



# IMF Working Paper

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## Macroeconomic and Welfare Costs of U.S. Fiscal Imbalances

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**IMF Working Paper**

Fiscal Affairs Department

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**Abstract**

In this paper we use a general equilibrium model with heterogeneous agents to assess the macroeconomic and welfare consequences in the United States of alternative fiscal policies over the medium-term. We find that failing to address the fiscal imbalances associated with current federal fiscal policies for a prolonged period would result in a significant crowding-out of private investment and a severe drag on growth. Compared to adopting a reform that gradually reduces federal debt to its pre-crisis level, postponing debt stabilization for two decades would entail a permanent output loss of about 17 percent and a welfare loss of almost 7 percent of lifetime consumption. Moreover, the long-run welfare gains from the adjustment would more than compensate the initial losses associated with the consolidation period.

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*“History makes clear that failure to put our fiscal house in order will erode the vitality of our economy, reduce the standard of living in the United States, and increase the risk of economic and financial instability.”*

Ben S. Bernanke, 2011 Annual Conference of the Committee for a Responsible Federal Budget

## I. INTRODUCTION

One of the main legacies of the Great Recession has been the sharp deterioration of public finances in most advanced economies. In the U.S., the federal debt held by the public surged from 36 percent of GDP in 2007 to around 70 percent in 2011. This rise in debt, however impressive, gets dwarfed when compared to the medium-term fiscal imbalances associated with entitlement programs and revenue-constraining measures. For example, the non-partisan Congressional Budget Office (CBO) foresees the debt held by the public to exceed 150 percent of GDP by 2030 (see Figure 1). Similarly, Batini et al. (2011) estimate that closing the federal “fiscal gap” associated with current fiscal policies would require a permanent fiscal adjustment of about 15 percent of GDP.<sup>1</sup>

While the crisis brought the need to address the U.S. medium-term fiscal imbalances to the center of the policy debate, the costs they entail are not necessarily well understood. Most of the long-term fiscal projections regularly produced in the U.S. and used to guide policy discussions are derived from debt accounting exercises. A shortcoming of such approach is that relative prices and economic activity are unaffected by different fiscal policies, and that it cannot be used for welfare analysis.<sup>2</sup> To overcome those limitations and contribute to the debate, in this paper we use a rational expectations general equilibrium framework to assess the medium-term macroeconomic and welfare consequences of alternative fiscal policies in the U.S. We find that failing to address the federal fiscal imbalances for a prolonged period would result in a significant crowding-out of private investment and drag on growth, entailing a permanent output loss of about 17 percent and welfare loss of almost 7 percent of lifetime consumption. Moreover, we find that the long-run welfare gains from stabilizing the federal debt at a low level more than compensate the welfare losses associated with the consolidation period. Our results also suggest that the crowding-out effects of public debt are an order of magnitude bigger than the policy mix effects: Reducing promptly the level of public debt is significantly more important for activity and welfare than differences in the size of government or the design of the tax reform.

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<sup>1</sup> The “fiscal gap” is defined as the adjustment that would be needed for the government to meet its intertemporal budget constraint.

<sup>2</sup> For example, while the debt held by the public in 2035 is projected to be 84 percent of GDP in CBO’s Extended-Baseline scenario but 187 percent in its Alternative Fiscal scenario (CBO 2011), the GDP growth and the real interest rate projected for the medium-term are the same in both scenarios.

The focus of this study is on the costs and benefits of fiscal consolidation for the U.S. over the medium-term to long-term. In this sense, we explicitly leave aside some questions on fiscal consolidation that, while very relevant for the short-run, cannot be appropriately tackled in this framework. One example is assessing the effects of back-loading the pace of consolidation in the near term—while announcing a credible medium-run adjustment—in the current context of growth below potential and nominal interest rates close to zero. A related relevant question is what mix of fiscal instruments in the near term would make fiscal consolidation less costly in such context. While interesting, these questions are beyond the scope of this paper.

The quantitative framework we use is a dynamic stochastic general equilibrium model with heterogeneous agents, and endogenous occupational choice and labor supply. In the model, ex-ante identical agents face idiosyncratic entrepreneurial ability and labor productivity shocks, and choose their occupation. Agents can become either entrepreneurs and hire other workers, or they can become workers and decide what fraction of their time to work for other entrepreneurs. In order to make a realistic analysis of the policy options, we assume that the government does not have access to lump sum taxation. Instead, the government raises distortionary taxes on labor, consumption, and income, and issues one period non-contingent bonds to finance lump sum transfers to all agents, other noninterest spending, and service its debt. Given that the core issue threatening debt sustainability in the U.S. is the explosive path of spending on entitlement programs, the heterogeneous agents assumption is crucial: Our model allows for a meaningful tradeoff between distortionary taxation and government transfers, as the latter insure households from attaining very low levels of consumption. The complexity this introduces forces us to sacrifice on some dimension: Agents in our model face individual uncertainty but have perfect foresight about future paths of fiscal instruments and prices. Allowing for uncertainty about the timing and composition of the adjustment would be interesting, but would severely increase the computational cost.<sup>3</sup>

We compare model simulations from four alternative fiscal scenarios. The benchmark scenario maintains current fiscal policies for about twenty years. More precisely, in this scenario we feed the model with the spending (noninterest mandatory and discretionary) and revenue projections from CBO's *Alternative Fiscal* scenario (CBO 2011)—allowing all other variables to adjust endogenously—until about 2030, when we assume that the government increases all taxes to stabilize the debt at its prevailing level.<sup>4</sup> Three alternative scenarios assume, instead, the immediate adoption of fiscal reform aimed at gradually reducing the federal debt to its pre-crisis level. There are of course many possible parameterizations for

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<sup>3</sup> Uncertainty about the timing of fiscal consolidation is explored in Davig et al (2010) but in a representative agent setting.

<sup>4</sup> Since divergent trajectories of public debt cannot be the equilibrium outcome of an economy with at least some forward-looking agents participating in financial markets, we need to assume that some consolidation plan will be eventually adopted.

such reform reflecting, among other things, different views about the desired size of the public sector and the design of the tax system. We first consider an adjustment scenario assuming the same size of government and tax structure than the benchmark one in order to disentangle the sole effect of delaying fiscal adjustment—and stabilizing the debt ratio at a high level. We then explore the effect of alternative designs for the consolidation plan by considering two alternative adjustment scenarios that incorporate spending and revenue measures proposed by the bipartisan December 2010 Bowles-Simpson Commission.<sup>5</sup>

This paper is related to different strands of the macro literature on fiscal issues. First, it is related to studies using general equilibrium models to analyze the implications of fiscal consolidations. Forni et al. (2010) use perfect-foresight simulations from a two-country dynamic model to compute the macroeconomic consequences of reducing the debt to GDP ratio in Italy. Coenen et al. (2008) analyze the effects of a permanent reduction in public debt in the Euro Area using the ECB NAWM model. Clinton et al. (2010) use the IMF GIMF model to examine the macroeconomic effects of permanently reducing government fiscal deficits in several regions of the world at the same time. Davig et al. (2010) study the effects of uncertainty about when and how policy will adjust to resolve the exponential growth in entitlement spending in the U.S.

The main difference with our paper is that these works rely on representative agent models that cannot adequately capture the redistributive and insurance effects of fiscal policy.<sup>6</sup> As a result, such models have by construction a positive bias towards fiscal reforms that lower transfers, reduce the debt, and eventually lower the distortions by lowering tax rates. Another unappealing feature of the representative agent models for analyzing the merits of a fiscal consolidation is that, in steady state, the equilibrium real interest rate is independent of the debt level<sup>7</sup>, whereas in our model the equilibrium real interest rate is endogenously affected by the level of government debt, which is consistent with the empirical literature.<sup>8</sup>

Second, the paper is related to previous work using general equilibrium models with infinitely lived heterogeneous agents, occupational choice, and borrowing constraints to analyze fiscal reforms, such as Li(2002), Meh (2005) and Kitao (2008). Differently from these papers, that impose a balanced budget every period, we focus on the effects of debt dynamics and fiscal consolidation reforms. Also, since we focus on reforms over an extended

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<sup>5</sup> See “*The Moment of Truth*”, The National Commission on Fiscal Responsibility and Reform, December 2010.

<sup>6</sup> More precisely, Forni et al. (2010), Coenen et al. (2008) and Davig et al. (2010) have two groups of representative agents.

<sup>7</sup> In the deterministic steady state of a representative agent model, the real interest rate is pinned down by the subjective discount factor and the growth rate, and it does not depend on fiscal policy variables.

<sup>8</sup> See Laubach (2009), Engen and Hubbard (2004) and Baldacci and Kumar (2010).

period of time we augment our model to include growth. Moreover and as in Kitao (2008), we explicitly compute the transitional dynamics after the reforms and analyze the welfare costs associated with the transition.

The rest of the paper is organized as follows. Section II presents the model we use and section III discusses its calibration. In section IV we detail the fiscal policy scenarios that we use to assess the cost of failing to address the fiscal imbalances for a prolonged period; the results are shown in section V. Finally, section VI concludes.

