawn. In particular, research specifically on Portugal points to a long-term impact on GDP of between 0.2 and 0.6 percent, slightly lower than our interval that spans 0.7 to 1 percent. Generally, the literature suggests a more conservative impact, the exception being Stähler and Thomas (2012). What our model has in common with their research is that the public-sector account is highly disaggregated, separating productive spending such as public investment. This proves to be a crucial modeling option that seems to make all the difference, given that our model, as well as theirs, captures all of the relevant dynamic feedback effects between the tax policy changes, the endogenous adjustment of the various macroeconomic aggregates, and their transmission to the different tax revenues through the respective tax bases.

With respect to how the results can change under different modeling specifications, it is worth highlighting that long-term GDP gains are more significant when, instead of pursuing a strategy of fiscal consolidation aimed at reducing the ratio of public debt to GDP, the additional tax revenues that appear as tax bases endogenously adjust to larger macroeconomic aggregates are recycled back into the economy in the form of even lower payroll tax rates that firms pay. Also, one should expect the existence of frictions in the labor market to lower the GDP gains, even in the long run. Finally, targeting the reduction in firms' Social Security contributions can boost the increase in income even further. There is a growing consensus [see OECD (2014c), for example] that structural unemployment is more prevalent amongst low-skilled workers, whose tasks are also more likely to be mechanized or automated. In this spirit, we support Drèze and Malinvaud (1994) who argue that minimum wages ought to be exempt from firms' Social Security contributions. Making firms' payroll taxes progressive and broadening their scope beyond low-skilled workers would be a worse alternative as there is a tradeoff between unemployment and productivity. Employing even the least productive will inevitably lower productivity.

Table 7
Summary of the literature on the long-term impact on GDP of a fiscal devaluation worth 1% of GDP (deviations in percent)

Country or region	Author(s)	Variants or key characteristic	Long-term effect on GDP
Portugal	Banco de Portugal (2011)	-	0.6
	European Central Bank (2011b)	-	0.3
	European Commission (2011)	With - Without reduction of public debt	0.2 - 0.5
Spain	European Commission (2013)	-	0.1
	Boscá, Doménech, and Ferri (2013)	With reduction of public debt	0.6
	Stähler and Thomas (2012)	Non-Ricardian households	2.3
PIGS	Engler, Ganelli, Tervala, and Voigts (2013)	Sticky wages	0.9 - 1.4
Euro Area	European Commission (2008)	-	0.2
	In't Veld (2011)	With - Without a cost of living adjustment	0.3 - 1
	Vogel (2013)	-	0.3
	Lipińska and von Thadden (2012)	Incomplete - Complete financial integration	0.1 - 0.2
21 OECD countries	Arnold, Brys, Heady, Johansson, Schwellnus, and Vartia (2011)	Revenue-neutral shift from income to consumption tax	0.3 - 1
Germany	Boeters, Böhringer, Büttner, and Kraus (2006)	Heterogeneous agents	0.5
France	European Commission (2013)	-	0.1
	Coupet and Renne (2008)	-	0.1
	Heyer, Plane, and Timbeau (2012)	Multi-sector model	0.3
	Langot, Patureau, and Sopraseuth (2012)	Labor-market frictions	0.1
	Fève, Matheron, and Sahuc (2009)	With - Without matching frictions in the labor market	0.3 - 0.9
	Gauthier (2009)	Non-targeted - Targeted reduction in FSSC	0.1 - 0.7
Italy	European Commission (2013)	-	0.1
	Annichiarico, Di Dio, and Felici (2014)	Non-Ricardian households	0.1

Note: All studies use a general equilibrium model, with the exception of Arnold *et al.* (2011) that estimates an econometric model using panel data.

