Who Bears the Public Debt Burden and How? Understanding the Distribution of Public Debt Burden

M. Saifur Rahman*
Department of Finance and Economics
King Fahd University of Petroleum and Minerals
Email: murahman@kfupm.edu.sa
Phone: 966-03-860-4449

July 18, 2012

Abstract

This paper uses a saver-spender model where both agents are inter temporal optimizers to analyze the distributional effect of rising debt that is created by various combinations of debt-financed expansionary fiscal policies and their possible contractionary adjustments. The paper shows that debt burden on the saver and on the spender that results from these policy combinations are almost always unequal. Debt burdens vary significantly among different debt generating policy choices and their alternative financing schemes. The debt burden inequality results are quite robust to alternative empirically plausible parameter values. The paper also looks at projected fiscal scenario under the provisions of recently passed American Recovery and Reinvestment Act (ARRA) and argues that the act might reduce debt burden inequality.

Key Words: Savers-spenders model, rule of thumb consumer, inter temporal optimizers, fiscal policy, debt financing, debt burden.

JEL code: E62, H2, H3, H6

1 Introduction

Government debt is at the heart of current macroeconomic debate across the globe. The causes and consequences of rising debt have come under scrutiny both from the academia and policy making institutions. Debt is generally created when the government cannot finance budget through tax revenue and has to rely more on bond financing. Debt is a burden to the government because it has to be paid back with interest. Debt is important for several reasons. First, debt is usually accumulated slowly over a long period of time. Debt conceals with it, the history of fiscal policy of a country. In the short run, selling debt by the government might be a good news for everyone because debt relieves budgetary pressure and allows government to undertake its development expenditures, cut taxes and raise transfers to its population. Analyzing debt is therefore understanding the effect of fiscal policy on the macroeconomy. Second, if debt continues to rise in such a way that it might not be financed with current taxes while maintaining current level of expenditures and transfers, then government is forced to resort back to contractionary policies, raising back taxes again or cut its expenditures. Rising debt therefore, sends alarming

*The main idea behind the paper originated while I was a graduate student at the Indiana University. I would like to thank Eric Leeper for all his valuable suggestions during my research. I would also like to thank Nora Traum and Hess Chung for all their comments. Finally, I thank all the participants of the 2011 CIM seminar series at KFUPM. This material is based upon work supported by the Junior Faculty Research Grant No. JF100005, from King Fahd University of Petroleum and Minerals. Usual disclaimer applies.

signals to the economy which creates an expectation of future contractionary policies. Thus, over a longer time horizon, government shifts the burden of debt onto its population. However, the choice of a policy that creates debt in the first place and also the choice of how to finance the created debt is crucial to understand how debt will actually effect the macroeconomy. More over, not everyone is effected by the same fiscal policy in the same way. Poor people might be more sensitive to changes in transfers than rich people. Furthermore, If taxes are the chosen policy options, then debt burden analysis should be similar to analyzing the incidence of tax burden. But analysis of debt burden could go beyond the analysis of tax incidence because non-tax policies such as government spending or transfers can create debt which can be financed by other non-tax policies. Regardless of how debts are generated and how they are financed, the effect of debt depends on the underlying structure of the economy; the income distribution, the behavior and endogenous response of the consumers, situation of the labor and capital market and most importantly, on the structure of the fiscal framework.

In this paper, I use a simple heterogenous agent based RBC model which is tractable enough but captures some of the most important aspect of heterogeneity in USA which include differences in savings behavior, credit market access and finally, differential treatment of tax and transfer policies. My model of choice is a modified version of the *saver-spender* model where both agents are inter temporal optimizers. Savers capture the top 60% population in the income distribution while the spenders capture the bottom 40%. Spenders pay less labor tax but also receive more transfers from the government.

In the paper, I study the effect of permanent changes of a complete menu of fiscal policies and their alternative financing outlined in Leeper and Yang(2008), Chung and Leeper(2009), Leeper, Plante, and Traum [Leeper et al. (2010) from now] and Leeper, Traum and Walker [Leeper et al. (2011)from now]to understand the distributional aspects of these debt-financed policies both in the short run and along the transition path to a new steady state in the long run. I also employ the present value approach used in the above papers to understand the distribution of the present value of debt burden that is born by the relatively richer saver and the relatively poorer spender. Several interesting results stand out. First, it shows that since spenders consume their entire disposable income, adjustments to transfers are no longer inconsequential; lowering transfers to spenders (or to both groups) has a direct negative effect on their consumption and a positive impact of their work effort. Furthermore, since both groups participate in the labor market, transfers also effect consumption and work effort of the savers as well. Second, debt burden inequality varies significantly among alternative fiscal policies and their adjustments. Third, capital tax cuts never pay for themselves. They are usually paid by the labor tax revenue. Fourth, labor tax cuts also do not pay for themselves. They are usually paid out by the capital tax revenue. Fifth, fiscal policies are not symmetric; switching policy between shock and adjustment produces opposite results. Sixth, using transfer to raise debt generally increase debt burden inequality. Seventh, group specific policies to raise debt generally leads to the largest debt burden inequality. Eighth, debt burden inequality results are robust to empirically plausible parameter values. Finally, the paper looks at alternative fiscal and macroeconomic projections under the recently passed American Recovery and Reinvestment Act [ARRA from now] following Congressional Budget Office [CBO(2011) from now] and argues that the provisions under the ARRA might actually reduce debt burden inequality.

2 Dynamic Fiscal Policy, Debt Burden and Heterogenous Agent Based Modeling

The analysis of debt burden is very old, which appeared in as early as Domar (1944). The main concern of the early works on debt burden was whether budget deficit should be debt-financed or tax-financed. The main conclusion, which also showed up in other later classic papers such as Bowen, Davis and Kopf(1960) and Vikrey (1961) is that if deficit is financed by tax, then present generation is hurt while if it is financed by debt, future generations would hurt. This is because future generations would be faced with an increased tax to pay off the interest and the principle of the debt. In his seminal work, Modigliani (1961) showed how tax financing displaces consumption while debt-financing effects capital stock and also provided a measurement of dynamic debt burden both in the short run as well as in the long run. Although none of the papers cited above analyzed the distribution of debt burden, at least Domar (1944) was aware of its importance. Domar (1944) argued, "*burden of a domestically held debt depends to a great extent on the distribution of the debt ownership (* between bond and non-bond holders, page 799*)*". Diamond (1965) forwarded this debate by showing intergenerational effect of debt. In his seminal work, Barro (1974) dismissed earlier works in debt burden by re-iterating the arguments provided by Buchanan (1958) and pointing out that difference between debt-financing and tax-financing is simply between paying higher tax now or paying later. However, one of the main criticisms of the so-called *Ricardian Equivalence* is that many people cannot borrow, and so do not consume according to their permanent income. They would like to consume more today, but because of liquidity or credit constraint, they are constrained to consuming less. A tax cut for these people eases their liquidity constraint and allows them to consume more [Dornbusch, Fischer and Startz (2011)]. Therefore, income distribution clearly matters for understanding public debt burden.

Income heterogeneity is an important feature of the USA economy. For example, Porteba(1988) found that anticipated tax change did not change consumption for some people. This, he argued, was an evidence of the violation of life-cycle hypothesis(LCH). Wolff(1998) looked at the Survey of Credit Finance data and found that almost 20% of the people surveyed had zero/negative wealth. Finally, Shapiro and Slemrod(1995) asked what people will do with the extra money from Bush's 1992 tax cut. 43% said they would spend the entire money. All these findings suggest that a hybrid model such as Campbell and Mankiw(1989, 1990) where the population is divided into saver(who satisfies LCH) and spender(who does not satisfy LCH), would be a better approximation of the U. S. economy and could be used for more accurate policy analysis. Campbell and Mankiw's empirical estimates also confirmed this idea. In recent times, there have been development of a new class of models built around the empirical results of Campbell and Mankiw(1989, 1990). Papers from this new and rapidly increasing pool includes Mankiw(2000), Mankiw and Weinzierl(2006), Erceg, Guerrieri and Gust(2005) and Forni, Monforte, and Sessa (2006), Joint Committee on Taxation [JCT (2006) from now], Yang(2006), Gali, Salido and Valles[Gali et al. (2007) from now], Traum and Yang (2010), Leeper et al. (2011) and Drautzburg and Uhlig (2011). In all these models, there are two kinds of agents. The first group is called the *saver* who has access to the credit market and save by participating in the capital market. The second group is called the *spender* who does not have any access to the credit market, or does not save. Here the savers are *bond holders* while the spenders are *non-bond holders* in Domar (1944) sense. Therefore, this model has a unique combination of agents who follow life cycle hypothesis(saver) and agents who do not (spender).

The analysis of dynamic fiscal policy in conjunction with debt burden is rather complicated. Changing taxes or any other fiscal policy today has the effect that they might be needed to change again in the future. If these two policies are considered together, something that is done under the so-called *dynamic scoring*, then debt incidence could be very similar to the analysis of tax incidence. But the traditional dynamic scoring exercises suffer from two problems. First, they use representative agent based macroeconomic models[JCT (2005a, 2005b)]. Second, they do not consider the wider set of policy options that are available to the fiscal authority for debt financing, which is evident in Mankiw and Weinzierl(2006). These models do not permit the analysis of either the distributional aspect of tax incidence or more generally, debt incidence. Although Mankiw and Weinzierl(2006) experimented with the famous *saver-spender* model[Mankiw(2000)] with limited heterogeneity, they only studied tax policy. With no tax heterogeneity (and other restrictions, which I will discuss later), they could not analyze the distributional aspects of their fiscal policy experiments. The second problem has been addressed extensively in papers by Leeper and Yang(2008) and Leeper et al. (2010, 2011) which considered the full menu of fiscal financing and highlighted the importance of alternative financing of fiscal policies. The first problem has also been addressed by JCT (2006) which, for the first time, used a heterogeneous agent based model to consider the effect of tax cuts. But its fiscal financing considered only two options, changing transfers and government spending. Finally, there has been many papers that look at non-tax policies that raise debt which can be financed by other non-tax or non-distortionary tax policies. The effect of raising government spending or transfer that raises debt have been analyzed extensively in papers like Baxter and King(1993) and Chung ad Leeper(2009). But their use of representative agent based model prevented them from analyzing the distribution of debt burden, or debt incidence. Finally, in empirical studies, there has been very little work on looking at the full menu of fiscal policy financing options available to the government. Leeper et al. (2010) have carried out their fiscal policy analysis by estimating a wider menu of fiscal polices and their financing schemes, but by using a single representative agent based RBC model. In recent times, Traum and Yang (2010) and Leeper et al. (2011) have used a saver-spender model similar to Gali et al. (2007) and have also considered alternative fiscal financing schemes.

In the U. S. economy, both state and federal level government responds to rising debt by undertaking off-setting policies, although policy lags may vary. For example, when the debt-output ratio rose rapidly in the early and mid-1980s (partly due to the large personal income and corporate tax cuts in the Economic Recovery Act of 1981), the Gramm-Rudman-Hollings balanced-budget law was enacted in 1985 to reduce deficits [Leeper and Yang (2008)]. In the 1986 Economic Recovery Act, tax rates again were cut but other measures (such as taxing capital gain) were enacted to shift tax burden from individual to corporate sector. The Omnibus Budget Reconciliation Acts of 1990 and 1993, which increased individual and corporate income tax rates, were passed to reduce government debt. A rapidly rising debt-GDP ratio since 2001 again resulted in recommendations for cutting federal deficits. There have also been fiscal polices that have more effect on a subset of the income distribution than other, such as Bush administration's budget in 2007 proposing spending reductions in Medicare and other social programs or an extension of unemployment benefit in recent times. Finally, recent surge in debt-GDP ratio has resulted in Budget Control Act of 2011 which has raised debt ceiling by about $400 billion and has targeted to cut government spending by $917 billion in the next 10 years.

The present paper would like to analyze the distributional aspect of debt burden highlighted by Domar (1944) in a dynamic general equilibrium model setting. I develop a modified version of the savers-spenders model. In my model, I assume that the spenders are credit constrained and at the same time inter temporal optimizers. I impose the assumption of internal habit persistence on the preference of both the saver and the spender. This forces everyone in the economy to think at the inter temporal margin. The model will also be different from the previous papers cited above, except Yang(2006), in the sense that it will have both tax and transfer heterogeneity. Following Leeper and Yang(2008), I maintain the assumption that private agents are endowed with all the information needed to form rational expectations. Agents anticipate future offsetting policies during periods of expanding debt. Budget solvency in the model means that the inter temporal government budget constraint is satisfied both *ex ante* and *ex post*. While the debt-output ratio after a tax cut or a rise in government spending(or transfers) can be permanently higher, debt cannot permanently grow faster than the economy.

3 The Model

Following Mankiw(2000), Yang(2006) and JCT(2006),the economy has two types of infinitely-lived agents: savers and spenders, competitive firms, and a government. Both the population and the total amount of time an agent is endowed with is normalized to 1. A fraction F of the agents are savers and the remaining $(1-F)$ are spenders.

3.1 Optimization of the Saver

The savers consume, save and work in this model. The representative saver chooses consumption(C_t^a), investment(I_t^a), government issued one period bonds(B_t^a), and labor supply (L_t^a) to maximize utility over consumption and leisure($1-L_t^a$):

$$\underset{\{C_t^a,K_t^a,L_t^a,B_t^a\}}{Max:} \quad E_0 \sum_{t=0}^{\infty} \beta_1^t \left[\frac{(C_t^{*a})^{1-\gamma_1}-1}{1-\gamma_1} + \chi^a \frac{(1-L_t^a)^{1-\theta_1}}{1-\theta_1} \right] \tag{1}$$

subject to the budget constraint:

$$C_t^a + I_t^a + B_t^a \leq (1-\tau_t^k) r_t K_{t-1}^a + (1-\tau_t^{L_a}) W_t L_t^a + R_{t-1}^b B_{t-1}^a + tr_t^a \tag{2}$$

$$C_t^{*a} = C_t^a - b_1 C_{t-1}^a \tag{3}$$

The law of motion for capital has the following form:

$$K_t^a = (1-\delta) K_{t-1}^a + I_t^a \tag{4}$$

Here, $\beta_1$is the subjective discount factor for the saver. The elasticity of inter-temporal substitution(IES) for the consumption and leisure for the saver are $\frac{1}{\gamma_1}$ and $\frac{1}{\theta_1}$ respectively($\gamma_1 > 0, \theta_1 \geq 0$). r_t and W_t are respectively the rental rate of capital and the wage rate. τ_t^k,$\tau_t^{L_a}$are tax rate on capital and labor income of the saver. δ is the economic depreciation rate of capital . $\chi^a$is the weight that saver places on leisure. $b_1$indicates the degree of *internal habit persistence* for the saver.

Let λ_t^a be the Lagrangian multiplier associated with the budget constraint. Let us also define, real after tax return on capital R_t^k as:

$$R_t^k = (1-\tau_t^k) r_t + (1-\delta) \tag{5}$$

Combining equation(5) with first order conditions gives us four familiar first order conditions:

$$(C_t^{*a})^{-\gamma_1} - E_t \beta_1 b_1 \left(C_{t+1}^{*a}\right)^{-\gamma_1} = \lambda_t^a \tag{6}$$

$$\chi^a (1-L_t^a)^{-\theta_1} = \left\{ \left(C_t^a - b_1 C_{t-1}^a\right)^{-\gamma_1} - E_t \beta_1 b_1 \left(C_{t+1}^a - b_1 C_t^a\right)^{-\gamma_1} \right\} (1-\tau_t^{L_a}) W_t \tag{7}$$

$$\lambda_t^a = E_t \beta_1 \lambda_{t+1}^a R_{t+1}^k \tag{8}$$

$$\lambda_t^a = E_t \beta_1 \lambda_{t+1}^a R_t^b \tag{9}$$

Equation(7) shows that the labor supply decision of the saver depends on the inter temporal consumption decisions.

