Saving Europe?
Some Unpleasant Supply-Side Arithmetic of Fiscal Austerity

Enrique G. Mendoza*
Department of Economics
University of Pennsylvania
Philadelphia, PA 19104
and NBER

Linda L. Tesar†
Department of Economics
University of Michigan
Ann Arbor, MI 48109
and NBER

Jing Zhang‡
Department of Economics
University of Michigan
Ann Arbor, MI 48109§

December 13, 2012

Preliminary and Incomplete

Abstract

JEL: Keyword:

*Email: mendoza@econ.umd.edu

†Email: ltesar@umich.edu

‡Email: jzhang@umich.edu

§Tesar gratefully acknowledges the Isle de France di Marco Foundation and the Paris School of Economics for their support during the early phases of the project.

1 Introduction

The ongoing European debt crisis radically changed the nature of fiscal policy discussions in the European Union. Until recently, tax discussions were largely centered on the harmonization of national tax rates, particularly VAT rates, and measures to mitigate the ostensibly negative effects of tax competition (Sorensen, 2001; Kellerman and Kammer, 2009). Since the 1970s, EU member states have worked to bring value-added taxation into alignment and to remove barriers to capital and labor movements across borders. Steps to create a common playing field for corporate taxation (the Common Consolidated Corporate Tax Base) have met with less success.

The European debt crisis changed the focus away from issues of harmonization and put the emphasis instead on the spillover effects of potential sovereign default by some EU members, the need to tighten fiscal coordination within the eurozone, and the need to implement far reaching country-specific fiscal austerity programs to address fiscal imbalances. Even before the 2008 global financial crisis, many countries in the eurozone were pushing up against the public debt ceiling of 60 percent of GDP, a condition of the Maastricht Treaty. The slowing of economic activity combined with increased transfer payments, financial system bailouts, and fiscal stimulus programs in the aftermath of the 2008 crisis resulted in a ballooning of debt ratios, in some cases well above 100 percent of GDP. A number of countries, including Portugal, Greece, Italy, Ireland and Spain, and to a lesser extent France and the Netherlands, have adopted austerity measures that involve expenditure reductions and increases in tax rates in an attempt to stem the growth of budget deficits and the accumulation of debt.

While much ink has been spilled in both the financial and academic press on the pros and cons of austerity measures in response to the European debt crisis, there has been surprisingly little discussion of the constraints imposed on fiscal policy by being part of a region that is economically integrated. Estimates of the sustainability of alternative fiscal plans (Abiad and Ostry, 2005), fiscal space (Ostry et al., 2010), and the scope for raising revenue (Trabandt and Uhlig, 2009, 2012) tend to treat countries in Europe as isolated economic units, which sets aside the nontrivial potential for a tax base erosion due to factor mobility or for spillover effects on the budgets and welfare of other member countries. This is paradoxical, because externalities of fiscal policy have otherwise been widely discussed in the theoretical literature on international tax competition and in broader EU policy studies on tax harmonization and capital income tax competition (see, for example, the survey by Persson and Tabellini (1995), the books by Frenkel et al. (1991) and Turnovsky (1997), and the quantitative studies by Klein et al. (2005), Sorensen (1999), Sorensen (2003) and Eggert (2000)).

In previous research, Mendoza and Tesar (1998) and Mendoza and Tesar (2005) developed a framework for studying the quantitative implications of tax reforms in the presence of global externalities resulting from national tax policy changes. First, they studied the global effects of unilateral changes in capital or labor taxes that are neutral in the present value of total tax revenue through the adjustment of consumption taxes. By focusing on revenue neutrality in present value, this framework allows the government to make efficient use of debt markets to smooth the tax burden over time. Then they solved for the equilibrium tax structures that result from strategic interaction of national tax authorities by solving one-shot games under Nash competition and under global cooperation.

In this paper we modify their framework to answer a very different set of questions. Instead of studying tax reforms, we are interested in examining how the external effects of national tax policies influence the response of countries with a high degree of economic integration to large fiscal shocks (i.e. the eurozone). We propose a two-country model in which the home country is intended to represent the periphery countries (Greece, Ireland, Italy, Portugal and Spain, the "GIIPS" group) and the foreign country represents the remainder of eurozone members (Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, the Netherlands, Slovenia and Slovakia; the "EU10"). The starting point is a once-and-for-all unanticipated fiscal shock, equivalent to the observed increase in the average public debt-to-GDP ratio of the GIIPS and EU10 between 2008 and 2011, which measured about 24 percentage points of GDP for the former and 17 percentage points for the latter. To maintain fiscal solvency, this implies that the net present discounted value of primary fiscal balances, discounted at equilibrium public debt prices, must also increase by the same percentage points. We assume that countries remain committed to harmonization in the VAT and therefore rely on an adjustment in factor income taxes. The perturbation to the pre-fiscal-shock stationary equilibrium then poses these key questions:

1. Assuming government outlays are unchanged, what responses of taxes on factor incomes are required in order to restore fiscal solvency? (which includes the serious possibility that, because of Laffer curve considerations explained below, there actually may not exist a tax structure that can restore fiscal solvency, or that some tax structures that may do it exhaust the revenue-generating ability of particular taxes).

2. What are the global externalities resulting from tax policies that can restore solvency in response to large fiscal shocks? (because of these externalities, unilateral national tax austerity in the GIIPS, which faced a much larger debt shock, can result in welfare loses larger than what the same policies could produce under autarky, and can induce unintended welfare gains in the EU10 group; that is, austerity in one region can result in prosperity in another).

3. If national tax authorities recognize the externalities and engage in strategic interaction, what will be the tax structures we can expect as a result of one-shot Nash tax competition in response to the fiscal shock, and how do they differ from the ones that would be obtained instead if the two groups of countries respond cooperatively to the fiscal shock.

4. How do the answers to the above questions change if we introduce haircuts that partially redistribute the effect of the fiscal shock across the two country groups.

The model that we use to answer these questions is the workhorse two-country Neoclassical model with exogenous growth driven by labor-augmenting technological change. In this setup, the global externalities of national tax policies are driven by international transmission effects operating through three channels: (1) relative prices, because national tax changes alter the prices of financial assets (including internationally traded assets and public debt instruments) as well as factor prices at home and abroad; (2) the distribution of wealth, because efficiency effects of national tax changes affect the allocations of capital and net foreign assets across countries; and (3) the erosion of tax revenues, because via the first two channels national tax policies affect the ability of foreign governments to raise tax revenue, forcing them to restore their fiscal solvency by adjusting their own taxes or outlays.

These channels are essential for evaluating fiscal consolidation efforts in Europe and play a central role in answering the four questions that we posed. In our view, these externalities are not mere academic curiosities. There is ample evidence of capital flight from the periphery countries of Europe, much of it to the perceived safety of Germany. Some of this flight is triggered by concerns about bank solvency and the potential collapse of the euro, issues that are beyond the scope of this paper. However, businesses also cite rising taxes on capital as an impetus to relocation. (See for example, "EuroCrisis: Big Business Leaving Greece," International Business Times, October 12, 2012 by Paul A. Ebeling, Jr., and "Euroview: Capital Fleeing Entire Periphery, not just Greece," EFX News, May 25, 2012, by Jack Duffy.)

To study the impact of fiscal consolidations and their externalities, we use numerical simulations of the model calibrated to the pre-crisis stance of fiscal policies and macroeconomic aggregates of the two country groups in which we split the eurozone, the GIIPS and EU10. We perform various exercises with these simulations. First, we examine the capacity to raise revenue in each of the two regions by mapping out dynamic Laffer curves for the present value of tax revenue as tax rates on capital and labor income vary. We find that, relative to closed-economy estimates of the Laffer curve (e.g. Trabandt and Uhlig, 2010), open-economy Laffer curves shift down and to the left. Indeed, the shifts can be so sizable as to make raising the revenue needed to respond to the observed fiscal shock infeasible, and this assuming that countries continue to have access to debt markets (since by examining present value Laffer curves we are allowing governments to use public debt to smooth taxation).

