ABSTRACT

Title of Dissertation:	THE MACROECONOMICS OF FISCAL CONSOLIDATIONS
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In the past decade, numerous governments had to adjust their fiscal balance, as a result of the Great Recession and most recently due to the fall in commodity prices. In Chapter 1, I construct a novel dataset to estimate the revenue-raising potential and expenditure-cutting space for 129 countries, and decompose their fiscal consolidation capacity into specific tax and spending categories. Then, I compare the estimated fiscal potential with the consolidation required to stabilize the debt ratio. Finally, I show that the estimated fiscal consolidation capacity in 2007 helps to predict (i) the size of fiscal stimulus in response to the crisis, and (ii) the GDP costs associated with the downturn.

In Chapter 2, I employ a quantitative general equilibrium model with heterogeneous agents, occupational choice, endogenous labor supply, and growth to study the implications for the US of the higher debt to GDP ratio that would result from delaying the adjustment of its medium term budgetary imbalance. I find that compared to a scenario where the debt ratio is stabilized in 2011, postponing the

adjustment for twenty-five years would entail a permanent output loss of 22 percent and a fall in welfare of 13 percent in consumption equivalent terms. Moreover, when the transitional dynamics are considered, I find that once the debt ratio exceeds 100 percent of GDP, the welfare losses from further delays in the adjustment exceed the short run gains.

THE MACROECONOMICS OF FISCAL CONSOLIDATIONS

by

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Chapter 1:

Revenue and Expenditure Gaps - A Cross Country Analysis

1. Introduction

At any point in time, governments may require additional resources either to meet development goals, improve infrastructure, increase human capital, or adjust their fiscal balance. However, some countries might not be able to meet their aspirations given their fundamentals. In this paper I calculate the fiscal consolidation potential for 129 countries, and decompose the estimated fiscal potential into specific tax and spending categories.

I compute each country's additional revenue capacity and expenditure-cutting space as the difference between observed and expected revenues and expenditures (as a share of GDP), considering the country's economic and demographic characteristics. To have reasonable benchmarks, I first estimate the determinants of government's revenues and expenditures, and then compute the expected values from these estimates. The capacity for fiscal consolidation is then estimated as the sum of potential revenue increases and expenditure cuts that are feasible given the country's characteristics.

By construction, the expected revenues and expenditures are simply the conditional averages of observed in-sample values, and do not correspond to the maximum possible revenues (which would require a Laffer-curve-type of analysis) or the minimum possible expenditures (which entails political economy or efficiency considerations).[1] Thus, the fitted values may be understood as the expected revenues and expenditures for a given country, if its fiscal effort was the same as in other countries with similar fundamentals.

This implies that the true fiscal potential could be underestimated by this methodology, as it is not uncommon that in the wake of a crisis countries manage to undertake massive fiscal efforts, as confirmed by the experiences in Ireland, Spain, and Portugal after the global financial crisis. However, this indicator of fiscal

[1] In the United States, the Congressional Budget Office routinely evaluates the adequacy of different sub-categories of revenues and expenditures by comparing them to their long run averages (see for example CBO 2017). However, long-run averages might not be reasonable benchmarks if the conditions in a country have changed (or are expected to change in the future), for example due to tax changes, population aging, or the availability of natural resources.

consolidation capacity might be more realistic, given the political constraints of fiscal policy, as the government shutdowns in the United States attest.

Earlier works have conducted this type of analysis for revenues, using the IMF's Government Financial Statistics (GFS) database. However, they have not decomposed the estimated revenue potential into specific policy instruments (taxes). Moreover, apart from Afonso et. al. (2005), I am not aware of other works that have attempted to estimate the expenditure-cutting space −a crucial element of the fiscal consolidation plans implemented by various European governments.[2]

To overcome some of these limitations, in this paper I construct a novel dataset that combines data from GFS and IMF's country reports (Article IV consultations and revisions to ongoing programs). The dataset contains a complete decomposition of government's revenue and expenditure from 2005 until 2016 (as a share of GDP) for 168 countries. Revenues are decomposed into seven sub-categories: (1) *taxes on personal income and profits*, (2) *other taxes (includes property taxes)*, (3) *payroll taxes*, (4) *taxes on consumption*, (5) *taxes on international trade*, (6) *grants*, and (7) *other non-tax revenues*. Expenditures are decomposed into four sub-categories: (1) *government consumption (includes the compensation of employees and the purchase of goods and services)*, (2) *interest payments*, (3) *transfers and subsidies (includes grants and social security benefits)*, and (4) *gross acquisition of nonfinancial assets (gross public investment).*[3]

I then estimate the determinants of revenues and expenditures both overall and for each of the sub-categories. I find that revenues and expenditures can be reasonably explained by variables that broadly fall into three classes: (i) measures of the stage of development, (ii) demographic characteristics, and (iii) indicators of the structure of the economy. In particular, I find that countries with a higher level of development, elevated dependency ratios, and a larger share of net oil and gas exports tend to have higher revenues and expenditures. Compared to the rest of the world, European countries have higher revenues from payroll and from consumption taxes, Sub-Saharan African countries from taxes to trade and Middle Eastern countries from non-tax revenues. Sub-Saharan African and Middle Eastern countries have higher government consumption outlays explained by elevated wage bills. European and Middle Eastern countries have higher transfers and subsidies, although in the former

[2] The October 2016 IMF's Fiscal Monitor estimated that 60 percent of the planned fiscal consolidation in advanced economies with debt-to-GDP ratios above 60 percent or cumulative fiscal adjustment higher than 3 percent of GDP would come from the expenditure side.

[3] These spending categories correspond to the so-called economic classification, as opposed to the functional classification (defense, education, health, social security and housing, economic services, other government services, and interests). The economic classification is preferred in this document due to data availability, as it is typically employed in IMF's country documents.

these are mostly explained by pension benefits and in the latter by subsidies (e.g. food, energy).

Since revenues from grants, non-tax sources, and taxes to international trade might not be under the control of the policy maker, the additional revenue-raising capacity is estimated as the sum of the additional revenue capacity from personal income and profit taxes, property taxes, consumption taxes, and payroll taxes. Similarly, the expenditure-cutting space is computed as the sum of the cutting space in government consumption, social expenditures, and public investment (as the interest bill might not be easily modifiable).

To get a sense of the potential for fiscal consolidation to address fiscal sustainability, I compare the estimated fiscal consolidation capacity to an estimate of the fiscal adjustment needed to stabilize each country's debt-to-GDP ratio. I make two assumptions to minimize the effects of any short run (cyclical) considerations. First, long-run (potential) growth equals the predicted GDP growth for five years in the future as published in the IMF's World Economic Outlook (WEO).[4] Second, the long-run interest rate equals the rate implied by the predicted debt service in WEO five years in the future (which in turn is a weighted average of the predicted rates of all concessional and non-concessional loans for all maturities).

Finally, I show that the estimated fiscal consolidation capacity in 2007 can be used to predict (i) the size of the fiscal stimulus in response to the Great Recession, and (ii) the real cost from the crisis. I find that countries with a large consolidation capacity in 2007 had less fiscal space at the time of the crisis, and so were less likely to respond to the negative external shock, and as a result had a slower recovery −which translated into larger output costs from the crisis. This occurs because a high consolidation capacity means that a country either overspends or undertaxes (or both) relative to its peers, which translates into less space for a fiscal stimulus −as it would be difficult to further cut taxes or raise spending.

A large fiscal consolidation capacity means that a county has ample room to raise (cut) various revenue (expenditure) categories, but it also means that it has less space for expansionary fiscal policy (which was exactly the required policy response in 2008). Hence, the findings in this paper highlight the importance for countries with large consolidation potential and fiscal needs to adjust their public finances to rebuild the fiscal space that would allow them to better respond to the next crisis.

[4] This assumes that five years in the future (the maximum projection period in WEO), economic growth will revert to its long-run value.

2. Data

Previous works have estimated the determinants of government's revenue performance (as a share of GDP) applying panel data techniques to the IMF's GFS database. For example, Pessino and Fenochietto (2010) employ a stochastic frontier analysis to estimate tax efforts. Baunsgaard and Keen (2010) analyze whether countries eventually recover the lost revenues from trade liberalization reforms. Gupta et. al. (2012) find that foreign grants displace domestic tax revenues as opposed to concessional loans. The most recent Regional Economic Outlook for Sub-Saharan Africa (May 2018) estimates tax efforts for countries in the region and attempts to draw lessons from successful fiscal consolidation episodes.

However, even though widely used, GFS data has two problems. First, although in principle it has data for about 150 countries from 1980 until 2016 (for the central government, sub-national governments, and general government), in practice the coverage varies widely across countries. For example, for 2016 there was data for only about 110 countries and for 2017 only four countries have reported data. In fact, only about 100 countries have consistently reported data since 2005 either for the central or general government.[5] Second, the reported values are commonly mistaken as they differ markedly from those published in WEO and IMF's country reports.[6]

Moreover, previous papers have only focused on aggregate revenue, and thus have not decomposed the estimated revenue potential into specific policy instruments (taxes). Furthermore, apart from Afonso et. al. (2005), there have not been recent estimates of the expenditure-cutting space, although spending reductions are the cornerstone of most European consolidation plans currently being implemented.[7]

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[5] Furthermore, prior to the GFS 2001 manual, fiscal statistics were reported on a cash basis following the GFS 1986 manual. Starting in 2002 countries gradually started to report their statistics on an accrual basis. Nonetheless, about 40 percent of sample countries still report their statistics on a cash basis. Also, about 10 percent of the countries only report statistics for the central government. In other words, only about half of the sample countries report fiscal statistics for the general government on an accrual basis (moreover, the degree of coverage of the general government also varies significantly across countries).

[6] Since country reports result from detailed discussions between IMF's staff and country authorities these statistics are presumably more reliable. For further discussion see Baunsgaard and Keen (2010).

[7] Afonso et. al. (2005) estimate potential expenditure savings for 23 industrialized countries based on a public performance indicator that averages the outcomes of what they consider to be the objectives of the government (income distribution, stability of GDP growth, inflation, GDP per capita, GDP growth, unemployment rate, enrollment rates in secondary school, educational attainment as measured by the math and science scores in the PISA report, infant mortality, life expectancy, and quality of infrastructure). They compute the expected savings in public expenditures as the distance to the minimum spending that could produce the same level of output (same level of the performance indicator), if the country reduced its inefficiencies and attained the estimated production possibility frontier.

To overcome these limitations, I construct a new database that combines GFS data with IMF's country reports (see further details in the appendix), where I decompose for 168 countries the government's revenues and expenditures from 2005 until 2016 (as a share of GDP).[8] The list of countries in the dataset is presented in **Table 1.1**. To ease the comparisons across countries, these are further classified into one of four income categories from the World Bank (based on the gross national income per capita in USD according to the Atlas method −which employs five-year averages of the exchange rate to avoid excessive fluctuations in the indicator).

Unfortunately, 84 of the countries in the sample (presented in **Table 1.2**) only report fiscal statistics for the central government, and others only report their statistics on a cash basis. Some papers have attempted to solve this inconsistency by excluding all countries that do not report statistics for the general government on an accrual basis, which implies restricting the analysis to a small sample of advanced countries.[9] Other works instead only take the information from the central government for all countries. However, this offers an incomplete analysis of the fiscal position in most countries (especially for those that are highly decentralized).

In this paper, I incorporate all available information (cash or accrual, general government or central government) and attempt to limit the effects of these problems in two ways: first, by using a dummy variable for countries that only report statistics for the central government as a candidate explanatory variable for the government's revenues and expenditures; and second, by repeating the analysis with a restricted sample that only includes the more advanced (richest) countries in the sample (which presumably have better statistics). The results suggest that the methodological differences in the fiscal statistics (in terms of coverage and accounting basis) are not too important for the analysis, since the dummy variable is never significant in any of the revenue or expenditure regressions (possibly because it is correlated with the country's level of development), but also because the estimated revenue potential and expenditure-cutting space are quite similar when using the complete or restricted sample.[10]

[8] Acosta-Ormaechea and Morozumi (2012, 2013) construct a similar dataset for about 60 countries by combining GFS with OECD data to investigate the effects on per-capita growth of changes in tax composition and of a public expenditure reallocation.