3.2 Optimization of the Spender

The spenders consume and work in this model. The representative spender chooses consumption(C_t^p) and labor(L_t^p) to maximize utility over consumption and leisure($1 - L_t^p$):

$$\underset{\{C_t^p, L_t^p\}}{Max}: \; E_0 \sum_{t=0}^{\infty} \beta_2^t \left[\frac{\left(C_t^{*p}\right)^{1-\gamma_2} - 1}{1-\gamma_2} + \chi^p \frac{(1-L_t^p)^{1-\theta_2}}{1-\theta_2} \right] \tag{10}$$

subject to the budget constraint:

$$C_t^p \leq (1 - \tau_t^{L_p}) W_t L_t^p + tr_t^p \tag{11}$$

$$C_t^{*p} = C_t^p - b_2 C_{t-1}^p \tag{12}$$

Here γ_2,b_2, τ_t^{Lp},χ^p have the similar interpretation for the spender as was with the saver.

Let λ_t^p be the Lagrangian multiplier associated with the budget constraint. The first order conditions are as follows:

$$\left(C_t^{*p}\right)^{-\gamma_2} - E_t \beta_2 b_2 \left(C_{t+1}^{*p}\right)^{-\gamma_2} = \lambda_t^p \tag{13}$$

$$\chi^p (1 - L_t^p)^{-\theta_2} = \left\{ \left(C_t^p - b_2 C_{t-1}^p\right)^{-\gamma_2} - E_t \beta_2 b_2 \left(C_{t+1}^p - b_2 C_t^p\right)^{-\gamma_2} \right\} (1 - \tau_t^{L_p}) W_t \tag{14}$$

Equation(14) shows that the labor supply decision of the spender depends on the inter temporal consumption decisions. The spenders are, therefore, neither *rule of thumb consumers*, nor are they *intra temporal optimizers*. They are simply *credit constrained*. This is a direct contrast with Mankiw (2000), Yang(2006), Gali et al.(2007), Traum and Yang (2010) and Leeper et al. (2011)[1].

3.3 Optimization of the Firm

The representative firm maximize its profit by choosing amount of aggregate capital and labor K_t and L_t

$$\underset{\{K_t, L_t\}}{Max}: K_t^{\alpha} L_t^{1-\alpha} - W_t L_t - r_t K_{t-1} \tag{15}$$

$$Y_t = K_{t-1}^{\alpha} L_t^{1-\alpha} \tag{16}$$

The first order conditions for the firm determines the wage and the rental rate:

$$W_t = (1-\alpha)\frac{Y_t}{L_t}, \; r_t = \alpha \frac{Y_t}{K_{t-1}} \tag{17}$$

[1] Mankiw (2000), Gali et al.(2007), Traum and Yang (2010) and Leeper et al. (2011) also assume that the spenders' labor decisions follow savers' choices. This is clearly unintuitive because this copy-cat rule would yield the odd result that a change in the savers' labor income tax rate that did not affect the spenders' labor income tax rate would nonetheless affect the spenders' labor decisions (JCT 2006). By design, my model contrasts that.

3.4 The Government

The government collects taxes from the savers and the spenders, issues bonds,provides transfers and consumes part of the goods as government spending which is unproductive. The government budget constraint looks like:

$$R^b_{t-1}B_{t-1} + TR_t + G_t = T_t + B_t \tag{18}$$

Where T_t is the total tax revenue collected from labor tax and capital tax defined as:

$$T_t = T^l_t + T^k_t \tag{19}$$

$$T^l_t = T^{l_a}_t + T^{l_p}_t = F * \tau^{L_a}_t W_t L^a_t + (1-F) * \tau^{L_p}_t W_t L^p_t \tag{20}$$

$$T^k_t = \tau^k_t r_t K_{t-1} \tag{21}$$

Finally,the total transfer in the economy, TR_t looks like:

$$TR_t = TR^a_t + TR^p_t \tag{22}$$

Where TR^a_t, $TR^p_t$are aggregate transfers to the savers and the spenders, to be defined shortly.

The government also has to maintain inter temporal budget solvency. This will be achieved by using two conditions. First, any equilibrium must satisfy the *transversality conditions* (TVC) for the debt and capital accumulation:

$$E_t \lim_{T\longrightarrow\infty} \beta_1^{t+T} u'\left(C^{*a}_{t+T}\right) B_{t+T} = 0 \tag{23}$$

$$E_t \lim_{T\longrightarrow\infty} \beta_1^{t+T} u'\left(C^{*a}_{t+T}\right) K_{t+T-1} = 0 \tag{24}$$

Imposing the TVC on the flow budget constraint of the government (equation 18) and substituting equation 19, 20, 21 and values of W_t and r_t from equation 17, we derive the inter temporal budget constraint for the government:

$$\frac{B_t}{Y_t} = s^B_t = \sum_{j=0}^{\infty} d_{t,t+j} \left[\begin{array}{c} (1-\alpha)\,\tau^{L_a}_{t+j} \frac{FL^a_{t+j}}{L_{t+j}} + (1-\alpha)\,\tau^{L_p}_{t+j} \frac{(1-F)L^p_{t+j}}{L_{t+j}} \\ +\alpha\tau^k_{t+j} - s^G_{t+j} - s^{TR}_{t+j} \end{array} \right] \tag{25}$$

Where $d_{t,t+j} = \Pi^{j-1}_{i=o} R^{-1}_{t+i} \frac{Y_{t+i+1}}{Y_{t+i}}$, $s^G_t = \frac{G_t}{Y_t}$ and $s^{TR}_t = \frac{TR_t}{Y_t}$. Equation(25) implies that the TVC condition for debt is satisfied.

Furthermore, following Leeper and Yang(2008), the government uses different policy rules to adjust for any debt-financed tax cuts. In terms of log deviations from the steady state, the policy rules are summarized as follows:

$$\hat{TR}^a_t = \varphi_{TR^a}\hat{Y}_t + q_{TR^a}(\hat{s}^B_{t-1}) + \hat{u}^{TR^a}_t + \hat{u}^{TR}_t, \quad \hat{u}^{TR^a}_t = \rho_{TR^a}\hat{u}^{TR^a}_{t-1} + \epsilon^{TR^a}_t, \quad \hat{u}^{TR}_t = \rho_{TR}\hat{u}^{TR}_{t-1} + \epsilon^{TR}_t \tag{26}$$

$$\hat{TR}^p_t = \varphi_{TR^p}\hat{Y}_t + q_{TR^p}(\hat{s}^B_{t-1}) + \hat{u}^{TR^p}_t + \hat{u}^{TR}_t, \quad \hat{u}^{TR^p}_t = \rho_{TR^a}\hat{u}^{TR^p}_{t-1} + \epsilon^{TR^p}_t, \quad \hat{u}^{TR}_t = \rho_{TR}\hat{u}^{TR}_{t-1} + \epsilon^{TR}_t \tag{27}$$

$$\hat{G}_t = \varphi_G\hat{Y}_t + q_G(\hat{s}^B_{t-1}) + \hat{u}^G_t, \quad \hat{u}^G_t = \rho_G\hat{u}^G_{t-1} + \epsilon^G_t \tag{28}$$

$$\hat{\tau}_t^{L_a} = q_{L_a}(\hat{s}_{t-1}^B) + \hat{u}_t^{L_a} + \hat{u}_t^{L},\quad \hat{u}_t^{L_a} = \rho_{L_a}\hat{u}_{t-1}^{L_a} + \epsilon_t^{L_a},\ \hat{u}_t^{L} = \rho_{L_o}\hat{u}_{t-1}^{L} + \epsilon_t^{L} \tag{29}$$

$$\hat{\tau}_t^{L_p} = q_{L_p}(\hat{s}_{t-1}^B) + \hat{u}_t^{L_p} + \hat{u}_t^{L},\quad \hat{u}_t^{L_p} = \rho_{L_p}\hat{u}_{t-1}^{L_p} + \epsilon_t^{L_p},\ \hat{u}_t^{L} = \rho_{L_o}\hat{u}_{t-1}^{L} + \epsilon_t^{L} \tag{30}$$

$$\hat{\tau}_t^{K} = q_K(\hat{s}_{t-1}^B) + \hat{u}_t^{K},\quad \hat{u}_t^{K} = \rho_K\hat{u}_{t-1}^{K} + \epsilon_t^{K} \tag{31}$$

Here, $s_{t-1}^B = \frac{B_{t-1}}{Y_{t-1}}$,$(q_{TR^a}, q_{TR^p}, q_G) \leq 0$,$(q_{L_a}, q_{L_p}, q_K) \geq 0$,$\rho_s \in [0,1]$ and $\epsilon_t^{s}\tilde{}i.i.d.N(0,1)$ for $s = \{TR^a, TR^p, TR, L_a, L_p, L, K, G\}$. Here ϵ_t^{TR} and $\epsilon_t^{L}$are shocks to both transfers and both labor tax rates. The rules build in a one-year delay for the response of an offsetting policy[2]. The q's are called *fiscal adjustment parameters*. In these policy rules. I allow government spending and transfers to respond to changes in current (φ_{TR^a}, φ_{TR^p}, $\varphi_G \geq 0$) as well as lag output and labor taxes, capital tax to respond to changes in lag output to capture the *automatic stabilizing* role of income tax and transfers. Following Leeper and Yang (2008), I set φ_{TR^a}=φ_{TR^p}=$\varphi_G = -1$. When the debt-output ratio rises above its initial steady-state level, one of the future distorting tax rates is raised, the government consumption is reduced, or the transfer is lowered to maintain fiscal solvency. To isolate the impacts of each financing instrument, one of the q's is nonzero in each experiment. For example, if both the transfer is adjusted, $q_{TR^a} = q_{TR^p} < 0$, $q_G = q_K = q_L = 0$. The magnitudes of the q's characterize how strongly the offsetting policy reacts to debt policy..

3.5 Aggregation

The aggregate variables are defined as follows:

$$I_t = F * I_t^a,\ B_t = F * B_t^a,\ K_t = F * K_t^a \tag{32}$$

$$TR_t^a = F * tr_t^a,\ TR_t^p = (1-F) * tr_t^p \tag{33}$$

$$L_t = F * L_t^a + (1-F) * L_t^p \tag{34}$$

$$C_t = F * C_t^a + (1-F) * C_t^p \tag{35}$$

The aggregate resource constraint looks like:

$$C_t + I_t + G_t = Y_t \tag{36}$$

In addition, I will define aggregate budget constraint for the savers and the spenders:

$$FC_t^a + I_t + B_t = (1-\tau_t^k)r_t K_{t-1} + (1-\tau_t^{L_a})W_t F L_t^a + R_{t-1}^b B_{t-1} + TR_t^a \tag{37}$$

$$(1-F)C_t^p = (1-\tau_t^{L_p})W_t(1-F)L_t^p + TR_t^p \tag{38}$$

[2]In this paper, I do not consider policy rules with longer delays or exogenous policy rules such as the ones used in Trabandt and Uhlig (2006). Both of them could be undertaken easily but does not change the main results of this paper. Furthermore, I allow labor taxes and transfers to the saver and the spender to respond to debt separately. The latter polices also have been used in Leeper et al.(2011).

3.6 Definition of Competitive equilibrium

A competitive rational expectations equilibrium is defined as the agent's decisions, $\{C_t^{a,p}, L_t^{a,p}, K_t^a, B_t^a\}_{t=0}^{\infty}$, the firm's decisions, $\{L_t, K_t\}_{t=0}^{\infty}$, prices, $\{W_t, r_t\}_{t=0}^{\infty}$ and policy variables, $\{B_t, G_t, \tau_t^K, \tau_t^{L_a}, \tau_t^{L_p}, TR_t^a, TR_t^p\}_{t=0}^{\infty}$, such that, given initial levels of capital and debt, K_{t-1} and B_{t-1}, the optimality conditions for the different kinds of agents and firm's problems are solved; the goods, capital, labor and the bond markets clear; the transversality conditions for capital and debt hold; the government budget constraint and the policy rules are satisfied. I will only consider the ranges of the fiscal adjustment parameters- the q's- that are consistent with the existence of a rational expectations equilibrium.

3.7 Calibration and Solution Method

The model is calibrated at an annual frequency. Table 1 reports the benchmark values of parameters and the steady state values of variables before any permanent fiscal policy change. I report two set of values for certain parameters and steady state values. For much of the discussion in the paper, the baseline model is calibrated to average 1947-2005 US data. In section 7, I look at debt burden inequality under recent policy changes where I calibrate the model to the average 1983-2007 US data. The model implies that in the original steady state, the fraction of time spent on working is 0.2 in the aggregate[3]. I therefore set $L = 0.2$ for both samples. The consumption-output ratios are 0.63 and 0.67 for 1947-2005 and 1983-2007, the investment-output ratios are 0.17 and 0.14, the government spending-output ratios are 0.20 and 0.19, and the debt-output ratios are 0.376 and 0.40, roughly corresponding to the ratio of federal debt held by the public to GDP in 2005 and average debt-GDP ratio for the 1983-2007 period[Table 78, economic report of the President(2010)]. Transfer-output ratios are 0.07 and 0.11 which are roughly equal to the average government social benefits (NIPA Table 3.1 line 19) as a share of GDP, 1947-2005 and 1983-2007. I assume common values of certain parameters for both sample. For example,the value of α is set be 0.36, implying a labor income share of 0.64. The value of β_1 and β_2 are set to be 0.96, implying an annual steady state real interest rate of 4%. The value of δ is set to be 0.06 which falls between the values estimated in Cooley (1995) and King and Rebelo (1999). In my model, I assume that the spenders constitute the bottom 40% of the income distribution following Wolff(1998) and Shapiro and Slemrod(1995). Therefore, the value of F (fraction of saver) is 0.60 which is taken from JCT (2006), and is close to the value reported by Campbell and Mankiw (1990). The value of V (fraction of transfers to the saver) is set to be 0.40 for the 1947-2005 sample which is taken from Yang (2006) who cites the 2002 March Current Population Survey (CPS) which reports that about 70 percent of government transfers (including social security, supplemental security income, workers' compensation, food stamp, etc.) went to people at the bottom 50% of the income distribution. However, in 2010, CPS reports that about 90% of the government transfer payment went to the bottom 40% of the income distribution. As a conservative estimate for the value of V for 1983-2007, I set it to be 0.20[4].The value of θ_1 is set to 1 which is reported by Chang and Kim (2006) while the value of θ_2 is 2 which indicates a lower inter temporal elasticity of substitution of labor for the spender. Since there are no available

[3] According to Bureau of Labor Statistics, the mean value of average weekly working hours for production workers are 35.4 hours for the 1966-2005 and 34.3 hours for the 1983-2007 sample, implying approximately 21% of time of a week for the former and 20% for the latter sample.

[4] 2010 CPS's Annual Social and Economic Supplement survey (formerly known as March supplements)only reported the number of people who received transfer payments at different quintile of the income distribution. The median income in 2010 was about $49,500 for USA. In 2010, out of the people who reported receiving government transfers, 97.24% of their income fell between $10,000 and $49,999. However, the size of the transfer payments received by each person or by each quintile is not reported. Given the recent economic crisis, it is not an unreasonable to assume that the 97% of the people could receive more than 90% of the transfers. Therefore, the value of V is assumed to be 0.2 for the 1983-2007 sample is a conservative estimate.

separate estimate for θ_2, I take this value from Yang (2006) who cites Domeij and Floden (2005)[5] for an indirect measurement similar to my assumed value. The value of $\gamma_1$and γ_2 are assumed to be 1 which is taken from Leeper and Yang (2008). These values indicate inter temporal elasticity of substitution of consumption to be 1 which is larger than reported by Ogaki and Reinhart (1998). The value of internal habit persistence parameters, $b_1$and b_2 are taken from Burnside, Eichenbaum and Fischer(2005) and are close to the value reported by Leeper et al. (2010). Since there is no general consensus about the exact values of θ_1, θ_2, γ_1, γ_2, F, V, b_1 and b_2, I will provide sensitivity analysis for each of them in section 6. Finally, the values of the preference weights on leisure, χ^a and χ^p are chosen so that in the steady state they satisfy the condition that $L = 0.2$.

The steady state capital tax rate (τ^K)for 1947-2005 and 1983-2007 are calculated to be 0.35 and 0.320 which are average capital tax rate for those samples calculated by a method developed in Jones (2002). Detailed descriptions of the calculations are provided in the appendix. I use labor tax rate for the saver and the spender for 1947-2005 sample from Yang (2006). I also calculate average labor tax for the two groups for the 1983-2007 sample following Yang (2006). I use the values of τ^{L_a} to be 0.253 and 0.304 for 1947-2005 and 1983-2007 samples respectively. The values of τ^{L_p} are 0.096 and 0.117 for the two samples.