Second, we examine the impact of a change in tax policy in one region on the allocations, and in particular, the fiscal balance, of the other region. Our framework allows us to study the impact of a change in domestic tax policy (for example, an increase in the labor income tax rate in the GIIPS countries) on the fiscal balance in the rest of Europe. In all cases, the welfare costs of unilateral tax hikes are costly for the region undertaking the policy reform and are positive for the region that remains passive. Further, the revenue gains for the region that remains passive are sizable. Finally, the revenue increases are always substantially larger in the closed economy than in the open economy. These results, taken together, suggest that there are likely to be important externalities from tax policy changes in Europe and that there may be room for gains from policy coordination or capital controls.

Third, in light of the large externalities we find, we solve for the outcome of Nash and cooperative equilibria tax games. Our preliminary results suggest that because of the positive revenue externalities, an increase in one region's tax rate implies that the other region can meet its revenue target with a lower tax rate. Intuitively, the tax rates that emerge from a Nash game are lower than the tax rates needed to meet the revenue target when each region acts unilaterally. [The results of a game that involves strategies over both capital and labor tax rates are in progress.]

2 A Two-Country Model of Global Tax Externalities

The framework for our analysis is a two-country version of the standard neo-classical balanced-growth model under perfect foresight. The two countries, with the home country (H) intended to represent the GIIPS region and the foreign country (F) intended to represent the EU10 region, are perfectly integrated through trade in one-period discount bonds and consumption goods. Each country is inhabited by identical, infinitely-lived individuals. The countries produce a single tradable good using capital and labor as input. Preferences and technology are assumed to be identical. As is the case in the eurozone, however, the countries differ in that they have fully independent national fiscal authorities, which can set different policies for taxation and government outlays, specified in detail below. Capital and labor are modeled as immobile factors, but trade in bonds is sufficient to create important global spillovers of national tax policies that affect the global distribution of wealth, including the size of the global capital stock and its distribution across countries. In addition to this wealth reallocation mechanism, national tax policies trigger also the other two mechanisms driving global externalities via relative prices and revenue erosion noted in the introduction.

We present below the structure of preferences, technology and the government sector of the H country. The same structure applies to the F country, and when is relevant to distinguish variables or decisions across the two we use asterisks to identify the F country.

Households

The representative household in H maximizes lifetime utility over consumption, c_t, and leisure, $1 - l_t$, according to:

$$\sum_{t=0}^{\infty} \left[\beta(1+\gamma)^{1-\sigma}\right]^t \frac{(c_t(1-l_t)^a)^{1-\sigma}}{1-\sigma}, \quad \sigma > 1, \; a > 0, \text{ and } 0 < \beta < 1. \tag{1}$$

The parameter β is the household's subjective discount factor, $\frac{1}{\sigma}$ is the intertemporal elasticity of substitution in consumption, and a is a coefficient that governs the intertemporal elasticity of labor supply for a given value of σ.

As in the standard neoclassical framework of King et al. (1988), growth is driven by labor-augmenting technological change that occurs at exogenous rate γ. Accordingly, all variables (except labor and leisure) are rendered stationary by dividing by the level of this technological factor.[1] In addition, the stationarity-inducing transformation requires changing the discount factor to $\beta(1+\gamma)^{1-\sigma}$ and adjusting the laws of motion of accumulable assets so that date-$t+1$ stocks grow by the balanced-growth factor $1+\gamma$.

The household maximizes (1) subject to a sequence of period budget constraints:

$$\begin{aligned} &(1+\tau_c)c_t + (1+\gamma)(k_{t+1} + q_t b_{t+1} + q_t^g d_{t+1}) + \left(\frac{\eta}{2}\left(\frac{x_t}{k_t} - z\right)^2 - 1\right) k_t \\ &= (1-\tau_L)w_t l_t + (1-\tau_K)(r_t - \delta)k_t + b_t + d_t + e_t, \end{aligned} \tag{2}$$

for $t = 0, ..., \infty$, given the initial conditions $k_0 > 0$, b_0, and d_0. The household takes as given government-determined proportional tax rates on consumption, labor income and capital income, denoted τ_C , τ_L , and τ_K, respectively, and lump-sum government transfer or entitlement payments, denoted by e_t. The household also takes the factor payment rates to labor w_t and capital r_t, and the prices of government bonds and foreign bonds, q_t^g and q_t as given (the gross real rates of return on these bonds are $R_t^g = \frac{1}{q_t^g}$ and $R_t = \frac{1}{q_t}$, respectively).

The left-hand-side of (2) measures household expenditures, which include purchases of con-

[1]The assumption that growth is exogenous implies that in this model tax policies do not affect long-run economic growth. This is in line with the empirical and quantitative findings of Mendoza et al. (1997).

sumption goods inclusive of the indirect tax, new capital goods, k_{t+1}, international bonds, b_{t+1}, and domestic government bonds d_{t+1}. The price of capital and the price of consumer goods differ because investment incurs quadratic adjustment costs as a function of the ratio of net investment x_t to existing capital k_t. The coefficient η determines the speed of adjustment of the capital stock, while z is set equal to the long-run investment-capital ratio to ensure that at steady state the capital adjustment cost is zero. Net investment adjusted for exogenous technological progress is defined as $x_t = (1+\gamma)k_{t+1} - (1-\delta)k_t$, where δ is the rate of depreciation of the capital stock.

The right-hand side of equation (2) shows the household after-tax income. This includes net-of-tax income from wages and capital, assuming for the latter that the tax code provides a depreciation allowance. The household also pays or collects payments on holdings of public and international bonds, and receives lump-sum entitlement payments from the government.

This model features three assumptions of the tax system that effectively limit portfolio choice: First, capital income is taxed according to the residence principle, while bond payments are not taxed. Second, countries can tax capital income at different tax rates. Third, there is perfect cross-country capital mobility in the market for international bonds. The limitations for capital mobility are implied by the fact that supporting the existence of a competitive equilibrium under these assumptions implies that we also need to assume that all domestic physical capital is owned entirely by domestic agents (see Mendoza and Tesar, 1998; Frenkel et al., 1991). If this is not the case, cross-country arbitrage of returns across capital and bonds at a common global price for the latter implies that world competitive equilibrium requires identical capital income taxes. Other forms of financial-market segmentation, such as trading costs or short-selling constraints, could be introduced for the same purpose, but they make the model less tractable.[2]

The model also imposes a no-Ponzi condition on households. This restriction, along with the flow constraint in (2) will imply that the present value of expenditures equals the present value of after-tax income plus initial asset holdings.

[2]The assumptions of extreme home bias and residence-based taxation could be replaced with source-based taxation and this would result in similar saving and investment optimality conditions that would support competitive equilibria with different capital income tax rates across countries. However, while actual tax codes tend to be source-based, most industrial countries have bilateral tax treaties that render tax systems largely residence-based (see Frenkel et al., 1991).

Firms

Firms employ labor and capital to maximize profits, taking factor prices as given. The production function is assumed to be Cobb-Douglas:

$$y_t = F(k_t, l_t) = k_t^{1-\alpha} l_t^{\alpha}, \tag{3}$$

where α is labors share of income and $0 < \alpha < 1$. Firms behave competitively so the value of output equals total factor payments. $y_t = w_t l_t + r_t k_t$.