[9] Accrual accounting provides a better picture of government balances as it reflects all the revenues and expenditures that were actually earned and incurred during the reporting period. For example, revenues on an accrual basis often occur before actual cash is received from the taxpayers. Moreover, it avoids the temptation for governments to delay payments to artificially lower the (cash) deficit by the end of the fiscal year.

[10] As could be expected based on these findings, the results (not shown) are similar if the countries from Table 1.2 are excluded from the sample.

For each country in the dataset, revenues are decomposed into seven sub-categories: (1) *taxes on personal income and profits*, (2) *other taxes*, (3) *payroll taxes*, (4) *taxes on consumption*, (5) *taxes on international trade*, (6) *grants*, and (7) *other non-tax revenues*. The first sub-category pools together personal and corporate income taxes because only in more advanced economies is a complete decomposition of these taxes available. The second sub-category includes revenues from property taxes, stamp taxes, taxes to financial transactions, and any other unexplained tax revenues. The last sub-category includes royalties, proceeds from capital income (interest and dividends), and the sale of goods and services. To aid the comparison across countries, corporate tax revenues directly related to natural resources were reclassified in the dataset as other *non-tax revenues.*[11] The observed revenues for each sub-category in 2016 (as a share of GDP) are presented in **Table 2.1** through **Table 2.4**.

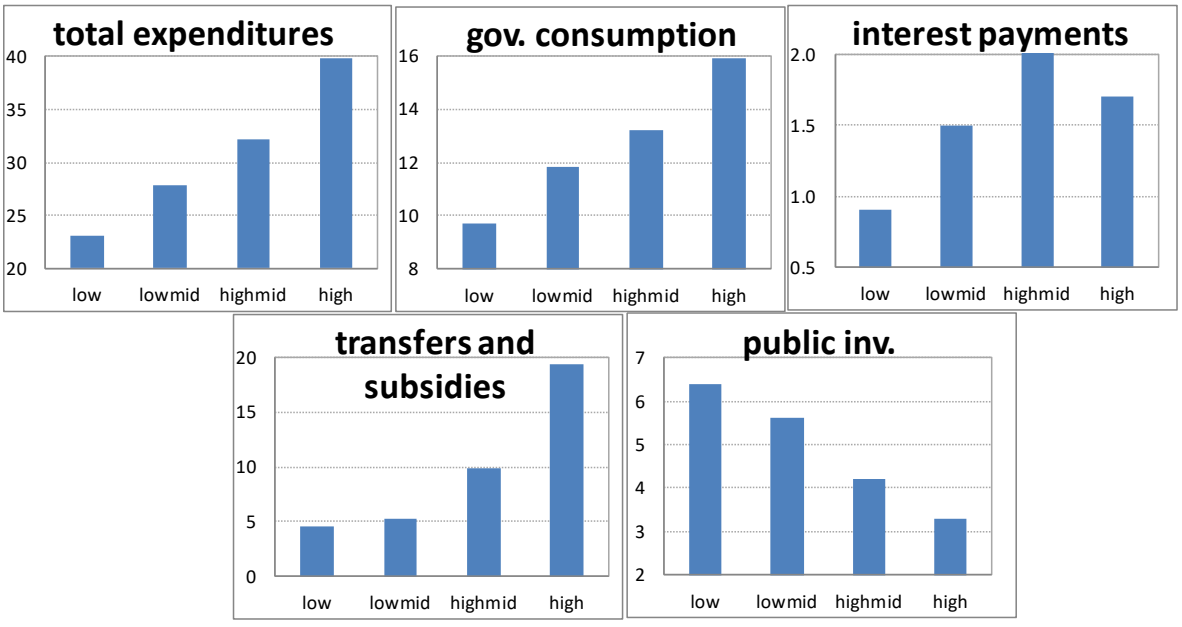
Figure 1: Median revenues by income level in 2016 (percent of GDP)

[11] Some previous works simply exclude resource-rich countries from their analysis.

Expenditures are decomposed into four sub-categories: (1) *government consumption*, (2) *interest payments*, (3) *transfers and subsidies*, and (4) *gross acquisition of nonfinancial assets*. The first sub-category includes all wages and salaries paid to public employees including social security contributions made by the employer, and the consumption of goods and services. The third sub-category pools together social security benefits, grants, subsidies, and other unexplained expenditures, because in most countries the information for each of these sub-components is not available. The last sub-category comprises gross public investment (including depreciation costs, as net investment is only available for advanced countries). The observed expenditures for each sub-category in 2016 (as a share of GDP) are presented in **Table 3.1** through **Table 3.4**.

The medians in 2016 by income level for each of the revenue sub-categories are presented in **Figure 1**. It can be readily observed that countries with a higher income level also have higher revenues as a share of GDP. These are explained by higher income taxes, payroll taxes, other taxes, consumption taxes, and non-tax revenues. However, as countries become richer, they receive fewer revenues from taxes to international trade (lower tariffs). Poorer countries do not have payroll taxes, since in general they do not have social security systems in place. Richer countries do not receive grants, except for some eastern European countries that receive cohesion funds from the EU.

Figure 2: Median expenditures by income level in 2016 (percent of GDP)



Similarly, the medians in 2016 by income level for each of the expenditure sub-categories are presented in **Figure 2**. Countries with a higher income level also have higher expenditures as a share of GDP. These are explained by higher government consumption, interest payments, and social benefits. Interestingly, gross public investment falls as countries become richer, which might reflect the fact that more developed countries already have a large stock of public capital (and thus the marginal product of public capital is smaller) or that in these countries the private sector executes some of these investments (by means of public-private partnerships).[12]

3. Estimation of expected revenues and expenditures

The determinants of government's revenues and expenditures are estimated, using annual data for a balanced panel of 129 countries from 2005 to 2016, with the following specification:

$$y_{i,t} = \alpha + \alpha_j + \gamma_t + \beta x_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where $y_{i,t}$ denotes overall revenues or expenditures or one of its sub-categories (as a share of GDP) for country i in period t. $x_{i,t}$ are explanatory variables used in previous studies, such as in Baunsgaard and Keen (2010), Afonso et. al. (2005), and Rodrik (1998). Data for the explanatory variables are taken from the IMF, World Bank, Economist Intelligence Unit, and United Nations (see further details in the appendix). To limit endogeneity issues, the explanatory variables are lagged by one year (so that the data for the explanatory variables goes from 2004 to 2015).

The regressions include yearly fixed effects γ_t to control for global factors, but do not include country-specific fixed effects, as this would defeat the purpose of the exercise of trying to estimate the expected revenues or expenditures of a country with particular characteristics, which would otherwise be entirely captured by the country dummy. However, the regressions include regional dummies α_j based on IMF area departments (presented in **Table 1.3**) to control for region-specific characteristics or fiscal preferences.[13] The regressions employ standard errors that are robust to heteroskedastic and possibly autocorrelated errors.

3.1. Explanatory variables

The log of the *gross national income per capita* is expected to be positively associated with revenues and expenditures. Public economic theory suggests that since the demand for public goods is income-elastic (Wagner's law), more developed

[12] The October 2014 IMF's WEO argued that infrastructure is becoming increasingly inadequate in many advanced and emerging economies. It advocated for a debt-financed increase in public investment given the substantial economic slack that prevailed in most of these countries and the fact that interest rates are expected to remain relatively low for the foreseeable future.

[13] Similar results are obtained if geographical dummies (based on continents) are used instead.

economies have a higher provision of public goods and thus are forced to impose higher effective tax rates (either via higher nominal rates or fewer exemptions). Also, in more developed countries: (i) the tax base is larger, (ii) the tax administration is more effective in implementing the tax code, and (iii) voluntary tax compliance is presumably higher as taxpayers are more educated, there are better institutions, and governments are usually perceived as less corrupt.

The *old-age dependency ratio* measures the proportion of the population of retirement age as a share of the working age population. It is expected that the dependency ratio is positively correlated with revenues and expenditures, as countries would require higher revenues to finance additional age-related expenditures (such as health and pensions).[14]

Political participation is measured by the turnout in the latest national election. The Meltzer and Richard (1981) model predicts that under a voting system where the degree of fiscal redistribution is determined by the median voter, rising inequality should result in higher redistribution (as the median voter becomes relatively poorer than the average voter). In practice, more unequal countries tend to have less redistribution.[15] One possible explanation, as explained by Benabou (1990) and Acemoglu and Robinson (2008), is that richer people (the elite) are more likely to vote and control the democratic process as they have higher incentives not to lose their dominant position. Thus, it is expected that in a system with higher political participation the elites are less likely to control the political outcome, and this should be associated with higher income redistribution (e.g. higher income taxes and social expenditures, but lower consumption taxes).

Higher *net oil and gas exports* are expected to be associated with elevated expenditures (government consumption, social expenditures, and public investment) but also with lower tax revenues (as rich countries might not feel the need to tax their population to provide public services).[16] Thus, it is expected that although resource rich countries have high overall revenues this is mostly explained by non-tax revenues as their tax intake tends to be low.

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[14] The *youth dependency ratio* (proportion of the population younger than 16 years as a share of the working age population) was also considered as an alternative control, but it was not found to be a significant determinant of revenue or expenditure. However, as expected it is correlated with higher government consumption (additional outlays related to education) and lower transfers and subsidies (lower spending in pensions).

[15] For example, the US has less redistribution than western Europe which has less redistribution than Scandinavian countries.

[16] It should be noted that since royalties and tax revenues directly related no natural resources are classified as non-tax revenues, oil and gas exports might be uncorrelated or even negatively correlated with (non-resource related) tax revenues.

In countries with a higher ratio of *imports to GDP*, the tax base for taxes to international trade is larger, and thus proceeds from this tax should increase.

The *growth gap* in year t is defined as the difference between observed GDP growth in year t and predicted growth in WEO for 2021 (used as a proxy for potential growth). This variable is intended to control for the effects of the business cycle.[17] A common assumption for advanced economies is that revenues tend to be acyclical and expenditures countercyclical. However, as shown by Frankel et. al. (2016), fiscal policy tends to be procyclical in many developing countries.

The *debt-to-GDP ratio* is expected to be positively correlated with interest payments, because for a given interest rate the debt service is costlier, and because the interest rate tends to rise with the debt ratio as the probability of default increases as in D'Erasmo and Mendoza (2017).

It is expected that in countries with an *outstanding IMF program* (listed in **Table 4**) the government's revenues from grants are higher, as a large share of program countries are eligible for concessional financing.

The log of the *annual gross minimum wage* in USD (as reported by the Doing Business survey of the World Bank) is expected to be positively correlated with higher government spending, because in richer countries the average cost of providing services is higher, even after adjusting for purchasing power.[18] It should also be noted that the minimum wage might also capture the quality of public services, which is presumably higher in more developed economies.

Previous works have also included as explanatory variables the share of self-employment or of agriculture in GDP to control for the difficulty to collect taxes, the inflation rate to control for seignorage revenue, the Gini coefficient to control for inequality, and various indexes to control for the quality of institutions. None of these additional variables was significant in any of the revenue or expenditure regressions and were thus not included in the baseline specification. Similarly, the debt ratio and minimum wage are not included in the regressions for revenues and the import ratio is excluded from the expenditure regressions, as they are never significant (as expected).

[17] Very similar results are obtained if an output gap measure (estimated with a traditional HP filter) is used instead. The growth gap measure is preferred because output gap estimates tend to be sensitive to the sample period and the statistical technique used to "filter" the data.

[18] About 20 percent of the countries in the sample are considered "no minimum wage countries" in the Doing Business survey, either because they only have a minimum wage for the public sector or because they have different minimum wages for different sectors of the economy set by collective bargaining agreements. For these countries I employed the public sector minimum wage and when it was not available I used the minimum wage for the manufacturing sector.