Benchmark settings of the fiscal adjustment parameters, the q's, are presented in Part 1.1 of table 2[6]. These values are chosen so that after a permanent 1% reduction in the capital or labor tax rates, or a 1% permanent increase in government spending, total transfers or transfer to the saver or to the spender, the economy evolves to a new steady state in which the debt-output ratio rises from 0.376 to 0.442, the postwar average for the ratio of privately held federal debt to GDP [1947-2005, Table 78, Economic Report of the President (2006)][7]. In order to generate permanent shocks, I set all ρ's, the shock persistence parameters, to be equal to 1. An analytical solution of the model is not available; the equilibrium conditions are log-linearized around the original steady state and analyzed in terms of percentage deviations from that steady state. The model is solved using Sims(2001)'s algorithm[8].

4 Dynamic Impact of Permanent Fiscal Policy Changes Under Alternative Financing Schemes: SR and LR Effects

In this section, I report dynamic effects of some permanent fiscal policy changes that raise debt which is financed by alternative financing schemes which were outlined in section 3.4. One will notice three kinds movements in the fiscal variables. First, there will be *targeted or main policy*

[5] Domeij and Floden (2005) reports that when the credit constrained population is added to their sample, the estimated value of their θ went down compared to other estimates, suggesting that the inter-temporal elasticity of substitution for labor for the credit constrained population is smaller than the non credit constrained population.

[6] A quick comparison between part 1.1 of table 2 and estimated (posterior) fiscal adjustment parameters in table 2 of Leeper et al. (2010) and table 1 of Traum and Yang (2010) reveals three important differences. First, since Leeper et al. (2010) allows fiscal policies to adjust differently for output and debt (while I force them to be same), the adjustment coefficients are different. Second, most of the q's (except for q_{TR^a} and q_{TR^p}) are quite comparable with Traum and Yang (2010) who also allows for fiscal policies to adjust same for output and debt. Third, some of my fiscal policy experiments are clearly counter-factual. However, since I am interested in understanding debt burden inequality from all possible combinations of fiscal policy experiments (including those that are and are not used in actual practice), I will include all of them in my analysis for a complete picture.

[7] Section 6 reports the sensitivity of outcomes to variations in the strength of fiscal responses to another long run debt-output ratio.

[8] Similar to Baxter and King (1993) and Leeper and Yang (2008), I examine permanent fiscal policy changes by using a log-linear version of my model. The use of log-linearization may raise concerns about the quality of the first-order approximation when the equilibrium is away from the original steady state. Such concerns are alleviated by the facts that the equilibrium system for the model is nearly loglinear and that the size of policy changes considered here is fairly small.

which will change as an unanticipated shock which is immediately known to be permanent, following Baxter and King (1993). Second, there will be *specified adjustments* which will follow some specific rules as mentioned in section 3.4, which agents have full knowledge of. Third, there might be movements in other components of the budget constraint which are neither main policies nor are they specified adjustment. These movements will come from *automatic stabilizing effect* (from government spending, transfers and taxes) through interaction between the consumers' and government budget constraint and the aggregate resource constraint.

4.1 Analysis of Some Policies that Create Similar Debt Burden

Figure 1 reports one of the most popular debt generating fiscal policy mixes which was extensively analyzed in other papers such as Baxter and King(1993), Chung and Leeper(2009), Leeper et al. (2010, 2011) and Traum and Yang (2010). Here, there is a 1% unanticipated increase in government spending which is immediately known to be permanent and is financed by adjustment to the transfers of both the saver and the spender. That means I set $q_{TR^a} = q_{TR^p} = -0.4197$ taken from part 1.1 of table 2 while all other q's are set to zero. The experiment is similar to Baxter and King (1993) but different from Leeper et. al (2010) or Traum and Yang (2010) because they consider temporary changes in government spending. Recall that saver's marginal tax rate is 2.6 times higher than the spender while the spender enjoys 60% of the total transfer. As in Baxter and King (1993), an unanticipated increase in government spending to be financed by future decline in transfers creates a large negative wealth effect. Both the saver and the spender responds by reducing consumption and working more in the short run. The wealth effect is also reinforced by negative substitution effect. However, upon impact spender's labor supply is almost unchanged but then slowly goes up because of his habit persistence and limited inter temporal smoothing. Saver tackles this problem by working more upon impact. With increased aggregate labor supply, real wage rate goes down immediately. But the increase in labor supply shifts the marginal product schedule for capital up, thereby raising real interest rate. In the short run, an accelerator mechanism operates to generate an increase in investment and capital accumulation. Increased capital income therefore allows saver to quickly reduce labor supply in the short run. In the short run, we see dramatically different financing by the saver and the spender. Spender adds to debt in the first 5 years from his labor tax revenue and finances debt from his declined transfers (panel 3,1). The situation almost reverses within 10 years. Spender feels the heat more because his expected future transfer will go down more than the saver. Therefore, increased work effort by the spender finances debt from labor tax revenues while labor tax revenues from the saver starts going down. In the long run, increased capital income again allows saver to enjoy more consumption and leisure despite decline in his transfers and his labor supply goes down even further. Spender continues to work more to smooth out his consumption because his increased wage income (due to working more) cannot neutralize his declined transfer income. With no change in labor tax rate, labor tax revenue from the spender remains higher than the original steady state during the transition path, while it declines slightly below the original steady state for the saver. With no change in capital tax rate, increased capital accumulation by the saver also produces higher capital tax revenue. Finally, transfer to the spender in absolute terms goes down more than that of the saver, although their percentage decline remains the same following the designated fiscal rule (panel 3,3). Each of these changes helps to finance debt.

In summary, spender finances debt by an increase in labor tax revenue and a large decline in transfer. Saver finances debt by a smaller increase in labor tax revenue and a smaller decline in transfer than the spender but by a large increase in capital tax revenue. In the end, the debt burden between the saver and the spender appears to be similar.

Figure 2 reports the dynamic effect of a 1% permanent cut in saver's labor tax to be financed by adjustment to labor tax to both the saver and the spender. This policy also produces dramatically different results in the short run and in the long run. For the saver, a cut in his labor tax increases his after tax labor return. Upon impact, the substitution effect prompts the saver to dramatically increases his labor supply. However, increased labor supply is not sufficient to make up for the labor rate cut because increased labor supply reduces wage rate. As a result, saver's labor tax revenue goes down upon impact. Spender's labor supply is almost unchanged upon impact and so is his labor tax revenue. Increased labor supply reduces capital-labor ratio and raises real interest rate. As a result, both investment and capital accumulation goes up which raises capital tax revenue upon labor tax cut. As both labor tax rates are gradually raised during the transition path, spender's labor supply remains almost unchanged or close to original steady state. For the saver, increased capital income and substitution effect allows him to slowly reduce his labor supply in the long run below the original steady state. As aggregate labor supply subsides, wage rate increases. This, coupled with increased labor tax rate, increases spender's labor tax revenue quite high at the new steady state. However, with his labor tax rates slowing going up (and labor supply sharply going down), saver's labor tax revenue start going up but stays close to the original steady state. This means that a labor tax cut (even after adjustment) to the saver cannot expand his labor tax base sufficiently. Capital tax revenue remains above the original steady state throughout the transition path. Furthermore, due to automatic stabilizing effect, transfers to both groups go up in the short run (because increased aggregate labor supply raises output) although they subside below the original steady state in the long run.

In summary, saver finances debt by an increase in capital tax revenue and adds to debt by a decline in his labor tax revenue and an increase in his transfers. Spender finances debt by a substantial increase in his labor tax revenue and adds to debt by a larger increase in transfers (in absolute terms) than the saver. In the end, we might see a more equitable distribution of debt burden between the saver and the spender.

4.2 Analysis of Some Policies that Create Unequal Debt Burden

I now present two cases which might lead to a substantially unequal distribution of debt burden. Figure 3 reports the dynamic effect of a permanent rise in the transfer to the saver to be financed by a gradual adjustment to his own transfer[9]. This produces interesting policy outcomes. Although transfers in my model are distortionary, the responses of consumption, labor supply and investment depends on the agents' expectation about how the policy would be financed [Leeper et al. (2011)]. With no expected change in his transfers, labor supply by the spender is almost unchanged[10]. For the saver, interestingly, negative income effect from the expected decline in transfers also appears to be not strong enough to make him work harder or even accumulate more capital. This is because raising transfer quickly and declining it slowly creates no distortion and leaves capital-labor ratio unchanged throughout the transition path. There is hardly any change in the labor tax revenue from the saver and the spender, nor there is any significant change in the capital tax revenue . The effect of this policy combination appears to be almost non-distortionary because both policy change and adjustment applies to the same group. Therefore, decline in transfer as adjustment for the saver bears the full debt burden. This also entails quite unequal debt burden between the saver and the spender in the sense that one group bears all debt burden while the other bears nothing.

Figure 4 reports the dynamic effect of a permanent 1% cut in capital tax to be financed by

[9] In this paper, I allow tax rates, government spending and transfers to adjust to their own shocks. This is in contrast with Leeper and Yang (2008). Although own adjustment policies are somewhat different, they were included for completeness. Due to recent policy changes to address current fiscal crisis, change and adjustment to the same fiscal instrument has become warranted. In light of this, Leeper et al. (2010, 2011) and Traum and Yang (2010) all consider change and adjustment of the same fiscal variable. Furthermore, Congressional Budget Office (CBO) regularly considers tax cut-tax rise experiments. For more detail, see CBO (2004).

[10] A careful look at the y-axis scale in all the panels clarifies this point.

both transfers, another popular tax policy studied in the existing literature. Here, $q_{TR^a} = q_{TR^p} = -0.35866$. The negative wealth effect causes aggregate labor supply goes up (mainly from the saver), causing real interest rate to go up. Cutting capital tax raises after tax return on capital as well. With tax cut being permanent and is expected to be financed by transfers, investment by the saver goes up substantially similar to Traum and Yang (2010) with their persistent but temporary capital tax cut case. Although capital accumulation goes up, the interest rate effect is not strong. Therefore, the expansion of capital tax base is not sufficient to make up for the tax cut. As a result, capital tax revenue goes down in the short run. This means that a cut in capital tax rate does not pay for itself. Capital tax revenue also remains low in the long run and continues to be below the original steady state throughout the transition path. As mentioned earlier, the negative income effect from future decline in transfers also make the saver work more in the short run, there by driving down the wage rate. But with increased capital income, saver's labor supply quickly goes down in the short run and remains very close to the original steady state level. During the transition path, capital-labor ratio rises back slowly towards the new steady state as suggested by Baxter and King (1993), thereby raising wage rate. Increased wage rate raises saver's labor tax base and therefore, his labor tax revenue. Spender continues to work very hard both in the short run (after decline in his labor supply upon impact) and in the long run which produces higher labor tax revenue during the transition path and to the new steady state. Because of his lower marginal tax rate, spender cannot produce as big of an increase in labor tax revenue as the saver.

In summary, saver adds to debt by producing a significantly smaller capital tax revenue. Saver finances debt by a larger increase in labor tax revenue and a smaller decline in transfer than the spender. Larger labor tax revenue (mainly due to higher marginal tax rate) by the saver somewhat neutralizes decline in capital tax revenue and transfer, but not all. Spender finances debt by a smaller increase in labor tax revenue and a larger decline in transfers than the saver. As a result, we might expect a quite unequal debt burden born by the saver and the spender.

Figures 5, 6, 7 and 8 report the dynamic effect of the complete set of fiscal policy changes along with all their possible financing on the distribution of debt burden. There appears to be three kinds of results. First, in some cases both group either finances or creates debt. Second, in some cases one group finances debt while the other group adds to debt. Third, as I have already shown in figure 3, one group bears the full burden of debt while the other group bears nothing. Several results stand out.

1. Government Spending Hike Generates More Capital Tax Revenue. A permanent increase in government spending almost always raises capital tax revenue, unless it is financed by raising both labor tax rate or by its own adjustment. When both labor tax is raised to finance government spending(figure 5, panel 4,1), after tax return on labor goes down, causing labor supply to go down and the saver accumulates less capital (because interest rate goes down). When government spending itself adjusts(figure 5, panel 8,1), reduction of it causes a positive income effect which offsets the short run expansionary effect in the long run and prompts saver to enjoy more consumption(and leisure) and less capital accumulation.

2. Capital Tax Cut Never Pays For Itself. This is because it fails to generate enough expansion of the tax base to make up for the tax cut. This result is consistent with Yang (2006). Capital tax cut is always financed by labor tax revenue (most of which comes from the spender), unless capital tax itself is raised for adjustment(figure 5, panel 7,2). In this case, capital tax revenue goes down in the short run but increases in the long run due to adjustment.

3. Labor Tax Cut does not Pay For Itself. Neither individual nor both tax cuts pay for themselves in the long run, unless they are raised back as adjustment, which I will explain later. In almost all cases, capital tax revenue pays for the labor tax cuts. This is because labor tax cuts cannot generate enough increase in the tax base to raise labor tax revenue (because wage rate decreases). But it can raise capital tax revenue through increase in capital accumulation (because of interest rate effect) when transfers adjust [figure 6, panels (1,2),(2,2),(3,2)] or through adjustment in capital tax rate(figure 6, panel 7,2). When saver's labor tax is cut, rise in after tax wage rate increases labor supply which raises the labor tax revenue from the spender. Adjustments to transfers[figure 7, panels (1,1), (2,1), (3,1)], government spending(figure 7, panel 8,1) or capital tax revenue from capital tax rate adjustment(figure 7, panel 7,1) could also help to pay for labor tax cut. But saver's labor tax revenue goes down in all cases. When spender's labor tax rate is cut while others adjust[figure 7, panels (1,2)- (8,2)], we see similar results. These policies also increase debt burden inequality because one group finances debt while the other group adds to debt.

4. Using Labor Tax Both as a Shock and Adjustment Could Pay for Itself. When both labor taxes are cut at same proportion(figure 6, panel 4,2), saver gets a larger cut and will also receive a larger adjustment(increase). This positive effect from labor tax cut dominates negative effect from future rise in tax rate and allows him to increase labor supply almost immediately, which increases capital accumulation. Saver's labor tax revenue goes down (because of the tax cut) and capital tax revenue go up in the short run. The spender, on the other hand, gets a smaller tax cut than the saver. Spender starts increasing his labor supply in the short run. In the long run, higher wage income and capital income allows the saver to work less. But the rise in tax rate (due to adjustment) tends to compensate for the lower tax base. As a result,saver's labor tax revenue go up in the long run. Spender continues to increase his labor supply even in the long run and his labor tax revenue go up. Tax cuts that raised debt are therefore financed by rise in both saver's(labor and capital) and spender's(labor) tax revenue. Similar thing is observed when saver's labor tax is cut and adjusted(figure 7, panel 5,1) or spender's labor tax is cut and adjusted (figure 7, panel 6,2). But these policies will also raise debt burden inequality where the burden inequality is significant for the latter case.

5. Switching Policy between Shock and Adjustment Produces Opposite Results. Interchanging the fiscal instruments between shocks and adjustments produces opposite results. For example, when government spending is raised and both transfers adjust(figure 1, panel 1,1), all tax revenues go up. When both transfers are raised and government spending is adjusted(figure 6, panel 8,1), we see them going down. This is because the effect of different fiscal policies differ between them as well as in time. While negative income effect from a rise in government spending is more distortionary and makes everyone work more and increase capital accumulation in the short run, positive income effect from a rise in transfers make them work less and reduce capital accumulation. In the long run, wealth effect from expected fall in transfers(when G is the main policy) prompts further increase in the tax bases while the long run effect of a gradual cut in government spending(when transfers are main policy) further reduces tax bases. This opposite result is true for capital tax- labor tax pair[figure 5, panel (4,2) and figure 6, panel (7,2)] as well as any other combinations.