Public Sector

Fiscal policy in this economy has three components. The first component is government outlays, and is composed of pre-determined sequences of government purchases on goods and services, g_t, and transfer/entitlement payments to households, e_t, for $t = 0, ..., \infty$. These uses of government funds are unproductive in the sense that they do not directly alter household utility or firm output. The second component is the set of time invariant tax rates on consumption τ_C, labor income τ_L and capital income τ_K. The third component is the level of government-issued debt, d_t. The government must satisfy this sequence of budget constraints:

$$d_t - (1+\gamma) q_t^g d_{t+1} = \tau_C c_t + \tau_L w_t L_t + \tau_K (r_t - \delta) k_t - (g_t + e_t). \tag{4}$$

The right-hand-side of this equation shows the primary fiscal balance (tax revenues net of total outlays on government purchases and entitlements). If there is a primary deficit, the government needs to issue new debt at face value and adjusted for growth, $(1+\gamma) q_t^g d_{t+1}$, that exceeds the existing debt by enough to finance the primary deficit.

In addition to (4), we also impose a no Ponzi game condition on the government. This condition ensures that the present value of government revenues net of expenditures equals the initial public debt d_0.[3] This present value needs to be discounted at the equilibrium interest rates of public debt.

[3]Note that, as explained in Mendoza and Tesar (1998), public debt in this model is Ricardian in the sense that the equilibrium dynamics of government debt can be equivalently characterized as a sequence of lump-sum transfers between government and households, T_t (which is different from explicit entitlement payments e_t), with these transfers

Consolidation of the government's constraint with the household's constraint in (2) and the firm's zero profit condition in (4) yields the economy-wide budget constraint for the home region:

$$F(k_t, l_t) - c_t - g_t - x_t - \left(\frac{\eta}{2}\left(\frac{x_t}{k_t} - z\right)^2 - 1\right) k_t = (1+\gamma) q_t b_{t+1} - b_t. \quad (5)$$

Competitive Equilibrium

A competitive equilibrium for this two-region economy is a sequence of prices the $\{r_t,\ r_t^*,\ q_t,\ q_t^g,\ q_t^{g*},\ w_t,\ w_t^*\}$ and allocations $\{k_{t+1},\ k_{t+1}^*,\ b_{t+1},\ b_{t+1}^*,\ x_t,\ x_t^*,\ l_t,\ l_t^*,\ c_t,\ c_t^*,\ d_{t+1},\ d_{t+1}^*\}$ for $t = 0, ..., \infty$ such that: (a) households in each region maximize utility subject to their corresponding budget constraints and no-Ponzi game constraints, taking as given all fiscal policy variables as well as pre-tax prices and factor rental rates, (b) firms maximize profits subject to the Cobb-Douglas technologies taking as given pre-tax factor prices, and (c) the government budget constraints hold for given tax rates and exogenous sequences of government purchases and entitlements, and (d) the following market-clearing conditions hold in the global markets of goods and bonds

$$y_t + y_t^* = c_t + c_t^* + x_t + \frac{\eta}{2}\left[\frac{x_t}{k_t} - z\right]^2 k_t + x_t^* + \frac{\eta^*}{2}\left[\frac{x_t^*}{k_t^*} - z^*\right]^2 k_t^* + g_t + g_t^*, \quad (6)$$

$$b_t + b_t^* = 0. \quad (7)$$

Optimality Conditions and Channels of International Externalities

The model yields three key optimality conditions that will guide our intuition for the external effects of austerity measures from one region to another. These conditions are discussed in detail in Mendoza and Tesar (1998) and Mendoza and Tesar (2005). Here we highlight the implications that will be important for the European fiscal policy experiments we consider. The Euler equations for capital (excluding adjustment costs for simplicity), international bonds and domestic government

set equal to the primary fiscal balance. We use this to simplify the numerical solution of the model. Once we have the equilibrium sequence of these transfers, the implied equilibrium dynamics for public debt follows from an initial condition d_0, and the government budget constraint.

bonds are as follows:

$$\frac{(1+\gamma)u_1(c_t, 1-l_t)}{\beta u_1(c_{t+1}, 1-l_{t+1})} = (1-\tau_K)[F_1(k_{t+1}, l_{t+1}) - \delta] + 1 = \frac{1}{q_t} = \frac{1}{q_t^g}, \tag{8}$$

$$\frac{(1+\gamma)u_1(c_t^*, 1-l_t^*)}{\beta u_1(c_{t+1}^*, 1-l_{t+1}^*)} = (1-\tau_K^*)[F_1(k_{t+1}^*, l_{t+1}^*) - \delta] + 1 = \frac{1}{q_t} = \frac{1}{q_t^{g*}}. \tag{9}$$

Because households in each region have access to the global market for bonds, and therefore have the same opportunity for consumption smoothing, the intertemporal marginal rate of substitution will be equalized across regions and will be equal to the rate of return on the international bond. Households in each region face a distortionary tax on the return to capital investment. Therefore, while the after-tax rate of return on capital will be equalized across regions, the pre-tax return need not be, and hence the level of the capital stock and output may differ across regions due to differences in capital taxation. As explained earlier, this holds at a competitive equilibrium because we assume all domestic capital is owned only by domestic agents. Arbitrage in asset markets implies that the price of external bonds and domestic public bonds are equalized. Hence, at equilibrium: $q_t = q_t^g = q_t^{g*}$.

Mendoza and Tesar (1995) studied a unilateral change in the capital income tax that resulted in a permanent reallocation of physical capital, and ultimately a permanent shift in wealth, from the high tax to the low tax region. Note that in the long run, the global interest rate will be a function of β, γ and σ, and is invariant to the level of taxation. However, the paper showed that the interest rate does change along the transition path and alters the paths of consumption, output and international asset holdings. These dynamics will turn out to be important here as regions alter tax rates in an effort to reduce overall debt burdens.

The optimality condition for labor supply reflects the distortionary effects of the labor tax and the consumption tax:

$$\frac{u_2(c_t, 1-l_t)}{u_1(c_t, 1-l_t)} = \frac{(1-\tau_L)}{(1+\tau_C)} F_2(k_t, l_t) \tag{10}$$

A symmetric condition holds in the other region. Taxes on labor and consumption both drive a wedge between the marginal rate of substitution between leisure and consumption and the after-tax real wage (the pre-tax real wage being equal to the marginal product of labor). In the full general equilibrium, however, the distortionary effect on allocations is much greater for the labor tax because it affects both the return to labor, which reduces an input into production, in addition to distorting the households leisure-consumption trade-off. Despite the fact that labor is immobile internationally, changes in the labor tax rate will have large spillover effects. An increase in the labor tax rate reduces the return to capital, changing the world interest rate and the allocation of capital, consumption and bond holdings across regions.

3 Calibration and Pre-Crisis Fiscal Policy within the Eurozone

We calibrate our model to capture the fiscal policy stance in 2008 of the 15 largest countries in the eurozone (Cyprus and Malta are excluded from our sample). Table 1 shows the main components of national income and (consolidated) government statistics as shares of GDP for all 15 countries. The last two columns compute GDP-weighted ratios for the countries split into the two regions that are the focus of our analysis: GIIPS for the periphery countries of Greece, Ireland, Italy, Portugal and Spain and EU10 for the remaining countries. The GIIPS group accounts for roughly one-third of total GDP of the 15 countries.