3.2. Revenues

The regressions for total revenue, for each of the sub-categories, and for domestic tax revenue (which excludes the proceeds from taxes to international trade, grants, and non-tax revenues, as they are not directly under the government's control) are presented in **Table 5**.[19] As expected, I find that more developed countries, as measured by income per capita, have higher revenues but receive fewer grants (as a share of GDP). The higher revenues are due to higher proceeds from income taxes, payroll taxes, and non-tax revenues. Interestingly, the results suggest that in more developed countries the revenues from consumption taxes are lower. Since domestic tax revenues are higher in more developed countries, these results suggest that these countries prefer direct taxes over indirect taxes, possibly because the latter are more regressive. An alternative explanation is that governments in poor countries rely more on VAT proceeds because, even though they also dislike their regressive nature, they are easier to administer.

Domestic tax revenues (as a share of GDP) are higher in countries where GDP growth is above its long-run level, because of additional proceeds from taxes to goods and services and income taxes. All other revenue categories seem to be acyclical.

Countries with elevated dependency ratios have higher domestic tax revenues, explained by additional proceeds from income, consumption, and payroll taxes. The former could be explained because older persons are richer and thus the tax base for wealth or income taxes would presumably be larger. However, the other results might seem counterintuitive, because if a country has an older population this would decrease its consumption and payroll tax bases (since old persons consume less, as shown in Fernández-Villaverde and Krueger (2007), and because a smaller share of the population would be working). However, it is important to note that the old-age ratio is also a proxy for spending pressures from age-related expenditures (pensions and health care). Thus, for the government's budget constraint to hold, it must be true that countries with higher spending also have higher revenues.[20]

Not surprisingly, countries with higher net exports of oil and gas have higher total revenues since their non-tax revenues are larger. However, it interesting that they have less domestic tax revenues (due to lower taxes to income, consumption, and

[19] Even though governments control tariff rates actual collections are mostly out of their control, as these are highly dependent on the exchange rate and on the economy's openness (which is mostly a function of the country's size and proximity to international markets). For countries whose major imports are oil and gas related, these are highly dependent on the international prices. For countries that import intermediate goods to be re-exported after some process, these will mostly depend on the demand for the processed good from its trading partners.

[20] In other words, it might be the case that an aging population per se would lower the tax base and reduce revenues, but to maintain its fiscal balance the government reacts by raising its effective tax rates as needed.

international trade), which implies that the proceeds from the sale of natural resources tend to displace traditional tax revenue sources. In other words, resource-rich countries can afford lower taxes, which are undesirable but necessary in poorer countries.

As expected, in countries with a higher ratio of imports to GDP, the base for taxes to trade is larger and thus the revenues from this category are higher. In countries with higher political participation, the proceeds from income taxes are higher, which should increase the redistribution of resources (consumption taxes are also higher, but their magnitude is less than proportional, and in any case a sizeable proportion of these proceeds are from the consumption by richer persons). In countries with an outstanding IMF program the government's revenue from grants is higher, which highlights the fact that a high share of these countries receives concessional financing. It is important to note that these grants do not seem to have a significant impact on revenues from other categories.

Compared to the rest of the world, countries in the Middle East and Central Asia (MCD) tend to have elevated non-tax revenues; countries in Sub-Saharan Africa (AFR) receive more revenues from taxes to international trade; and countries in Europe (EUR) have higher proceeds from payroll and consumption taxes.[21]

To further investigate the cyclical behavior of revenues, **Table 5.1** compares the estimated coefficient for the *growth gap* explanatory variable in the baseline regression (presented in **Table 5**) with those obtained in a regression that interacts this variable with dummy variables for low, middle and high-income countries while maintaining all other explanatory variables unchanged. The results suggest that the revenues from domestic taxes, taxes to goods and services and income taxes are procyclical in low and middle-income countries, but acyclical in high-income countries. **Table 5.2** presents the correlation of the estimated residuals, which validates the OLS estimation (compared to a SUR) as the different revenue categories do not appear to be correlated.

3.3. Expenditures

The regressions for total expenditures, for each of the sub-categories, and for primary expenditures (which excludes interest payments as they are not directly controllable by the government) are presented in **Table 6**.

I find that countries have additional outlays (as a share of GDP) when they have: (i) a higher income per-capita (as predicted by Wagner's law), as it is associated with higher spending in transfers and subsidies, (ii) elevated dependency ratios, which result in additional age-related spending (in health and pensions), (iii) more political participation, which induces additional expenditure for redistribution (in transfers and

[21] The omitted category in Tables 5 and 6 is Asia and Pacific (APD).

subsidies and in government consumption [22]), (iv) higher debt ratios, as their interest payments escalate, and (v) larger oil and gas exports, which are also associated with higher spending for redistribution and with increases in public investment. Government consumption is higher in countries that provide higher quality public services (as proxied by the *minimum wage*), and in countries with higher political participation or larger oil and gas proceeds.

Spending on transfers and subsidies is higher (as a share of GDP) in countries that: (i) are more developed, (ii) have elevated dependency ratios, (iii) have more political participation, and (iv) have higher oil and gas exports. The former is explained because social security systems tend to be more generous and cover a higher proportion of the population in advanced countries. In fact, poorer countries typically have no social security schemes in place, but only poorly designed subsidies (e.g. for food and fuel) that could have a higher impact if better targeted (IMF 2016a).

Public investment is elevated in countries: (i) with higher growth, (ii) with more revenues from oil and gas, and (iii) that receive more grants (as they are commonly attached to a specific use or project). This suggests that most countries invest more in good times (public investment appears to be highly pro-cyclical). This may be explained by the fact that for most countries access to international capital markets is quite restricted and even erratic.[23] A competing explanation might be that if growth shocks are serially correlated the marginal product of capital would be higher in fast-growing economies.

I find that, compared to the rest of the world, Middle Eastern (MCD) and European (EUR) countries tend to have higher spending on transfers and subsidies, although these outlays are mainly explained by pension benefits in the latter and by subsidies in the former. Sub-Saharan African (AFR) and Middle Eastern (MCD) countries have high government consumption due to elevated public wage bills.[24] In fact, in many of these countries the government is the biggest formal employer as a large fraction of the population is self-employed (see for example, Behar and Mok 2013).

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[22] Woo et. al. (2016) find in a panel of 17 OECD countries that increases in the public-sector wage bill tend to be associated with lower inequality.

[23] This is problematic, as this behavior can exacerbate the real costs of negative shocks as countries are forced to cut their investment exactly at a time where it would be ideal to conduct counter-cyclical policies, as they cannot get sufficient funding. Furthermore, this behavior can also induce significant cost overruns in large projects (which last several years) if work needs to be halted due to the absence of funding. It is important to note that although private investment is optimally procyclical, a countercyclical fiscal policy is optimal because it allows further consumption smoothing for credit constrained individuals who cannot self-insure.

[24] This is consistent with the notion that poor countries (primarily in Africa and the Middle East) tend to use public employment to alleviate poverty and unemployment (see for example, Tamirisa and Duenwald 2018).

To deepen the analysis of the cyclical behavior of expenditures, **Table 6.1** compares the estimated coefficient for the *growth gap* explanatory variable in the baseline regression (presented in **Table 6**) with those from a regression that interacts this variable with dummies for income level while maintaining all other explanatory variables unchanged. The results suggest that primary spending and outlays on transfers and subsidies are procyclical in low-income countries, acyclical in middle-income countries, and countercyclical in high-income countries. Thus, in poorer countries social spending becomes more generous during good times, while in advanced economies it is governed by automatic stabilizers (e.g. during good times less persons qualify for government assistance). The results for public investment are instead puzzling as they seem to suggest that it is countercyclical in poor countries but procyclical in rich countries.

Table 6.2 presents the correlation of the estimated residuals, which validate the OLS estimation (compared to a SUR) as the different spending categories do not appear to be correlated.

4. Fiscal gaps and adjustment needs

4.1. Fiscal gaps

Based on the above regressions, **Table 7.1** through **Table 7.4** present the estimated gaps for domestic tax revenues (*taxgap*) and primary expenditures (*primgap*) for 2016 (as a share of GDP), defined as the difference between observed and fitted values from the regressions.[25] A negative revenue gap for a particular country indicates that the observed revenues (as a share of GDP) from that particular sub-category are below what would be expected, taking into account the country's observable characteristics. Thus, in principle, this country could raise additional revenue from this sub-category.[26] Similarly, a positive expenditure gap means that given its characteristics a country is spending more than expected in that particular sub-category, and thus it might have some cutting space.

[25] Other works instead present their results in terms of an "effort index", computed as the ratio between observed and expected values. In this paper I present the results in terms of gaps (as a share of GDP), first because they are easier to understand, but more importantly to make the estimated fiscal consolidation capacity comparable to the adjustment needs. For example, an effort index of 160 per cent of tax revenues might imply a very different fiscal consolidation capacity depending on how large current revenues and expenditures are as a share of GDP.

[26] These measures should not be confused with revenue gap estimates that compare observed revenues to those that would be possible if all agents fully complied with the letter and spirit of the law (for the United Kingdom see HMRC 2017). The problem with these estimates is that they are implicitly measuring the size of the shadow economy or the effect of tax heavens, and thus it is not quite clear how much of this theoretical compliance gap is recoverable. Moreover, as the law could be changed, they are not really measuring how much is it feasible to raise revenues.

The fiscal gap is defined as the sum of the revenue-raising potential and expenditure-cutting space:

$$fiscalgap_{i,t} = -taxgap_{i,t} + primgap_{i,t} \quad (2)$$

For example, I find that Ireland, Switzerland and Iraq could potentially increase their tax revenues by about 10 pp of GDP. Lebanon, Croatia and Mauritius could augment their income tax revenues by around 5 pp of GDP. Ukraine, the United Kingdom, and Israel could raise their payroll tax revenues by about 5 pp of GDP. Liberia, the US and Belgium could augment their revenues from consumption taxes by about 5 pp of GDP.[27] Argentina, Saudi Arabia and France could presumably reduce their primary expenditures by about 10 pp of GDP. Brazil, Liberia and Australia could decrease their government consumption by around 9 pp of GDP. France, Argentina, and India could reduce their spending in transfers and subsidies by about 8 pp of GDP. Bolivia, Tajikistan, and Algeria could lower their public investment by about 8 pp of GDP.

Although it is interesting to analyze results for given revenue or expenditure sub-categories, as they reflect countries' fiscal preferences, it is better to focus on the overall gaps and not on individual sub-categories. For example, a given country may have low income taxes that are compensated by high revenues from consumption taxes (as in Argentina or Mauritius). Overall, tax revenue may be adequate, even if the composition is atypical or unfair. It would certainly be mistaken to argue that these countries should necessarily increase their income taxes because they are low, compared to peers, while ignoring the fact consumption taxes are higher than expected.[28] Similar arguments could be made for expenditures.[29]

Moreover, analyzing specific categories could miss policy changes where one type of revenue or spending category is replaced by another. For example, **Table 8** presents selected countries where the negative correlation between the estimated revenue or spending gaps for specific sub-categories is quite large and could indicate policy changes. It should be noted however, that even if this realignment across categories is caused by chance and not by specific policies, analyzing changes to specific sub-

[27] Belgium is an interesting case because although its standard VAT rate is 21%, which is higher than the OECD average, it has reduced rates (of 0%, 6% and 12%) for an important number of goods and services which erode the overall intake.

[28] For example, in Denmark the social security system is financed through income taxes and not with payroll taxes. Thus, their revenues from income taxes are abnormally elevated while their payroll taxes are unusually low. Something similar occurs in Iceland, where the payroll tax is only paid by employers.

[29] For example, in Germany, Luxembourg, Netherlands, and the Slovak Republic, spending is lower than expected on wages and higher in transfers and subsidies, as public employment in the health sector is small, as these governments finance the private provision of these services.

categories could miss the fact that overall revenues or spending might remain adequate due to the re-alignment.

To address these aggregation issues, the gaps for domestic tax revenues and primary expenditures are estimated in two ways: first, from the direct regression for this sub-category, and secondly as the sum of the estimated gaps from the regression of each of its sub-components. Using these estimates, it is possible to obtain an interval (not shown) representing a plausible range of estimates for these gaps. For the estimated revenue and expenditure gaps, the median absolute difference between the two measures is 0.71 and 0.85 pp of GDP, and the correlations between the two measures are 95 and 96 percent, respectively. The revenue and expenditure gaps reported in **Table 7.1** through **Table 7.4** are computed as the midpoint of these intervals. The estimated revenue and expenditure gaps are then decomposed into their sub-components, where the relative magnitudes of the gaps estimated from the regression for each sub-category are preserved, but their sum is conditioned to equal the overall revenue or expenditure gap.