6. Transfer Shocks Generally Increase Debt Burden Inequality. When transfers are raised while others adjust, care should be taken. Spenders are specially more sensitive to changes in transfers [Yang (2006)]. When both transfers are raised and labor taxes adjust(figure 6, panel 4,1), positive income shock from transfers dominate negative income effect from future labor tax increase in the short run for spender. He reduces his labor supply dramatically in the short run but raises it a bit when the transfer-effect begins to weaken in the long run. Saver receives a smaller increase in transfer. He responds by raising labor supply in the short run and gradually reducing it in the long run. Capital accumulation also goes down as interest rate falls in the long run. Higher tax rates ensure gain in labor tax revenue in the long run. With no change in capital tax rate, capital tax revenue goes down. When only saver's labor tax rate adjusts(figure 6, panel 5,1), saver's labor tax revenue goes up and spender's labor tax revenue goes down. When capital tax adjust(figure 6, panel 7,1), the situation is opposite to the labor tax adjustment case. Now both labor tax revenue goes down and capital tax revenue goes up. When government spending adjusts (figure 6, panel 8,1), we already saw that all revenues go down in the long run. However, other than government spending adjustment, each of the adjustments indicates significant inequality in the debt burden faced by the saver and the spender because of unequal change in transfers between them and also changes in tax revenues in opposite directions.

7. Group Specific Policy Shocks Generally Increase Debt Burden Inequality. When transfer to either the saver or the spender is raised while other policies adjust, some part of the mechanism described above is repeated. But now, we see a wider inequality in debt burden, as was already shown in figure 3. As figure 8 shows, the debt burden falls heavily on to the group whose policies are changed and adjusted. Furthermore, we already saw that group specific labor tax policy increases debt burden inequality (figure 7).

8. Using Transfer Both as a Shock and Adjustment is Tricky. When transfers are used both as main policy and as adjustments, we see very interesting short run and long run dynamics. When both transfers adjust(figure 6, panel 1,1), spender reduces labor supply in the short run. In the long run, we see an increase in his labor supply as a response to transfer adjustment. Spender's labor tax revenue simply follows his labor supply response. Saver, on the other hand, responds very little to this policy combination. His labor supply and capital accumulation dips in the short run and stays below but close to the original steady state in the long run. Adjustments in transfers and rise in spender's tax revenue counter-act with decline in the total tax revenue from the saver. As a result, we might a see an equitable share of debt burden between the saver and the spender. The next section will provide a quantitative verification of this assertion. When only one transfer adjusts, however, the inequality will increase significantly. When saver's transfer adjust(figure 6, panel 2,1), saver's labor tax revenue and his transfer finance debt, while others add to it. When spender's transfer adjust(figure 6, panel 3,1), spender's labor tax revenue and his transfers finance debt, while others add to it. Similar situations are repeated when individual transfers are used as main policy instruments while total or group specific transfers adjust, as evident in figure 8.

5 Distribution of Debt Burden under Alternative Financing Schemes: Present Value Calculations

The graphical analysis in the previous section showed how a rise in debt caused by some fiscal shocks are financed by the tax revenues and transfers to the saver and the spender with aid from specified policy adjustment rules. The dynamic effect of debt and its financing on the transition path towards the new steady state was crucial for understanding how the saver and the spender finances (or creates) debt along the way. Since the saver and the spender do not always finance (or create) debt together (and most of the times go in opposite direction), a more quantitative analysis of debt burden is needed. This section attempts to quantify the amount of debt funded by the saver and the spender to understand their relative debt burden. The idea behind this section is to calculate the present value of the debt caused by the combination of a policy shock and a policy adjustment and analyze what fraction of the present value of the debt is funded by the saver or the spender. This is a theme that has recently been pursued by Chung and Leeper(2009)and Leeper et al.(2010, 2011). Following Chung and Leeper(2009), the log-linearized present value budget constraint can be written as:

$$\hat{B}_t = E_t \sum_{j=1}^{\infty} \beta^j \left(\frac{T^l}{B} \hat{T}^l_{t+j} + \frac{T^k}{B} \hat{T}^k_{t+j} - \frac{G}{B} \hat{G}_{t+j} - \frac{TR^a}{B} \hat{TR}^a_{t+j} - \frac{TR^p}{B} \hat{TR}^p_{t+j} - \frac{1}{\beta} \hat{R}_{t+j-1} \right) \quad (39)$$

Here, B, G, TR^a, TR^p, are the steady state value of the respective variables while T^l, T^k are the steady state value of the labor and capital tax revenue.β is the constant discount factor

[11]. Here, $\hat{T^l_{t+j}}$, $\hat{T^k_{t+j}}$, $\hat{G_{t+j}}$, $\hat{TR^a_{t+j}}$, $\hat{TR^p_{t+j}}$denote changes in total labor tax revenue, capital tax revenue, government spending, total transfer to the saver and total transfer to the spender. Equation (39) decomposes fluctuations in real debt into expected changes in the composition of net-of-interest surpluses, at constant discount rates, and expected changes in real discount rates. I further decompose the debt financing by the labor tax revenue for the two groups. To do this, let us define the tax revenue from labor tax to be:

$$T_t^{L_a} = \frac{\tau_t^{L_a} (1-\alpha) F L_t^a}{L_t}, T_t^{L_p} = \frac{\tau^{L_p} (1-\alpha) (1-F) L_t^p}{L_t} \tag{40}$$

Substituting equation(40) into (39) and using equation (20) gives us a further decomposition of the debt innovation in terms of tax revenue of the saver and the spender as follows:

$$\hat{B_t} = E_t \sum_{j=1}^{\infty} \beta^j \left(\frac{T^{L_a}}{B} \hat{T^{L_a}_{t+j}} + \frac{T^{L_p}}{B} \hat{T^{L_p}_{t+j}} + \frac{T^k}{B} \hat{T^k_{t+j}} - \frac{G}{B} \hat{G_{t+j}} - \frac{TR^a}{B} \hat{TR^a_{t+j}} - \frac{TR^p}{B} \hat{TR^p_{t+j}} - \frac{1}{\beta} \hat{R_{t+j-1}} \right) \tag{41}$$

Table 3 shows each of the present-value components in (41), following a shock to each of the exogenous process when the shock is calibrated to raise debt by one unit of the final good[12]. Fiscal adjustment parameters are summarized in part 1.1 of table 2. Sign of each component of the budget constraint shows whether it adds to or finances debt. If the sign of a component of the budget constraint has the same sign as the change in debt, the component is expected to move to support the change in debt or finance debt. Therefore, a positive sign on tax revenues, transfers or government spending means they fund debt while they add to debt when signs reverse. Rows 4 to 10 show how each component of the budget constraint finances the present value of debt generated by any of the eight fiscal shocks when government adjusts its transfers to both the saver and the spender. Row 10 shows movement of the discount rate in response to changes in debt. Row 11 shows budgetary surplus calculated by adding up rows 4 to 9. Rows for R and Surplus sum to changes in debt (which is 1). Row 12 reports total debt burden financed (or added) by the saver which is derived by adding capital tax revenue, saver's labor tax revenue and transfer(row 5, 6 and 8). Row 13 reports total debt financed (or added) by the spender which is derived by adding spender's labor tax revenue and transfer(row 7 and 9). Row 14 reports the gap between the debt burden born by the spender and the saver. I use the sign and magnitude of the gap as a simple measure for understanding the distribution of debt burden between the saver and the spender.

Table 3 supports all my debt burden analysis from the previous section. Let me start with the case when both transfers adjust to fiscal policy changes. Column 2 reports financing when government spending is permanently raised as an unanticipated shock. We see G (government spending) moves against debt or adds to debt, as expected. Higher government spending reduces wealth and induces more work effort and capital accumulation. With unchanged labor and capital tax rate, capital tax revenue and labor tax revenue from both saver and spender go up to finance debt. Transfers go down according to the adjustment policy. As graphical analysis in the previous section suggested, spender fiances debt with a larger increase in labor tax revenue ($1.24 > 1.00$)

[11] For a more elaborate discussion about the derivations, please see Chung and Leeper(2009), page 6 and Leeper et al. (2010), equation 19.

[12] The total debt that needs to be financed by the saver and the spender should also include increase in the initial innovation in debt. Since I am interested in only the fiscal (tax and transfer) burden of debt and since this initial debt shows up as an asset to the saver (who buys them), I refrain from including it in my calculation and only focus on how future debt stream is financed by the two groups (through changes in tax revenues and transfers) in my model. However, excluding initial debt innovation does not change the conclusions of the paper about debt burden inequality. I thank Hess Chung for clarifying this point.

and a larger decline in the transfers (15.42 > 10.28) than the saver. But saver also(in addition to his labor tax revenue) finances debt from capital tax revenue. The gap between the total debt burden between the saver and the spender is small, suggesting that they share a comparable fraction of debt among them, although spender bears more debt. When capital tax is permanently cut to raise debt(column 3), both the saver and the spender again finances debt. The gap between debt burden between them becomes even larger, suggesting an unequal share of debt burden, as was seen in figure 4.

When both labor tax rate is permanently cut(column 4), saver's labor tax revenue goes down considerably more because he received a larger tax cut(figure 6, panel 2,2). Saver adds to debt from his labor tax revenue and finances debt from his capital tax revenue and adjustment to his transfers. Spender on the other hand, finances debt from a significant cut in his transfer and adds to debt from a small decline in his labor tax revenue. Over all, saver adds to debt and spender finances debt, creating an unequal distribution of debt burden between them. When saver's labor tax is only cut(column 4), saver adds more debt and the inequality in debt burden increases more. When spender's labor tax is cut(column 5), the situation is reversed. Saver now finances debt while spender adds to it. Debt burden inequality is still high.

An increase in both transfers to raise debt(column 6) reduces debt burden inequality, as we saw in figure 6, panel (1,1). Saver adds to debt from his labor and capital tax revenue. Spender finances a minor portion of debt from his labor tax revenue. Transfers mainly finance debt and at the end, both the saver and spender bears similar debt burden while spender taking a larger share, as analysis from previous section indicated. When only saver's transfer is raised(column 7), transfer to and labor tax from the spender finances debt. For saver, the initial increase in transfer is not offset by gradual adjustment. Hence it remains higher than before in the new steady state. As a result, saver completely adds to debt while spender bears most of it. This fiscal policy combination creates the largest inequality in debt burden when both transfers adjust. The situation is almost reversed when the transfer to spender is raised(column 9) where spender now adds to debt while saver bears most of it.

The rest of table 3 reports debt burden for other alternative financing schemes. In order to save space, I only report the debt burden of the saver and the spender and their differences. Several other results stand out from the rest of the debt burden analysis. First, the largest inequality in debt burden occurs when savers transfers are raised while spender's transfers adjust (column 8, row 22). This is also the case when the spender finances the largest amount of debt in terms of numbers. Second, raising and adjusting transfers to both groups (column 7, row14) create the most equitable distribution of debt burden between the saver and the spender. . Third, shocks to saver's transfers and adjusting saver's transfer (column 8, row 17) makes saver bear the whole burden of debt, as discussed in figure 3. Finally, in terms of numbers, saver bears the largest debt when spender's labor tax is cut and saver's transfers are adjusted (column 6, row 16).

6 Sensitivity Analysis

Table 4 reports sensitivity analysis for alternative debt-GDP ratio target. Here, the economy moves to a new long run steady state where the debt-GDP ratio is 1, a possibility which is no longer a theoretical consideration given the recent trend in debt-GDP ratio [CBO (2011)]. Part 1.2 of table 2 reports the value of fiscal adjustment parameters that will be used for this analysis. However, saver's labor tax cut or rise in transfers to either the saver or the spender could not be used to take debt-GDP ratio to 1 because it violated conditions for uniqueness and existence of a solution in my model. For these three policy changes, Part 1.2 of table 2 reports values of adjustment parameters that will take the economy to a new steady state with debt-GDP ratio to be equal to 0.4794. A quick comparison between the first and second part of table 2 reveals that the fiscal adjustment parameters are significantly less aggressive when long run debt-GDP ratio is raised. Several results stand out. First, all debt burden results from table 3 appear to be robust in table 4. This means that the numbers change but they do not change the direction of the debt burden inequality. For example, raising saver's transfer and adjusting spender's transfer (column 8, row 22) still create the largest debt burden inequality. Second, with less aggressive adjustment parameters, debt burden inequality increases in almost all cases.

Table 5 reports sensitivity analysis for alternative values of the structural parameters of the model. In order to save space, I only report results for three financing schemes; total transfers, saver's transfer and spender's transfer adjustment. The fiscal parameters used in these experiments corresponds to the baseline values detailed in part 1.1of table 2. Table 5 only reports the gap of debt burden between the saver and the spender under alternative fiscal policy shocks, reported in each column. I also report only a subset of the parameter values that were experimented and that ensures uniqueness and existence of a solution to the model. These numbers should be compared with row 14, 18 and 22 of table 3. It can be seen that changing structural parameters of the model significantly changes the magnitude of the debt burden inequality, as they should since changing structural parameters dramatically changes the dynamics of the model. What I would like to show is whether changing structural parameters change the direction of the debt burden or not, for example, going from spenders bearing more debt than the savers to savers bearing more than the spenders and vice versa. This could be detected by changing signs of the gap compared to the baseline results in table 3[13]. Several results stand out. First, debt burden results are robust to different values of F (fraction of savers) and b (internal habit persistence parameter). Second, the value of V (fraction of transfer going to the saver)is sensitive. Larger values of V (compared to baseline value) are robust when total transfers (except when government spending is raised) or spender's transfer (except when spender's labor tax or transfers are used as shocks) adjust or when saver's transfer adjust. Smaller values of V (compared to baseline value) are robust when both transfers or spender's transfer adjust but not robust when saver's transfer adjusts in case of four shocks. Third, the value of θ is very sensitive. Smaller values of θ which corresponds to a larger inter temporal elasticity of substitution for labor and are consistent with values used in other papers[Leeper et al. (2010)], appears to be robust under all three adjustments. As the value of θ is raised or when $\theta_1 > \theta_2$, signs on the gap for almost all shocks change under alternative adjustments. Finally, the values of γ are also sensitive but more robust than θ for empirically plausible values.

7 Debt Burden Inequality and Current Fiscal Crisis

The Great Recession and recent financial crisis have have created an unprecedented fiscal crisis in the USA. Widespread economic downturn coupled with measures to restore the financial sector of the economy such as the Emergency Economic Stabilization Act of 2008 have pushed annual budget deficit to surpass $1 trillion in 2009. Between 2007 and 2010, nominal government spending has increased by about 13%. During the same time, debt-GDP ratio has gone up by almost 73%, revenue-GDP ratio has gone down by 12% and transfer-GDP ratio has gone up 32%. In order to counter this fiscal crisis, the government has taken several decisive measures. In addition to raising the debt ceiling, the government has passed the ARRA into law in 2011(which also formalized the increase in debt ceiling). The key features of this act are to reduce government spending and transfers and therefore, to curb debt. In light of these major events, The CBO(2011) provided a road map for the long run economic projections for the US economy till 2035. CBO (2011) provides two kinds of projections. First, it provides *extended baseline projections* which is based on the strict adherence to current law and assumptions that a) labor and capital tax cuts (which

[13] Detailed results for table 5 is available upon request.

were enacted in 2001 and then extended as late as in 2010) would be eliminated and rates will be raised to their pre-2001 levels, b) government spending cuts will follow ARRA law and c) transfer payments would go down to their lowest percentage of GDP since World War II (decline by about a third). Second, CBO (2011) also provides *alternative fiscal scenario* which assumes that a) labor and capital tax cuts would be maintained (taxes would not change) and b) decline in the transfer payments would be modest. Under the *extended baseline projections,* debt-GDP ratio is projected to go up to 0.84 in 2035 and under the *alternative fiscal scenario*, it is expected to go up to 1.90.