## II. THE MODEL

The model is similar to Aiyagari and McGrattan (1998). The economy is closed and inhabited by a continuum of infinitely lived agents normalized to one. Time is discrete and each period represents a year. Individuals are endowed with one unit of time, and each period decide whether to become workers or entrepreneurs, as in Kitao (2008) and Cagetti and De Nardi (2009).<sup>9</sup> Upon deciding to become workers, agents optimally choose how many hours to offer. Entrepreneurs invest in a productive project and hire other workers, and can borrow from financial intermediaries, but face a borrowing constraint as a consequence of limited enforcement. There is no aggregate uncertainty, but agents receive idiosyncratic shocks to their labor productivity and entrepreneurial ability. Markets are incomplete because there is no insurance for the idiosyncratic shocks, leading agents to accumulate precautionary savings. The production technology combines capital, labor (measured in efficiency units) and entrepreneurship ability, and displays a deterministic trend in the labor augmenting productivity. Along the balanced growth path of this economy there will be fluctuations in an individual's occupational choice, consumption, hours worked, income, wealth and taxes paid, but per capita values grow at constant rates.

### A. Preferences

Households maximize their expected discounted lifetime utility

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t, h_t) \right\},$$

where  $\beta$  is the time discount factor,  $c \geq 0$  denotes consumption and  $h \geq 0$  is time devoted to work. The momentary utility function is of the form proposed by Greenwood, Hercowitz, and Huffman (1988):

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<sup>9</sup> Quadrini (2000) and Kitao (2008) show that models with entrepreneurs are more successful in replicating the wealth distribution in the U.S.

$$u(c, h) = (c - \rho\omega h^\phi)^{1-\sigma} / 1 - \sigma \quad (1)$$

where the Frisch elasticity of the labor supply is given by  $1/\phi - 1$ , the intertemporal elasticity of substitution by  $1/\sigma$ , and  $\rho$  is a scale parameter that determines the relative value of leisure. These preferences, which Gali et al. (2011) find are well supported by U.S. data, imply that labor supply is independent of the distribution of wealth. The level of aggregate labor augmenting technology  $\omega$ , given by  $\omega' = \gamma\omega$ ,  $\gamma \geq 1$ , enters the utility to ensure balanced growth.

Agents are ex-ante identical. Each period they face idiosyncratic shocks to labor productivity  $\theta$  and to entrepreneurial ability  $z$ , which affect their returns to working and operating a firm. The shocks follow autoregressive Markov processes of order one that evolve according to the transition matrices  $\Gamma_\theta = Pr(\theta'|\theta)$  and  $\Gamma_z = Pr(z'|z)$ . Agents are ex-post heterogeneous with respect to their individual asset holdings  $a$ , their labor productivity  $\theta$  and their entrepreneurial ability  $z$ .

## B. Occupational Choice

Every period after the uncertainty is resolved agents choose their occupation  $o$  to maximize their professional income  $y$ :

$$y = \max_{o \in \{l, e\}} \{(1 - \tau^h)wh\theta, \pi\} \quad (2)$$

Agents can become workers  $l$  and receive the after tax labor income  $(1 - \tau^h)wh\theta$ , where  $w$  is the gross wage per efficiency unit of time  $h\theta$  and  $\tau^h$  represent payroll tax, or entrepreneurs  $e$  and make a profit  $\pi$ . The occupational choice allows for endogenous entry and exit of entrepreneurs from the productive sector and of workers from the labor force.

## C. Consumer's Problem

The recursive formulation of the consumer's problem is:

$$V(a, \theta, z) = \max_{a', h \geq 0} u(c, h) + \beta \sum \Gamma V(a', \theta', z') \quad (3)$$

$$s. t. \quad (1 + \tau^c)c \leq (1 - \tau^y)y + tr + Ra - a' \quad (4)$$

$$R = 1 + (1 - \tau^y)r \quad (5)$$

where  $a \geq 0$  denotes one-period non-contingent deposits in a financial intermediary, which pre-tax return is  $r$ ,  $\tau^c$  are consumption taxes and  $\tau^y$  represents the individual income taxes. Lump sum payments from the government  $tr$  are assumed to be strictly positive to avoid lump-sum taxation. Since  $y$  is the solution to the occupational choice problem presented in



equation (2), the consumer's problem is an implicit function of this decision.<sup>10</sup> From the first order condition of the consumer's problem, the optimal individual labor supply function for workers is:

$$h(\theta)^* = \left[ \frac{(1-\tau^y)(1-\tau^h)w\theta}{(1+\tau^c)\rho\phi} \right]^{1/\phi-1} \quad (6)$$

The consumption saving decision is determined by a policy rule  $a'(a, \theta, z)$ , that together with the labor supply decision, and the transition probabilities of the labor productivity and entrepreneurial ability shocks  $\Gamma = \Gamma_\theta \otimes \Gamma_z$ , induce the distribution of agents in this economy  $\mu(a, \theta, z)$ .

#### D. Entrepreneur's Problem and Financial Intermediation

Entrepreneurs combine rented private capital  $k$  and hired labor in efficiency units  $n$  with their own entrepreneurial ability  $z$  to produce output according with the following technology:

$$f(z, k, n) = (\omega z)^v [k^\alpha (\omega n)^{1-\alpha}]^{1-v} \quad (7)$$

The share of output that goes to the variable factors is determined by the span of control parameter  $1 - v$ , as in Lucas (1978). Production exhibits decreasing returns to capital and labor, and the entrepreneurs make a positive profit  $\pi$  from managing a firm.

The profit function of an entrepreneur solves:

$$\begin{aligned} \pi(a, z) &= \max_{\{n, k\}} \{f(z, k, n) - wn - (r + \delta)k - \psi \max(0, k - a)\} \quad (8) \\ \text{s. t.} \quad & k \leq \lambda a \end{aligned}$$

where  $a$  represents the stock of asset holdings of the entrepreneur deposited at the financial intermediary or bank,  $k$  is its desired stock of capital for production and  $n$  is its demand for labor efficiency units. Capital depreciates at the rate  $\delta$  and  $\psi$  represents the spread between the borrowing and the lending rates. The financial intermediation sector is perfectly competitive. Then, by the zero profit condition, the rental price of capital is  $r + \delta + \psi \max(0, k - a)$ . Since the opportunity cost of the internal funds is  $r + \delta$ , the entrepreneur only pays an external finance premium if he wishes to borrow more capital than he holds. The individual's entrepreneurial ability is  $z$  and  $w$  is the wage per efficiency unit of labor. The solution to this problem are the input demand functions  $n(a, z)$  and  $k(a, z)$ .

The financial intermediation sector takes deposits from all agents, lends money to the entrepreneurs and invests in one period risk free government bonds  $B$ . Since both

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<sup>10</sup> We assume that  $h = 0$  for entrepreneurs.

investments are risk free, in equilibrium the financial intermediary is indifferent between lending money to the government or the entrepreneurs. Also, since the two investments are identical from the agent's perspective we assume that agents save in the generic asset  $a$ .

There is a credit enforceability problem in this economy. When an entrepreneur deposits  $a$  units of collateral in the bank and rents  $k$  units of capital he can divert a fraction  $1/\lambda$ , with  $\lambda \geq 1$ , of the borrowed money. The only punishment for diverting funds is that the entrepreneur loses his collateral. Hence, the financial intermediary only lends up to the point where the borrowers will not renege on their obligation  $\frac{1}{\lambda}k \leq a$ . Consequently, the entrepreneurs are subject to a collateral constraint that limits the amount they are allowed to borrow based on their individual asset holdings.

### E. The Government

The government does not have access to lump sum taxation. It gets revenues from a consumption tax  $\tau^c$ , a payroll tax  $\tau^h$ , an income tax  $\tau^y$ , and by issuing one period risk free bonds  $B$ . The government gives lump-sum transfers to all agents; these transfers are the model proxy for spending on entitlements (Social Security, Medicare and Medicaid) and other social programs (e.g. unemployment benefits). The government spends an exogenously determined amount on public consumption goods  $g$  (all noninterest spending not included in transfers) and rolls-over its debt by selling risk free bonds to the financial intermediary.

### F. Aggregates

The aggregate asset holdings  $A$  are computed by integrating over the individual asset holdings of all households:

$$A = \sum_{a,\theta,z} \mu(a, \theta, z) \quad (9)$$

Similarly, aggregate consumption  $C$  and transfers  $Tr$  are found by integrating over all agents. The aggregate labor supply  $L_s$  is found by integrating the individual labor supply in efficiency units of all workers. The aggregate labor demand  $L_d$  is computed by integrating the individual labor demand in efficiency units of all entrepreneurs.

The aggregate demand for capital  $K_d$  is found by integrating over the individual demands for capital from all entrepreneurs. The aggregate supply of capital  $K_s$  is computed as the residual from aggregate savings after the government's financing needs are covered:

$$K_s = A - B \quad (10)$$

The aggregate output ( $GDP$ ) is found by integrating the individual production from each entrepreneur.

### G. Market Clearance

The equilibrium in the capital market requires that:

$$K_s = K_d = K \quad (11)$$

The equilibrium in the labor market requires that:

$$L_s = L_d = L \quad (12)$$

The occupational choice requires that:

$$l + e = 1 \quad (13)$$

The government's budget constraint is:

$$\tau^h w L + \tau^y (rA + Y) + \tau^c C + B' = (1 + r)B + g + Tr \quad (14)$$

### H. Timing of Events

At the beginning of each period the labor productivity and entrepreneurial ability shocks are realized. After observing the shocks the agents make their occupational choice. Workers decide what fraction of their unit of time to work. Entrepreneurs go to the financial intermediary for credit, rent capital and then they hire their desired efficiency units of work. After production takes place, the entrepreneurs compensate the workers and repay their loans. Workers pay their payroll taxes. The financial intermediary reimburses the depositors and makes zero profits. All agents pay income taxes on the yields from their savings and on their income from their occupation in the current period. They finally decide how much to consume and deposit their savings in the financial intermediary. The financial intermediary first buys government bonds and the remaining funds are the loanable resources for the entrepreneurs in the next period.