Even focusing independently on the estimated revenue or expenditure gap is problematic, as it misses the obvious fact that due to the existence of the government's budget constraint, the estimated revenue and expenditure gaps are positively correlated.[30] Therefore, its best to analyze the estimated fiscal gaps that encompass all the revenue and expenditure information. A country with average revenues and expenditures for a given set of characteristics would appear to have no additional fiscal consolidation capacity (a fiscal gap of zero). A negative fiscal gap means that if a given country closed its revenue and expenditure gaps (if its revenues and expenditures were the same as the conditional average of its peers), its fiscal balance would deteriorate. A positive value shows the extent of improvement in the fiscal balance that would be possible to achieve given the country's characteristics (its fiscal consolidation capacity).

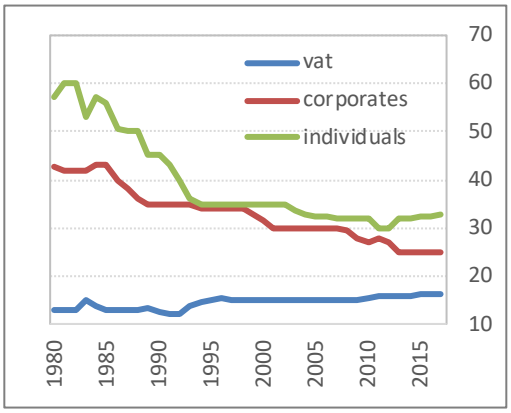
For example, the estimated revenue gap for Paraguay is -0.7. Hence, it could presumably raise its revenues by 0.7 pp of GDP, as its revenues from income and other taxes are around 1.9 and 0.6 pp below its peers, while its revenues from payroll and taxes to goods and services are 1.5 and 0.3 pp higher than expected. The estimated expenditure gap implies that Paraguay should be able to cut its expenditures by 0.5 pp of GDP given its characteristics and the spending of its peers. This is explained by the fact that its government consumption expenditures and public investment are 1.7 and 0.1 pp above the average of its peers, while its spending in transfers and subsidies is 1.2 pp lower than expected. Overall, the estimated fiscal gap for Paraguay for 2016 is 1.2 pp of GDP. Hence, about 60 percent of its fiscal gap is explained by its revenue-raising capacity. Both the size and composition of the fiscal

[30] In other words, countries with higher revenues would also spend more both in absolute terms and compared to peers.

gap vary significantly across countries and change gradually over time for a given country.

It is important to note that the expected revenues (or expenditures) are generally below (above) a country's maximum (minimum) historical values both for the total and for each of the sub-categories. Moreover, it is not clear that historical values are the correct benchmark to assess revenue-raising capacity or expenditure-cutting space. For example, nowadays most countries need to spend much more than in the past in health and pensions due to population aging. **Figure 3** uses data from Vegh and Vuletin (2015), to show that while the standard VAT rate for the median country has marginally increased in the past three decades, the standard corporate rate and highest marginal personal income tax rates have sharply decreased.[31] Thus, lower current revenues compared to history are not necessarily evidence of some unused potential.

Figure 3: Median tax rates (percent)



Similarly, if a country experienced a phase of unsustainable growth due to a real estate boom or a financial bubble, which resulted in very high but atypical tax revenues, it would be incorrect to deduce that this country has untapped (current) revenue potential just because it is collecting lower revenues than it used to, as those vigorous tax revenues may never return. Moreover, for some countries the estimated revenue potential might be above their own historical values, but the fact that it has never had such high revenues does not necessarily imply that the revenue potential is non-existent. Maybe such revenues were not possible in the past but are currently within reach given changes in the country's characteristics.

Reassuringly, the estimated fiscal gaps in this paper are broadly in line with previous country specific analyses and recommendations by IMF fiscal experts (see IMF (2010a) for a summary of policy prescriptions for fiscal consolidation for individual

[31] The latter reflects the secular tendency of countries to lower their tax rates (for direct taxes) to become more competitive and attract foreign investment, due to the increased mobility of capital and rich individuals. For example, in the US the effective corporate tax rate fell from about 40 percent in the 1950s to about 20 percent in 2016.

countries). For example, the IMF has argued that Mexico and Indonesia could increase their fiscal revenues, and these countries indeed have negative estimated revenue gaps. The IMF has also argued that Argentina, Brazil, Belgium, Finland and South Africa could reduce their expenditures, and these countries indeed have positive estimated expenditure gaps. For specific revenue sub-categories IMF (2010a) argued that (i) Germany and Mexico could increase VAT revenues by eliminating the reduced VAT rate for particular items; (ii) Japan has a low statutory VAT rate compared to other countries; (iii) Italy has low VAT compliance compared to other OECD countries; (iv) Japan and Korea could augment personal income tax revenues by broadening their base (since they have relatively high top rates). The results in Table 7 confirm that Germany, Mexico, Japan, and Italy are estimated to have negative gaps for the taxes on goods and services, and that Korea and Japan have negative estimated gaps for the income tax. Naturally, the proposed methodology in this document cannot confirm whether the low revenues in these countries are due to low rates or low compliance, but the similarities with detailed country analyses are nonetheless encouraging.[32]

4.2. Fiscal adjustment needs

Since the size of the government is a political choice of its citizens (or their rulers), in this paper I refrain from any discussion of the optimal size of government, or the efficiency or fairness of the composition of revenues or expenditures. Instead I focus on the amount of fiscal consolidation required to stabilize the debt-to-GDP ratio in the medium run, recognizing that for some countries the debt ratios will continue to rise in the short run.

Naturally, such consolidation is only a minimum requirement for debt sustainability. For example, this estimate completely abstracts from liquidity considerations, domestic financing constraints, the probability that negative shocks could derail debt sustainability and the question of the optimal debt level. This is important because in many countries the debt ratio is currently at historically elevated levels (in some cases even above wartime peaks), initially because of the Great Recession and more recently due to the fall of commodity prices. Thus, it might be optimal for some countries to reduce their indebtedness, and not just to stabilize the debt ratio. For example, the average debt ratio was 60 percent of GDP in advanced economies prior

[32] The correlation between statutory tax rates from Vegh and Vuletin (2015) and from KPMG with the estimated fiscal gaps is about 25 percent for taxes to goods and services, 25 percent for payroll taxes and 40 percent for income taxes. The IMF introduced in 2013 a Tax Administration Diagnostic Assessment Tool (TADAT) to assess the relative strengths and weaknesses of a country's tax administration. About 50 countries have been assessed and the correlation with the estimated fiscal gaps for income taxes and for taxes to goods and services are about 35 and 30 percent (the assessments on the quality of risk management, timely filing of declarations and transparency seem to be particularly relevant).

to the financial crisis and is currently about 110 percent.[33] Moreover, this measure does not consider the expected increases in age-related expenditures (pensions and health) or unfunded contingent liabilities. For example, **Table 9** shows that age-related expenditures are expected to increase by about 1 percent on average in the next ten years. [34]

The primary balance pb (as a share of GDP) that stabilizes the debt-to-GDP ratio at level d is:

$$pb = \frac{(i-g)}{(1+g)} d \qquad (3)$$

where i is the nominal interest rate, and g is the growth rate of nominal GDP (obviously the result does not vary if the real interest rate and real GDP growth are used instead). The nominal interest rate is computed for each country as the implied rate in their projected debt service, which in turn is a weighted average of the rates for all concessional and non-concessional domestic and foreign loans at all maturities. Thus, in a country with a high share of concessional financing the effective interest rate might be below the current market (marginal) rates.

Since current growth and interest rates might be atypical in the short run, I instead proxy for their long run values to better reflect the country's medium term fiscal adjustment needs (devoid of cyclical considerations). The long run nominal GDP growth rate is approximated by the predicted nominal growth for five years ahead in WEO. Similarly, the expected debt-to-GDP ratios and interest payments for five years in the future are also taken from WEO. Thus, the required fiscal adjustment is defined as the difference between the primary balance that would be required to stabilize the debt ratio at its projected level in 2021 and the observed primary balance in 2016.

The estimated required fiscal adjustments (as a share of GDP) are presented in **Table 10.1** through **Table 10.4**.[35] The distribution of the adjustment needs is skewed to the left (few countries have large fiscal needs). About 55 per cent of the countries have

[33] According to the Spring 2018 Fiscal Monitor, current debt levels were last seen in the aftermath of World War II, with debt exceeding 100 percent of GDP in about one quarter of these countries. Similarly, in emerging market and middle-income economies, debt is at 50 percent of GDP on average, levels last seen during the 1980's debt crisis, with debt exceeding 70 percent of GDP in one-fifth of these countries. In low-income developing countries, debt now exceeds 40 percent of GDP on average, almost half of which is non-concessional, with debt exceeding 60 percent in one quarter of these countries.

[34] Estimates are from the Spring 2018 Fiscal Monitor, which includes projections for about 100 countries. Similarly, IMF (2010b, 2011) had estimated that on average public health care and pension spending would rise about 3 and 1 pp of GDP in the next two decades, respectively.

[35] A negative requited fiscal adjustment means that the country would need a fiscal loosening to stabilize its debt ratio to prevent it from falling (although, as mentioned earlier, these countries might instead prefer to reduce their post-crisis indebtedness).

negative required adjustments, and thus do not seem to need further adjustments to stabilize their debt ratios. 20 per cent of countries require moderate adjustments (less than 2 pp of GDP), while the remaining 25 percent require larger efforts. For example, Spain and Brazil will need an adjustment of about 1.5 pp of GDP to stabilize its debt ratio at 94 and 88 per cent of GDP. The United States would need an adjustment of 1.7 pp of GDP to stabilize its debt at 117 per cent of GDP (which implies a federal debt in the hands of the public, the measure favored by CBO, of about 85 per cent of GDP).

4.3. Fiscal consolidation gaps

To get a sense of the relative size of the estimated fiscal consolidation capacity, **Table 11.1** through **Table 11.4** present the fiscal consolidation gap, defined as the difference between the estimated fiscal gap and the required fiscal adjustment, for countries that require some tightening to stabilize their debt ratio in the medium run. A negative fiscal consolidation gap suggests that the estimated fiscal consolidation potential is not sufficient to stabilize the debt ratio. Naturally, this does not mean that these countries face an imminent crisis or that they do not have enough instruments to implement the required fiscal consolidation.[36] It only indicates that the country would presumably need to exert a fiscal effort that is beyond the average of countries with similar characteristics and might also need to implement accompanying structural reforms.

Based on this metric, I find that some of the countries with the biggest fiscal difficulties are Lebanon, Zambia, Nigeria, and Iran, with adjustment needs that exceed their estimated fiscal consolidation capacity by more than 5 pp of GDP. It should be noted, however, that since fiscal gaps are defined as the sum of the computed revenue and expenditure gaps, the estimated fiscal gaps might be understated if a country with a need to consolidate only alters its overall revenues (expenditures) if they are below (above) its peers. This alternative *optimistic* estimation of the fiscal gap is also presented in **Table 11.1** through **Table 11.4**).[37] Naturally, under this assumption the estimated fiscal capacity is larger and most countries would have sufficient fiscal consolidation capacity to stabilize their debt ratio.

[36] For example, Uhlig and Trabandt (2011) compute Laffer curves for the United States and EU-14 countries and conclude that the maximum possible tax revenues would be about 100 per cent of GDP if the labor tax or the capital tax were increased to about 60 percent, and that consumption taxes have no peak (there is no Laffer curve), and thus in theory they would always provide additional revenues when increased. However, in practice these hypothetical boundaries might not be relevant for policy purposes as the political and social costs of such extreme measures would be unbearable (moreover, achieving the maximum possible fiscal revenues is not necessarily efficient or desirable).