The first three rows of Table 1 shows the effective tax rates on consumption, labor and capital, corresponding to the tax distortions in our model. These tax rates are updated estimates of aggregate effective tax rates calculated from revenue and national income accounts statistics following the methodology introduced by Mendoza et al. (1994). Such tax rates have now been used in a number of studies including Carey and Tchilinguirian (2000), Sorensen (2001) and recently by Trabandt and Uhlig (2009) and Trabandt and Uhlig (2012). This methodology uses the wedge between reported pre-tax and post-tax macro variables on various tax bases (namely, private consumption expenditures and national income attributable to labor and to capital) to infer the tax burden borne by those bases. There are several advantages to using these tax rates. First, this method allows for a fairly simple approach to estimating effective tax rates at the macro level, despite the numerous differences and complexities of national tax systems. Second the taxes computed here correspond directly to the tax distortions in the model. Finally, the taxes are reasonably close to estimates produced by the OECD and other sources that use more details from the tax code than our method, but ours are much easier and more transparent to compute. The obvious disadvantages are that our estimates are average, and not marginal tax rates. The tax rates therefore miss important effects coming from the distribution of the tax structure and do not account for particular features of the tax code that could affect allocations at the margin.

Relative to the tax rates reported in Mendoza et al. (1994), we make one significant modification to the calculation of labor and capital taxes by incorporating supplemental wages (namely, by adding the contribution of employers to social security and private pension plans to the tax base for personal income—see Trabandt and Uhlig 2009 for a detailed discussion). The data on supplemental wages was not available at the time of our 1994 calculations and, because this adjustment affects the calculation of the personal tax rate, it will alter the estimates of both the labor and capital income taxes. In general, this adjustment will make the labor tax base bigger and therefore the labor tax rate will be smaller than our previous estimates.[4]

Macroeconomic aggregates and tax rates are shown in Table 1. Consumption tax rates are higher in the EU10 region at 0.18 relative to the rate of 0.14 in the GIIPS region. Labor income taxes also tend to be higher in EU10 though both are quite high at 0.36 and 0.33. Capital taxes are lower at 0.20 and 0.21. We observe that the GIIPS region has both a higher consumption share and a higher investment share relative to EU10. Countries in the GIIPS region tend to have trade balance deficits with the exception of Ireland. Turning to government revenue statistics, the table indicates that both revenue and expenditure shares are higher in EU10, but the gap between revenue and expenditures in the two regions is about the same.

The last rows in the table report figures on government debt, which are instrumental in motivating our fiscal policy experiments. Government debt to GDP reflects general government consolidated gross debt reported by Eurostat. These are the figures used to measure compliance with the Maastricht Treaty. Under the Treaty, eurozone member governments are to keep this ratio

[4]Trabandt and Uhlig make a further adjustment to the original Mendoza, Razin and Tesar formulas by attributing some of the operating surplus of corporations and non-incorporated private enterprises to labor, with the argument that this is the return to entrepreneurs rather than to capital. While in principle this could be true, it is not obvious how much of the operating surplus should be allocated to labor. In the absence of additional information about the source of the operating surplus, we chose not to make this particular adjustment.

below 60 percent of GDP. As of 2008, eight countries in our sample were in compliance with the Treaty. The next row reports debt in 2011 as a fraction of GDP in 2008. We hold the denominator (GDP in 2008) fixed so that we can compare the growth in nominal debt over those three years, separating from changes in GDP over the recession. As the table shows, debt levels between 2008 and 2011 exploded; only five countries remain in compliance and some of the lower debt countries (e.g. Spain) continue to have escalating debt as of this writing. In EU10 the debt ratio climbed 17 percentage points to 0.82, while in GIIPS the ratio increased by 24 percentage points reaching a group average of 1.03. One of the experiments we will perform in this paper is to calculate the permanent tax rate increases required to generate revenue (inclusive of transition dynamics) sufficient to reduce 2011 government debt to its 2008 levels.

Table 2 shows the parameter values we use in our numerical experiments and the balanced growth allocations of our model. These allocations will be the starting point for our fiscal policy experiments. The model is calibrated to quarterly data. The depreciation rate, δ, is set at 0.015 to match a 6 percent annual rate of depreciation. The labor share of income is set to 0.61 and the rate of labor augmenting technical change, γ, is 0.002 corresponding to an average annual European growth rate of 0.9 percent. We set the capital adjustment parameter, η, to 2. This is consistent with estimates of the elasticity of investment in response to permanent changes in the capital tax rate (Cummins et al., 1996). The rate of time discount is set equal to 0.991, consistent with a steady state real interest rate of 1 percent per annum. For preference parameters, the coefficient of risk aversion, σ, is set equal to 2, and the Frisch elasticity of labor supply to 2.675. The relative size of the two regions, ϕ, is based on 2008 GDP.

The lower panel of Table 2 compares the macro ratios produced by the model with those in the data. Those marked with an asterisk are used to solve the model. Those without an asterisk are produced endogenously by the model. The model produces a higher consumption share of the GIIPS region relative to EU10 as in the data, though the model GIIPS level is a bit high relative to the data. The investment share in EU10 is slightly higher in the model relative to the data. Tax revenue is lower in the model than in the data, and the gap between revenue and government expenditures is also consequently low in both regions relative to the data. Overall the model captures the relative magnitudes of macro aggregates in the two regions.

4 Fiscal Policy Adjustment in Europe

To motivate our experiments, we start with the fiscal stance of the European countries in 2008, on the eve of the global financial crisis. Iterating the government's budget constraint in (4) forward, we obtain the standard fiscal solvency condition that follows from the intertemporal budget constraint evaluated at $t = 0$ (base year 2008):

$$\frac{d_0}{y_0} = \left[\sum_{t=0}^{\infty} (\Pi_{s=0}^{t} q_s) \left(REV_t - EXP_t \right) \right] \frac{1}{y_0}, \tag{11}$$

where REV_t is the sum of tax revenues from labor, capital and consumption, and $EXP_t = g_t + e_t$. Assuming that at date-0 the public debt outstanding of the European countries was consistent with solvency, the present discounted value of the projected primary fiscal balance should equal the value of the outstanding debt in 2008. Based on the data in Table 1, the ratio of government debt to GDP in 2008 is 0.65 in EU10 and 0.79 in GIIPS. We then observe that by 2011 and as a result of the various fiscal effects of the 2008 financial crisis (financial bailouts, fiscal stimuli, falling revenues and rising transfer payments with the Great Recession), as well as underlying structural fiscal problems, the debt of the two regions experienced an sharp upward shift to ratios of 0.82 and 1.03 percent of GDP respectively (an increase of 17 percentage points in EU10 and 24 in GIIPS). We assume that these debt shocks are a once-and-for-all unanticipated perturbation to the fiscal balance of the government (i.e. to date-0 public debt), and use the model to study the positive and normative effects of alternative strategies governments implement to restore fiscal solvency. This implies that these strategies are required to raise tax revenue or reduce outlays so that the present discounted value of the primary fiscal balance increases by the 24 percentage points in GIIPS and 17 percentage points in EU10.

For each tax policy experiment, we solve jointly for the transition paths of each economy and for the post-tax-change steady state allocations. In a closed economy, the new steady state will be a relatively straightforward function of the new tax policy. In an open economy, however, adjustments along the transition will involve international borrowing and lending, which will in turn affect the long-run level of external debt, consumption and wealth of each region. To solve this system, we employ a shooting algorithm that iterates on the long-run net foreign asset position until each region's budget constraint and the global market clearing conditions are satisfied (see Mendoza and Tesar, 1998, for details).

4.1 Unilateral Tax Increases and Laffer Curves

The first experiment we consider is an increase in the labor tax rate in the GIIPS region. Recall from Table 1 that the desired increase in revenue in order for debt to return to its 2008 level is 0.24 times output in 2008. Figure 1 illustrates the present value of tax revenues as a share of pre-crisis output generated from changes in the labor tax rate starting from observed tax rates in 2008. The solid line traces out a dynamic Laffer curve for the GIIPS region for labor tax rates ranging from 0.3 to 0.65. The maximal increase in revenue (i.e. the peak of the Laffer curve) corresponds to a tax rate of around 0.5, generating incremental revenues of 0.7, well above the 0.24 target as a share of 2008 output.