In this section, I try to mimic fiscal and macroeconomic policy behavior under the *extended baseline projections* and *alternative fiscal scenario* in my saver-spender model to understand the nature of debt burden inequality under each of these projections. In order to capture the increase in government spending during 2007-2010 and how the economy adjusts under two projections, I assume that there is a 10% permanent increase in government spending which is to be financed by alternative fiscal policies under extended baseline and alternative scenarios. Instead of analyzing fiscal and macroeconomic behavior using graphs like figure 1, I will use a concept of debt multiplier which is defined as follows; define debt finance by the saver and the spender as follows:

$$\text{Saver Finance=SAF}_t = T_t^k + T_t^{L_a} - TR_t^a\text{,Spender Finance=SPF}_t = T_t^{L_p} - TR_t^p$$

The debt multiplier for the saver and the spender at time t would be defined as follows:

$$\text{Saver multiplier}(t) = \frac{\Delta \text{SAF}_t}{\Delta B_t},\ \text{Spender multiplier}(t) = \frac{\Delta \text{SPF}_t}{\Delta B_t} \tag{42}$$

During the transition path and at the new steady state, the debt multipliers[14] would tell us whether the saver and the spender are financing debt or adding to it. Table 6 shows values of the fiscal parameters that were used to carry out different experiments. Table 7 shows dynamics of debt burden inequality under two situations; a 30-year window in which debt-GDP rises to its projected ratio under two scenarios within 30 years and a 100-year window when it reaches projected ratio in 100 years. Under the 30-year window, uniqueness and existence of a solution to my rather simple model did not allow me to consider fiscal parameters that could take the economy to a debt-GDP ratio of 1.90 under the extended scenario. Therefore, debt-GDP ratio is raised to approximately 1 (≈0.9978) for the extended scenarios. However, this problem does not occur in the 100-year window. In CBO(2011) projections, extended baseline expects adjustment of taxes, transfers and government spending all together. CBO (2011)'s projections are obviously not entirely certain. Therefore, I additionally report several counter-expected experiments where one or more fiscal policies adjust while others remain unchanged. For example, in baseline projections under 30-year window, when only transfers adjust (row 6), I set $q_{TR^a} = q_{TR^p} = -0.25757$ where transfer-GDP ratio declines by 53% to 0.05 in the new steady state, which is close to the lowest transfer-GDP ratio since 1963. When capital tax and government spending (row 14) or labor taxes and government spending adjust together(row 17), the tax rates slowly are raised to their 2000 level, which is reported in table 1. When transfers adjust with other fiscal variables, transfer-GDP declines by about 30% [close to what CBO(2011) projects] to 0.08 in the new steady state in the 30-year window. Under the 100-year window, it goes down less, 23% in extended scenario and 27% in alternative scenario. When all adjusts (under extended scenario), taxes are raised to their 2000 levels and transfer-GDP declines by 30% in 30-year window and 23% in 100-year window.

[14] In theory, there is no concept as debt multiplier because debt is an endogenous variable. I am abusing this notion because I could not find any proper alternative term. Alternatively, I could have used ΔG as the common denominator which could have made the use of term *multiplier* more appropriate. However, during the transition path, government spending would go down while saver and spender could finance debt, creating confusing sign of the multiplier. I therefore use ΔB as the common denominator for the finance multipliers.

Several results stand out. First, responses at initial impact are always opposite where the spender adds to debt and saver finances it, as were seen in figure 1. Other than when government spending only adjusts, spender starts financing debt within 15 years of the shock. In the long run, spender finances more debt than the saver. As the gap between the present value of debt finance (column 8) shows, spender indeed bears more debt, which is comparable to results in table 3 and 4 (column 1). When only government spending adjusts, spender takes more time to finance debt but eventually bears more debt burden in the long run. Second, comparing between the two windows, 100-year adjustments create less debt burden inequality. This is because under a longer time adjustment (and also to a higher debt-GDP ratio of 1.90), government spending and taxes can be adjusted more aggressively (compare fiscal parameters in table 6 between 30-year and 100-year windows) while allowing transfers to go down less in the extended scenario. Transfers also go down less in the alternative scenario under the 100-year window, allowing spender to bear less debt burden. Third, Both extended and alternative sceneries suggest a greater debt burden inequality compared to baseline results in table 3 and 4. This underlines the changes in macroeconomic and fiscal dynamics of the US economy in recent times. From 1947-2005 sample to 1983-2007 sample, average capital tax rates have gone down by 8.58% while saver's and spender's labor taxes have increased by 20% and 21% respectively. In the 1983-2007 sample, by assumption, spenders receive a larger share of the transfers. These indicate a significant unequal fiscal position between the saver and the spender. But the most important result that stands out from table 7 is that debt burden inequality is greater under the alternative scenario than under the extended baseline scenario. This suggests that the policy provisions under the ARRA might actually reduce debt burden inequality, compared to if it was not enacted. This is because ARRA calls for raising capital and labor taxes, suggesting the saver would bear a larger share of the debt burden. However, how the debt management amendment under the ARRA would affect economic growth and income distribution is a legitimate question but is beyond the scope of this paper.

8 Conclusion

The present paper uses a simple heterogeneous agent based RBC model to understand the distribution of debt burden that results from a wide menu of debt-financed fiscal policies and their possible financing schemes. While previous papers on debt burden inequality looked at longrun distribution of debt, this paper makes a modest contribution by also looking at both short run and long run debt burden inequality and their dynamic interaction. Second, the paper also used some recently developed method to analyze how present value of debt could be distributed depending on a particular debt generating fiscal policy and its financing scheme. Third, although the degree of heterogeneity modeled in the paper is limited and the method of measuring debt burden inequality is rudimentary, the paper, within its limited capacity, shows that not only are permanent tax cuts not self financing, they can shift significant debt burden on to people who do not benefit from the cuts. Fourth, the paper also extends the menu of policy options that are available to the policy makers interested in maintaining a specific debt target. Finally, the paper looked at recent policy changes to combat current fiscal crisis and argues that stricter debt management amendment might actually reduce debt burden inequality in favor of the poorer people. Yet, debt burden could be a politically sensitive issue. For a policy maker, however, understanding debt burden could be very important. The choice of a particular policy combination would eventually depend on the policy maker's choice and its political viability. In this respect, the paper hopes to provide some fresh results for a discussion in the political and academic discourse. Future research might analyze political viability of each of the debt generating fiscal policy combinations in search of the optimal debt management.

Appendix: Calculation of Capital Tax and Labor Tax Rates

Following Jones (2002), capital and labor taxes are calculated in several steps. First, average personal income tax is calculated from the NIPA data as

$\tau^p = \frac{FIT\ +\ SIT}{W + \frac{PRI}{2} + CI}$

where, FIT is the federal income taxes (Table 3.2, line 3), SIT is state and local income taxes (Table 3.3, line 3), W is wages and salaries (Table 1.12, line 3), PRI is proprietor's income (Table 1.12, line 32) and CI is capital income defined as sum of rental income (Table 1.12, line 12), corporate profits (Table 1.12, line 13), interest income (Table 1.12, line 18) and $\frac{PRI}{2}$.

Capital tax rate is then calculated as

$\tau^k = \frac{\tau^p CI\ +\ CT\ + PT}{CI\ +\ PT}$

where CT is taxes on corporate income (Table 1.12, line 14) and PT is property taxes (Table 3.3, line 8). My calculated average capital tax rate for 1947-2005 is different from Yang (2006). This is because Yang(2006) calculated average federal and state (and local) capital tax rates separately and added them to get an aggregate average capital tax rate while I only calculated capital tax rate for the federal level. I did this because I assume that most of the fiscal policy experiments in my paper focus on changing (and adjusting) the capital tax rate at the federal level. My calculated average capital tax rate for 1983-2007 is different from Leeper et al. (2010). This is because they calculated the rate based on the following formula:

$\tau^k = \frac{\tau^p CI\ +\ CT}{CI\ +\ PT}$

I also calculate capital tax rate for 2000 using the same method for policy analysis.

Average labor tax rate is calculated as

$\tau^L = \frac{\tau^p (W + \frac{PRI}{2}) +\ CSI}{EC + \frac{PRI}{2}}$

where CSI is contributions for government social insurance (Table 3.2, line 11) and EC is compensation of employees (Table 1.12, line 2). But the calculation of separate labor tax for the saver and the spender is non-trivial. Yang (2006) calculates average labor tax rates for the 1947-2005 sample in four steps by assuming that 6/7 of the pre-tax labor income is earned by the saver. First, she calculates aggregate average federal and state (and local) labor tax rate following Jones (2002). Second, she uses Individual Tax Model at the Joint Committee on Taxation [JCT (2005 b)] to compute the average federal labor income tax rates for those in the top 60 percent of the labor income distribution among filers with positive labor income, based on the 2003 sample of Individual Statistics of Income [Internal Revenue Service (2006)]. Third, She assumes that the state and local labor income tax rates on average have the same progressivity as the federal labor income taxes and that 6/7 of pre-tax labor income are earned by savers. With above assumptions, she calculates state and local labor tax for the saver and the spender. Finally, she adds federal and state (and local) labor taxes to get an aggregate measurement of labor tax rate for both groups. I used labor tax rates for the saver and the spender for the 1947-2005 sample from Yang (2006). This gives me the value of τ^{L_a} and $\tau^{L_p}$to be 0.253 and 0.096 respectively. However, I do not have access to the Individual Tax Model. Therefore, for the 1983-2007 sample, I retained all the assumptions of Yang (2006) and calculated labor tax rate for the saver by augmenting the aggregate labor tax rate (only federal level) as follows:

Labor Tax for the saver at year t=($\frac{\text{Average Saver's Labor Tax in 1947-2005 sample}}{\text{Average Aggregate Labor Tax for 1947-2005 sample}}$)xAggregate labor tax rate at year t

I used same method to calculate yearly labor tax rate for the spender and took average over the relevant sample to get the average labor tax rate for both groups. Furthermore, I only calculated federal labor tax rates for both groups for the 1983-2007 sample and also for 2000 for policy analysis.

References

[1] Baxter, M., and R. G. King(1993):"Fiscal Policy in General Equilibrium," *American Economic Review*, 86,1154–1174.

[2] Barro, Robert J.(1974):"Are government bonds net wealth?," *Journal of Political Economy*, 82(6),1095-1117.

[3] Bowen, W.G., R.G. Davis and D. H. Kopf (1960):"The Public Debt: A Burden on Future Generations?," *The American Economic Review*, 50,701-6.

[4] Buchanan, J. M. (1958): Public Principles of the Public Debt, Homewood, Illinois: Richard D. Irwin, 1958.

[5] Burnside, C., M. Eichenbaum, and J. D. M. Fisher(2000):"Assessing the Effects of Fiscal Shocks,"NBER Working Paper,7459.

[6] Chung, Hess., Leeper, Eric, M (2009):"What Has Financed Government Debt?,"CAEPR Working Paper, 2007-015, Indiana University.

[7] Campbell, J. Y., and N. G. Mankiw (1989):"Consumption, Incomes, and Interest Rates: Reinterpreting the Time Series Evidence,"in *NBER Macroeconomics Annual* 1989, ed. by O. J. Blanchard, and S. Fischer,185-216,MIT Press.

[8] Campbell, J. Y., and N. G. Mankiw (1990):"Permanent Income, Current Income, and Consumption," *Journal of Business and Economic Statistics*, 8(3),265-279.

[9] Chang, Y., and S. B. Kim(2006):"From Individual to Aggregate Labor Supply:A Quantitative Analysis Based on a Heterogeneous Agent Macoreconomy,"*International Economic Review*,47(1).

[10] Cooley, T. F. (ed.) (1995): Frontiers of Business Cycle Research. Princeton University Press, Princeton, NJ.

[11] Congressional Budget Office (2011):CBO's 2011 Long-Term Budget Outlook, Washington, D.C.

[12] ———- (2004):"Macroeconomic Analysis of a 10 Percent Cut in Income Tax Rates," 2004-7,May,Washington, D.C.

[13] Diamond, Peter(1965):"Debt in a Neoclassical Growth Model," *The Amercian Economic Review*,55(5).

[14] Domar, Evsey D. (1944):"The "Burden of the Debt" and the National Income," *The American Economic Review*, 34(4),798-827.

[15] Domeij, D., and M. Floden (2005):"The Labor-Supply Elasticity and Borrowing Constraints: Why Estimates are Biased,"*Review of Economic Dynamics*, 9,242-262.

[16] Dornbusch, Rudiger, Stanley Fischer and Richard Startz (2011): Macroeconomics, Eleventh Edition, McGraw-Hill.

[17] Drautzburg, Thorsten, and Harald Uhlig (2011):"Fiscal Stimulus and Distortionary Taxation," *MFI Working Paper Series*, No. 2011-005.

[18] Economic Report of the President (2010):United states government printing office, Washington,D.C.

[19] Erceg, C. J., L. Guerrieri, and C. J. Gust (2005):"Expansionary Fiscal Shocks and the Trade Deficit,"*International Finance*, 8(3),363–397.

[20] Forni, L., L. Monforte, and L. Sessa (2006):"Keynes vs. Ricardo: Revisiting the Effects of Fiscal Policy in an Estimated DSGE Model for the Euro Area," Manuscript, Bank of Italy.

[21] Gali, J., D. Lopez-Salido, and J. Valles (2007):"Understanding the Effects of Government Spending on Consumption,"*Journal of the European Economic Association*,5(1),227-270.

[22] Internal Revenue Service (2006): *Individual Income Tax Returns 2003*, Statistics of Income.

[23] Joint Committee on Taxation (2006):"Background Information about the Dynamic Stochastic General Equilibrium Model Used By the Staff of the Joint Committee on Taxation in the Macroeconomic Analysis of Tax Policy," JCX-52-06,2006.

[24] —(2005a):"Macroeconomic Analysis of Various Proposals to Provide $500 Billion in Tax Relief," JCX-4-05.

[25] —(2005b):"Overview of Revenue Estimating Procedures and Methodologies Used by the Staff of the Joint Committee on Taxation,"

[26] Jones, J. B. (2002):"Has Fiscal Policy Helped Stabilize the Postwar U.S. Economy?,"*Journal of Monetary Economics*, 49(May),709–746.

[27] Leeper, E. M., S. -C. S. Yang (2008):"Dynamic Scoring: Alternative Financing Schemes,"Journal of Public Economics, 92(1-2),59–182.

[28] Leeper, E. M., Michael Plante and Nora Traum (2010):"Dynamics of Fiscal Financing in the United States,"*Journal of Econometrics*, 156,304-321.

[29] Leeper, E. M., Nora Traum and Todd B. Walker (2011):"Clearing up the Fiscal Multiplier Morass," Indiana University, mimeo.

[30] King, R. G., and S. Rebelo (1999): "Resuscitating Real Business Cycles," in *Handbook of Macroeconomics*, Volume 1B, ed. by J. B. Taylor, and M. Woodford, pp. 927—1007. Elsevier, Amsterdam.

[31] Mankiw, N. G., and M. Weinzierl (2006):"Dynamic Scoring: A Back-of-the- Envelope Guide,"*Journal of Public Economics*, 90 (8-9).

[32] Modigliani, Franco (1961):"Long-Run Implications of Alternative Fiscal Policies and The Burden of The National Debt,"*Economic Journal*, 71,730–755.

[33] Ogaki, M. and C. Reinhart, (1998):"Measuring Intertemporal Substitution:The Role of Durable Goods,"*Journal of Political Economy*, 105(5),1078-1098.

[34] Poterba, James, M. (1988):"Are Consumers Forward Looking? Evidence from Fiscal Experiments,"*American Economic Review* 78(May),413-418.

[35] Shapiro, Matthew D., and Joel Slemrod(1995):"Consumer Response to the Timing of Income:Evidence From a Change in Tax Withholding,"*American Economic Review* ,85 (March),274-283.

[36] Sims, C. A. (2001):"Solving Linear Rational Expectations Models,"*Journal of Computational Economics*,20(1-2).

[37] Trabandt, M., and H. Uhlig (2006): "How Far Are We From the Slippery Slope?The Laffer Curve Revisited," SFB 649 Discussion Paper 2006-023, Humboldt University.

[38] Traum, Nora and Shu-Chung SusanYang (2010):" When Does Government Debt Crowd Out Investment?," North Carolina State University, mimeo.

[39] Wolff, Nathan, Edward. (1998):"Recent Trends in the Size Distribution of Household Wealth," *Journal of Economic Perspectives,* 12(3), 131-150.

[40] Yang, Shu-Chun Susan (2006):"Distributional Analysis of Debt-Financed Capital Income Tax Cuts," Joint Committee on Taxation, mimeo.

[41] Vickrey, William. (1961):"The Burden of the Public Debt: Comment," *The American Economic Review*,51(1).