[37] In other words, the optimistic scenario assumes that taxes would not be lowered (or expenditures increased) if they are higher (lower) than expected. Thus, in this scenario the estimated fiscal gap is non-negative by definition.

Nonetheless, the *optimistic* scenario might overstate the true fiscal consolidation capacity. If the willingness to pay taxes is a function of the amount of public goods and services supplied by the government, it is conceivable that spending pressures could increase if the government increases its revenues or that the government might be forced to lower its taxes as it lowers its spending.

4.4. Robustness checks

As countries in the sample are so different, and since the fiscal statistics of poorer countries might not be sufficiently reliable or comparable to those of richer countries, I repeat the analysis for a restricted sample of more developed countries (102 countries classified by the World Bank as high middle income or high income, presented in **Table 1.1**). The regression results for the restricted sample (not shown) are qualitatively similar to those for the full sample, although as expected the in-sample fit of the estimations improves as there is less variance to explain, since the remaining countries are more homogeneous. The estimated coefficients remain significant, with the same sign, and comparable magnitudes. Thus, the estimated fiscal gaps from the full and restricted samples (presented in **Table 12**) are broadly unaffected −the correlation between the two measures is 97 percent.

The regional dummies are probably the most controversial explanatory variables in the baseline estimation. Their intended role is to account for systematic differences across regions after controlling for other determinants of revenues or spending. For example, European countries have much higher revenues and expenditures than other countries. Presumably, this reflects their preference for the government to have a significant role in the economy. Mechanically, the European dummy implies that the conditional average of revenues and expenditures for these countries is higher than for other countries. Thus, if two countries have similar structural characteristics, and the same revenues and expenditures (as a share of GDP), but one of them is European, the baseline estimates would suggest the European country has a larger revenue capacity and a smaller space to cut its expenditures (the overall fiscal gap could be higher or lower depending on which effect is larger).

However, it is not clear how limiting these regional differences in fiscal preferences really are. For example, Ireland and Switzerland have smaller governments, and thus it might be unreasonable to expect them to behave as other European countries. Likewise, Japan, South Korea, Singapore, and the United States also seem to prefer a smaller role for the government compared to other advanced economies. It is important to note that this does not necessarily mean that in case of need, these countries would not be able to reach the tax ratios observed in European economies.[38]

[38] For example, the VAT tax was increased in Japan from 5 to 8 percent in April 2014 and is expected to rise again to 10 percent in October 2019 (the latter has been postponed twice due to the weak state of the economy, from October 2015 and April 2017), to address the rising welfare costs associated

However, the recent history in the United States suggests that these fiscal constraints should not be entirely dismissed.
For the sake of robustness, I repeated the exercise without including regional dummies in the estimations. The regression results (not shown) are also robust to the exclusion of the regional dummies (the significance and sign of the estimated coefficients on other variables is similar), although as expected the in-sample fit of the estimations diminishes. The estimated fiscal consolidation capacities with and without the regional dummies are presented in **Table 13**. The correlation between the two measures is 96 percent.

Interestingly, for countries in Latin America, the Caribbean and Central America the estimated fiscal gaps fall by about 2.5 pp of GDP when the regional dummies are excluded, mostly due to a reduction in their expenditure-cutting space (which means the conditional average of expenditures for the peers of these countries is higher without the inclusion of the regional dummy). Something similar occurs for countries in Central Asia and North Africa. For the other countries the results remain broadly similar.

On the contrary, it is also conceivable that the regional dummies from the baseline specification, based on IMF area departments (presented in **Table 1.3**) are not detailed enough to capture meaningful differences across regions. **Table 14** presents a finer set of dummies based on geographical regions, where each of the dummies from the baseline specification is roughly split into four regions.[39] The regression results (not shown) are also robust to the inclusion of detailed regional dummies (as the significance and sign of the estimated coefficients is similar), although as expected the in-sample fit of the estimations improves (compared to the baseline specification). The estimated fiscal consolidation capacities with the more detailed regional dummies are presented in **Table 13**. The correlation with the baseline estimations is 88 percent but interestingly the correlation improves to 93 percent if countries from the Gulf Cooperation Council are not included. For countries in Central Asia and North Africa, their estimated fiscal gaps improve by about 3 pp of GDP with the detailed regional dummies due to an increase in their estimated revenue-raising potential.

The fiscal gaps are estimated only for revenue and expenditure categories considered to be under the government's control, which excludes the proceeds from taxes to trade, grants and non-tax revenues and interest spending. However, this assumption

with the rapid aging of its population. The last tax hike had occurred in 1997 when the rate was increased from 3 to 5 percent.

[39] The proposed regions attempt to use commonly used classifications, but of course some countries are problematic as they belong to more than one region. For instance, the list of countries that belong to Eastern Europe or the Balkans could be debatable.

might not be innocuous. For example, it could lead to an overestimation of the fiscal consolidation capacity for a country that receives a substantial amount of foreign grants or commodity revenues that are used to finance public spending, as the baseline specification would capture the additional spending but exclude the revenue source. To examine the robustness of the results, **Table 15** compares the fiscal consolidation capacity from the baseline specification with an alternative estimation that includes all revenue and spending categories. The correlation between the two measures is about 80 percent but as expected there are significant differences for countries with large proceeds from grants or commodity revenues. For the former, the fiscal consolidation capacity is unequivocally reduced.

For resource-rich countries the results are more interesting because the change to the consolidation capacity ultimately depends on whether the country has higher or lower than expected non-tax revenues considering its net commodity exports. For example, the results suggest that Kuwait, Iraq, Oman and Saudi Arabia receive about 10 percentage points of GDP less than what would be expected, while Norway, Botswana, Finland and Ecuador have non-tax revenues that are about 5 percentage point higher than expected. The explanation of this result is beyond the scope of this paper but might be related to the design of the fiscal regimes for their extractive industries or whether private participation in the sector is allowed.

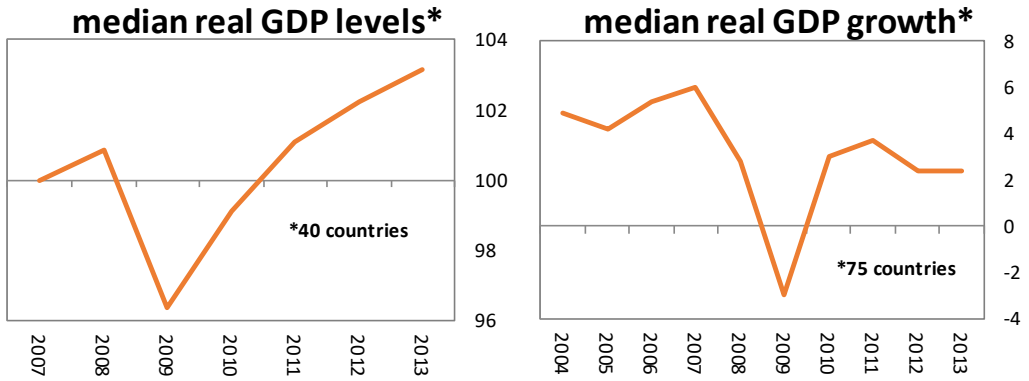
5. Fiscal gaps, fiscal space, and the cost of the Great Recession

A country has a large estimated fiscal gap when it has low revenues and/or high expenditures relative to other countries with similar characteristics. Normally, a large fiscal gap would imply a large fiscal deficit. Thus, having a large consolidation potential is not a good thing. It only indicates that a country has some revenue or expenditure sub-categories that are very different compared to its peers, and thus those areas would probably be good candidates to consider policy changes if the country were to initiate a fiscal consolidation.[40] Thus, the fiscal gap provides an indirect and inverse measure of fiscal space, defined as the size of discretionary fiscal measures that a country could implement to stimulate the economy in a recession.[41] In general, countries with a large consolidation potential are expected to have less fiscal space.

[40] Similarly, an overweight person with high blood pressure has a large potential to reduce pounds, but this would not be considered a good thing. Moreover, reducing weight would probably be a good candidate area to begin treatment for the blood pressure before considering any other intervention such as medications.

[41] IMF (2016b) defines fiscal space as the "the room to raise spending or lower taxes (…) without risking an unfavorable reaction from financial markets and undermining the longer-term health of the country's public finances.

Figure 4: Cost of the Great Recession



To analyze the relationship between the fiscal gap and fiscal space, I analyze whether the estimated fiscal gaps are correlated with the response of countries to the Great Recession and the costs of the downturn. The costs of the recession can be defined in terms of GDP levels or growth rates. For 40 countries in the sample (shown in **Table 16.1**), the Great Recession reduced real GDP below its 2007 (pre-crisis) level.[42] The left panel of **Figure 4** shows that for the median of these countries, real GDP in 2009 was about 4 pp below its 2007 level, the downturn lasted about three years (before real GDP returned to its 2007 level), and the cumulative output loss was about 7 pp (compared to a situation where GDP remained at its 2007 level). It is important to note that since the duration of the crisis varies across countries in the sample, the cumulative cost of the recession only considers the years in which GDP remained below its pre-crisis level (the maximum possible duration of the crisis is nine years, if real GDP in 2016 remained below its 2007 level).

For 75 countries in the sample (presented in **Table 16.2**), the real GDP growth rate fell below its 2007 (pre-crisis) value. The panel on the right of **Figure 4** shows that for the median of these countries, real GDP growth in 2009 was about 9 pp lower than in 2007 (the growth rate measure of the size of the shock), and growth has remained lower thereafter. The cumulative lost growth was about 16 pp compared to a situation where the economy kept growing at the pre-crisis rate. The cumulative cost of the crisis (in growth rates) only considers the years in which growth remained below its pre-crisis rate.[43]

[42] It should be noted that since the analysis is conducted with annual data (for the 129 countries with fiscal gap estimates), it is possible that a country had a technical recession (with two consecutive quarters of negative growth) and is not counted in this sample, if the sub-sequent recovery was strong enough to raise real GDP by the end of the year above its 2007 level.

[43] In 2011, several countries were also hit by the fall of commodity prices and thus the analysis assumes that for these countries the growth slowdown from the 2007 crisis ends in 20011 as it impossible to disentangle the effects from both shocks.

Table 17.1 shows that, for the 40 countries whose GDP fell below its pre-crisis level, the cumulative cost of the crisis was lower for countries that implemented some fiscal stimulus, after controlling for the size of the shock.[44] The latter is defined as the drop in real GDP from 2007 to the trough (for most countries the trough was reached in 2009). The size of the stimulus is proxied by the changes in the estimated fiscal gap over the crisis period. For example, if the real GDP of country i remained below its pre-crisis level until year t (it exceeded the pre-crisis level of real GDP in $t+1$), the size of the stimulus implemented by this country is proxied by:

$$stimulus_i = \int_{2007}^{t} \Delta fiscalgap_t d_t \qquad (4)$$

The estimated coefficient on the size of the shock implies that for each additional initial pp loss of GDP, the cumulative cost of the recession (in levels) increases by 4.6 pp of GDP, which suggests that the recession was highly persistent. The results show that an increase of one pp in the fiscal gap during the crisis (fiscal stimulus) is associated with a reduction of 0.6 pp in the cost of the crisis, while the second column of **Table 17.1** shows that the change in the fiscal deficit is not a significant determinant of the cost of the crisis. The change in the fiscal gap appears to be a better measure than the change in the overall deficit, possibly because it excludes changes that were not intended (not under the control of the policy maker).[45]

To explore whether the computed fiscal gaps are adequate measures of fiscal space, in the third column of **Table 17.1**, I analyze if the estimated pre-crisis fiscal gap (in 2007) is a significant determinant of the size of the fiscal stimulus implemented as a response to the Great Recession. The results suggest that the fiscal gap in 2007 is indeed a significant determinant of the size of the stimulus, while the debt-to-GDP ratio is not significant.[46] The fourth column of **Table 17.1** confirms that the cost of the recession was lower for countries that were able to implement a larger fiscal stimulus as a response to the crisis, instrumenting the stimulus (change in the fiscal gap) with the pre-crisis fiscal space. More precisely, the last regression uses as an explanatory variable the predicted size of the fiscal stimulus based on the computed fiscal gap for 2007.