The light dotted line illustrates the revenues generated by the changes in labor taxes if the GIIPS region were closed to international markets. Note that the closed-economy Laffer curve is steeper and the peak of the curve is higher and to the right of the open-economy Laffer curve. This means that the region can generate more revenue per percent tax rate increase if the economy is closed. This is also the first hint that estimating "fiscal space" or the capacity to raise revenue without taking into account factor mobility can lead to a large overestimate of the effectiveness of fiscal reforms. It is also suggestive that a short-run policy that combines capital controls with fiscal austerity could be more effective in reaching budget balance than fiscal austerity measures alone.

The third line in the figure, the dark dotted line, shows the revenue accruing to the EU10 region as the GIIPS region adjusts its tax rate. Note that the EU10 line is upward sloping; that is, as the GIIPS region increases taxes to raise additional revenue, more revenue is automatically generated abroad. The widening of the tax differential on capital between EU10 and GIIPS induces a reduction in the capital stock in GIIPS and an expansion in EU10. Returns to labor are also affected, and so the tax bases of both the labor and the capital tax expand in EU10 and shrink in GIIPS. This positive externality implies that the EU10 region enjoys an additional benefit from austerity programs in GIIPS that is overlooked in policy discussions of fiscal policy in Europe; not only does the tax adjustment in the GIIPS region mean that it will be in a better position to service its debt, it is also indirectly improving the balance sheet of the EU10 region through the endogenous shift in the tax base. In light of these externalities, we explore the implications of cooperative and non-cooperative strategies for raising revenue in Section 4.2 below.

Table 3 shows the outcome of an increase in the labor tax in GIIPS that meets its revenue target. The required labor tax increase is from 0.33 to 0.37. Of course, the increase in government revenue resulting from an increase in the labor tax comes at considerable cost to GIIPS welfare and output. Net (of transition) welfare falls by 2 percent in GIIPS and increases 0.11 percent in EU10. Figure 2 plots the dynamics of the two regions in response to the increase in the GIIPS labor tax. The impact on utility during the transition in GIIPS is positive; an increase in the labor income tax rate reduces labor supply, increases leisure and reduces the marginal product of capital, triggering a reduction in the capital stock. The gap between the "windfall" utility during the transition relative to its long-run drop is bigger in the closed economy than in the open economy. When the region is able to trade in financial assets, it can smooth the fall in utility and share the transitional adjustment with the EU10 region. Steady state output falls by 4 percent in GIIPS and increases 0.261 percent in EU10.

Figures 3 and 4 and Table 4 show the results from an increase in the capital tax rate in GIIPS. The open-economy Laffer curve for the capital tax rate (Figure 3) is considerably flatter than the corresponding Laffer curve for the labor income tax rate. Consequently, the scope for raising revenue from the capital tax is much smaller. Starting from a 2008 tax rate of 0.21 on capital, the GIIPS region reaches the peak of its open-economy Laffer curve at a much higher rate of around 0.6, but this dramatic tax hike only raises 0.55 percentage points of revenue, in excess of the target but requiring a hefty increase in the tax rate. The increase in the capital tax rate to 0.35 to reach the revenue target results in a larger drop of steady state output of 9.5 percent and welfare of 2.7 percent in GIIPS than the increase in the labor tax rate. The GIIPS tax increase produces sizable positive externalities for the EU10. The austerity measure in GIIPS produce a 0.10 percent increase in revenues in EU10 - more than halfway to its revenue target, a large welfare increase as well as an output increase of 1.19 percent.

We repeat these tax experiments for the case when EU10 increases its rates while GIIPS remains passive (see Figures 5 and 6 and Tables 5 and 6). By moving to the peak of its labor tax Laffer curve, the EU10 region can comfortably reach its debt target. In all cases, the welfare costs of the tax hikes are costly for the region undertaking the policy reform and are positive for the region that remains passive. Further, the revenue gains for the region that remains passive are sizable. Finally, the revenue increases are always substantially larger in the closed economy than in the open economy. These results, taken together, suggest that there are likely to be important externalities from tax policy changes in Europe and that there may be room for gains from policy coordination.

The previous analysis underestimates the cost of the austerity policy (and overestimates the revenue-generating capacity of the policy) for three reasons. First, by grouping countries together in a region, we are implicitly assuming that those countries act in unison, reducing the impact of tax base erosion resulting from an increase in domestic tax rates. To see the magnitude of this effect, we examine the effect of a truly unilateral austerity program in which, for example, Greece alone raises its tax rates and the rest of the eurozone remains passive. The results of this experiment — for each of the GIIPS countries — is reported in Table 7. Note that in this experiment, we hold all of the parameters the same relative to the previous analysis except for relative country size and the revenue target. Now, in the case of the capital income tax rates, only one of the GIIPS countries (Italy) is able to meet its revenue target; i.e., the others reach the peak of their Laffer curves before they generate sufficient revenue. An increase in the labor tax rate can generate sufficient tax revenues, but it requires a much higher rate than it did for the GIIPS region as a whole.

The second reason the costs of austerity may be underestimated is that we assume that the austerity program leaves long-run growth rates unaffected. To the extent tax rate changes affect growth rates, the required increase in taxes to generate sufficient revenue could be much larger, again due to the shrinkage of the tax base.

A third, and more subtle, reason costs may be underestimated is that there is relatively little scope for capital adjustment along the transition path in our model. Much of the revenue that is raised occurs along the transition path - in effect, the tax rate increase is a "surprise" tax on the capital stock. This is why our predicted tax revenues are larger (or equivalently, our Laffer curves are steeper and shifted to the right) relative to those based on steady state calculations, such as Trabandt and Uhlig (2009). In future work, we plan to explore a model with endogenous capacity utilization, that will allow for more flexibility in the capital response.

4.2 Strategic Tax Policy Adjustment and Gains from Cooperation

Above we considered tax policy adjustments in each region assuming the other region remains passive. The experiments make clear that there are sizable international externalities that affect welfare and budget balance. An important issue for consideration is how outcomes differ if governments act in their own best interests or if they choose to cooperate.

We approach this problem in two stages. First we ask a simple question: If each region is constrained to adjustment in a single tax instrument (e.g. the capital income tax), what is the Nash equilibrium tax rates that meets each region's revenue target while minimizing welfare loss. This turns out to be the lowest tax rate that meets the revenue target in each region. Figure 7 shows the "reaction function" for such a game over capital tax rates. Note that the reaction functions are downward sloping. Because of the positive revenue externalities, an increase in the foreign region's tax rate implies that the home region can meet its revenue target with a lower tax rate. The Nash equilibrium is at the intersection of the reaction functions. Intuitively, the tax rates that emerge from this game are lower than the tax rates needed to meet the revenue target when each region acted unilaterally. A similar result holds for the labor tax rate. Not surprisingly, this noncooperative outcome coincides with the cooperative outcome - given the other region's tax rate, the best choice for the home region is the lowest tax rate that meets its revenue requirement

The second stage (to be completed) is to consider the game that allows the government in each region to use both capital and labor tax instruments. In this situation there could be potential for cooperation that improves upon the Nash outcome.

References

Abiad, Abdul and Jonathan D. Ostry, "Primary Surpluses and Sustainable Debt Levels in Emerging Market Countries," *IMF Policy Discussion Papers*, January 2005, *104* (1).

Carey, David and Harry Tchilinguirian, "Average Effective Tax Rates on Capital, Labour and Consumption," *OECD Economics Department Working Papers: 258*, 2000.