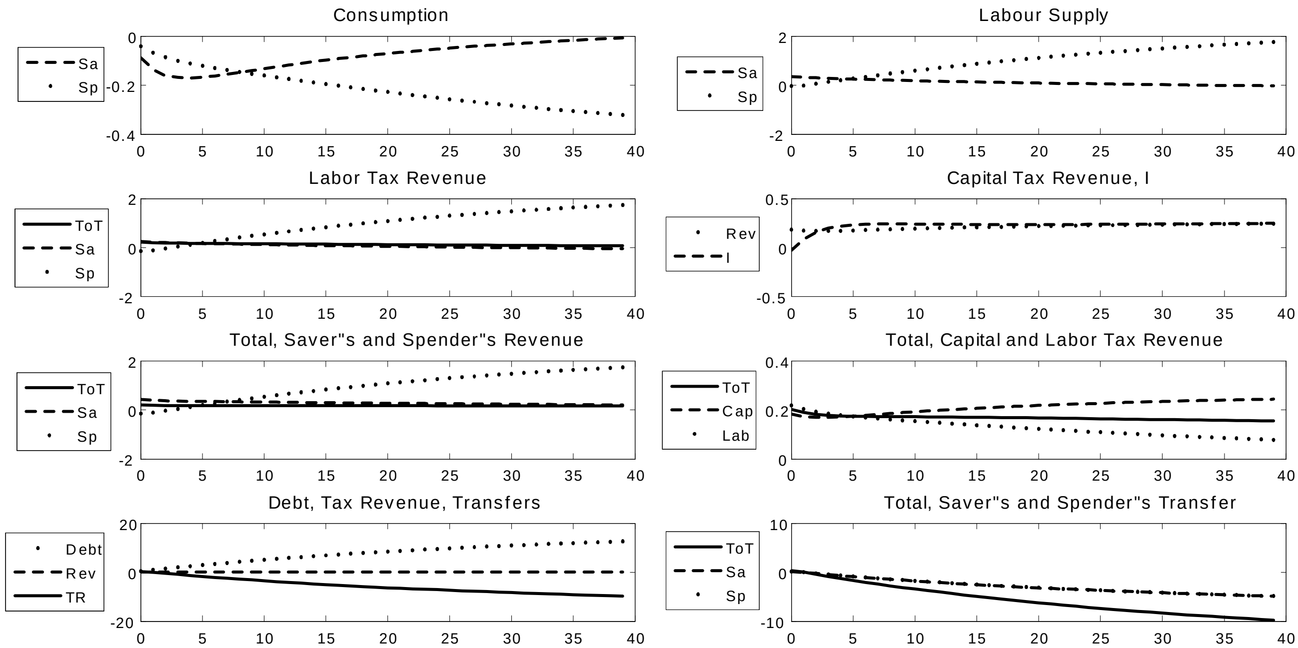

Figure 1: Government spending shock when both transfers adjust. Legends; Sa-saver, Sp-spender, ToT-in panel (2,1) total labor tax revenue, in panel (3,3) total tax revenue and in panel (4,4) total transfers, rev-capital tax revenue, TR-total transfers.

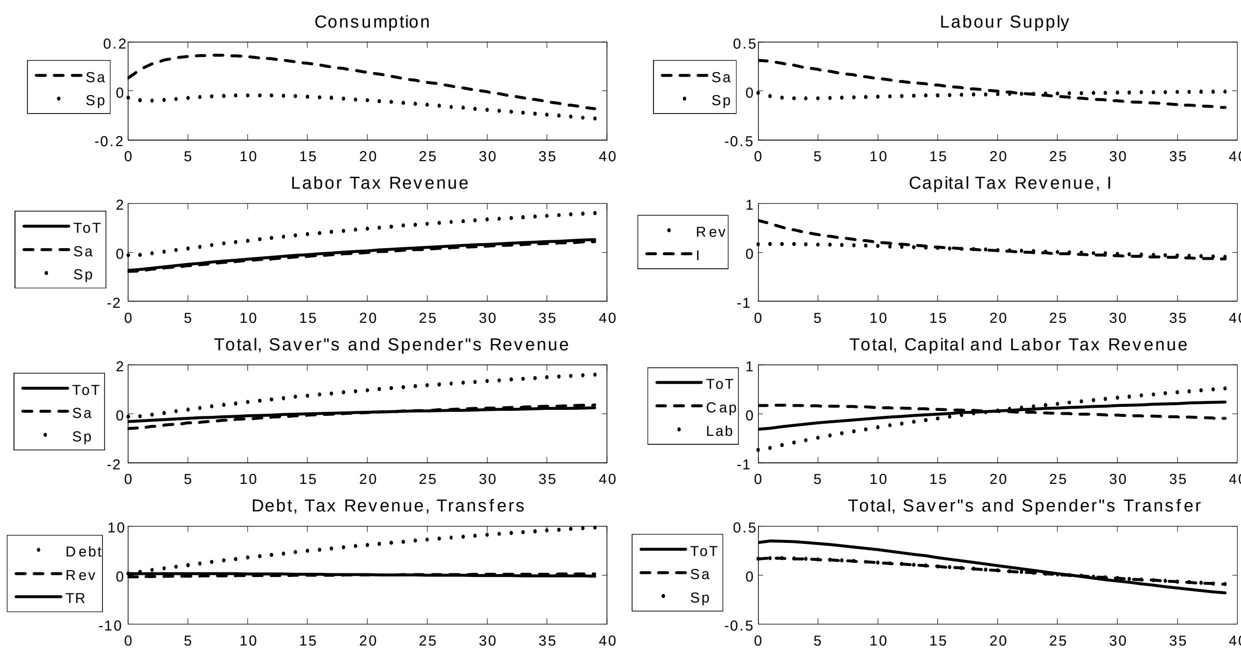

Figure 2: Saver's labor tax shock when both labor taxes adjust. Legends; Sa-saver, Sp-spender, ToT-in panel (2,1) total labor tax revenue, in panel (3,3) total tax revenue and in panel (4,4) total transfers, rev-capital tax revenue, TR-total transfers.

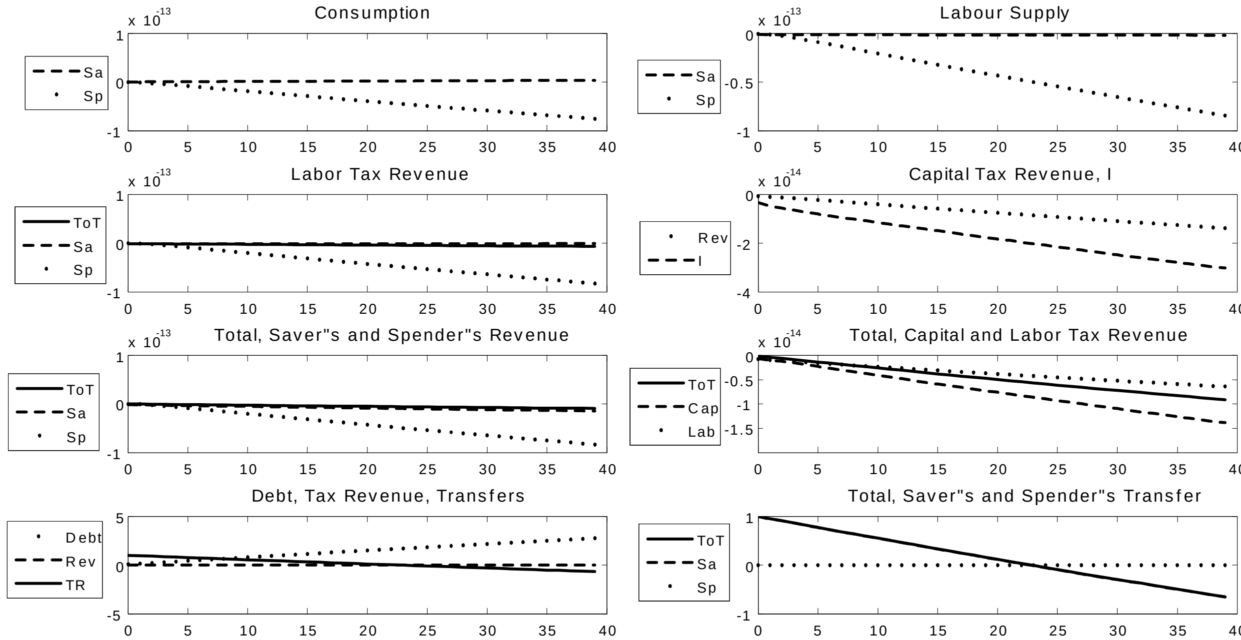

Figure 3: Shock to saver's transfers when saver's transfers adjust. Legends; Sa-saver, Sp-spender, ToT-in panel (2,1) total labor tax revenue, in panel (3,3) total tax revenue and in panel (4,4) total transfers, rev-capital tax revenue, TR-total transfers.

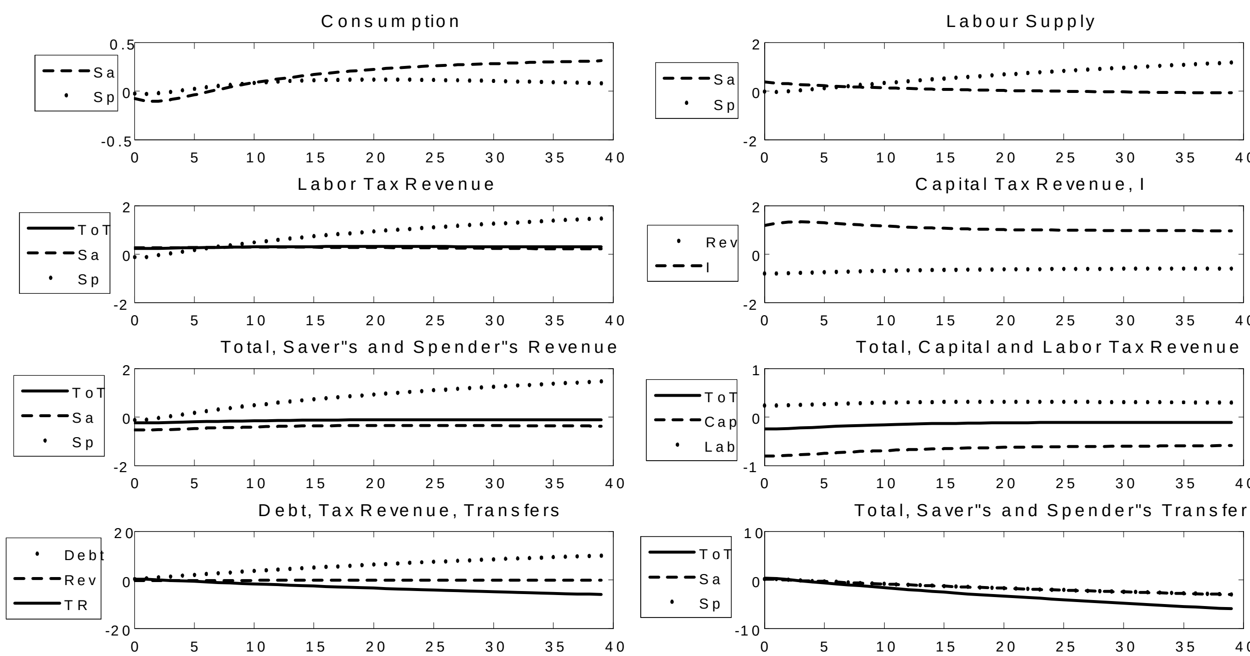

Figure 4: Capital tax shock when both transfer adjust. Legends; Sa-saver, Sp-spender, ToT-in panel (2,1) total labor tax revenue, in panel (3,3) total tax revenue and in panel (4,4) total transfers, rev-capital tax revenue, TR-total transfers.

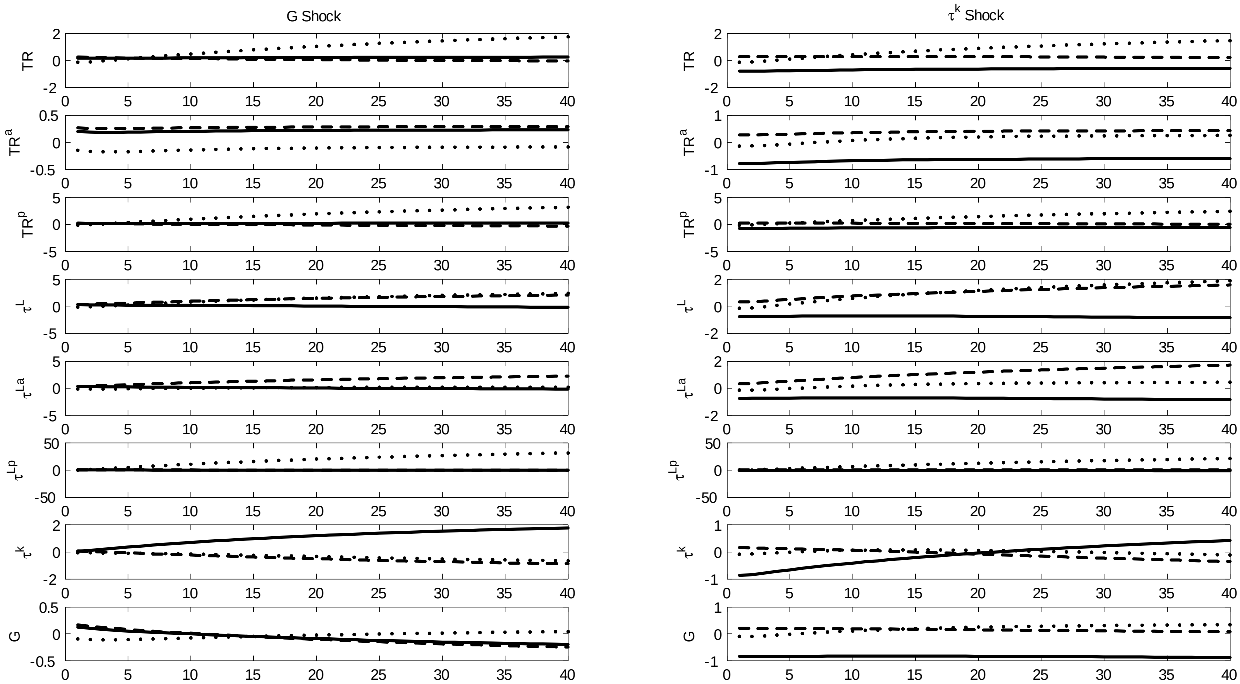

Figure 5:Government spending and capital tax shock. X,Y axis indicates shock,adjustment.Solid line-capital tax revenue; dashed line-saver's labor tax revenue; dotted line-spender's labor tax revenue.

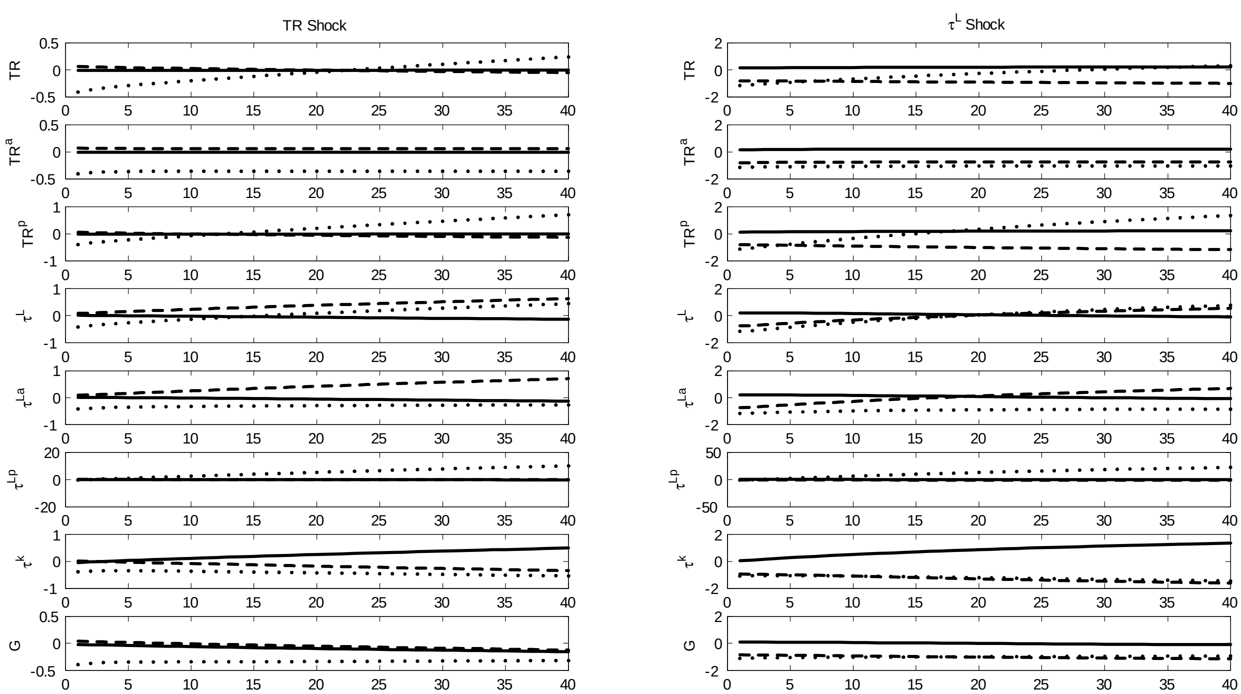

Figure 6:Total transfer and both labor tax shock. X,Y axis indicates shock, adjustment.Solid line-capital tax revenue; dashed line-saver's labor tax revenue; dotted line-spender's labor tax revenue.