Similarly, **Table 17.2** repeats the analysis for the 75 countries whose growth fell below its pre-crisis rate. The table shows that: (i) the cumulative cost of the crisis (in

[44] Some countries not only did not conduct a stimulus bur rather conducted a consolidation as they did not have the necessary financing.

[45] For example, it controls for changes in cyclical conditions and excludes changes from commodity prices or grants.

[46] Similar results were obtained if the debt ratio is replaced by the average yields in government's bonds in 2007 or if the debt is replaced by its distance to a "tolerable debt level" which varies by income level (the IMF uses as risk benchmarks a debt ratio of 50 percent of GDP for low income countries, 60 percent for emerging countries and 100 percent for advanced economies.

growth rates) was lower for countries that implemented a fiscal stimulus after controlling for the size of the initial shock; (ii) the change in the fiscal deficit is not a significant explanatory variable of the cost of the crisis; (iii) the pre-crisis fiscal space is a significant determinant of the size of the fiscal stimulus (the debt-to-GDP ratio is still not significant); and (iv) the cumulative cost of the crisis was lower in countries with a larger pre-crisis fiscal space as they able to implement a larger fiscal stimulus.

6. Conclusions

In this paper I estimate the size and composition of the fiscal consolidation capacity for 129 countries around the world, compare it to the required adjustment that would be needed to stabilize each country's debt ratio, and show that the consolidation capacity in 2007 is a significant determinant both of the size of the fiscal stimulus as a response to the global financial crisis, and of the real costs of the recession. Overall the results suggest the importance for countries to continue to implement fiscal consolidation plans to restore the fiscal buffers (space) that would allow them to have a countercyclical response in the next crisis, which would diminish its output costs.

The results in this work are only suggestive, as they depend on the estimated equations. Moreover, for some countries, institutional or political constraints might make unattainable the estimated size of potential revenue increases or expenditure cuts. Thus, these results cannot replace individual country studies and recommendations (such as the ones provided in the IMF technical assistance reports) that are specifically tailored to incorporate country-specific features and needs (for example, they might advise how to enhance the enforcement of the tax code or improve the budgeting process by focusing on results). Nonetheless, the exercise in this paper is useful as it illustrates in a standardized manner the size and composition of the fiscal adjustments that in principle could be achievable by a given country if it wished to adjust its fiscal imbalance. Moreover, it provides benchmarks that might be used for assessing fiscal policy outcomes, understanding a countries' particular fiscal preferences, or providing a reasonable starting point for a discussion of policy reform options.

A number of interesting issues cannot be addressed with the proposed methodology, and thus remain beyond the scope of this paper. The two most salient are: (i) the efficient policy mix between revenue and expenditure measures (and more precisely between specific taxes and spending categories) given a desired size of fiscal consolidation, and (ii) the optimal debt level (and moreover how fast should the fiscal consolidation be). More recently, the policy debate has turned to the possibility of changing the mix of the consolidation to make it more growth-supportive (smaller fiscal multiplier) or to ameliorate its distributional consequences.

Chapter 2:

The Costs of Delaying the Fiscal Consolidation in the US

1. Introduction

The sharp worsening of public finances in the US since the Great Recession brought the need for fiscal reform to the center of the policy debate. The federal debt held by the public surged from 36 percent of GDP in 2007 to 69 percent in 2011, and the Congressional Budget Office (CBO, 2011) projected that without changes in policy, the debt ratio would continue to rise without bound due to population aging and the rising costs of health care (as seen in **Figure 1**). Given this grim long-term fiscal scenario, how soon should the US adjust its fiscal imbalance? What are the implications of delaying the reform and allowing the debt to GDP ratio to rise further?

This paper contributes to the policy debate by using a DSGE model to compute the macroeconomic and welfare costs for the US of the higher debt to GDP ratio that would result from delaying the adjustment of its medium term budgetary imbalance.[47] In the model there are two sectors of production, a corporate and an entrepreneurial sector, that rent capital and hire workers, and have a production technology with a labor augmenting deterministic trend. Each period, ex-ante identical agents face uninsurable idiosyncratic entrepreneurial ability and employment productivity shocks, and choose their occupation. Agents can either become entrepreneurs and hire other workers, or become workers themselves.

To make a realistic analysis of the policy options, I assume that the government does not have access to lump-sum taxation or state-contingent bonds. Instead it gets revenues from distortionary taxes to labor, consumption, and income, and by issuing one period risk-free bonds. The revenues are used to service its debt, pay for lump-sum transfers to all agents, and finance an exogenously determined level of other non-interest spending.

I calibrate the model to match the US fiscal situation in 2007. I then take the long run projections from CBO for spending in transfers and other non-interest outlays (which

[47] CBO estimated in 2011 that to immediately stabilize the debt to GDP ratio the government would need to permanently improve its fiscal position by 4.9 percent of GDP per year, but that the required adjustment would rise to almost 13 percent of GDP is the adjustment was postponed until 2025. Yet these estimates result from debt accounting exercises that assume that interest rates and growth remain constant as the debt rises, and thus do not capture the effects that higher government indebtedness has on the agents' incentives to work, save, and invest. Moreover, since these estimates do not come from a model, it is not possible to analyze the welfare implications of delaying the adjustment.

entail a large imbalance between revenues and expenditures, and thus imply a continuously rising debt to GDP ratio) to analyze the consequences of stabilizing the debt ratio at various levels by adjusting the income tax. I find that delaying the fiscal adjustment and allowing the debt ratio to increase would have large macroeconomic and welfare effects. In the model, stabilizing the debt to GDP ratio after twenty-five years (when it reaches 200% instead of 69% in 2011), would entail a permanent output loss of 22% and welfare change equivalent to a permanent reduction of 13% in consumption.

Moreover, I find that if the government delays the adjustment for more than ten years, allowing the debt ratio to exceed 100 percent of GDP, the short run welfare gains from further delaying the adjustment are smaller than the long run costs. This occurs because for low levels of debt, the distortions in the economy are not as large as agents with sufficient ability and capital are able to switch occupations and resort to self-employment to partially shield from the fall in available jobs and wages that results from the crowding out of capital for production. However, as the debt continuous to rise the distortions increase as the scale and productivity of the new entrepreneurs falls and thus the hedge becomes less efficient.

Since heterogeneity and entrepreneurship are not compulsory elements for a model of debt stabilization, I examine the importance of these features by comparing the steady-state results from the benchmark model with those from two alternative models without entrepreneurship: a representative agent framework and an Aiyagari model with heterogeneity. I find that both heterogeneity and entrepreneurship are important to capture relevant mechanisms that result from a higher public indebtedness. Ignoring these elements would reduce the estimated long-run costs of allowing the debt ratio to increase, because as the debt ratio rises more workers switch to the entrepreneurial sector start low-quality firms which intensifies the crowding out as they compete for financing with the government and with more productive entrepreneurs.

This paper is related to the representative agent work of Forni, Gerali and Pisani (2011), which studies the macroeconomic consequences for Italy of reducing the debt to GDP ratio by 10% in ten years, and to IMF (2010c), which analyzes the macroeconomic effects of lowering the fiscal deficit by 1%. However, a key drawback from the representative agent models is that in this framework, the equilibrium interest rate is independent of the debt ratio, which is at odds with the empirical literature (i.e. Laubach 2009). Another disadvantage from this class of models is that they cannot adequately capture the distributive and insurance effects of fiscal policy.

The paper also builds on the literature that uses general equilibrium models with heterogeneous agents to analyze changes in fiscal policy. For example, Domeij and Heathcote (2004) compute the welfare consequences of increasing the labor income tax to reduce the capital income tax; Aiyagari and McGrattan (1998) study the optimum quantity of debt; Conesa, Kitao and Krueger (2009) calculate the optimal

capital income tax and the optimal progressivity of the labor income tax; and Conesa and Krueger (1999) examine the political support for a social security reform. The main difference with these works is that this paper allows for entrepreneurship, which augments the estimated costs of a higher debt ratio due to the distortions that arise when some agents change their occupation to circumvent the effects of crowding out.

More recent papers have studied fiscal policy problems in models with entrepreneurship, financial frictions, and occupational choice. Cagetti and De Nardi (2009) analyze the effects of abolishing the estate tax and replacing it with an increase in the consumption or the income tax; Kitao (2008) investigates the effect of lowering the capital income tax; Li (2002) computes the optimal subsidy to the loan repayments of entrepreneurs financed with income taxes; and Meh (2005) quantifies the effects of switching from a progressive to a proportional income tax system. Differently from these works, this paper allows for trend growth, endogenizes the labor supply, and does not impose a balanced budget in every period as it analyzes the implications of the different debt dynamics that result from alternative fiscal scenarios.

2. Model

The model extends the work of Aiyagari and McGrattan (1998) to incorporate entrepreneurship, as in Kitao (2008). The economy is closed and inhabited by a continuum of infinitely lived agents normalized to unity. Time is discrete and a period represents one year. Individuals are endowed with a unit of time and decide every period whether to become workers or entrepreneurs, in which case they invest in a productive project and hire other workers. There are two sectors of production that manufacture the same type of good, a corporate and an entrepreneurial sector, that rent capital and hire workers. Upon deciding their occupation for the current period, workers optimally choose what fraction of their time to work in either of the two sectors, and entrepreneurs choose what fraction of their time to work in their own firm. The entrepreneurs finance their investment with their own resources and can borrow from a financial intermediary, but face a borrowing constraint because debt repayments are not perfectly enforced.

2.1. Shocks

Agents are ex-ante identical. There is no aggregate uncertainty, but each period agents receive idiosyncratic shocks to labor productivity θ_t and entrepreneurial ability z_t, which affect their returns from working and operating a firm. Markets are incomplete because the agents can only trade assets with returns that are not state contingent. As a result, no insurance is available for the idiosyncratic shocks and individuals accumulate assets a to partially self-insure. The shocks follow autoregressive Markov processes of order one that evolve according to the transition matrices $\Gamma_\theta = Pr(\theta'|\theta)$ and $\Gamma_z = \Pr(z'|z)$, where $\Gamma = \Gamma_\theta \otimes \Gamma_z$ is the Kronecker product of the individual transition matrices. Ex-post, agents are heterogeneous with

respect to their individual asset holdings a_t, their labor productivity θ_t and their entrepreneurial ability z_t.

2.2. Technology

The economy has two sectors of production: a non-corporate sector that consists of entrepreneurial households that manage their own business, and a corporate sector populated by large firms characterized by anonymity that operate in perfectly competitive markets and do not face a borrowing constraint. The production function for the representative firm of the corporate sector in period t is:

$$F(K_t^c, N_t^c) = (K_t^c)^{\alpha}(\omega_t N_t^c)^{1-\alpha} \quad (1)$$

This Cobb-Douglas technology takes as inputs the aggregate capital K_t^c and efficiency units of labor N_t^c used in the corporate sector. α is the capital share, and ω_t is the level of aggregate labor productivity.

Entrepreneurs employ their entrepreneurial endowment z_t to manage their own business instead of supplying their working endowment θ_t for a wage in the labor market. The production function for a given entrepreneur in period t is:

$$f(z_t, k_t, n_t) = (\omega_t z_t)^{v}[{k_t}^{\alpha}(\omega_t n_t)^{1-\alpha}]^{1-v} \quad (2)$$

This technology takes as inputs the individual entrepreneurial ability z_t, the stock of capital rented by the entrepreneur k_t, the efficiency units of labor employed by the firm n_t (which includes the fraction of time that entrepreneurs work in their own firm as explained below), and the level of aggregate labor productivity ω_t. Since managerial ability is a fixed factor, this technology exhibits decreasing returns to scale and the entrepreneurs make a positive profit π_t from managing a firm, as in Lucas (1978). The share of output that goes to the variable factors is determined by the span of control parameter $1 - v$.