### I. Equilibrium

A recursive competitive equilibrium for this economy is given by the sequences of occupational choices  $o_t(a, \theta, z)$ , labor supply decisions  $h_t$ , value functions  $V_t(a, \theta, z)$ , policy functions  $a'_t(a, \theta, z)$ , input demand functions  $n_t(a, z)$  and  $k_t(a, z)$ , factor prices  $w_t$  and  $r_t$ , the stock of aggregate capital  $K_t$ , the aggregate labor supply  $L_t$ , and distributions  $\mu_t(a, \theta, z)$ , given the sequences of the fiscal policies  $\{\tau^c, \tau^y, \tau^h, g, B, tr\}_t$  the level of aggregate labor augmenting technology  $\omega_t$ , and the transition probabilities of the shocks  $\Gamma$ , such that:

- i. The sequences of the occupational choices, labor supply decisions, value functions, and policy functions solve the consumer's problem given the sequences of the factor prices, fiscal policies, the level of labor augmenting technology, and the transition probabilities of the employment productivity and entrepreneurial ability shocks.

- ii. The sequence of input demand functions solve the entrepreneur's problem given the sequences of factor prices, fiscal policies, the deterministic trend, and the transition probabilities of the entrepreneurial ability shock.
- iii. The sequence of distributions is induced by the sequences of occupational choices, labor supply decisions, policy functions, the deterministic trend, and the transition probabilities of the shocks.
- iv. The government's budget constraint is satisfied every period, but the stock of debt varies endogenously.
- v. The capital and labor markets clear every period.

To transform the model to a stationary form, let:  $\hat{c} = \frac{c}{\omega}$ ;  $\hat{w} = \frac{w}{\omega}$ ;  $\hat{k} = \frac{k}{\omega}$ ;  $\hat{K} = \frac{K}{\omega}$ ;  $\hat{a} = \frac{a}{\omega}$ ;  $\hat{A} = \frac{A}{\omega}$ ;  $\hat{g} = \frac{g}{\omega}$ ;  $\hat{B} = \frac{B}{\omega}$ ;  $\hat{tr} = \frac{tr}{\omega}$  and  $\widehat{GDP} = \frac{GDP}{\omega}$ . In balanced growth equilibrium, which corresponds to the steady state of the transformed economy,  $\hat{c}$ ,  $\hat{w}$ ,  $\hat{k}$ ,  $\hat{K}$ ,  $\hat{a}$ ,  $\hat{A}$ ,  $\hat{g}$ ,  $\hat{B}$ ,  $\hat{tr}$  and  $\widehat{GDP}$  are stationary variables. Along the balanced growth path there will be fluctuations in individual variables (consumption, hours worked, wealth, etc.) but per capita variables will be growing at the constant gross rate  $\gamma$  and cross-sectional distributions will be constant over time.

### III. CALIBRATION

We need to assign values to 20 parameters in the model. For 7 of those parameters ( $\sigma, \psi, \delta, \alpha, \gamma, v, \phi$ ) we use values that are common in the literature. For the rest ( $\beta, \rho, \lambda, \rho_\theta, \rho_z, \sigma_\theta, \sigma_z, g, tr, B, \tau^h, \tau^y, \tau^c$ ), we calibrate their values to match selected targets in U.S. data. For the initial steady state we used data from 2007 from CBO and the Office of Management and Budget (OMB) of the White House. Table 1 summarizes the calibration.

**Preferences.** The subjective discount factor  $\beta$  is set to 0.91 such that the equilibrium risk free rate  $r$  is 3 percent in the initial steady state, a reasonable value for the long run equilibrium real interest rate in the U.S. The coefficient of relative risk aversion  $\sigma$  is 1.5 in line with the findings of Attanasio et al. (1999). The curvature of labor supply parameter  $\phi$  is 3 such that the Frisch elasticity is 0.5 as recommended by Chetty et al. (2011) for the intensive margin of the labor supply. The labor disutility parameter  $\rho$  matters only for scaling and is set to normalize the average labor input  $h$  to one in the initial steady state.

**Entrepreneurship Activity and Production.** The share of output of the entrepreneurs  $v$  is 0.15 as in Atkinson and Kehoe (2005). The capital income share  $\alpha$  equals 0.36 as in Kitao (2008). The annual depreciation rate  $\delta$  is 6 percent following Stokey and Rebelo (1995). The

gross growth rate of labor augmenting technological progress  $\gamma$  is 1.02, consistent with CBO's assumptions for the next decades.<sup>11</sup>

The external finance premium  $\psi$  is 1.7 percent which corresponds to the average spread between risky (Baa) and risk free (TR10) bonds in the period 2005 – 2006. The tightness of the collateral constraint  $\lambda$  is 1.5 such that the average ratio of liabilities over assets for all entrepreneurs equals 0.47, which was the average from 1990-2007 in the Flow of Funds of the Federal Reserve in the Business Sector.

**Idiosyncratic Risk.** The persistence of the labor productivity shock  $\rho_e$  and the entrepreneurial ability shock  $\rho_z$  are set to 0.9 following Storesletten et al. (2004). The standard deviation of the labor productivity shock  $\sigma_e$  is set at 0.2 as in Cagetti and De Nardi (2006), and the standard deviation of the entrepreneurial ability shock  $\sigma_z$  at 0.4. The labor productivity and entrepreneurial ability processes are approximated with five and three state Markov processes respectively, using the methodology of Tauchen (1986).

**Fiscal Policy.** The information on the government's expenditures at the federal level is taken from the OMB. Along this paper we classify the federal expenditures in three categories (see Table 2 for details): 1) spending on transfers; 2) other noninterest spending; and 3) interest payments.<sup>12</sup> Spending on transfers ( $tr$ ) includes outlays on: unemployment benefits; Medicaid; Medicare; Social Security; disability payments; veterans; food assistance; supplemental income assistance; family support; and child credit. It amounted to 12 percent of GDP in 2007. Out of this, 8.8 percent of GDP was due to mandatory spending on Medicaid, Medicare and Social Security.

Other government noninterest spending ( $g$ ) includes outlays on: national defense; international affairs, administration of justice and general government; energy, transportation, science, and technology; and other undistributed spending. This category, which enters as wasteful spending in our model, was 5.9 percent of GDP in 2007. However, to compensate for the fact that we cannot include in our model the government's revenues from tariffs and seigniorage, we reduced the government's spending in this category in every period by 0.4 percent of GDP.

On the revenues side, the tax rates are calibrated such that the government's revenues from

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<sup>11</sup> CBO's assumptions over the long term imply an average growth rate in labor productivity—real output per hour worked—of 1.7% a year. Given other assumptions on population and immigration growth, CBO's projection for average real GDP growth from 2022 through 2085 was 2% per year in the 2010 long-term outlook and 2.2% in the 2011 outlook. In our model we abstract from population growth and assume that the level of labor augmenting technological progress grows at 2% per year.

<sup>12</sup> Our classification of spending is motivated by how it affects households' disposable income. Instead, CBO's classification of spending in mandatory and discretionary outlays is based on whether they can be modified in the ordinary budgetary process.

each tax in the initial steady state match those of the U.S. federal government in 2007, as reported by the OMB. The tax rate on consumption  $\tau^c$  is 0.7 percent to match the revenues of 0.47 percent of GDP from the excise taxes of the federal government. The payroll tax  $\tau^h$  is 15.8 percent to match the revenues of 6.26 percent of GDP from the social security contributions. The income tax  $\tau^y$  is 16.3 percent to match 11.9 percent of GDP revenue from the federal income tax in 2007.

The stock of debt  $B$  in the initial steady state is set to 36 percent of GDP, which was the federal debt in hands of the public in 2007 according to CBO.

#### IV. THE POLICY EXPERIMENTS

We use the model, first to simulate the implications of postponing the fiscal consolidation in the U.S. for an extended period. Second, and against this benchmark, we compute the repercussions from assuming that the U.S. immediately embarks in a gradual fiscal consolidation plan to stabilize the debt to GDP at its pre-crisis level in the medium-term. Along the simulations we analyze the endogenous response of the main macroeconomic aggregates and the effect on welfare due to the alternative fiscal policies, both at the new steady state and along the transition towards it.

All the fiscal scenarios we build inherit the same fiscal legacy from the Great Recession: Compared to pre-crisis levels (1) the cost of the transfers increased by 1.2 percent of GDP, (2) other noninterest spending jumped by about 3 percent of GDP, and (3) the debt held by the public almost doubled, increasing from 36 to 69 percent of GDP. The only difference in assumptions across scenarios is on the projected path of fiscal policy, as explained in the following sections.

##### A. The *Delay* Scenario

In the *delay* scenario we assume that fiscal policy remains as in current legislation for twenty years. More precisely, we feed the model with the paths that CBO deems most likely for outlays on entitlement programs and other noninterest spending (see Figure 2).<sup>13</sup> CBO projects an ever-increasing spending in transfers due to the aging of the population and rapid increases in health care costs, which results in an escalating debt-to-GDP ratio.<sup>14</sup> However, an explosive path for debt cannot be the equilibrium outcome of an economy with forward-

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<sup>13</sup> Figure 1 plots the series used in the model based in CBO's *Alternative Fiscal Scenario* (see CBO 2011).