5. Concluding remarks

The goal of this chapter was to determine the most likely long-term economic and budgetary impact of a fiscal devaluation on the Portuguese economy. The dynamic general equilibrium model we used has two unique features that make it an ideal instrument. Not only is the public sector modeled in great detail, both on the spending and the revenue sides, but also all relevant tax bases are fully endogenous and adjust optimally to changes in policy. Capturing all these dynamic feedbacks is crucial in this exercise, because even ex-ante revenue-neutral tax policies end up affecting the budget balance, as the various macroeconomic aggregates that determine the tax bases reflect the sum of behavioral responses.

This study contributes to the literature on the general-equilibrium effects of a fiscal devaluation in three ways. First, we determine what the long-term impact of this tax swap is in a context of exogenous growth, where the main driver is the broadening of the tax base and the reduction of tax distortions. We find that a fiscal devaluation worth 1 percent of steady-state GDP can permanently increase long-term income by as much as 1 percent, and that fiscal consolidation in the form of a falling public debt to GDP ratio is an added bonus. Second, we ask how these results change when a cost of living adjustment (COLA) is part of the package, albeit it a way that leaves the budget deficit to GDP ratio unchanged in the year the tax swap is implemented. We find that, with a full COLA, long-term income is only permanently raised by 0.7 percent, but then any previous gains in terms of higher employment are wiped out, and so is the progress on the fiscal consolidation front. This suggests that the Government should forci-

bly argue against a full COLA, especially for the younger economic agents, because everyone benefits from the shift to a tax system with fewer distortions, albeit not to the same extent become some economic agents have fewer years to live. The final contribution this study makes to the literature is to investigate if there are any nonlinear effects in the long-term impact of this tax swap. Here we find that fiscal devaluations greater than 2 percent of steady-state GDP rapidly incur in diminishing returns. This happens to be the magnitude of the impulse needed to lower the statutory firms' payroll tax rate in Portugal to the level now seen in Germany, and should be interpreted as an upper bound for the set of reasonable proposals. Thus, fiscal devaluations with an impulse of more than 2 percent of GDP make little economic sense.

At this point it is customary to discuss both the policy implications and the caveats of our results. It is worth highlighting that the various issues we have examined in this chapter are of interest far beyond Portugal or just the reality of peripheral economies of a currency union such as the euro area. As shown in Table 1, there are many countries in Europe that exhibit alarmingly-high overall labor tax wedges that are a serious handicap to improving macroeconomic performance both in terms of income per head and labor utilization [see Eurogroup (2014)].

With respect to the implications of our research for the rethinking of fiscal policy options in Europe, there are two key choices that need to be carefully evaluated.

The first choice is whether any additional fiscal space should be used to lower the stock of public debt to GDP, or alternatively if these extra resources ought to be recycled back into the economy in the form of tax cuts, in order to promote lower distortions and to accelerate economic growth. Cogan, Taylor, Wieland and Wolters (2013: 413) go so far as to argue in favor of a smart fiscal consolidation that goes beyond reducing public indebtedness. This discussion is relevant for the literature on the long-term impact of a fiscal devaluation to the extent that GDP could be further increased if, instead of reducing the ratio of public debt to GDP, the additional fiscal space were recycled back into the economy in the form of lower payroll taxes that firms pay towards Social Security.

The second choice that policymakers of the fiscal policy realm need to ponder is whether a fiscal devaluation is really an adequate strategy or, alternatively if they need to expand their menu of options to consider all possible fiscal instruments in their quest for a reform package that significantly lowers the overall labor tax wedge, improves labor utilization in Europe, and accelerates its convergence to the US in terms of income per person.

In the run up to its 78 billion EUR bailout from the EU and the IMF in June 2011, a fiscal devaluation was proposed for Portugal. Although widely discussed at the time [see, for example, Reis (2010) and Governo de Portugal (2011)], the Government decided not to go ahead. In light of the cautious tone set by De Mooij and Keen (2013), as well as the more recent evidence that suggests that the short-to-medium-term effects of a fiscal devaluation crucially depend on the accommodative stance of the monetary authority, especially when policy interest rates are close to their zero lower bound [see Eggertsson, Ferrero, and Raffo (2014)], with the benefit of hindsight, this seems to have been a wise decision. Now, with the results presented in this chapter, we add another reason why a fiscal devaluation is probably not the recommended policy. Given that this kind of tax swap does not lower the overall labor tax wedge very significantly and, as a result, long-term GDP gains are rather disappointing, we conclude that better alternatives must to be sought, and policymakers in Europe need to look elsewhere in their quest for packages that enhance long-term GDP performance.