Cummins, Jason G., Kevin A. Hassett, and R. Glenn Hubbard, "Tax Reforms and Investment: A Cross-Country Comparison," *Journal of Public Economics*, October 1996, *62* (1-2), 236–273.

Eggert, Wolfgang, "International Repercussions of Direct Taxes," *FinanzArchiv*, January 2000, *57* (1), 106–125.

Frenkel, Jacob A., Assaf Razin, and Efrain Sadka, *International Taxation in an Integrated World*, MIT Press, 1991.

Kellerman, Christian and Andreas Kammer, "Deadlocked European Tax Policy: Which Way Out of the Competition for Lowest Taxes?," *European Tax Policy*, 2009, pp. 127–141.

King, Robert G., Charles I. Plosser, and Sergio T. Rebelo, "Production, Growth and Business Cycles: I. The Basic Neoclassical Model," *Journal of Monetary Economics*, March 1988, *21* (2), 195–232.

Klein, Paul, Vincenzo Quadrini, and Jose-Victor Rios-Rull, "Optimal Time-Consistent Taxation with International Mobility of Capital," *B.E. Journal of Macroeconomics: Advances in Macroeconomics*, 2005, *5* (1), 1–34.

Mendoza, Enrique G. and Linda L. Tesar, "Supply-Side Economics in a Global Economy," *NBER Working Paper 5086*, January 1995.

_ **and** _ , "The International Ramifications of Tax Reforms: Supply-Side Economics in a Global Economy," *American Economic Review*, June 1998, *88* (1), 226–245.

_ **and** _ , "Why Hasn't Tax Competition Triggered a Race to the Bottom? Some Quantitative Lessons from the EU," *Journal of Monetary Economics*, January 2005, *52* (1), 163–204.

_ **, Assaf Razin, and Linda L. Tesar**, "Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption," *Journal of Monetary Economics*, December 1994, *34* (3), 297–323.

_ **, Gian Maria Milesi-Ferretti, and Patrick Asea**, "On the Ineffectiveness of Tax Policy in Altering Long-Run Growth: Harberger's Superneutrality Conjecture," *Journal of Public Economics*, October 1997, *66* (2), 99–126.

Ostry, Jonathan D., Atish R. Ghosh, Karl Habermeier, Marcos Chamon, and Mahvash S. Qureshi, "Capital Inflows: The Role of Controls," *Revista de Economia Institucional*, 2010, *12* (23).

Persson, Torsten and Guido Tabellini, "Double-Edged Incentives: Institutions and Policy Coordination," in Gene M. Grossman and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 3, Elsevier, North Holland, 1995, pp. 1973–2030.

Sorensen, Peter B., "Optimal Tax Progressivity in Imperfect Labour Markets," *Labour Economics*, September 1999, *6* (3), 435–452.

_ , "Tax Coordination and the European Union: What Are the Issues?," *University of Copenhagen Working Paper*, 2001.

_ , "International Tax Competition: A New Framework for Analysis," *Economic Analysis and Policy*, September 2003, *33* (2), 179–192.

Trabandt, Mathias and Harald Uhlig, "How Far Are We From the Slipery Slope?," *NBER Working Paper 15343*, 2009.

_ **and** _ , "How Far Are We From the Slipery Slope? The Laffer Curve Revisited," *European Central Bank, Working Paper Series: 1174*, 2010.

_ **and** _ , "How do Laffer Curves Differ Across Countries?," *BFI Paper no. 2012-001*, 2012.

Turnovsky, Stephen J., *International Macroeconomic Dynamics*, MIT Press, 1997.