<sup>14</sup> According to CBO spending in Medicare and Medicaid and in Social Security would increase by 3.6% and 1.2% of GDP respectively, and other non-interest spending would decrease by 3.6% of GDP, between 2011 and 2030. Based on these projections and our reclassification of spending categories, the *delay* scenario foresees government transfers increasing by 4.2% of GDP and other noninterest spending decreasing by 3% of GDP during the same period.

looking agents trading in financial markets. So we need to assume that some consolidation plan is eventually adopted. To this end, in the *delay* scenario we suppose that after 2030 the spending in transfers stabilizes such that primary spending to GDP becomes stationary and that all taxes are adjusted as needed to stabilize the debt.

Since *GDP* is an endogenous variable in the model, in order to match CBO's projected paths for spending as a share of GDP, we followed an iterative process: i) we guessed a path for spending in real terms and computed the equilibrium transition of all the other variables in the model; ii) we compared the resulting spending as a share of GDP with the projections from CBO and updated our guess as required; and iii) we repeated the process until obtaining a reasonable match. Regarding revenues, we assumed that tax rates remain fixed until the adjustment period, obtaining a primary balance to GDP series that is broadly in line with CBO's projections (see Figure 3).

## B. The *Adjust* Scenarios

To quantify the costs of delaying the resolution of fiscal imbalances and stabilizing the public debt at a higher level, we need to contrast the *delay* scenario with others in which the imbalances are addressed more promptly. To this end, we designed three alternative *adjust* scenarios under which fiscal policy is reformed to stabilize the debt held by the public at its pre-crisis level (i.e. about 36 percent of GDP) over the medium-term. The first adjustment scenario (labeled *passive adjust* scenario) assumes the same spending paths than under the *delay* scenario and the same tax reform, but introduced earlier so as to reduce the debt ratio towards its pre-crisis level. Since the policy mix is the same, comparing the *delay* and the *passive adjust* scenarios allows to quantify the sole effect of postponing fiscal consolidation—or, more precisely, stabilizing the debt ratio at a higher level. The other two adjustment scenarios (labeled *active*) are aimed at exploring the effects of alternative consolidation plans. They are variations of the *passive adjust* scenario that incorporate, in steps, spending and revenue measures that have been discussed in some bipartisan institutions.

**The *passive adjust* scenario.** The fiscal policy mix under the *passive adjust* scenario is the same than in the *delay* scenario: the primary spending-to-GDP ratio converges to the same level over the medium-term (about 23 percent of GDP) and in both settings all taxes are adjusted proportionally to stabilize the debt ratio. The tax rates in the *passive adjust* scenario are assumed to be increased once and immediately in 2011, and then decreased permanently around twenty years later, so as to stabilize the debt to GDP at its pre-crisis level (in the *delay* scenario taxes are assumed to increase only after 2030). The only difference then is the long-run debt level and, accordingly, the level of individual taxes needed to finance its interest payments.

**The *active adjust* scenarios.** We assume two *active* adjustment scenarios, which borrow elements from the proposal by the 2010 National Commission on Fiscal Responsibility and

Reform (the Bowles-Simpson proposal, aimed at stabilizing the debt held by the public by 2014 and at reducing it to 40 percent of GDP by 2035). On the spending side, the Bowles-Simpson Commission proposed to freeze discretionary and security spending until 2020 and to reduce social spending by reforming Medicare and Medicaid. The Commission estimates that, compared with their own baseline scenario, these reforms would by 2020 lower the cost of health care by 0.3 percent of GDP, reduce the cost of pensions by 0.1 percent of GDP, diminish the cost of other social programs by 0.2 percent of GDP, and reduce other noninterest spending by 1.3 percent of GDP (see Table 4). We constructed the spending series for both *active adjust* scenarios by applying these projected savings to the spending series in our *delay* scenario, and starting in 2020 we assume that the savings become permanent (see Figure 2). The long-run primary spending-to-GDP ratio is about 2 percent lower than under the *passive adjust* scenario.

On the revenue side, the Commission proposed a comprehensive tax reform that includes eliminating tax expenditures, simplifying the code, broadening the base, reducing the statutory tax rates, using the chained CPI to calculate the tax brackets, introducing a carbon tax, and increasing the maximum allowable wage that is subject to the payroll tax. The lion's share (around 80 percent) of the increased revenue that the Commission expects falls under income tax and deductions. In this sense and to explore further the tax-composition effects, the *active (1) adjust* scenario still assumes that all taxes are adjusted proportionally, while the *active (2) adjust* scenario follows more closely the Commission proposal by assuming that the tax reform falls entirely on the personal income tax. As in the *passive adjust* scenario, we further assume that the relevant tax rates are increased once and immediately in 2011, and then decreased permanently around twenty years later, so as to stabilize the debt-to-GDP ratio at its pre-crisis level.

## V. RESULTS

We divide the analysis of the results in three parts. First, we examine the long-run effects under each scenario by comparing the steady states at which the economy stabilizes around 2035. Specifically, we evaluate the macro aggregates (GDP, consumption, etc.) and the welfare differential across scenarios. Second, we analyze the equilibrium paths for macro aggregates during the transitional dynamics implied by the *delay* and the *active (2) adjust* scenarios.<sup>15</sup> Finally, we compute the overall welfare differential across the *delay* and the *active (2) adjust* scenarios, considering both the long-run and the transition period.

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<sup>15</sup> Choosing the *active (2) adjust* scenario for the transitional dynamics is a conservative choice, as this scenario could be seen as a higher bound in terms of adjustment costs: it combines transfer cuts with a tax mix that relies only on a heavy distortionary tax. Besides, its design follows more closely a bipartisan proposal, capturing elements that broadly count with support across the political spectrum.



## A. The Long-Run Effects

### What is the effect of delaying fiscal consolidation?

We first compare the long-run macroeconomic effects under the *delay* and the *passive adjust* policy scenarios. Since the policy mix is the same, we interpret the result of this comparison as the sole effect of postponing fiscal adjustment—and consequently stabilizing the debt ratio at a higher level.

**Interest Rates.** The long-run federal debt in hands of the public is 200 percent of GDP in the *delay* scenario, while it is only 36 percent in the *passive adjust* scenario. With a larger stock of debt that needs to be financed in the *delay* scenario and lower incentives to work, save and produce due to higher taxation, the equilibrium interest rate needs to be sufficiently high to increase private savings. The equilibrium real interest rate under the *delay* scenario is 8.85 percent, 468 basis points (bps) higher than in the *passive adjust* scenario. The endogenous response of the equilibrium interest rate to changes in the public debt implies an elasticity of 29 bps for every 10 percentage point increase in the debt-to-GDP ratio, in line with previous empirical estimates. For example, Engen and Hubbard (2004) conclude that an increase of 10 percent in the U.S. federal debt to GDP would increase the long term real interest rate by 30 bps. Laubach (2009) finds that a 10 percent increase in projected debt to GDP would raise the five year ahead ten-year forward Treasury rate by 40 bps. Similarly, Baldacci and Kumar (2010) estimate that for a panel of 31 advanced and emerging economies a ten percentage point increase in the debt-to-GDP ratio typically leads yields on ten-year government bonds to increase by 50 bps.

**Capital and Labor.** The high interest rates in the *delay* scenario imply that for those entrepreneurs that do not have enough internal funding, the cost of borrowing sufficient capital is too high for them to compensate for their income under the outside option (i.e. wage income). As a result, the share of entrepreneurs in the *delay* scenario is roughly one half the share under the *passive adjust* scenario and the aggregate capital stock is about 17 percent lower. The higher share of workers in the *delay* scenario implies a higher labor supply. Together with a lower labor demand (due to a lower capital stock), this leads to a real wage that is more than 19 percent lower. Total hours worked are similar in the two steady states as lower individual hours offset the higher share of workers.

**Output and Consumption.** The crowding-out effect of fiscal policy under the *delay* scenario leads to large permanent losses in output and consumption. The level of GDP is about 16 percent lower in the *delay* than in the *passive adjust* scenario and aggregate consumption is 3.5 percent lower. Moreover and as depicted in Figure 4, the wealth distribution is significantly more concentrated under the *delay* scenario.<sup>16</sup>

**Welfare.** The effect of lower aggregate consumption and more concentrated wealth distribution under the *delay* scenario implies that welfare is significantly lower than in the *passive adjust* scenario. Using a consumption equivalent welfare metric we find that the average difference in steady state welfare across scenarios would be equivalent to permanently increasing consumption to each agent in the *delay* scenario economy by 6 percent while leaving their amount of leisure unchanged. We interpret this differential as the permanent welfare gain from stabilizing public debt at its pre-crisis level. A breakup of the welfare comparison of steady states by wealth deciles, shown in Figure 5, suggests that all agents up to the 7<sup>th</sup> deciles of the wealth distribution would be better off under fiscal consolidation.

### **What are the effects of alternative fiscal consolidation plans?**

We now explore how changes in the composition of the consolidation package would affect the results. To this end we extend the comparison to include the *active (1)* and *active (2) adjust* final steady states.

**Interest Rates.** While the federal debt in hands of the public is 36 percent of GDP in all three *adjust* scenarios, the interest rates are marginally different due mainly to differences in tax rates. Primary spending in both *active adjust* scenarios is lower than in the *passive* one, requiring less tax pressure. However, the tax reform is tilted towards the income tax in the *active (2) adjust* scenario—while all taxes are raised in the same proportion under the *active (1) adjust* scenario. As a result, even if revenue to GDP is the same, the equilibrium real interest rate is higher in the *active (2) adjust* scenario. In fact, the interest rate is even higher than in the *passive adjust* scenario, in which a higher revenue ratio is required. In any case, the differences between interest rates across *adjust* scenarios (in the order of 10bps) are minor vis-à-vis the differences with the *delay* scenario (around 470 bps).