As we have shown in this study, by design [revisit Equation (1)], a fiscal devaluation is a very limited strategy in reducing the overall labor tax wedge because, ceteris paribus, although it lowers the cost of labor for firms, it also lowers the consumption wage for workers. The proof of this is that the long-term effects on GDP are rather small, something that other studies have also found. Here, there is fundamentally a choice between an efficient tax reform [see European Commission (2008)] and a more ambitious fiscal reform that is friendly to economic growth. In both cases, given that budget neutrality is an active constraint that is here to stay, there will be a need to trade off distortionary tax margins. In the search for a better tax mix, only a package that primarily favors faster capital accumulation can promote significant progress in terms of GDP. In this regard, an investment tax credit is preferred to a lower corporate income tax rate, insomuch as the former effectively lowers the price of new capital, while the latter mostly benefits installed capital. To improve the utilization of labor, not only are lower payroll taxes needed so that firms want to hire more workers, but also there must be better incentives for households to want to work. In that regard, lower personal income taxes or workers' contributions to Social Security can help, but what is crucial is that if tax cuts such as these are financed through higher VAT rates, then the shift to encourage greater participation in the labor market is partly undone through a lower consumption wage. Thus, as other studies have suggested [see, for instance, Arnold, Brys, Heady, Johansson, Schwellnuss and Vartia (2011)], there is a need to explore new sources of financing, such as environmental taxes and recurrent taxes on residential property. Better still would be a growth-friendly fiscal reform where these tax cuts and productive public spending such as public investment on infrastructure and on human capital could be financed by scaling back other public outlays, as well as the welfare state.

With respect to the caveats of our analysis, it would be interesting to determine how our results would change in a context of endogenous growth, where fiscal policy has the potential to change not only the level of GDP but also its steady-state rate of growth [see, for example, Barro and Sala-i-Martin (1992), and Saint-Paul (1992)]. This exercise would then provide us with an upper bound of the macroeconomic long-term effects of a fiscal devaluation in Portugal. In a setting where, for example, public investment activities in infrastructure and in human capital support private decisions, a greater utilization of labor can not only improve general macroeconomic performance but can also spur faster GDP growth. As effective labor is a composite of human capital and the number of hours worked, endogenous growth makes the labor market channel even more important. This can be crucial to measure, even more accurately, the long-term gain of a fiscal devaluation.

More importantly, from a methodological perspective, the simulation model we use is inadequate to determine the short- and medium-term effects of a fiscal devaluation. For those shorter horizons, the model would have to be adapted to feature an endogenous rate of unemployment and to include neo-Keynesian features where, for example, labor demand and investment schedules depend far more on aggregate demand conditions than on the cost of labor and the interest rate.

References

Alogoskoufis, G., Bean, C., Bertola, G., Cohen, D., Dolado, J., and G. Saint-Paul, 1995, "Unemployment: Choices for Europe," *Monitoring European Integration,* Vol. 5 (London: Centre for Economic Policy Research).

Altomonte, C., Aquilante, T., and G. Ottaviano, 2012, *The Triggers of Competitiveness: The EFIGE Cross-Country Report*, Bruegel Blueprint Series (Brussels: Bruegel).

Annichiarico, B., Di Dio, F., and F. Felici, 2014, "Fiscal Devaluation Scenarios: A Quantitative Assessment for the Italian Economy," Working Paper No. 1 (Roma: Ministero dell'Economia e delle Finanze, Dipartimento del Tesoro).