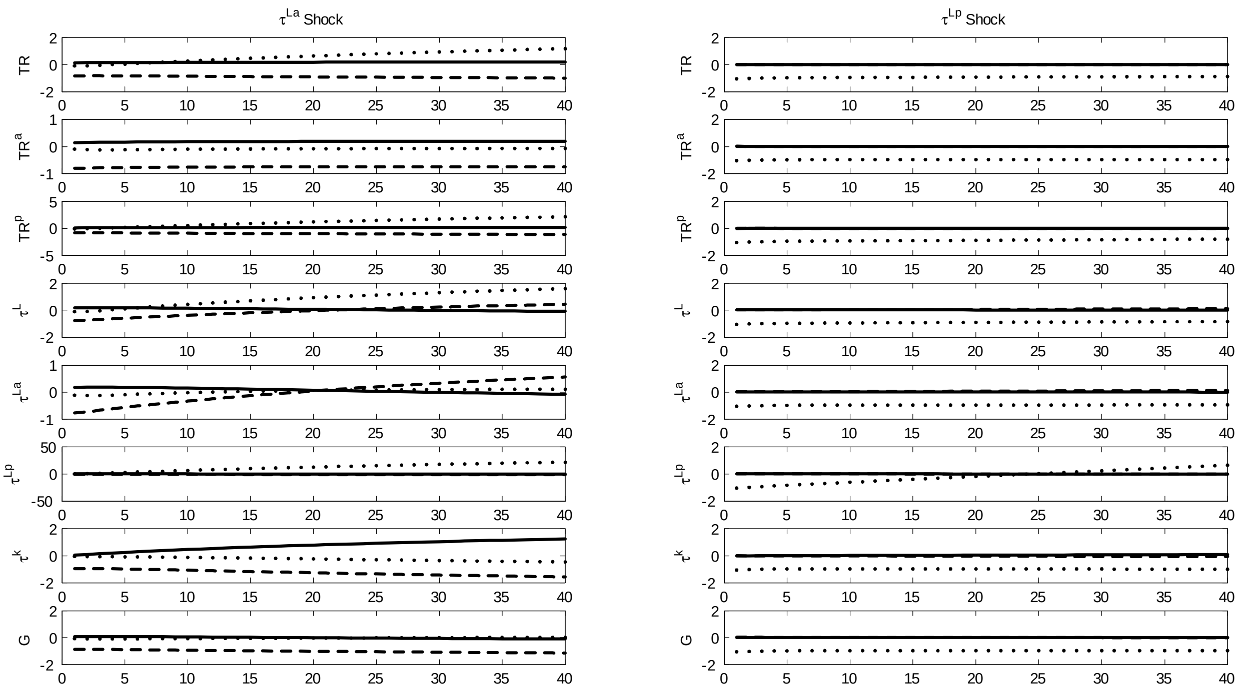

Figure 7:Saver's and Spender's labor tax shock. X,Y axis indicates shock,adjustment.Solid line-capital tax revenue; dashed line-saver's labor tax revenue; dotted line-spender's labor tax revenue.

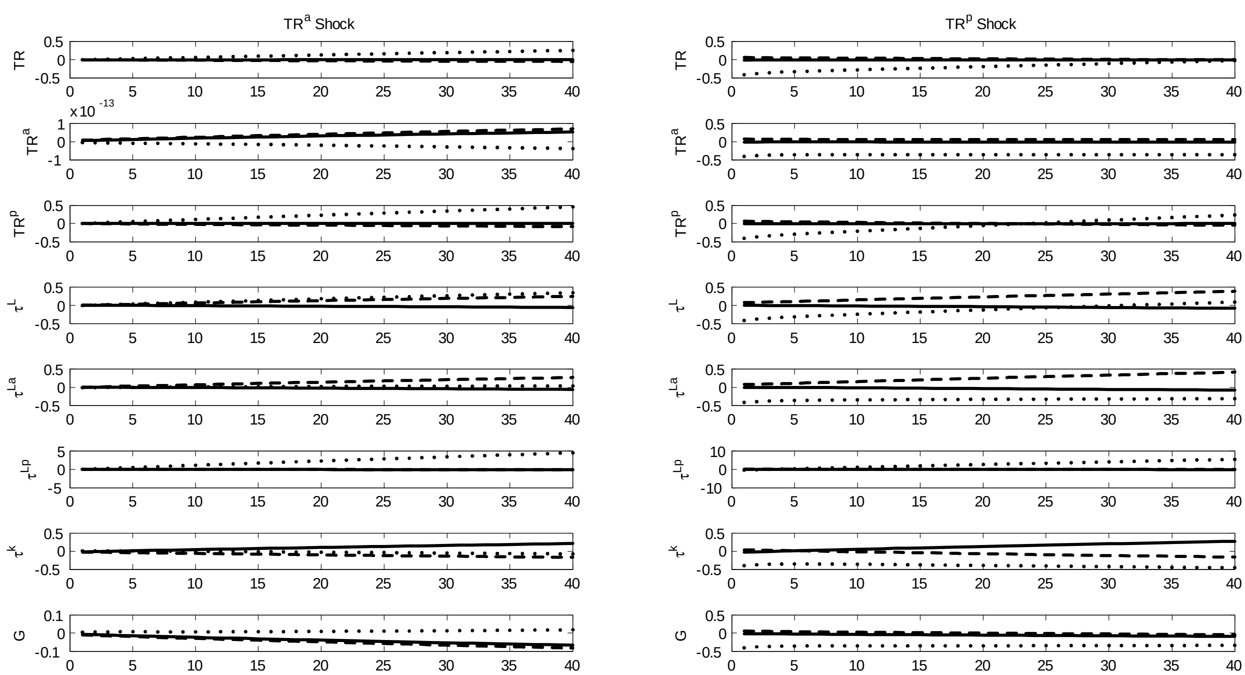

Figure 8:Saver's and spender's transfer shock. X,Y axis indicates shock,adjustment.Solid line-capital tax revenue; dashed line-saver's labor tax revenue; dotted line-spender's labor tax revenue.

Parameter	Value	Parameter	Value	Value	Value
α	0.36				
$\beta_1 = \beta_2$	0.96				
F	0.60		**1947-2005**	**1983-2007**	**2000**
χ^a	2.721	V	0.40	0.20	
χ^p	2.543	τ^K	0.35	0.320	0.341
L	0.2	τ^{L_a}	0.253	0.304	0.334
$\gamma_1 = \gamma_2$	1	τ^{L_p}	0.096	0.117	0.128
$b_1 = b_2$	0.6	S^C	0.63	0.67	
θ_1	1	S^B	0.376	0.40	
θ_2	2	S^I	0.17	0.14	
δ	0.06	S^{TR}	0.07	0.11	
F	0.60	S^G	0.20	0.19	

Table 1: Benchmark Parameter values.

	Part 1.1: Baseline							
Row:Parameters / Column:Shocks	G	τ^k	τ^L	τ^{L_a}	τ^{L_p}	TR	TR^a	TR^p
$q_{TR^a} = q_{TR^p}$	$-.4197$	$-.35866$	$-.37231$	$-.36315$	$-.24966$	$-.3009$	$-.26840$	$-.27594$
q_{TR^a}	$-.96265$	$-.8227$	$-.8540$	$-.8330$	$-.5726$	$-.69019$	$-.61563$	$-.63292$
q_{TR^p}	$-.7441$	$-.6359$	$-.6601$	$-.64386$	$-.44268$	.53349	$-.47588$	$-.48923$
$q_{L_a} = q_{Lp}$	.18624	.15916	.16521	.16115	.11079	.13352	.11910	.12245
q_{L_a}	.20055	.17139	.17791	.17353	.11929	.14378	.12825	.13185
q_{Lp}	2.6102	2.23065	2.31556	2.25858	1.55446	1.87142	1.66964	1.7163
q_K	.20839	.1781	.18487	.18032	.12409	.14941	.13330	.13703
q_G	$-.13604$	$-.11626$	$-.12068$	$-.11771$	$-.08099$	$-.09753$	$-.08701$	$-.08945$
	Part 1.2: Sensitivity Analysis							
	G	τ^k	τ^L	τ^{L_a}	$\overset{*}{\tau^{L_p}}$	TR	$\overset{*}{TR^a}$	$\overset{*}{TR^p}$
$q_{TR^a} = q_{TR^p}$	$-.2617$	$-.25386$	$-.25572$	.25448	$-.24394$	$-.24432$	$-.25845$	$-.26376$
q_{TR^a}	$-.60977$	$-.58223$	$-.58649$	$-.58365$	$-.55951$	$-.5603$	$-.59278$	$-.60497$
q_{TR^p}	$-.46389$	$-.45117$	$-.4534$	$-.45121$	$-.43258$	$-.43728$	$-.45831$	$-.46766$
$q_{L_a} = q_{Lp}$	.116104	.11265	.113477	.11292	.10826	.10842	.11471	.11705
q_{L_a}	.12502	.12130	.12219	.12159	.11656	.11674	.12351	.12604
q_{Lp}	1.62788	1.58012	1.5915	1.58391	1.51964	1.52185	1.6085	1.641
q_K	.12997	.12615	.12706	.126454	.12132	.12149	.12842	.13102
q_G	$-.08483$	$-.08234$	$-.08293$	$-.08254$	$-.07917$	$-.07929$	$-.08382$	$-.08552$

Table 2: Part 1.1 of the table shows fiscal adjustment parameters under various policy rules for baseline. Columns show different policy shocks while rows show values of the fiscal parameters that will be used to raise debt-GDP ratio from 0.376 to 0.442 in the new steady state. Part 1.2 of the table shows fiscal adjustment parameters under various policy rules for sensitivity analysis of fiscal parameters. Parameters are used to take the new long run value of S^B from 0.376 to 1. Here "*" indicates the shocks which takes the value of S^B from 0.376 to 0.4794 in the new steady state.

Row: Financed By / Column: Shocks to	G	τ^k	τ^L	τ^{L_a}	τ^{L_p}	TR	TR^a	TR^p
ΔB	1	1	1	1	1	1	1	1
	Both Transfer Adjusts							
G	-29.95	-13.74	-6.69	-6.57	-8.36	0.50	0.11	0.84
T^k	3.32	-16.46	4.21	4.14	5.27	-0.32	-0.07	-0.53
T^{L_a}	1.00	6.58	-21.09	-22.57	0.86	-0.52	-3.70	1.97
T^{L_p}	1.24	1.72	-0.40	1.21	-24.30	0.04	1.37	-1.01
TR^a	10.28	9.68	10.10	10.03	11.17	0.55	-13.03	11.26
TR^p	15.42	14.52	15.14	15.04	16.75	0.82	16.41	-11.45
R^b	-0.30	-1.31	-0.28	-0.27	-0.39	-0.08	-0.09	-0.08
Surplus	1.30	2.31	1.28	1.27	1.39	1.08	1.09	1.08
Debt Financed by Sa	14.59	-0.20	-6.78	-8.41	17.30	-0.29	-16.72	13.22
Debt Financed by Sp	16.66	16.25	14.75	16.25	-7.54	0.87	17.78	-12.45
Gap(=Sp-Sa)	**2.06**	**16.45**	**21.52**	**24.66**	**-24.84**	**1.15**	**34.57**	**-25.14**
	Saver's Transfer Adjusts							
Debt Financed by Sa	32.53	18.70	11.17	9.39	37.48	17.71	1.00	30.87
Debt Financed by Sp	-1.26	-2.64	-3.21	-1.56	-27.68	-17.13	0.00	-30.62
Gap(=Sp-Sa)	**-33.79**	**-21.34**	**-14.37**	**-10.95**	**-65.16**	**-34.83**	**-1.00**	**-61.50**
	Spender's Transfer Adjusts							
Debt Financed by Sa	0.70	-14.85	-20.68	-22.21	1.63	-14.24	-30.60	-1.42
Debt Financed by Sp	30.54	30.88	28.66	30.05	8.08	14.82	31.57	1.65
Gap(=Sp-Sa)	**29.83**	**45.73**	**49.34**	**52.26**	**6.45**	**29.06**	**62.17**	**3.06**
	Government Spending Adjusts							
Debt Financed by Sa	-2.63	-18.36	-23.96	-25.46	-2.44	-17.65	-33.95	-4.98
Debt Financed by Sp	0.41	-0.84	-1.50	0.13	-25.51	-15.27	1.70	-28.63
Gap(=Sp-Sa)	**3.04**	**17.52**	**22.46**	**25.59**	**-23.07**	**2.38**	**35.65**	**-23.66**
	Both Labor Tax Adjusts							
Debt Financed by Sa	23.42	9.09	1.97	0.27	27.53	8.60	-8.04	21.80
Debt Financed by Sp	1.83	0.59	-0.14	1.49	-24.41	-14.15	3.03	-27.69
Gap(=Sp-Sa)	**-21.59**	**-8.50**	**-2.11**	**1.22**	**-51.93**	**-22.75**	**11.07**	**-49.49**
	Saver's Labor Tax Adjusts							
Debt Financed by Sa	25.48	11.26	4.03	2.31	29.89	10.68	-5.99	23.90
Debt Financed by Sp	0.09	-1.25	-1.89	-0.24	-26.38	-15.90	1.30	-29.47
Gap(=Sp-Sa)	**-25.40**	**-12.51**	**-5.91**	**-2.55**	**-56.26**	**-26.58**	**7.29**	**-53.38**
	Spender's Labor Tax Adjusts							
Debt Financed by Sa	-3.89	-19.78	-25.33	-26.83	-3.98	-19.04	-35.40	-6.35
Debt Financed by Sp	24.89	24.96	23.03	24.47	1.94	9.27	26.07	-3.91
Gap(=Sp-Sa)	**28.78**	**44.73**	**48.36**	**51.30**	**5.92**	**28.31**	**61.46**	**2.45**
	Capital Tax Adjusts							
Debt Financed by Sa	11.08	-3.91	-10.12	-11.74	12.52	-3.97	-20.38	8.66
Debt Financed by Sp	1.98	0.86	0.12	1.72	-23.46	-13.52	3.32	-26.76
Gap(=Sp-Sa)	**-9.10**	**4.77**	**10.24**	**13.46**	**-35.97**	**-9.55**	**23.70**	**-35.42**

Table 3: The fraction of government debt innovations, due to shocks listed in columns 2 to 9, that are financed by each components of the government budget listed in rows 4 to 10. Fiscal parameters used in the experiment are listed in part 1.1 of table 2. In each experiment, the debt-output ratio in the long run is raised from 0.376 to 0.442.