**Capital and Output.** The smaller size of government in the two *active adjust* scenario relative to the *passive* one translates into higher capital stocks and higher output, increasing the gap with the *delay* scenario. Regarding the tax reform, the comparison between the two *active adjust* scenarios reveals that distributing the higher tax pressure on all taxes, including

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<sup>16</sup> Figure 4 plots the difference in the wealth concentration of the top percentiles between the distribution under the *delay* and the *passive adjust* scenarios (a positive value indicates higher concentration under the *delay* scenario).

consumption taxes, lowers distortions and results in a higher capital stock and in a growth friendlier consolidation: The difference in the output level between the *delay* and *active (1) adjust* scenario stands at 17.7 percent—while this difference is 17.1 and 15.7 percent for the *active (2) adjust* and *passive adjust* scenarios respectively.

**Consumption and Welfare.** While all *adjust scenarios* reveal a significant difference in long-run per-capita consumption and welfare with respect to postponing fiscal consolidation, the relative performance among them also favors a smaller size of government and a balanced tax reform. The difference in per-capita consumption with the *delay* scenario is 3.5, 5.8 and 5.4 percent respectively for the *passive*, *active (1)* and *active (2)* adjustment scenarios. The policy mix under the *active (1) adjust* scenario also ranks the best in terms of welfare, with the welfare differential with respect to the *delay* scenario being more than 7 percent of lifetime consumption.

### **Concluding remarks from the steady state comparison.**

Comparing the outcome differences between the *delay* scenario and each of the *adjust* scenarios reveals that reducing the size of government and distributing the higher tax pressure between all taxes result in higher long-term output, consumption and welfare. However, the marginal gain due to differences in the policy mix of the consolidation package gets dwarfed when compared to the benefits from reducing the debt ratio. Most of the long-run gain from fiscal consolidation is due to stabilizing the debt-to-GDP ratio at its pre-crisis level.

### **B. The Transitional Dynamics**

In this section we analyze the macroeconomic dynamics from 2011 to around 2035, when the economy reaches its new steady state, for the *delay* scenario and the *active (2) adjust* scenario (that for simplicity we denote “*adjust*” in sections V.B. and V.C.).<sup>17</sup> Figures 6 and 7 shows the time path of the fiscal and main macro aggregates starting in 2011, when the economy is no longer in the initial steady state because the debt, spending, and transfers to GDP are all higher. At the beginning of the period, under each scenario, the government announces its new fiscal policy, detailing the paths for government transfers, other noninterest spending, and tax rates for all future dates. As soon as the agents learn about the new policies, they re-optimize their behavior for each point in time, taking as given the paths of fiscal variables and prices. Aggregating the behavior of all agents in the economy for each point in time results in the dynamics for the aggregate variables depicted in Figure 7. After the policy variables become constant, the economy eventually converges to the corresponding steady state for each scenario—described in the previous section—where the distribution of agents over states becomes invariant and the aggregate variables grow at the deterministic productivity growth rate.

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<sup>17</sup> See footnote 15.

### ***Delay Scenario***

Fiscal policy in the *delay* scenario is characterized by government transfers to GDP increasing at a constant rate from 2015 onwards, financed by ever increasing public debt as the revenues to GDP remain broadly constant until the fiscal adjustment. Output, however, is endogenous and depends upon the occupational choice, hiring, working, and saving decisions of individual agents over time. Our model suggests that, taking into account the transitional dynamics, delaying the fiscal adjustment for two decades would entail a reduction of the average output growth rate in 2011-2035 by almost one half: While aggregate productivity grows deterministically at 2 percent per year, under the *delay* scenario the average annual GDP growth rate is 1.04 percent.<sup>18</sup>

The rise in government transfers has an expansionary effect on the economy until around 2020-2025, mainly through its effect on disposable income and savings—especially for lower-income households. Agents foresee that eventually the growth rate of real transfers will slow down (see Figure 6) and thus find it optimal to save part of the extra income they are receiving from the government to be able to smooth their consumption along the transition. The higher savings bring down the equilibrium interest rate. On the margin, with higher savings and lower interest rates, more agents find it optimal to become entrepreneurs (see Figure 8): Higher savings imply they can bring more inside funding to the entrepreneurship activity and a lower interest rate implies cheaper outside funding (i.e. rented capital in excess of their own savings). Both effects lead to higher profits, so as agents accumulate assets there is a gradual increase in the entrepreneur to worker ratio and in the stock of capital used in production. The increase in the capital stock augments the labor demand which, combined with less agents remaining as workers, leads to an increase in the real wage and higher individual hours worked. The combined effect of less workers but more working hours leads to an increase in aggregate effective hours. In this context, output per capita grows above the economy's productivity trend for about half of the transition towards the new steady state.

This process continues as transfers keep growing, but at a given point the lower marginal returns from the productive inputs reduce the incentives of individual agents to save and supply labor sufficiently and the flow of agents from labor to entrepreneurship stops. This entails a reversal of the trend in capital accumulation and output per capita. From there onwards, the effect of the unwinding of the agents' savings—especially from those more reliant on transfers—to compensate for their lower disposable income starts driving up the equilibrium interest rate. This reduces profits for the entrepreneurs, forcing more of them to become workers, which in turn depresses real wages and their disposable income even

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<sup>18</sup> The negative link between public debt and growth has been documented in empirical studies. For example Woo and Kumar (2010) estimate that an increase of 10% of GDP in the initial debt is associated with a slowdown in growth per capita of 0.15% per year, when the debt is above 90% of GDP.

further. Agents find it optimal to reduce their asset holdings continuously until the fiscal consolidation, as their return will be heavily taxed afterwards. Given that public debt is growing, this decline in asset holdings implies a strong reduction in the capital stock and a steep increase of the real interest rate which, in turn, raises the government's interest bill, accelerating the growth of public debt. Given the path of private capital, output contracts continuously until the fiscal adjustment—and a bit more abruptly on the very same period of the reform due to the effect of higher taxes on the labor supply. From there onwards, the only driving force for aggregate variables is the productivity growth.

Consumption per capita grows steadily along the *delay* scenario and only adjusts significantly when the fiscal consolidation kicks in. This is made possible, at the beginning, by the increasing path of output per capita and transfers and, later, by the unwinding of savings and the dwindling of private capital. The aggregate action of the individual agents entails a smooth consumption path along the transition until the fiscal adjustment. At an individual level though, some agents experience consumption growing at a somewhat higher rate in the first stage of the transition than in the second, while other agents experience the opposite trend. At the time of the fiscal consolidation, the large tax adjustment needed to stabilize public debt represents an aggregate shock that, though anticipated, affects all agents across the board and cannot be diversified away. Per capita consumption adjusts permanently to a much lower level.

### ***Adjust Scenario***

In the *adjust* scenario transfers to GDP increase more slowly and other noninterest spending to GDP contracts faster than under the *delay* scenario, and the primary spending to GDP stabilizes at a permanently lower level. Moreover, the personal income tax increases immediately in 2011—and when the consolidation is completed it is permanently decreased—by a sufficient amount to ensure that, given the paths of transfers and spending, the debt-to-GDP ratio stabilizes at its pre crisis level.<sup>19</sup> Despite the higher tax pressure to finance the debt consolidation, average annual output growth in 2011-2035 is 1.8 percent, significantly higher than under the *delay* scenario.

At the beginning of the transition period, the immediate increase in the personal income tax affects the agents' returns from asset holdings, leading to a sharp contraction in the supply of private capital and an increase in the (pre-tax) equilibrium interest rate. Entrepreneurs'

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<sup>19</sup> The endogenous path for the debt to GDP path we obtain implies a slightly more aggressive debt consolidation path than under the Commission's plan, in which this scenario is inspired: debt to GDP would be 48 percent by 2023 and 36 percent by 2035, as opposed to 60 percent and 40 percent, respectively, under the Commission's proposal. Altogether the simplifying assumptions on composition and timing of tax reform might overstate the welfare cost of consolidation under this scenario as it loads the adjustment on a highly distortionary tax—instead of sharing the burden with, for example, a higher consumption tax—and it frontloads the adjustment by assuming that taxes are increased immediately.

profits get negatively affected by the higher interest rates and taxes so, at the margin, being a worker becomes preferable for those with less inside funding. Real wages get affected by opposing forces: On the one hand, given that wage income is more heavily taxed, entrepreneurs need to offer higher wages to attract the same effective labor. However, as more entrepreneurs become workers, labor supply increases, depressing wages. Overall there is a slight contraction in real wages at the beginning of the transition, but total hours worked in the economy remain roughly constant.

After the implementation of the tax reform and until around 2025 the capital stock, per capital output and consumption grow almost at the deterministic growth rate of aggregate productivity. At that point and as debt reaches about 40 percent of GDP, the demand for private savings to finance the public debt recedes, lowering the equilibrium interest rate and releasing resources for private investment. Lower funding costs incentivize more agents to become entrepreneurs, raising the capital stock, labor demand and production. As output grows, government transfers augment even more, increasing aggregate disposable income and savings. Capital and output grow above trend for some time. After the income tax is permanently reduced, the equilibrium interest rate drops further and the capital stock adjusts.

The effort to reduce public debt implies average consumption growing below trend during the first phase of the transition, until around 2020-2025. When the debt reaches a low enough levels, per capita consumption starts growing above trend, to stabilize after 2035 at a higher level than under the *delay* scenario.