Arnold, J., Brys, B., Heady, C., Johansson, Å., Schwellnus, C., and L. Vartia, 2011, "Tax Policy for Economic Recovery and Growth," *Economic Journal*, Vol. 121 (February), pp. F59-F80.

Auerbach, A., 1985, "The Theory of Excess Burden and Optimal Taxation," Ch. 2, *Handbook of Public Economics*, Vol. 1, ed. A. Auerbach and M. Feldstein (Amsterdam: North-Holland).

Auerbach, A., Gokhale, J., and L. Kotlikoff, 1994, "Generational Accounting: A Meaningful Way to Evaluate Fiscal Policy," *Journal of Economic Perspectives*, Vol. 8, No. 1, pp. 73-94.

Bach, S., Haan, P., Hoffmeister, O. and V. Steiner, 2006, "Increasing the Value-Added Tax to Re-Finance a Reduction of Social Security Contributions? A Behavioral Microsimulation Analysis for Germany," mimeo (Berlin: Deutsches Institut für Wirtschaftsforschung).

Banco de Portugal, 2011, "The Impact of a Tax Change Aimed at Increasing the External Competitiveness of the Portuguese Economy," *Banco de Portugal's Economic Bulletin*, Spring, Vol. 17, No. 1, Box 2, pp. 39-42.

Barro, R., and X. Sala-i-Martin, 1992, "Public Finance in Models of Endogenous Growth," *Review of Economic Studies*, Vol. 59, pp. 645-661.

Blanchard, O., 2007, "Adjustment within the Euro: The Difficult Case of Portugal," *Portuguese Economic Journal*, Vol. 6, pp. 1-21.

Blanchard, O., Jaumotte, F., and P. Loungani, 2014, "Labor Market Policies and IMF Advice in Advanced Economies during the Great Recession," *IZA Journal of Labor Policy*, Vol. 3, No. 2, pp. 1-23.

Boeters, S., Böhringer, C., Büttner, T., and M. Kraus, 2006, "Economic Effects of VAT Reform in Germany," Discussion Paper No. 30 (Mannheim: Zentrum für Europäische Wirtschaftsforschung Gmbh).

Böhringer, C., Boeters, S., and M. Feil, 2005, "Taxation and Unemployment: An Applied General Equilibrium Approach," *Economic Modeling*, Vol. 22, pp. 81-108.

Boscá, J., Doménech, R., and J. Ferri, 2013, "Fiscal Devaluations in EMU," *Hacienda Pública Española/Review of Public Economics*, Vol. 206, pp. 27-56.

Calmfors, L., 1998, "Macroeconomic Policy, Wage Setting, and Employment – What Difference Does the EMU Make?," *Oxford Review of Economic Policy*, Vol. 14, No. 3, pp. 125-151.

Cavallo, D., and J. Cottani, 2010, "For Greece, a 'Fiscal Devaluation' is a Better Solution Than a 'Temporary Holiday' From the Eurozone," 22 February, URL: http://bit.ly/1lHomgm (London: Centre for Economic Policy Research, VOXEU.org).

Cogan, J., J. Taylor, V. Wieland, and M. Wolters, 2013, "Fiscal Consolidation Strategy," *Journal of Economic Dynamics & Control*, Vol. 37, pp. 404–421.

Commission of the European Communities, 1993, "Growth, Competitiveness and Employment: The Challenges and Ways Forward into the 21st Century," *Bulletin of the European Communities*, Suppl. 6, White Paper COM(93)700, December 5.

Coupet, M., and J. Renne, 2008, "Réformes Fiscales dans un Modèle DSGE France en Économie Ouverte," *Economie & prévision*, Vol. 2, N.° 183-184, pp. 199-222.

de Mooij, R., and M. Keen, 2013, "'Fiscal Devaluation' and Fiscal Consolidation: The VAT in Troubled Times," in *Fiscal Policy after the Financial Crisis,* ed. A. Alesina and F. Giavazzi, Chapter 11, pp. 443-494 (Massachussets: NBER Conference Report).