Figure 1: Laffer Curves for the GIIPS Labor Tax Rate

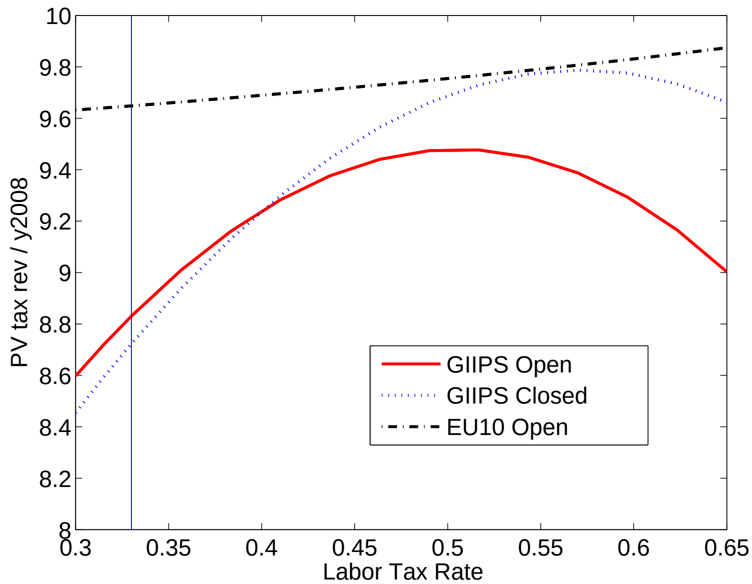

Figure 2: Macro Responses to a Labor Tax Rate Increase in GIIPS

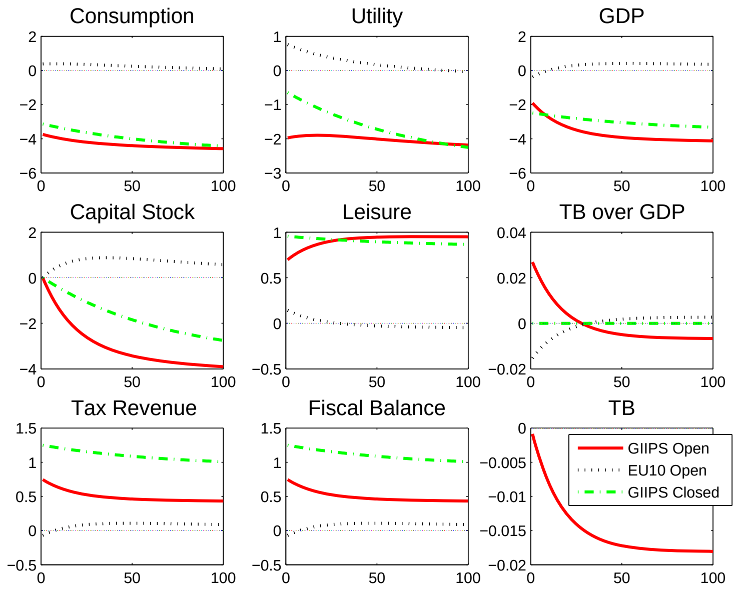

Figure 3: Laffer Curves for the GIIPS Capital Tax Rate

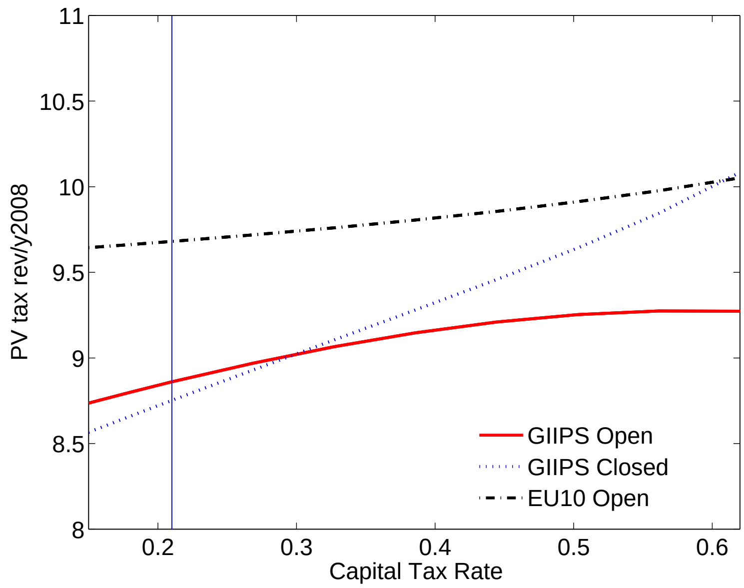

Figure 4: Macro Responses to a Capital Tax Rate Increase in GIIPS

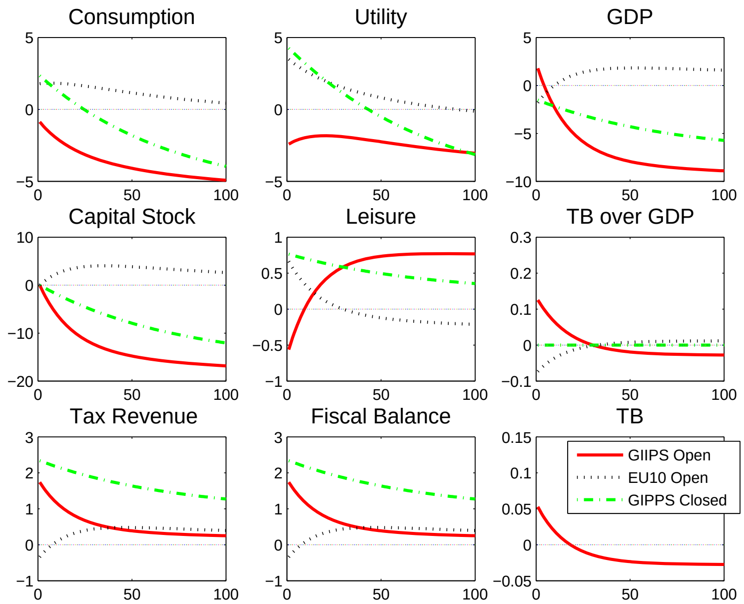

Figure 5: Laffer Curves for the EU10 Labor Tax Rate

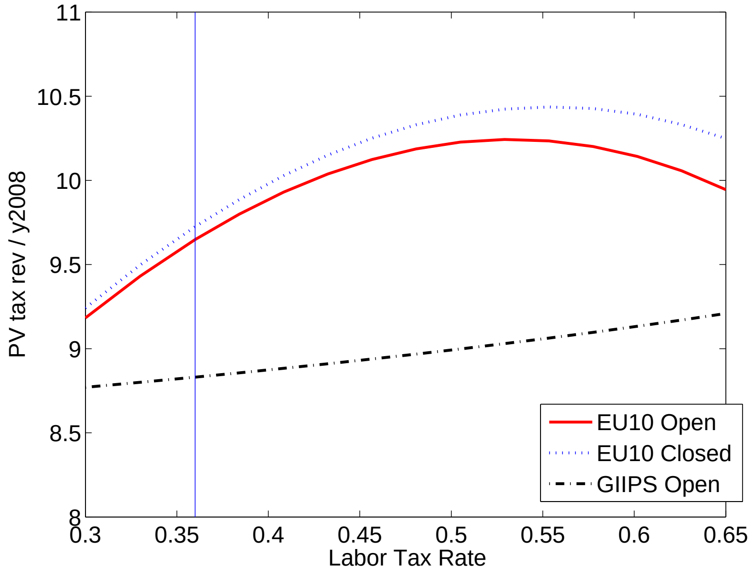

Figure 6: Laffer Curves for the EU10 Capital Tax Rate

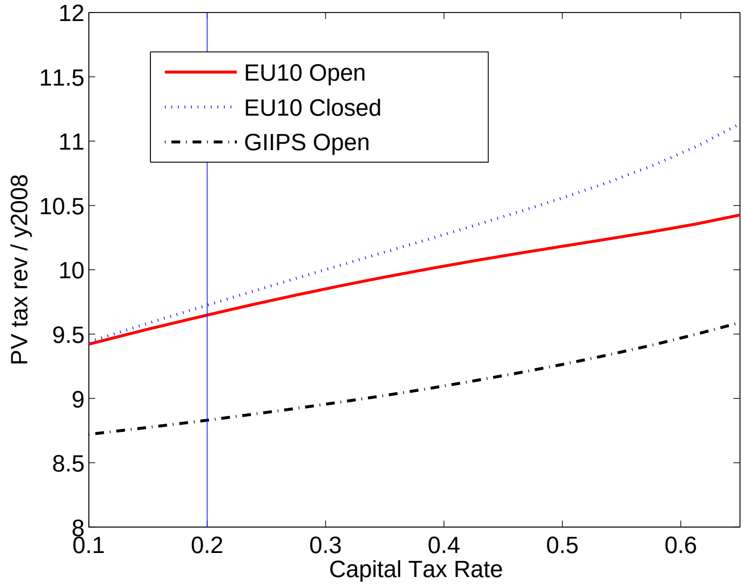

Figure 7: Best Responses over Labor Tax Rates

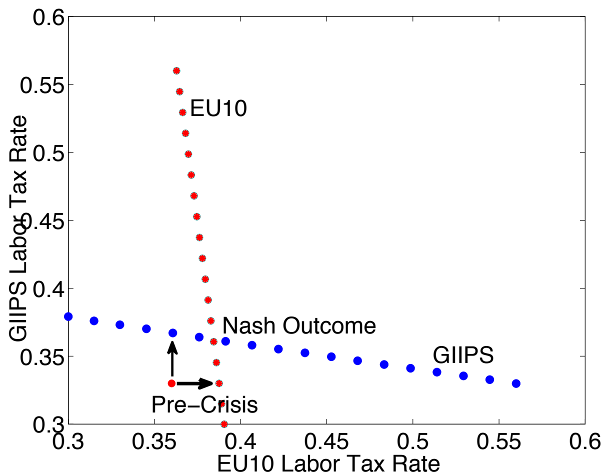

Table 1: MACROECONOMIC STANCE AS OF 2008

	EU10										GIIPS					GDP-weighted ave.	
	AUT	BEL	EST	FIN	FRA	GER	LUX	NET	SLK	SLA	GRE	IRE	ITA	POR	SPA	EU10	GIIPS
τ_C	0.19	0.17	0.22	0.24	0.17	0.17	0.33	0.20	0.17	0.25	0.15	0.21	0.13	0.18	0.12	0.18	0.14
τ_L	0.42	0.37	0.26	0.37	0.36	0.34	0.33	0.36	0.32	0.34	0.33	0.23	0.38	0.23	0.29	0.36	0.33
τ_K	0.16	0.27	0.09	0.21	0.25	0.16	0.17	0.19	0.09	0.13	0.12	0.17	0.25	0.20	0.17	0.20	0.21
c/y	0.53	0.52	0.55	0.52	0.57	0.56	0.33	0.45	0.57	0.53	0.72	0.51	0.59	0.67	0.57	0.55	0.59
x/y	0.23	0.24	0.30	0.22	0.22	0.19	0.22	0.20	0.28	0.32	0.24	0.22	0.22	0.23	0.29	0.21	0.24
g/y	0.19	0.23	0.19	0.22	0.23	0.18	0.16	0.26	0.17	0.18	0.18	0.19	0.20	0.20	0.19	0.21	0.20
tb/y	0.06	0.01	−0.04	0.04	−0.02	0.06	0.30	0.08	−0.02	−0.03	−0.14	0.09	−0.01	−0.10	−0.06	0.03	−0.03
Rev/y	0.42	0.43	0.32	0.42	0.41	0.36	0.35	0.38	0.29	0.37	0.31	0.29	0.41	0.41	0.32	0.39	0.36
Exp/y	0.19	0.23	0.19	0.22	0.23	0.18	0.16	0.26	0.17	0.18	0.18	0.19	0.20	0.20	0.19	0.48	0.46
Gov Def/y	−0.08	−0.07	−0.08	−0.07	−0.12	−0.08	−0.04	−0.08	−0.06	−0.08	−0.19	−0.14	−0.08	−0.04	−0.09	−0.09	−0.09
d_{2008}/y_{2008}	0.64	0.89	0.05	0.34	0.68	0.67	0.14	0.58	0.28	0.22	1.13	0.44	1.06	0.72	0.40	0.65	0.79
d_{2011}/y_{2008}	0.77	1.04	0.06	0.50	0.89	0.84	0.21	0.66	0.45	0.46	1.52	0.94	1.20	1.07	0.68	0.82	1.03
$\Delta d/y$	0.13	0.15	0.01	0.16	0.21	0.18	0.06	0.08	0.17	0.24	0.40	0.50	0.15	0.36	0.27	0.17	0.24

Source: OECD Revenue Statistics, OECD National income Accounts, and EuroStat.