### C. Overall Welfare Cost of Delaying Fiscal Consolidation

In the long-run the average welfare in the *adjust* scenario is higher than in the *delay* scenario by 6.7 percent of lifetime consumption. However, along the transition to the new steady state the *adjust* scenario is characterized by a costly fiscal adjustment that entails a lower path for per capita consumption, so it might not be necessarily true that an adjustment is optimal.

To assess the overall welfare ranking of the alternative fiscal paths, we extend the analysis of section III.A. by computing, for the *delay* and *adjust* scenarios, the average expected discounted lifetime utility starting in 2011. We find that even taking into account the costs along the transition, the *adjust* scenario entails an average welfare gain for the economy. The infinite horizon welfare comparison suggests that consumption under the *delay* scenario should be raised by 0.8 percent for all agents in the economy in all periods to attain the same average utility than under the *adjust* scenario (while leaving leisure unchanged). A breakup of this result by wealth deciles (see Figure 9) suggests that, as in the long-run comparison, the wealthiest decile of the population is worse off under the *adjust* scenario. Differently from the steady state comparison, however, the first four deciles also face welfare losses in the *adjust* scenario.

A few elements suggest that the average welfare gain reported (0.8 percent in consumption-equivalent terms) can be considered a lower bound. First, the calibrated subjective discount

factor from the model used to compute the present value of the utility paths entails a yearly discount rate of about 9.9 percent.<sup>20</sup> With such a high discount rate, the long-run benefits from the *delay* scenario are heavily discounted. Using a discount rate of 3 percent, the one used by CBO for calculating the present value of future streams of revenues and outlays of the government's trust funds, would imply a consumption-equivalent welfare gain of 5.9 percent (instead of 0.8 percent). Second, the model we are using has infinitely lived agents, so we are not explicitly accounting for the distribution of costs and benefits across generations.

## VI. CONCLUSIONS

We compare the macroeconomic and welfare effects of failing to address the fiscal imbalances in the U.S. for an extended period with those of reducing federal debt to its pre-crisis level and find that the stakes are quite high. Our model simulations suggest that the continuous rise in federal debt implied by current policies would have sizeable effects on the economy, even under certainty that the federal debt will be fully repaid. The model predicts that the mounting debt ratio would increase the cost of borrowing and crowd out private capital from productive activities, acting as a significant drag on growth. Compared to stabilizing federal debt at its pre-crisis level, continuation of current policies for two decades would entail a permanent output loss of around 17 percent. The associated drop in per-capita consumption, combined with the worsening of wealth concentration that the model suggests, would cause a large average welfare loss in the long-run, equivalent to about 7 percent of lifetime consumption. Our results also suggest that reducing promptly the level of public debt is significantly more important for activity and welfare than differences in the size of government or the design of the tax reform. Accordingly, even under consensus on the desirability to increase primary spending in the medium-run, it would be preferable to start from a fiscal house in order.

The model adequately captures that the fiscal consolidation needed to reduce federal debt to its pre-crisis level would be very costly. Still, extending the welfare comparison to include also the transition period suggests that a fiscal consolidation would be on average beneficial. After taking into account the short-term costs, the average welfare gain from fiscal consolidation stands at 0.8 percent of lifetime consumption.

We argue that our welfare results can be interpreted as a lower bound. This is because, first, we abstract from default so our simulations ignore the potential effect of higher public debt on the risk premium. However, as the debt crisis in Europe has revealed, interest rates can soar quickly if investors lose confidence in the ability of a government to manage its fiscal policy. Considering this effect would have magnified the long-run welfare costs of stabilizing

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<sup>20</sup> As in Kitao (2008), in our model we need a low calibrated subjective discount factor in order to match a target real interest rate of 3%.

the debt ratio at a higher level. Second, the high discount rate we use in the computation of the present value of utility exacerbates the short-term costs. If we recomputed the overall welfare effects in our scenarios using a discount rate of 3 percent, the welfare gain from a consolidation would be 5.9 percent of lifetime utility, instead of 0.8 percent. An argument for considering a lower rate to compute the present value of welfare is that by assuming infinitely lived agents we are not attaching any weight to unborn agents that would be affected by the permanent costs of delaying the resolution of fiscal imbalances and do not enjoy the expansionary effects of the unsustainable policy along the transitional dynamics.

The results in this paper are not exempt from the perils inherent to any model-dependent analysis. In order to address features that we believe are crucial for the issue at hand, we needed to simplify the model on other dimensions. For example, given the current reliance of the U.S. on foreign financing, the closed economy assumption used in this paper may be questionable. However, we believe that it would also be problematic to assume that the world interest rate will remain unaffected if the U.S. continues to considerably increase its financing needs. Moreover and as mentioned before, the model ignores the effect of higher debt on the perceived probability of default, which would likely counteract the effect in our results from failing to incorporate the government's access to foreign borrowing. The model also abstracts from nominal issues and real and nominal rigidities typically introduced in the new Keynesian models commonly used for policy analysis. However, we believe that while these features are particularly relevant for short-term cyclical considerations, they matter much less for the longer-term issues addressed in this paper.



**Table 1. Calibration**

Description	Parameter	Value	Target
Subjective discount factor	$\beta$	0.91	Such that $r$ is 3% in the initial steady state (long-run level according to CBO)
Relative risk aversion	$\sigma$	1.5	Attanasio et al. (1999)
Curvature of the labor supply	$\phi$	3	Chetty et al. (2011)
Normalization of the labor supply	$\rho$	0.0086	Such that $h=1$ in the initial steady state
Share of output of the entrepreneurs	$\nu$	0.15	Atkensons and Kehoe (2005)
Capital income share	$\alpha$	0.36	Kitao (2008)
Depreciation rate	$\delta$	0.06	Annual depreciation from Stokey and Rebelo (1995)
Growth of the deterministic trend	$\gamma$	1.02	The long-run growth rate in CBO projections
External finance premium	$\psi$	1.7%	Average spread between risky (Baa) and risk free (TR10) bonds 2005-2006
Tightness of the collateral constraint	$\lambda$	1.5	Liab./Assets (90'-07') in the non-farm business sector in the Flow of Funds is 0.47
Persistence labor productivity shock	$\rho_e$	0.9	Storesletten et al. (2004)
Persistence entrep. ability shock	$\rho_z$	0.9	Storesletten et al. (2004)
St. dev. labor productivity shock	$\sigma_e$	0.2	Cagetti and De Nardi (2006)
St. dev. entrepreneurial ability shock	$\sigma_z$	0.4	
Transfers (% of GDP)	$Tr$	12%	Spending in health, pensions and income Security was 12% of GDP in 2007
Other non-interest spending (% of GDP)	$g$	5.5%	Spending in defense, international affairs, justice, science, and technology in 2007
Consumption tax	$\tau^c$	0.7%	Revenues from excise taxes were 0.47% of GDP in 2007
Payroll tax	$\tau^h$	15.8%	Revenues from the payroll tax were 6.26% of GDP in 2007
Income tax	$\tau^y$	16.3%	Revenues from the income tax were 11.90% of GDP in 2007
Debt (% of GDP)	$B$	36%	Debt in hands of the public in 2007

**Table 2. Non-Interest Expenditures from the U.S. Federal Government as a percentage of GDP (2007)**

<b>Non-Interest Expenditure, Federal Government, 2007 (in percent of GDP)</b>	
<b>12.0%</b>	<b>Transfers</b>
1.9%	Medicaid
2.7%	Medicare
4.2%	Social Security
0.5%	Veterans
0.4%	Non-Mandatory Income Security
0.1%	General retirement and disability
0.7%	Federal employee retirement and disability
0.4%	Food and nutrition assistance
0.2%	Unemployment compensation
0.2%	Supplemental Security Income
0.2%	Family and Other Support Assistance
0.3%	Earned Income Tax Credit
0.1%	Child Tax Credit
0.1%	Recovery Rebate Tax Credit
<b>5.5%</b>	<b>Other noninterest spending</b>
4.0%	National Defense
0.6%	International Affairs, Administration of Justice, General Government
1.3%	Energy, Transportation, Science, Technology.
-0.4%	Adjustment for not including Seigniorage and Tariffs