Row: Financed by / Column: Shocks to	G	τ^k	τ^L	τ^{L_a}	τ^{L_a}	TR	TR^a	TR^p
ΔB	1	1	1	1	1	1	1	1
	Both Transfer Adjusts							
G	-29.89	-13.69	-6.63	-6.51	-8.36	0.54	0.12	0.85
T^k	3.27	-16.51	4.18	4.10	5.27	-0.34	-0.07	-0.54
T^{L_a}	0.94	6.54	-21.14	-22.63	0.86	-0.54	-3.70	1.96
T^{L_p}	1.24	1.72	-0.40	1.21	-24.30	0.04	1.37	-1.01
TR^a	10.30	9.70	10.11	10.04	11.17	0.56	-13.03	11.26
TR^p	15.45	14.55	15.17	15.06	16.75	0.84	16.41	-11.44
R^b	-0.31	-1.32	-0.29	-0.28	-0.39	-0.09	-0.09	-0.08
Surplus	1.31	2.32	1.29	1.28	1.39	1.09	1.09	1.08
Debt Financed by Sa	14.51	-0.27	-6.85	-8.48	17.29	-0.33	-16.80	12.68
Debt Financed by Sp	16.69	16.27	14.77	16.27	-7.54	0.88	17.78	-12.45
Gap(=Sp-Sa)	**2.18**	**16.54**	**21.62**	**24.76**	**-24.83**	**1.20**	**34.58**	**-25.13**
	Saver's Transfer Adjusts							
Debt Financed by Sa	32.53	18.70	11.17	9.39	37.48	17.71	1.00	31.34
Debt Financed by Sp	-1.26	-2.64	-3.21	-1.56	-27.68	-17.13	0.00	-30.62
Gap(=Sp-Sa)	**-33.79**	**-21.34**	**-14.37**	**-10.95**	**-65.16**	**-34.83**	**-1.00**	**-61.96**
	Spender's Transfer Adjusts							
Debt Financed by Sa	0.52	-14.99	-20.84	-22.35	1.62	-14.32	-30.62	-1.43
Debt Financed by Sp	30.62	30.95	28.72	30.12	8.08	14.85	31.58	1.65
Gap(=Sp-Sa)	**30.10**	**45.94**	**49.56**	**52.47**	**6.46**	**29.17**	**62.19**	**3.08**
	Government Spending Adjusts							
Debt Financed by Sa	-3.07	-18.72	-24.34	-25.83	-2.46	-17.85	-33.99	-5.02
Debt Financed by Sp	0.48	-0.79	-1.45	0.18	-25.51	-15.26	1.71	-28.64
Gap(=Sp-Sa)	**3.55**	**17.93**	**22.89**	**26.00**	**-23.05**	**2.59**	**35.70**	**-23.62**
	Both Labor Tax Adjusts							
Debt Financed by Sa	23.59	9.23	2.13	0.42	27.54	8.69	-8.02	21.81
Debt Financed by Sp	1.78	0.56	-0.17	1.46	-24.41	-14.15	3.02	-27.69
Gap(=Sp-Sa)	**-21.80**	**-8.68**	**-2.30**	**1.04**	**-51.94**	**-22.84**	**11.04**	**-49.50**
	Saver's Labor Tax Adjust							
Debt Financed by Sa	25.68	11.43	4.21	2.49	29.90	10.78	-5.97	23.92
Debt Financed by Sp	0.04	-1.28	-1.92	-0.27	-26.38	-15.91	1.30	-29.47
Gap(=Sp-Sa)	**-25.64**	**-12.71**	**-6.13**	**-2.76**	**-56.27**	**-26.69**	**7.27**	**-53.39**
	Spender's Labor Tax Adjusts							
Debt Financed by Sa	-4.43	-20.19	-25.76	-27.24	-4.00	-19.27	-35.44	-6.40
Debt Financed by Sp	25.07	25.10	23.17	24.60	1.95	9.34	26.08	-3.89
Gap(=Sp-Sa)	**29.50**	**45.29**	**48.93**	**51.84**	**5.95**	**28.61**	**61.52**	**2.51**
	Capital Tax Adjusts							
Debt Financed by Sa	10.37	-4.49	-10.76	-12.34	12.49	-4.31	-20.45	8.59
Debt Financed by Sp	2.13	0.97	0.23	1.83	-23.46	-13.50	3.33	-26.76
Gap(=Sp-Sa)	**-8.24**	**5.45**	**10.99**	**14.17**	**-35.94**	**-9.19**	**23.78**	**-35.36**

Table 4: Sensitivity analysis results for fiscal parameters.The fraction of government debt innovations, due to shocks listed in columns 2 to 9, that are financed by each components of the government budget listed in rows 4 to 10. Fiscal parameters used in the experiment are listed in part 1.2 of table 2. In each experiment, the debt-output ratio in the long run is raised from 0.376 to 1.0 while it is raised to 0.4794 only for shocks to transfer to saver (column 8), spender (column 9) and labor tax to spender (column 6).

Row: Parameter Values / Column: Shocks to	G	τ^k	τ^L	τ^{L_a}	τ^{L_p}	TR	TR^a	TR^p
ΔB	1	1	1	1	1	1	1	1
	Both Transfer Adjusts							
$\theta_1 = \theta_2 = 0.25$	0.76	12.19	22.08	22.20	-25.74	0.64	35.26	-27.15
$\theta_1 = 1, \theta_2 = 1$	1.90	16.27	21.36	24.50	-25.16	1.04	34.39	-25.36
$\theta_1 = \theta_2 = 2$	13.33	**-107.51**	**-60.44**	**-24.30**	-70.68	**-7.14**	4.53	-221.14
$\theta_1 = 2, \theta_2 = 1$	23.81	286.18	**-53.49**	**-23.29**	-86.26	7.60	60.56	-32.99
$\gamma_1 = \gamma_2 = 2$	2.53	**-2.16**	30.50	23.19	**24.62**	1.03	33.57	-24.58
$\gamma_1 = 2, \gamma_2 = 1$	2.86	**-26.43**	36.24	23.14	**24.87**	**-0.29**	30.47	-24.77
$\gamma_1 = 1, \gamma_2 = 2$	1.98	9.97	14.42	18.49	-25.04	1.26	34.47	-24.79
$F = 0.50$	2.12	18.27	18.20	24.76	-24.74	1.31	34.75	-24.87
$F = 0.70$	1.97	14.55	24.03	24.45	-24.28	0.96	34.35	-25.48
$V = 0.50$	**-3.94**	10.75	15.29	18.64	-31.40	0.71	28.18	-31.74
$V = 0.20$	14.69	28.47	34.61	37.35	-0.20	2.18	47.98	-11.30
$b_1 = b_2 = 0.40$	2.02	15.59	21.08	24.71	-23.68	1.19	34.64	-24.88
$b_1 = 0.60, b_2 = 0.80$	2.07	16.41	21.53	24.63	-26.39	1.11	34.58	-8.04
$b_1 = b_2 = 0$	1.96	16.76	20.71	24.86	-22.11	1.20	34.69	-24.46
	Saver's Transfer Adjusts							
$\theta_1 = \theta_2 = 0.25$	-35.81	-25.58	-14.28	-14.04	-109.95	-35.66	-1.0	-63.49
$\theta_1 = 1, \theta_2 = 1$	-33.77	-21.32	-14.36	-10.92	-65.49	-34.59	-1.0	-61.22
$\theta_1 = \theta_2 = 2$	-30.47	**16.24**	-7.79	**23.02**	-86.07	-47.75	-1.0	-83.38
$\theta_1 = 2, \theta_2 = 1$	-32.20	**282.70**	**1.86**	**29.73**	-87.15	-47.51	-1.0	-84.18
$\gamma_1 = \gamma_2 = 2$	-31.94	-36.64	-3.90	-11.11	**58.42**	-33.84	-1.0	-59.76
$\gamma_1 = 2, \gamma_2 = 1$	-28.72	-54.60	**5.07**	-8.18	**56.53**	-32.11	-1.0	-56.74
$\gamma_1 = 1, \gamma_2 = 2$	-33.62	-27.51	-21.44	-16.98	-64.97	-34.65	-1.0	-61.11
$F = 0.50$	-33.97	-20.64	-18.16	-11.09	-64.69	-34.95	-1.0	-61.61
$F = 0.70$	-33.62	-22.11	-11.40	-10.88	-72.36	-34.63	-1.0	-61.29
$V = 0.50$	-33.36	-20.27	-14.17	-10.58	-64.28	-28.75	-1.0	-61.56
$V = 0.20$	-9.35	**2.47**	**7.74**	**9.11**	-10.38	-8.74	**9.46**	-12.84
$b_1 = b_2 = 0.40$	-33.93	-21.46	-14.98	-11.14	-62.48	-34.75	-1.0	-61.10
$b_1 = 0.60, b_2 = 0.80$	-33.72	-21.22	-14.37	-10.93	-67.83	-34.96	-1.0	-61.92
$b_1 = b_2 = 0$	-34.12	-21.66	-15.46	-11.30	-58.54	-34.53	-1.0	-60.27
	Spender's Transfer Adjusts							
$\theta_1 = \theta_2 = 0.25$	30.11	42.50	51.27	51.30	-35.96	29.78	64.38	2.02
$\theta_1 = 1, \theta_2 = 1$	29.93	45.82	49.44	52.35	6.57	29.06	62.25	2.85
$\theta_1 = \theta_2 = 2$	41.98	**-164.14**	**-94.34**	**-54.74**	**-41.51**	**-40.76**	**-2.15**	52.88
$\theta_1 = 2, \theta_2 = 1$	72.30	289.37	**-100.74**	**-68.37**	**-44.88**	53.29	19.61	**-139.30**
$\gamma_1 = \gamma_2 = 2$	29.32	24.64	57.23	49.86	**-1.66**	28.15	60.45	2.77
$\gamma_1 = 2, \gamma_2 = 1$	27.40	**-4.56**	60.46	47.47	0.31	24.41	54.90	0.05
$\gamma_1 = 1, \gamma_2 = 2$	29.38	38.83	42.03	45.80	5.74	28.93	61.81	3.21
$F = 0.50$	29.78	48.12	46.10	52.27	5.96	29.16	62.22	3.35
$F = 0.70$	29.93	43.37	51.89	52.23	13.56	28.97	62.17	2.71
$V = 0.50$	30.36	46.94	49.66	52.74	**-33.40**	35.08	40.94	**-102.02**
$V = 0.20$	28.79	43.32	48.72	51.35	5.13	16.44	62.00	30.17
$b_1 = b_2 = 0.40$	29.76	45.97	48.93	52.41	6.34	28.98	62.22	3.13
$b_1 = 0.60, b_2 = 0.80$	29.84	45.62	49.39	52.23	5.81	29.12	62.21	2.94
$b_1 = b_2 = 0$	29.73	46.34	48.56	52.71	6.01	28.75	62.22	3.15

Table 5: Sensitivity analysis results for deep parameters.Table only reports the gap of debt burden between the spender and the saver. Fiscal parameters used in the experiment are listed in part 1.1 of table 2.

Part 1.1: Extended Baseline Scenario(30 Years)						
Row:Parameters / Column:Adjustment by	G	TR^a, TR^p	TR^a, TR^p, G	τ^k ,G	$\tau^{L_a}, \tau^{L_p}, G$	All
$q_{TR^a} = q_{TR^p}$		-0.25757	-0.1361			-0.1407
q_G	-0.13706		-0.0647	-0.1367	-0.13632	-0.0609
q_K				0.0007		0.0007
$q_{L_a} = q_{L_p}$					0.001	0.001
Part 1.2: Alternative Scenario(30 Years)						
$q_{TR^a} = q_{TR^p}$		-0.14772	-0.11			
q_G	-0.0905		-0.0311			
Part 2.1: Extended Baseline Scenario(100 Years)						
$q_{TR^a} = q_{TR^p}$		-0.351	-0.10			-0.10
q_G	-0.1827		-0.1305	-0.17662	-0.18187	-0.1293
q_K				0.009		0.007
$q_{L_a} = q_{L_p}$					0.001	0.001
Part 2.2: Alternative Scenario(100 Years)						
$q_{TR^a} = q_{TR^p}$		-0.194	-0.03			
q_G	-0.1015		-0.0858			

Table 6: Fiscal parameters used for extended baseline and alternative scenario.Part 1.1 of the table shows fiscal adjustment parameters under various policy rules for extended baseline scenario in 30-year window when there is a 10% permanent increase in government spending.Columns show different policy adjustments while rows show values of the fiscal parameters that will be used to raise debt-GDP ratio from 0.40 to 0.84 in the new steady state within 30 years. Part 1.2 shows fiscal adjustment parameters under various policy rules for alternative scenario in 30-year window when debt-GDP ratio is raised from 0.40 to 1.0. Part 2.1 shows adjustment parameters for the extended baseline scenario in 100-year window where the debt-GDP ratio is 0.84 in the new steady state. Part 2.2 shows adjustment parameters for the alternative scenario in 100-year window where the debt-GDP ratio is raised to 1.90.

Part 1.1: Extended Baseline Scenario(30 Years)							
		Finance Horizon					PV Finance
Adjustment	**Debt Multiplier**	**Impact**	**10YR**	**15YR**	**20YR**	**30YR**	**Gap**
G	Saver Multiplier	0.61	0.02	0.00	-0.01	-0.02	**3.29**
	Spender Multiplier	-0.56	-0.02	0.00	0.01	0.01	
TR^a,TR^p	Saver Multiplier	0.75	0.26	0.25	0.24	0.24	**15.48**
	Spender Multiplier	-0.70	0.23	0.26	0.28	0.30	
TR^a,TR^p,G	Saver Multiplier	0.68	0.15	0.13	0.12	0.12	**9.70**
	Spender Multiplier	-0.63	0.11	0.14	0.15	0.17	
τ^k ,G	Saver Multiplier	0.61	0.02	0.00	-0.01	-0.02	**3.24**
	Spender Multiplier	-0.56	-0.02	0.00	0.01	0.01	
τ^{L_a}, τ^{L_p},G	Saver Multiplier	0.61	0.02	0.00	-0.01	-0.02	**3.18**
	Spender Multiplier	-0.57	-0.02	0.00	0.01	0.02	
All	Saver Multiplier	0.69	0.15	0.14	0.13	0.12	**9.75**
	Spender Multiplier	-0.64	0.12	0.15	0.16	0.17	
Part 1.2: Alternative Scenario(30 Years)							
G	Saver Multiplier	0.68	0.03	0.01	0.0	-0.01	
	Spender Multiplier	-0.62	-0.03	-0.01	0.0	0.01	
TR^a,TR^p	Saver Multiplier	0.78	0.19	0.17	0.17	0.16	**16.66**
	Spender Multiplier	-0.72	0.13	0.16	0.18	0.19	
TR^a,TR^p,G	Saver Multiplier	0.74	0.14	0.12	0.11	0.10	**11.48**
	Spender Multiplier	-0.69	0.07	0.10	0.12	0.13	
Part 2.1: Extended Baseline Scenario(100 Years)							
G	Saver Multiplier	0.56	0.01	-0.01	-0.02	-0.03	**2.99**
	Spender Multiplier	-0.51	-0.02	0.00	0.01	0.02	
TR^a,TR^p	Saver Multiplier	0.72	0.34	0.33	0.33	0.32	**15.32**
	Spender Multiplier	-0.68	0.33	0.37	0.39	0.41	
TR^a,TR^p,G	Saver Multiplier	0.61	0.10	0.09	0.08	0.08	**6.53**
	Spender Multiplier	-0.56	0.09	0.11	0.12	0.13	
τ^k ,G	Saver Multiplier	0.55	0.04	0.0	-0.01	-0.02	**2.54**
	Spender Multiplier	-0.51	-0.02	0.0	0.01	0.02	
τ^{L_a}, τ^{L_p},G	Saver Multiplier	0.56	0.01	0.0	-0.01	-0.02	**2.91**
	Spender Multiplier	-0.52	-0.02	0.0	0.01	0.02	
All	Saver Multiplier	0.61	0.11	0.09	0.08	0.08	**6.41**
	Spender Multiplier	-0.56	0.09	0.11	0.12	0.13	
Part 2.2: Alternative Scenario(100 Years)							
G	Saver Multiplier	0.66	0.03	0.01	0.0	-0.01	**3.56**
	Spender Multiplier	-0.61	-0.03	-0.01	0.0	0.01	
TR^a,TR^p	Saver Multiplier	0.77	0.21	0.19	0.19	0.18	**15.60**
	Spender Multiplier	-0.71	0.16	0.19	0.21	0.22	
TR^a,TR^p,G	Saver Multiplier	0.68	0.06	0.04	0.03	0.02	**5.44**
	Spender Multiplier	-0.62	0.0	0.02	0.03	0.04	

Table 7: Saver and Spender debt multipliers and gap in the present value of debt finance when there is a 10% permanent increase in government spending. Column 1 shows different fiscal policy adjustments under baseline and alternative scenario. Column 3-7 shows debt multipliers at different points during the transition path to the new steady state.