Drèze, J., and E. Malinvaud, 1994, "Growth and Employment: The Scope of a European Initiative," *European Economic Review*, Vol. 38 (April), Nos. 3-4, pp. 489-504.

Eggertsson, G., Ferrero, A., and A. Raffo, 2014, "Can Structural Reforms Help Europe?," *Journal of Monetary Economics*, Vol. 61, pp. 2-22.

Engler, P., Ganelli, G., Tervala, J., and S. Voigts, 2013, "Fiscal Devaluation in a Monetary Union," School of Business & Economics Discussion Paper No. 18 (Berlin: Freie Universität).

Eurogroup, 2014, "Structural Reform Agenda – Thematic Discussions on Growth and Jobs: Reduction of the Tax Wedge," Press statement, 8 July (Brussels: European Union).

European Central Bank, 2013, *Competitiveness Research Network: First Year Results*, June (Frankfurt am Main: European Central Bank, The Competitiveness Research Network).

European Central Bank, 2011a, "Fiscal Devaluation – A Tool for Economic Adjustment," *Monthly Bulletin*, December, Box 2, pp. 101-102.

European Central Bank, 2011b, "Fiscal Devaluation in Portugal: Results from Model-Based Simulations and Institutional Aspects," unpublished (Frankfurt am Main: European Central Bank, Research Department).

European Commission, 2013, "Study on the Impacts of Fiscal Devaluation," Taxation Papers Working Paper No. 36 (Brussels: European Commission, Directorate-General for Taxation and Customs Union).

European Commission, 2012, "Statistical Annex of the European Economy," *European Economy*, Spring, Directorate-General for Economic and Financial Affairs (Brussels: European Commission).

European Commission, 2011, "The Macroeconomic Effects of a Fiscal Devaluation – Results from Model Simulations," *The Economic Adjustment Programme for Portugal: First Review – Summer 2011*, Occasional Papers No. 83, Box 5, pp. 20-21 (Brussels: European Commission, Directorate-General for Economic and Financial Affairs).

European Commission, 2008, "The Efficiency of Tax Systems: Shifting Taxation from Labour to Consumption: Note for the EPC Working Group on Quality of Public Finances" (Brussels: European Commission).

Eurostat, 2014, *Taxation Trends in the European Union: Data for the EU Member States, Iceland and Norway* (Luxembourg: Eurostat).

Fahri, E., Gopinath, G., and O. Itskhoki, 2014, "Fiscal Devaluations," *Review of Economic Studies*, Vol. 81, No. 2, pp. 725-760.

Felipe, J., and U. Kumar, 2011, "Do Some Countries in the Eurozone Need an Internal Devaluation? A Reassessment of What Unit Labour Costs Really Mean," 31 March, URL: http://bit.ly/1qnKTOZ (London: Centre for Economic Policy Research, VOXEU.org).

Fève, P., Matheron, J., and J. Sahuc, 2009, "La TVA Sociale: Bonne ou Mauvaise Idée?," Working Paper No. 38, May (Toulouse: École d'économie de Toulouse).

Gabrisch, H., and K. Staehr, 2014, "The Euro-Plus Pact: Cost Competitiveness and External Capital Flows in the EU Countries," Working Paper No. 1650 (Frankfurt am Main: European Central Bank, The Competitiveness Research Network).

Gauthier, S., 2009, "Un Exercice de TVA Sociale," *Économie et Prévision*, N.° 187 (Paris: Ministère de Finances et des Comptes Publics, and Ministère de l'Économie, de l'Industrie et du Numérique).

Gordon, R., 2004, "Two Centuries of Economic Growth: Europe Chasing the American Frontier," National Bureau of Economic Research Working Paper No. 10662, August (Massachussets: NBER).

Governo de Portugal, 2011, *Relatório Sobre a Desvalorização Fiscal*, Julho (in Portuguese).