**Table 3. Steady State Comparison**

Steady State Values		initial	passive adjust	active (1) adjust	active (2) adjust	delay	Difference (delay w.r.t. each adjust):		
							passive	active (1)	active (2)
Debt to GDP ratio	$\hat{B}/\overline{GDP}$	36%	36%	36%	36%	200%	164%	164%	164%
Real interest rate	$r$	3.00%	4.17%	4.10%	4.21%	8.85%	468bps	475bps	464bps
Aggregate capital stock	$\hat{K}$	0.202	0.181	0.186	0.182	0.150	-17.3%	-19.5%	-17.7%
Gross wage	$\hat{w}$	0.646	0.640	0.641	0.631	0.516	-19.4%	-19.5%	-18.2%
Aggregate labor	$\hat{L}$	0.106	0.100	0.102	0.103	0.104	4.1%	2.3%	1.5%
GDP	$\overline{GDP}$	0.125	0.117	0.120	0.119	0.099	-15.7%	-17.7%	-17.1%
Aggregate consumption	$\hat{C}$	0.087	0.085	0.087	0.086	0.082	-3.5%	-5.8%	-5.4%
% Workers		73.9%	73.9%	73.2%	74.1%	87.8%	13.9%	14.5%	13.7%
% Entrepreneurs		26.1%	26.1%	26.8%	25.9%	12.2%	-13.9%	-14.5%	-13.7%
Consumption revenues, % of GDP		0.5%	2.3%	1.8%	0.5%	5.4%	3.1%	3.6%	4.9%
Labor revenues, % of GDP		6.3%	8.3%	7.5%	6.4%	11.2%	3.0%	3.8%	4.8%
Income revenues, % of GDP		11.9%	14.0%	13.2%	15.5%	23.7%	9.8%	10.6%	8.3%
Total revenues, % of GDP		18.6%	24.5%	22.5%	22.5%	40.4%	15.9%	17.9%	17.9%
Transfers, % of GDP	$\hat{T}_T / \overline{GDP}$	12.1%	17.5%	16.8%	16.8%	17.5%	0.0%	0.8%	0.8%
Other noninterest spending, % of GDP	$\hat{g} / \overline{GDP}$	5.5%	5.5%	4.2%	4.2%	5.5%	0.0%	1.3%	1.3%
Primary expenditures, % of GDP		17.6%	23.1%	21.0%	21.0%	23.0%	0.0%	2.0%	2.0%
Primary surplus, % of GDP		1.1%	1.5%	1.4%	1.5%	17.4%	15.9%	15.9%	15.9%
Interest Payments, % of GDP		1.1%	1.5%	1.4%	1.5%	17.4%	15.9%	15.9%	15.9%
Consumption tax rate	$\tau^c$	0.7%	3.2%	2.5%	0.8%	6.5%	3.4%	4.0%	5.8%
Labor income tax rate	$\tau^h$	15.8%	19.6%	18.2%	15.8%	23.0%	3.4%	4.8%	7.3%
Personal income tax rate	$\tau^y$	16.3%	18.9%	17.9%	20.9%	22.1%	3.1%	4.2%	1.2%
Welfare (Consumption Equivalent) <sup>1</sup>		-	6.0%	7.1%	6.7%	0.0%			

<sup>1</sup> Consumption under the delay scenario should be permanently raised by x% for all agents in the economy to attain the same average utility than under the adjust scenarios (while leaving leisure unchanged)

Figure 1. Projections from CBO alternative scenario, Long Term Budget Outlook, 2011

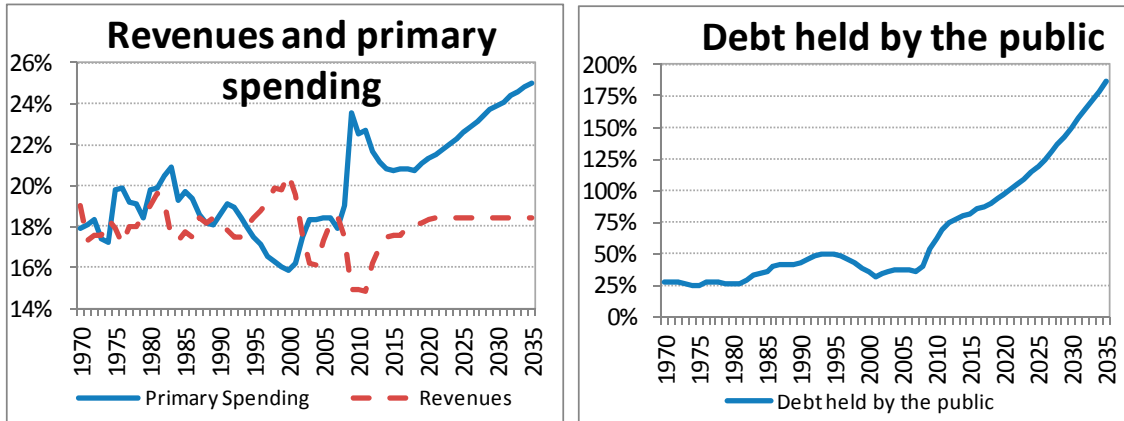


Figure 2. Primary expenditures in the *delay* and *adjust* scenarios

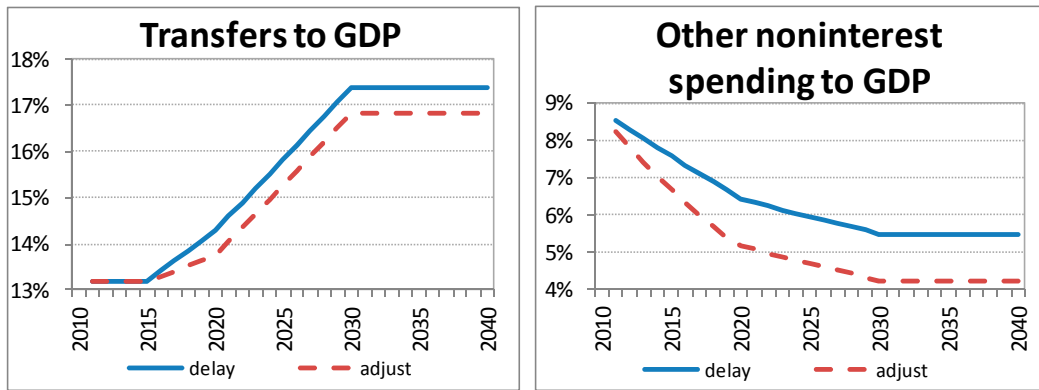
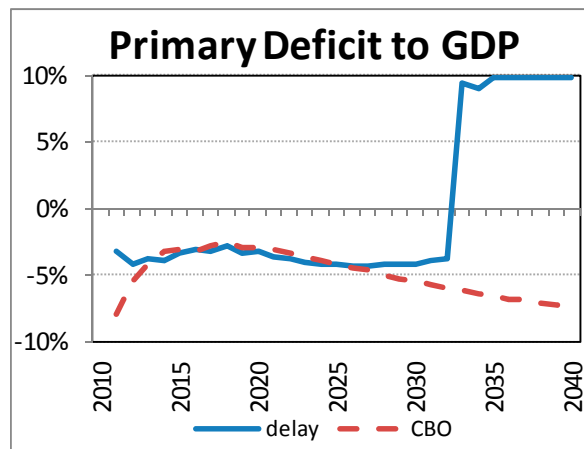


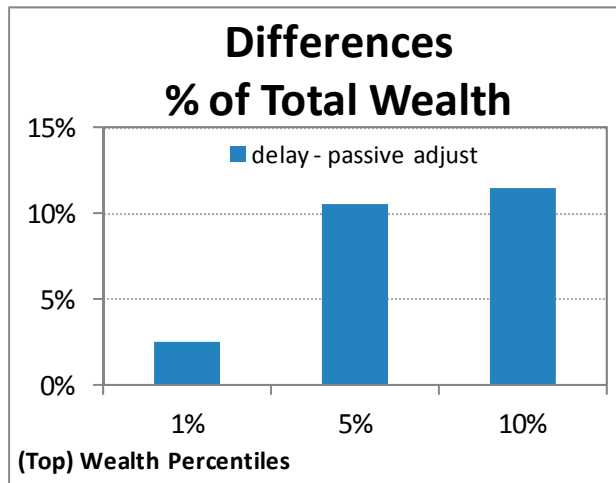
Figure 3. Primary deficit in the *delay* scenario and CBO's forecasts



**Table 4. CBO’s Alternative Fiscal Scenario and the Bowles-Simpson Commission’s plan**

Medium-term fiscal projections (in percent of GDP)	Actual	CBO Alternative Fiscal Scenario		Bowles-Simpson Commission	
	2010	2020	2035	2020	2035
Revenue	14.9	18.3	18.4	20.6	21.0
Outlays	24.3	25.5	33.9	21.8	21.0
Primary spending	22.5	21.3	25.0	18.6	
Net Debt held by the public	62.0	97.0	187.0	60.0	40.0

**Figure 4. Differences in the % of total wealth held by the top percentiles in the *delay* and *passive adjust* scenarios**