Technological change is labor augmenting in both sectors such that the economy exhibits a balanced growth path. The aggregate productivity of labor ω evolves as a linear deterministic trend with growth rate γ:

$$\omega' = \gamma\omega \quad (3)$$

2.3. Preferences

The agents have preferences over consumption and leisure represented by the function proposed by Greenwood, Hercowitz, and Huffman (1988). The utility for an agent in period t is:

$$u(c_t, h_t^i) = (c_t - \rho\omega_t {h_t^i}^{\phi})^{1-\sigma}/(1-\sigma) \quad (4)$$

Where $0 < h_t^i < 1$, $i \epsilon \{w, e\}$ is the fraction of time that the individual devotes to working, depending on his occupation as a worker or entrepreneur for the current period. The Frisch elasticity of labor supply is $1/(\phi - 1)$, the intertemporal elasticity of substitution is $1/\sigma$, and ρ is a scale parameter that determines the relative value of leisure. This functional form is convenient not only because it reduces the computational cost of solving the problem, as it implies that the aggregate labor supply is independent of the distribution of wealth, but also because according to Galí, Smets, and Wouters (2011) it provides a good fit with the US data. The level of the linear deterministic trend ω_t is included in the disutility of labor so that the labor supply remains bounded along the balanced growth path. This can be interpreted as implying that the productivity of the home production sector grows at the same rate as labor productivity in the entrepreneurial and corporate sectors.

2.4. Occupational choice

The government does not have access to lump sum taxation. It gets revenues from a consumption tax τ^c, a payroll tax τ^h, an income tax ${\tau_t}^y$, and by issuing one period risk-free bonds B_t. Each period agents choose their occupation to maximize their income given the realization of the idiosyncratic shocks:

$$max\ \{(1 - \tau^h) w_t h_t^w \theta_t,\ \pi_t(a_t, z_t, h_t^e)\} \tag{5}$$

As in Buera and Shin (2010) the occupational choice is a static problem because there is no uncertainty in the entrepreneurial activity, owing to the assumptions on the timing of the shocks, and no costs from switching occupations or from a time to build constraint.

Workers receive labor income that is a function of the payroll tax τ^h, the gross wage per efficiency unit of time w_t, their endowment of working ability θ_t, and the fraction of time that they choose to work h_t^w. Entrepreneurs employ their entrepreneurial endowment to manage their own firm and earn a profit $\pi_t(a_t, z_t, h_t^e)$. Entrepreneurs do not pay a self-employment tax. Thus, by working more in their own firm they could lower their wage bill and increase their profits. As a result, they would lower their payroll tax but increase their income tax payments.

Thus, an agent becomes an entrepreneur when his assets and entrepreneurial ability are large enough such that running his own business is more profitable than working for another firm. The occupational choice allows for the endogenous entry and exit of entrepreneurs from the productive sector and of workers from the labor force.

2.5. Collateral constraint

There is a perfectly competitive intermediation sector that collects deposits from all agents and lends to the entrepreneurs and the corporate sector. However, there is a credit enforceability problem, because when an entrepreneur deposits a_t units of collateral in a bank and rents k_t units of capital he can divert a fraction $1/\lambda$ of the

borrowed money, where ($\lambda \geq 1$). The only punishment for diverting funds is that the entrepreneur loses his collateral. Hence, the financial intermediaries only lend to the entrepreneurs up to the point where they do not renege on their obligations, implying ($\frac{1}{\lambda} k_t \leq a_t$). Consequently, the entrepreneurs are subject to a collateral constraint that limits the amount they are allowed to borrow based on their individual asset holdings. The firms in the corporate sector do not have any financing constraints.

2.6. Entrepreneur's profit

The profit of an entrepreneur in period t solves:

$$\pi_t(a_t, z_t, h_t^e) = max_{\{n,k\}}\{f(z_t, k_t, n_t) - w_t \max(0, n_t - h_t^e) - (r_t + \delta)k_t - \psi \max(0, k_t - a_t)\} \quad (6)$$

$$s.t. \qquad k_t \leq \lambda a_t \quad (7)$$

Where z_t is the individual's endowment of entrepreneurial ability, w_t is the wage per efficiency unit of labor, h_t^e is the fraction of time that the entrepreneur wishes to work in his own firm, a_t represents the stock of asset holdings of the entrepreneur deposited at the bank, k_t is his desired stock of capital for production, and n_t is his demand for labor efficiency units. The entrepreneur's own labor supply is part of the labor services used for production, and thus the entrepreneur only pays a wage to the labor demand that exceeds his own labor supply. The return on deposits is r_t and capital depreciates at the rate δ. The banks do not own the capital, but without loss of generality I assume they are in charge of investing to replace the capital that depreciates.

Since there are zero profits in banking, if the entrepreneur borrows less than he has deposited at the bank ($k_t \leq a_t$) he pays to the bank the opportunity cost of his internal funds $(r_t + \delta)$. However, if the entrepreneur wishes to borrow more than he has deposited at the bank ($k_t > a_t$), the bank undertakes a screening process that costs ψ for every unit of loaned money that exceeds the collateral. Hence, the entrepreneur only pays an external finance premium on his external financing. The solution to this problem generates the input demand functions $n_t(a_t, z_t)$ and $k_t(a_t, z_t)$.

2.7. Corporate firm's problem

The firms in the corporate sector hire workers in a perfectly competitive labor market and rent capital from the financial intermediaries; they do not face any collateral constraint, and do not pay the external finance premium. The representative firm in the corporate sector maximizes its profits:

$$max_{K_t^c,\, N_t^c}\, F(K_t^c, N_t^c) - w_t N_t^c - (r_t + \delta) K_t^c \qquad (8)$$

From the FOC the factor prices are determined by the usual marginal productivity conditions:

$$w_t = F_N(K_t^c, N_t^c) \qquad (9)$$

$$r_t = F_K(K_t^c, N_t^c) - \delta \qquad (10)$$

2.8. Assets

Agents cannot borrow. Thus, to insure their consumption they deposit their savings at a financial intermediary and get a return r_t. The intermediaries use the deposits to invest in one period risk-free government bonds B_t, and lend to the entrepreneurs and corporate sector. Since all investments are risk free, in equilibrium financial intermediaries are indifferent between lending to the government, entrepreneurs, or corporate sector. Because investments are identical from the agent's perspective, I assume that the agents save in the generic asset a.

2.9. Timing

At the beginning of each period the labor productivity and entrepreneurial ability shocks are realized. After observing both shocks the agents make their occupational choice and decide what fraction of their time to work. The entrepreneurs and the corporate sector go to the financial intermediaries for credit and then hire their desired efficiency units of labor. After production takes place, the entrepreneurs and the corporate sector compensate their workers and repay their loans. Workers settle their payroll taxes. Financial intermediaries reimburse depositors and make zero profits. All agents pay income taxes on the yield from their savings and on the income from their occupation in the current period.

The government gives lump-sum transfers to all agents, who then decide how much to consume, and deposit their savings at the financial intermediaries. The government spends an exogenously determined amount on other non-interest payments and rolls over its debt by selling risk-free bonds to the financial intermediaries. If the government has a fiscal deficit it sells additional bonds, and if it has a surplus it reduces its indebtedness. The funds that the financial intermediaries do not invest in the government bonds are the loanable funds for the entrepreneurs and the corporate sector in the next period.

2.10. Equilibrium

Since the problem has a deterministic trend it is not stationary. In order to transform the model into its stationary form let: $\hat{c} = \frac{c}{\omega}$, $\widehat{w} = \frac{w}{\omega}$, $\widehat{k'} = \frac{k'}{\omega}$, $\widehat{a'} = \frac{a'}{\omega}$, $\widehat{B'} = \frac{B'}{\omega}$, $\hat{g} = \frac{g}{\omega}$, $\widehat{tr} = \frac{tr}{\omega}$, and $\widehat{GDP} = \frac{\widehat{GDP}}{\omega}$. To avoid complicating the notation unnecessarily I omit

this transformation from the definition of the equilibrium, although the problem can only be solved in its stationary form.

2.10.1. Consumer's problem

The recursive formulation of the consumer's problem for period t is:

$$V_t(a_t, \theta_t, z_t) = max_{a_{t+1}, \{h_t^i \geq 0\}_{i \in \{w,e\}}} u(c_t, h_t) + \beta \sum \Gamma V_{t+1}(a_{t+1}, \theta_{t+1}, z_{t+1}) \quad (11)$$

$$s.t. \quad (1+\tau^c)c_t \leq (1-\tau_t{}^y) \max\{(1-\tau^h)w_t h_t^w \theta_t,\ \pi_t(a_t, z_t, h_t^e)\} + \mathrm{tr_t} + R_t a_t - a_{t+1} \quad (12)$$

$$R_t = 1 + (1-\tau_t{}^y) r_t \quad (13)$$

As in Buera and Shin (2010), the max operator in the budget constraint represents the occupational choice presented in equation (5). Thus, given the sequence of optimal static decisions for the occupational choice and intensive margin problems, the dynamic program is analogous to a standard capital accumulation problem with production. The profit for an entrepreneur of operating his business is given by the indirect profit function $\pi_t(a_t, z_t, h_t^e)$ presented in equations (6) and (7). Both workers and entrepreneurs choose the fraction of time that they work h_t^w or h_t^e, but entrepreneurs work in their own business. tr_t are transfers from the government that are restricted to be non-negative, to avoid the possibility of lump-sum taxation. From the FOC the optimality conditions for the intensive margin choices for workers and entrepreneurs are:

$$h_t^{w*} = \left[\frac{(1-\tau_t{}^y)(1-\tau^h)w_t\theta_t}{(1+\tau_t{}^c)\rho\phi}\right]^{1/(\phi-1)} \quad (14)$$

$$h_t^{e*} = \left[\frac{(1-\tau_t{}^y)w_t}{(1+\tau_t{}^c)\rho\phi}\right]^{1/(\phi-1)} \quad (15)$$

The consumption-saving decision is determined by a policy rule $a_{t+1}(a_t, \theta_t, z_t)$, 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 $\mu_t(a_t, \theta_t, z_t)$. This distribution can further be separated into the distribution of workers $\mu_t^w(a_t, \theta_t, z_t)$ and entrepreneurs $\mu_t^e(a_t, \theta_t, z_t)$ based on their occupational choices for the current period.

2.10.2. Aggregates

Aggregate asset holdings A_t are computed by integrating over the asset holdings of each household**:**

$$A_t = \int a_t \, \partial\mu_t(a_t, \theta_t, z_t) \quad (16)$$

Likewise, aggregate consumption C_t, and transfers are Tr_t are found by integrating over all agents.

Aggregate labor income Y_t^w is found by integrating over the labor incomes of each worker:

$$Y_t^w = \int (1-\tau^h) w_t h_t^w \theta_t \, \partial \mu_t^w(a_t, \theta_t, z_t) \qquad (17)$$

Where $\mu_t^w(a_t, \theta_t, z_t)$ is the distribution of workers in period t.

Aggregate entrepreneurial income Y_t^e is found by integrating over the profits of each entrepreneur:

$$Y_t^e = \int \pi_t(a_t, z_t, h_t^e) \, \partial \mu_t^e(a_t, \theta_t, z_t) \qquad (18)$$

Where $\mu_t^e(a_t, \theta_t, z_t)$ is the distribution of entrepreneurs in period t.

The aggregate labor supply L_t is found by integrating the labor supply in efficiency units of each worker:

$$L_t = \int h_t^w \theta_t \, \partial \mu_t^w(a_t, \theta_t, z_t) \qquad (19)$$

The aggregate labor demand from the entrepreneurial sector N_t^e is computed by integrating the individual labor demand in efficiency units from all entrepreneurs that exceeds their individual labor supply:

$$N_t^e = \int max(0, n_t - h_t^e) \partial \mu_t^e(a_t, \theta_t, z_t) \qquad (20)$$

The aggregate labor demand is the sum of the aggregate labor demand from the corporate sector N_t^c and the aggregate labor demand from the entrepreneurial sector N_t^e.

Similarly, the aggregate demand for capital from the entrepreneurial sector K_t^e is found by integrating over the individual demands for capital from all entrepreneurs. The aggregate demand for capital is the sum of the aggregate demand for capital from the corporate sector K_t^c and the aggregate demand for capital from the entrepreneurial sector K_t^e.