Heyer, É., Plane, M., and X. Timbeau, 2012, "Impact Économique de la «Quasi TVA Sociale» - Simulations Macroéconomiques et Sectoriels," *Revue de l'OFCE / Débats et politiques,* N.° 122, pp. 373-397.

Hoon, H, and E. Phelps, 1996, "Payroll Taxes and VAT in a Labor-turnover Model of the Natural Rate," *International Tax and Public Finance*, Vol. 3, No. 3, pp. 369-383.

In't Veld, J., 2011, "QUEST Model Simulations of a Budgetary Neutral Tax Shift from Social Security Contributions to Consumption Taxes in Portugal," unpublished (Brussels: European Commission).

International Monetary Fund, 2010, "From Stimulus to Consolidation: Revenue and Expenditure Policies in Advanced and Emerging Economies," Section III (Washington DC: International Monetary Fund, Fiscal Affairs Department).

Jaumotte, F., and P. Sodsriwiboon, 2010, "Current Account Imbalances in the Southern Euro Area," IMF Working Paper No. 139 (Washington: International Monetary Fund, European Department).

Keen, M, and R. de Mooij, 2012, "Fiscal Devaluation as a Cure for Eurozone Ills – Could It Work?," 6 April, URL: http://bit.ly/1uyqGpi (London: Centre for Economic Policy Research, VOXEU.org).

Keynes, J., 1931, "Addendum I to: Great Britain. Committee on Finance and Industry Report," pp. 190-209 (London: His Majesty's Stationery Office).

Krugman, P., and L. Taylor, 1978, "Contractionary Effects of Devaluation," *Journal of International Economics*, Vol. 8, Issue 3, pp. 445–456.

Langot, F., Patureau, L., and T. Sopraseuth, 2012, "Optimal Fiscal Devaluation," Discussion Paper No. 6624, June (Bonn: Institut zur Zukunft der Arbeit).

Lipińska, A., and L. von Thadden, 2012, "On the (In)effectiveness of Fiscal Devaluations in a Monetary Union," Finance and Economics Discussion Series Working Paper No. 71 (Washington DC: Federal Reserve Board, Divisions of Research & Statistics and Monetary Affairs).

Lucas, R., 2003, "Macroeconomic Priorities," *American Economic Review*, Vol. 93, No. 1, pp. 1-14.

Mankiw, N., M. Weinzierl, and D. Yagan, 2009, "Optimal Taxation in Theory and Practice," *Journal of Economic Perspectives*, Vol. 23, No. 4, Fall, pp. 147–174.

Ministério do Ambiente, Ordenamento do Território e Energia, 2012, *Factura Energética*, Available at: www.dgeg.pt (Lisboa: Direcção-Geral de Energia e Geologia).

Ministério das Finanças e da Administração Pública, 2012, *Estatísticas das Finanças Públicas*, Available at: www.gpeari.min-financas.pt (Lisboa: Gabinete de Planeamento, Estratégia, Avaliação e Relações Internacionais).

OECD 2014a, "GDP Per Head, US$, Current Prices, Current PPPs," Query to OECD Stat.Extracts, September 1, URL: http://bit.ly/1bqhoQQ (Paris: OECD).

OECD, 2014b, *Taxing Wages 2014* (Paris: OECD).

OECD, 2014c, *Portugal: Deepening Structural Reform to Support Growth and Competitiveness*, "Better Policies" Series (Paris: OECD).

Ohanian, L., Raffo, A., and R. Rogerson, 2008, "Long-term Changes in Labor Supply and Taxes: Evidence from OECD Countries, 1956-2004," *Journal of Monetary Economics*, Vol. 55, pp. 1353-1362.

Pereira, A., and R. Pereira, 2014a, "What Is It Going to Take to Achieve 2020 Emission Targets? Marginal Abatement Cost Curves and the Budgetary Impact of CO_2 Taxation in Portugal," Working Paper No. 105 (Virginia: The College of William and Mary, Department of Economics).