**Figure 5. Discounted sum of utility in steady state by wealth percentiles in *delay* and *passive adjust* scenarios**

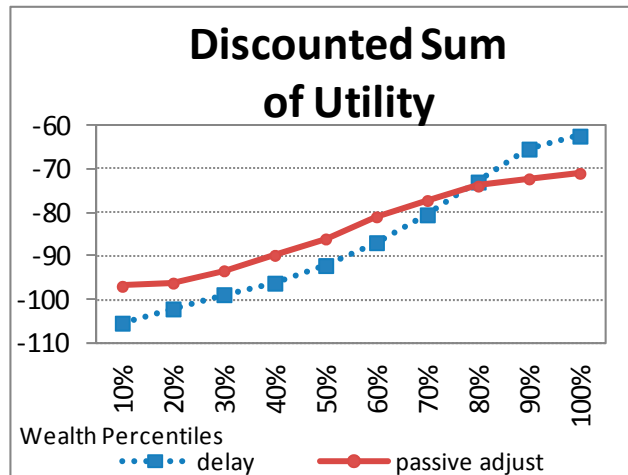
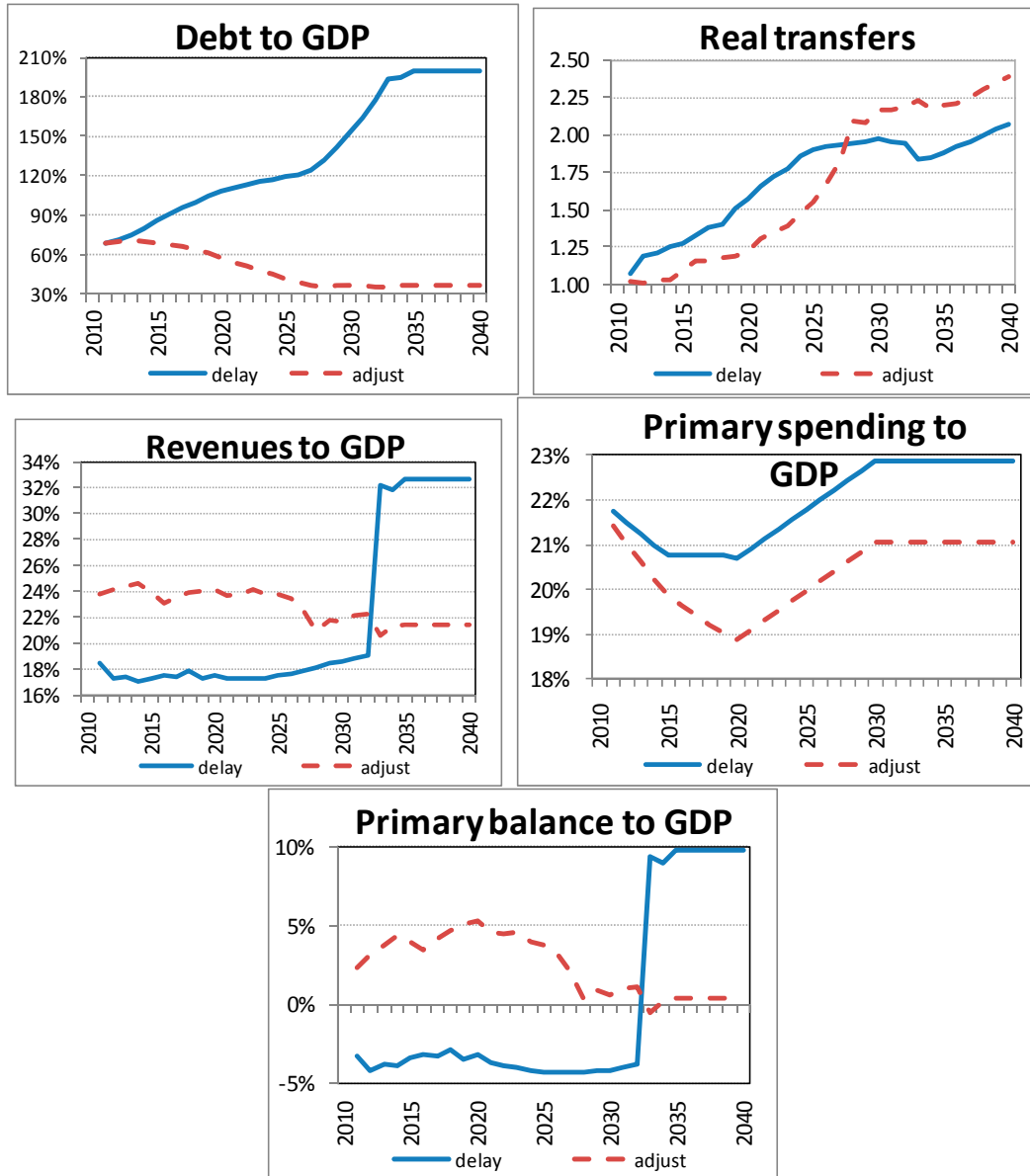
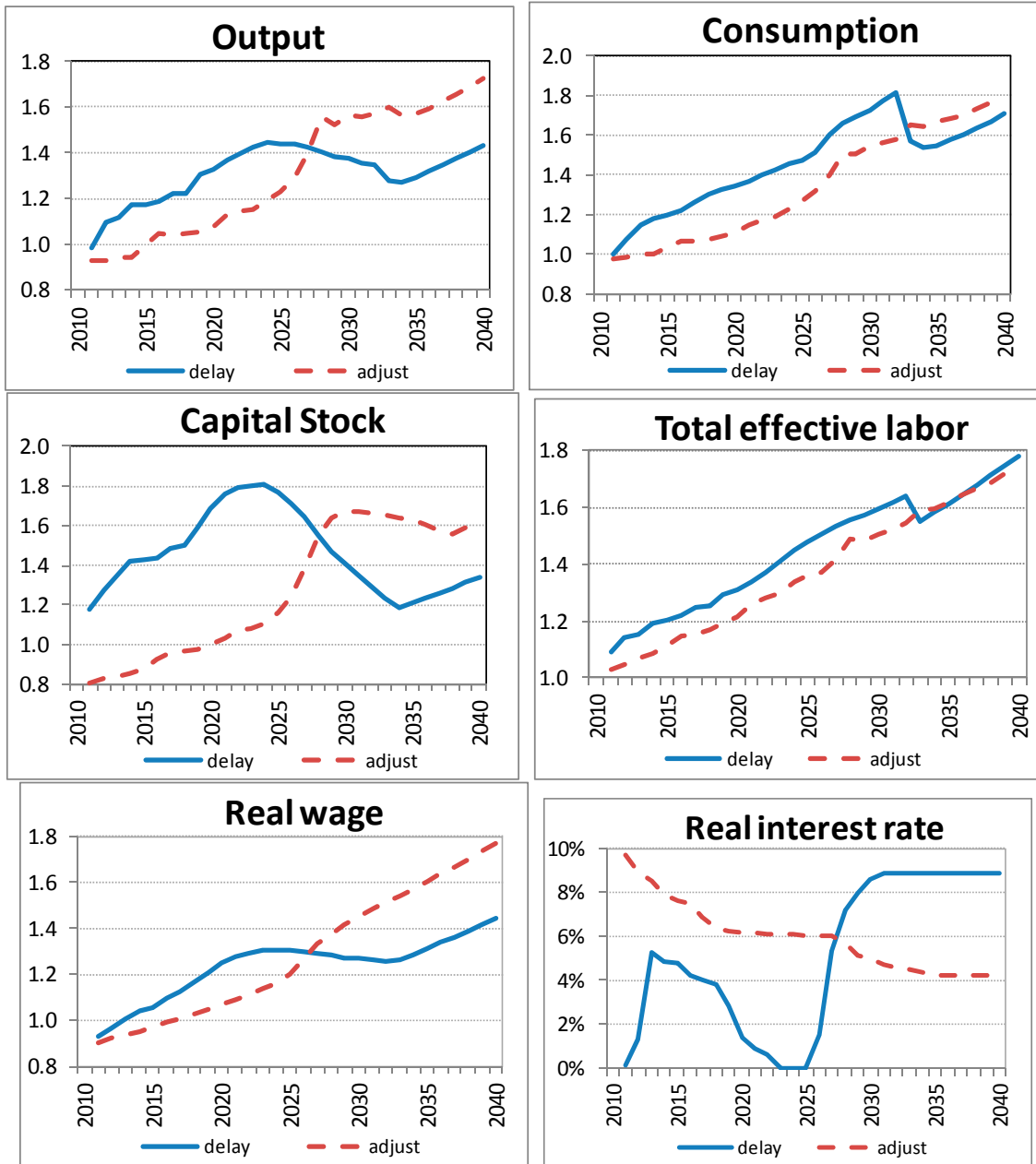


Figure 6. Model Simulations—Fiscal Variables



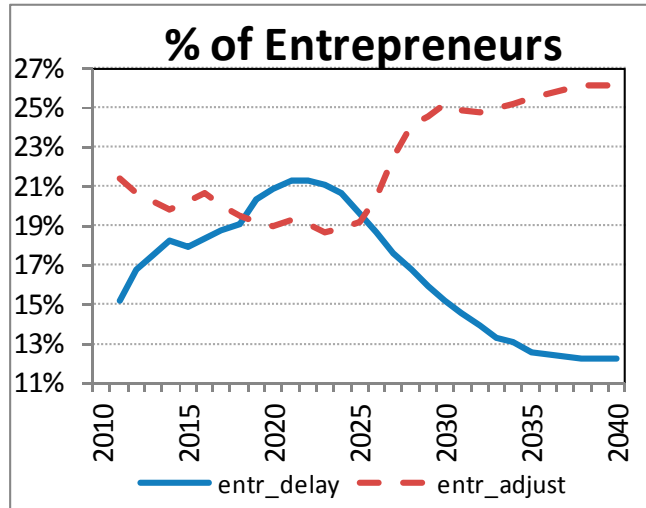
Note: “adjust” in these charts corresponds to the *active (2) adjust* scenario.

**Figure 7. Model Simulations—Main Macroeconomic Variables**



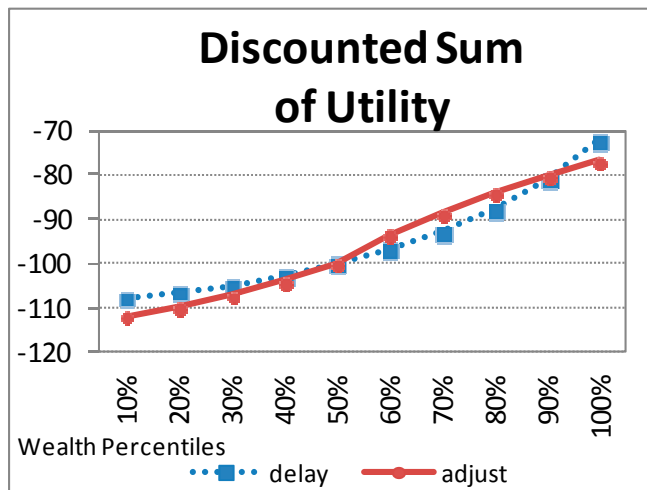
Note: All variables, except the real interest rate, have been rescaled to their initial steady state values; “adjust” in these charts corresponds to the *active (2) adjust* scenario.

**Figure 8. Share of Entrepreneurs in Economy**



Note: “adjust” corresponds to the *active (2) adjust* scenario.

**Figure 9. Present Discounted Sum of Utility by Deciles**



Note: “adjust” corresponds to the *active (2) adjust* scenario.



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