Table 2: PARAMETER VALUES AND STEADY STATE ALLOCATIONS

Technology and preferences:

δ	α	γ	η	β	σ	a	ϕ
0.015	0.610	0.002	2.000	0.991	2.000	2.675	0.544

Fiscal tax rates of 2008

	GIIPS	EU10
τ_C	0.14	0.18
τ_L	0.33	0.36
τ_K	0.21	0.20

Balanced growth allocations (GDP ratios) of 2008

	GIIPS		EU10	
	Data	Model	Data	Model
c/y	0.59	0.61	0.55	0.55
x/y	0.24	0.23	0.20	0.23
g/y^*	0.20	0.20	0.21	0.21
tb/y^*	−0.03	−0.03	0.03	0.02
Rev/y	0.36	0.33	0.39	0.36
Transfers/y	0.16	0.13	0.18	0.15

Table 3: MACROECONOMIC EFFECTS OF AN INCREASE IN THE GIIPS LABOR TAX RATE

	Open Economy				Closed Economy	
	GIIPS		EU10		GIIPS	
Tax rates	Old	New	Old	New	Old	New
τ_C	0.14	0.14	0.18	0.18	0.14	0.14
τ_L	0.33	0.37	0.36	0.36	0.33	0.37
τ_K	0.21	0.21	0.20	0.20	0.21	0.21
Change in PV of tax rev as % of initial GDP		0.24		0.02		0.30
Welfare effects (percent)						
Transitional cost		0.24		0.33		0.79
+ steady-state gain		−2.31		−0.22		−2.67
= net change		−2.07		0.11		−1.88
Percentage changes	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect
y	−1.91	−4.22	−0.38	0.26	−2.49	−3.58
c	−3.74	−4.73	−0.38	−0.06	−3.14	−4.82
k	0.00	−4.22	0.00	0.26	0.00	−3.58
Percentage point changes						
tb/y	2.69	−0.56	−1.53	0.23		
x/y	−2.06	−0.00	1.07	0.00	−0.12	0.00
r	−0.00	0.00	−0.00	0.00	−0.00	0.00
$1-l$	0.57	0.77	0.12	−0.05	0.77	0.68

Table 4: MACROECONOMIC EFFECTS OF AN INCREASE IN THE GIIPS CAPITAL TAX RATE

	Open Economy				Closed Economy	
	GIIPS		EU10		GIIPS	
Tax rates	Old	New	Old	New	Old	New
τ_C	0.14	0.14	0.18	0.18	0.14	0.14
τ_L	0.33	0.33	0.36	0.36	0.33	0.33
τ_K	0.21	0.35	0.20	0.20	0.21	0.35
Change in PV of tax rev as % of initial GDP		0.24		0.10		0.43
Welfare effects (percent)						
Transitional cost		1.06		1.54		4.00
+ steady-state gain		−3.75		−0.99		−5.60
= net change		−2.69		0.55		−1.60
Percentage changes	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect
y	1.79	−9.47	−1.79	1.19	−1.53	−7.19
c	−0.87	−5.64	1.79	−0.27	2.34	−6.14
k	0.00	−18.28	0.00	1.19	0.00	−16.23
Percentage point changes						
tb/y	12.55	−2.43	−7.32	1.04		
x/y	−11.08	−2.21	5.14	0.00	−2.57	−2.21
r	−0.00	0.00	−0.00	0.00	−0.00	−0.00
$1-l$	−0.46	0.61	0.54	−0.22	0.62	0.17

Table 5: MACROECONOMIC EFFECTS OF AN INCREASE IN THE EU10 LABOR TAX RATE

	Open Economy				Closed Economy	
	GIIPS		EU10		EU10	
Tax rates	Old	New	Old	New	Old	New
τ_C	0.14	0.14	0.18	0.18	0.14	0.18
τ_L	0.33	0.33	0.36	0.39	0.33	0.33
τ_K	0.21	0.21	0.20	0.20	0.21	0.21
Change in PV of tax rev as % of initial GDP		0.03		0.17		0.18
Welfare effects (percent)						
Transitional cost		0.42		0.35		0.60
+ steady-state gain		−2.00		−0.99		−2.18
= net change		0.08		−1.65		−1.58
Percentage changes	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect
y	−0.46	0.41	−1.59	−2.88	−1.91	−2.73
c	0.46	−0.09	−2.74	−3.69	−2.45	−3.74
k	0.00	0.41	0.00	−2.88	0.00	−2.73
Percentage point changes						
tb/y	−2.01	0.38	1.17	−0.17		
x/y	1.43	0.00	−0.90	−0.00	−0.09	−0.00
r	−0.00	0.00	−0.00	0.00	−0.00	0.00
$1 - l$	0.14	−0.08	0.48	0.53	0.57	0.49

Table 6: MACROECONOMIC EFFECTS OF AN INCREASE IN THE EU10 CAPITAL TAX RATE

	Open Economy				Closed Economy	
	GIIPS		EU10		EU10	
Tax rates	Old	New	Old	New	Old	New
τ_C	0.14	0.14	0.18	0.18	0.14	0.18
τ_L	0.33	0.33	0.36	0.36	0.33	0.33
τ_K	0.21	0.21	0.20	0.28	0.21	0.21
Change in PV of tax rev as % of initial GDP		0.10		0.17		0.23
Welfare effects (percent)						
Transitional cost		1.50		1.25		2.13
+ steady-state gain		−1.19		−2.43		−3.07
= net change		0.31		−1.18		−0.94
Percentage changes	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect	Impact Effect	Long-Run Effect
y	−1.65	1.45	0.00	−4.71	−1.00	−3.97
c	1.64	−0.32	0.25	−3.19	1.22	−3.60
k	0.00	1.45	0.00	−9.83	0.00	−9.13
Percentage point changes						
tb/y	−7.22	1.34	3.95	−0.69		
x/y	5.10	0.00	−4.22	−1.23	−1.48	−1.23
r	−0.00	0.00	−0.00	0.00	−0.00	0.00
$1-l$	0.49	−0.27	0.03	0.24	0.34	0.09

Table 7: PEAK INCREASE IN TAX REVENUES IN INDIVIDUAL GIIPS COUNTRIES

			Peak Rev Increase/y2008 of	
	Country Size	ΔDebt/y2008	Capital Tax Laffer Curve	Labor Tax Laffer Curve
Greece	0.026	0.40	0.145	0.517
Ireland	0.020	0.50	0.143	0.515
Italy	0.206	0.15	0.232	0.572
Portugal	0.019	0.36	0.142	0.514
Spain	0.134	0.27	0.199	0.552