Pereira, A., and R. Pereira, 2014b, "Environmental Fiscal Reform and Fiscal Consolidation: The Quest for the Third Dividend in Portugal," *Public Finance Review*, Vol. 42, No. 2, pp. 222-253.

Pereira, A., and R. Pereira, 2014c, "On the Environmental, Economic and Budgetary Impacts of Fossil Fuel Prices: A Dynamic General Equilibrium Analysis of the Portuguese Case," *Energy Economics*, Vol. 42, March, pp. 248-261.

Pereira, A., and R. Pereira, 2013, "Fossil Fuel Prices and the Economic and Budgetary Challenges of a Small Energy–Importing Economy: The Case of Portugal," *Portuguese Economic Journal*, Vol. 12, No. 3, pp. 181-214.

Pereira, A. and R. Pereira, 2012, "DGEP – A Dynamic General Equilibrium Model of the Portuguese Economy: Model Documentation," Working Paper No. 127 – Revised in 2014 (Virginia: The College of William and Mary, Department of Economics).

Pereira, A., and P. Rodrigues, 2007, "Pension Reform in Portugal: A Dynamic General Equilibrium Analysis," July (Lisboa: Portuguese-American Development Foundation).

Pereira, A., and P. Rodrigues, 2004, "Strategies for Fiscal Reform in the Context of the EMU: The Case of Portugal," *Review of Development Economics*, Vol. 8, No. 1, pp. 143-165.

Pereira, A., and P. Rodrigues, 2002, "On the Impact of a Tax Shock in Portugal," *Portuguese Economic Journal*, June, Vol. 1, No. 3, pp. 205–236.

Prammer, D., 2011, "Quality of Taxation and the Crisis: Tax Shifts from a Growth Perspective," Taxation Papers Working Paper No. 29 (Brussels: European Commission, Directorate-General for Taxation and Customs Union).

Prescott, E., 2004, "Why Do Americans Work So Much More Than Europeans?," *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol. 28, No. 1, pp. 2-13.

Reis, R., 2013, "The Portuguese Slump and Crash and the Euro Crisis," *Brookings Papers on Economic Activity*, Spring, pp. 143-193.

Reis, R., 2010, "Uma Alternativa Fiscal para Responder à Crise," *Jornal i*, 15 May (in Portuguese).

Saint-Paul, G., 1992, "Fiscal Policy in an Endogenous Growth Model," *Quarterly Journal of Economics*, Vol. 107, pp. 1243–1259.

Sørensen, P., Christiansen, V., and J. Dolado, 1997, "Public Finance Solutions to the European Unemployment Problem?," *Economic Policy*, Vol 12, No. 25 (October), pp. 221-264.

Stähler, N., and C. Thomas, 2012, "FiMod — A DSGE Model for Fiscal Policy Simulations," *Economic Modelling*, Vol. 29, pp. 239-261.

Thimann, C., 2013, "Die Bedeutung der Wettbewerbsfähigkeitauf dem Weg aus der Krise im Eurogebiet," *Perspektiven der Wirtschaftspolitik*, Vol. 14, Nos. 3-4, pp. 240–261 (in German).

Thirlwall, A., 1986, *Balance-of-Payments Theory and the United Kingdom Experience* (London: Palgrave Macmillan).

Tressel, T., S. Wang, J. Kang, and J. Shambaugh, 2014, "Adjustment in Euro Area Deficit Countries: Progress, Challenges, and Policies," *IMF Discussion Note*, SDN/14/7, July (Washington: International Monetary Fund).

Vogel, L., 2013, "The Impact of Structural Policies on External Accounts in Infinite-horizon and Finite-horizon Models," *Review of International Economics*, Vol. 21, No. 1, pp. 103-117.

World Economic Forum, 2012, *The Europe 2020 Competitiveness Report: Building a More Competitive Europe* (Geneva: World Economic Forum).