The aggregate supply of capital K_t is computed as the residual from aggregate savings after the government's financing needs are covered:

$$K_t = A_t - B_t \qquad (21)$$

Aggregate production GDP_t is the sum of the aggregate production from the entrepreneurial sector GDP_t^e and the corporate sector GDP_t^C.

2.10.3. Market clearing

Equilibrium in the capital market requires that for every t:

$$K_t = K_t^c + K_t^e \quad (22)$$

Equilibrium in the labor market requires that for every t:

$$L_t = N_t^c + N_t^e \quad (23)$$

The government's budget constraint for period t is:

$$\tau^h w_t L_t + \tau_t{}^y (r_t A_t + Y_t^w + Y_t^e) + \tau^c C_t + B_{t+1} = (1 + r_t) B_t + g_t + Tr_t \quad (24)$$

The revenues from distortionary taxation and debt issuance are used to service the government's debt, pay for the lump-sum transfers Tr_t, and finance an exogenously determined level of other non-interest spending g_t.

The resource constraint for this economy is:

$$GDP_t = C_t + g_t + K_{t+1} - (1 - \delta) K_{t+1} - \psi \int max(0, k_t - a_t) \; \partial \mu_t^e (a_t, \theta_t, z_t) \quad (25)$$

As usual, in every period aggregate production is spent on private consumption, public consumption, and net investment. The last term on equation (25) considers the resources that are used by the banking sector in the intermediation of resources to the entrepreneurial sector when the loans exceed the collateral.

2.10.4. Definition of equilibirium

A recursive competitive equilibrium for this economy consists of a balanced growth path given by the sequences of occupational choices, intensive margin decisions, value functions $V(a_t, \theta_t, z_t)$, policy functions $a'(a_t, \theta_t, z_t)$, input demand functions $n(a_t, z_t)$ and $k(a_t, z_t)$, factor prices w_t and r, the stock of aggregate capital K_t, aggregate labor L_t, and distributions $\mu(a_t, \theta_t, z_t)$, given the sequence of fiscal policies $\{\tau^c, \; \tau^y, \; \tau^h, \; g_t, \; B_t, \; tr_t\}$, the level of the labor augmenting technology ω_t, and the transition probabilities of the shocks Γ such that:

i. The sequence of the occupational choices, intensive margin decisions, value functions and policy functions solve the consumer's problem given the sequences of factor prices, fiscal policies, the deterministic trend, and the transition probabilities of the employment productivity and entrepreneurial ability shocks.
ii. The sequences 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 sequences of factor prices solve the sequence of maximization problems of the representative firm in the corporate sector.
iv. The sequence of distributions is induced by the sequences of occupational choices, intensive margin decisions, policy functions, the deterministic trend, and the transition probabilities of the shocks.
v. The government's budget constraint is satisfied every period.
vi. The capital and labor markets clear every period.

In the balanced growth path all variables grow at the constant rate γ except for the interest rate, the tax rates, the number of agents in the economy, and the time endowment. Along the balanced growth path, the transformed variables $\widehat{c_t}$, $\widehat{w}$, $\widehat{k_t}$, $\widehat{a_t}$, $\widehat{B_t}$, $\widehat{g_t}$, $\widehat{tr_t}$, and $\widehat{GDP_t}$ are constant.

3. Calibration

There are two sets of parameters in the model: ten are fixed a priori, either because they have been used by previous studies or because they can be estimated from the data without using the model, and twelve are calibrated to match selected targets in the initial steady state. The parameterization is presented in **Table 1**.

3.1. Parameters fixed a priori

The coefficient of relative risk aversion σ is 1.5 in line with the findings of Attanasio, Banks, Meghir and Weber (1999). The external finance premium ψ is 2%, which corresponds to the average spread between risky (Baa) and risk free (TR10) bonds in the US from 1990 to 2007 using monthly data. The annual depreciation rate δ is 6% following Stokey and Rebelo (1995). The capital income share α equals 0.36 as in Kitao (2008). The rate of growth of the deterministic trend γ is 1.02, in line with the assumption from CBO that the long run growth rate in the US is 2%. The share of output going to the fixed factor in the entrepreneurial sector v is 0.15 as in Atkenson and Kehoe (2005). The curvature of the labor supply ϕ is 3 such that the Frisch elasticity is 0.5, as recommended by Chetty, Guren, Manoli and Weber (2011) for the intensive margin of the labor supply.

The natural logarithm of the labor productivity and entrepreneurial ability processes are approximated with five and three-state Markov processes, using the methodology of Tauchen (1986). The persistence of the labor productivity shock ρ_θ is 0.91, and the standard deviation of the labor productivity shock σ_θ is 0.21, as estimated by Floden and Lindé (2001). The persistence of the entrepreneurial ability shock ρ_z is also fixed at 0.91.

3.2. Calibrated parameters

Information on the government's expenditures at the federal level is taken from the Office of Management and Budget of the White House. The classification of the different outlays as transfers or other non-interest spending is presented in **Table 2**.

Other non-interest spending g is calibrated to be 5.9 percent of GDP, which corresponds to the combined share of outlays for defense, international affairs, administration of justice, general government, energy, transportation, science, and technology in 2007. The initial stock of debt B is calibrated to be 36 percent of GDP, equal to the debt in hands of the public of the US federal government in 2007. The value of government's lump-sum transfer tr is calibrated to match the social spending of the federal government of 12 percent of GDP in 2007. This includes unemployment benefits, Medicaid, Medicare, Social Security, supplemental income assistance, and all other social spending programs. Although, the targets for g, B and Tr were selected without solving the model, the real value of these variables needs to be calibrated since GDP is an endogenous variable of the model.

The tax rates on consumption and labor income are calibrated implicitly such that the government's revenues from each tax in the initial steady state match those of the US federal government in 2007, as reported by the Office of Management and Budget. The tax rate on consumption τ^c is set to 0.7% to match the observed revenues of 0.47 percent of GDP from federal excise taxes. The payroll tax τ^h is set to 10.4% to match the observed revenues of 6.26 percent of GDP from Social Security contributions. The income tax τ^y is set to 16.7% to satisfy the government's budget constraint in the initial steady state.

ρ is a scale parameter that determines the relative value of leisure and is chosen such that on average workers spend $1/3$ of their time working in the initial steady state. The subjective discount factor β is set to 0.951, so that the equilibrium risk-free rate r in the initial steady state is 3%, which was the average real interest rate from 1990-2007 on one-year US treasury bills, and which coincides with the value used by CBO for their long-run projections. The tightness of the collateral constraint λ is 1.4, such that the average ratio of liabilities over assets for all entrepreneurs in the initial steady state equals 0.37, which was the average leverage ratio from 1990-2007 in the Non-Corporate Business Sector according to the Flow of Funds of the Federal Reserve.

The median value of the grid for the labor productivity shock x_θ is normalized such that average productivity of workers in the initial steady state is unity. The median value of the entrepreneurial ability shock x_z is normalized such that the percentage of entrepreneurs in the initial steady state is 11.5%, which corresponds to the percentage of households that are business owners and actively manage their own business in the 1989 Survey of Consumer Finances according to Cagetti and De Nardi (2006). The standard deviation of the entrepreneurial ability shock σ_z is calibrated to be 0.391 such that the corporate sector employs 72% of the total capital employed by the corporate and non-corporate sectors, which was the average in the Federal Reserve's Flow of Funds from 1990-2007.

3.3. Calibration of the alternative models

To assess the importance of heterogeneity and entrepreneurship, the steady state results from the benchmark model are compared with those from a non-stochastic representative agent model that lacks heterogeneity and entrepreneurship, and with those from an Aiyagari model with heterogeneity but not entrepreneurship. Hence, the Aiyagari model only has labor productivity shocks and the representative agent model does not have idiosyncratic shocks. These alternative models are detailed in the **Appendix** and their calibration is presented in **Table 1**. To make the three models comparable, the fixed parameters and calibration targets are identical across models.

4. Effects of delaying the fiscal consolidation

First, I analyze the long-run implications of the higher debt to GDP ratio that would result from postponing the adjustment of the US fiscal imbalance. Then, I compare the results from the benchmark model with those from two alternative models, one without heterogeneity and entrepreneurship, and another with heterogeneity but without entrepreneurship. Finally, I use the benchmark model to analyze the implications of delaying the adjustment but considering the transitional dynamics to the new steady state.

4.1. Long run Macroeconomic consequences

To compute the long run consequences of delaying the adjustment, I assume that only the income tax is adjusted to stabilize the debt ratio, while the outlays on transfers and other non-interest spending remain fixed at their CBO projected values for 2030, as I vary the debt target from 0 to 200 percent of output.[48]

The effect of the changes in the debt to GDP ratio on the equilibrium prices in the benchmark model are presented in **Figure 2**. As the stock of debt to be financed every period rises, it crowds out private savings and reduces the loanable funds for the corporate and entrepreneurial sectors. As the capital-labor ratio falls, the marginal product of capital increases and the marginal product of labor falls. Consequently, equilibrium interest rates rise and wages fall.

The effects of changes in the debt to GDP ratio on real variables in the benchmark model are presented in **Figure 3**. Due to crowding out, the stock of capital and the labor efficiency units used for production fall as the debt rises. Due to the fall in the inputs of production, aggregate production and consumption also fall with the increases in the debt ratio. In particular, in the benchmark model if the target debt to

[48] Although many possible fiscal instruments could be used to stabilize the debt ratio, the plan from the 2010 National Commission on Fiscal Responsibility and Reform (the Simpson-Bowles Commission) specifies that 80% of the additional revenues should come from increases in the effective income tax. Hence, to simplify the analysis, I assume that only the income tax is adjusted to stabilize the debt to GDP ratio.

GDP ratio increases from 0 to 200 percent, the equilibrium interest rate would be 1.9 percentage points higher, the wage would fall by 8 percent, production would be 28 percent lower and average consumption would fall by 20 percent.

In the benchmark model, as the debt to GDP ratio rises the percentage of entrepreneurs in the economy increases. This does not mean that increasing the government debt is beneficial. Quite the contrary, the increase in entrepreneurship occurs as an attempt by some agents to shield themselves from the drastic fall in wages by resorting to self-employment. The increase in the government's debt is akin in this model to a financial constraint on the corporate and non-corporate sectors that reduces the scale of their business and trims the availability of good employment opportunities. Thus, with fewer available jobs, self-employment becomes a second best for agents that have some entrepreneurial ability and sufficient capital.

To better understand the effects of the increase in the debt to GDP ratio in the benchmark model it is useful to separate the effects on the two sectors of production. The effects of the debt on the corporate sector are presented in **Figure 4**. Both the capital and labor used for production in the corporate sector fall as the debt increases, but the fall in capital is larger, and thus the capital-labor ratio falls. As the debt rises, the size of the representative firm in the corporate sector gets smaller, its production falls, and its share in aggregate GDP falls. In particular, if the debt target is 0 percent of GDP the corporate sector production would account for 52 percent of overall GDP, but if the debt target is 200 percent of GDP the corporate sector would only represent 13 percent of aggregate production.

The effects of the increase in the debt to GDP ratio on the entrepreneurial sector are presented in **Figure 5**. As the debt rises, some agents become entrepreneurs to try to circumvent the fall in wages, and thus the entrepreneurial sector begins to grow, demanding more labor and capital. However, the scale of production for these new entrepreneurs is small and their incomes are low. Since these startups are more labor intensive, the capital-labor ratio in the entrepreneurial sector gradually falls, and the size of the new firms in the sector continues to decrease as more agents change their occupation.

As the percentage of entrepreneurs grows, this sector increases its production, representing a higher share of aggregate GDP. However, the rise in production is not linear, which explains the non-linearity in the fall of the aggregate production. In particular, as the debt to GDP ratio increases from 0 to 100 percent production falls by 8 percent, but if the debt ratio further rises to 200 percent, GDP falls by an additional 20 percent. This occurs because as the debt continues to rise, the agents who switch their occupation from workers to entrepreneurs have lower entrepreneurial ability and assets on the margin.

To better illustrate this point, **Table 3** presents threshold values over assets a of the entrepreneurial decision rule for different combinations of the idiosyncratic shocks (θ, z). Recall that there are three states for entrepreneurial ability z (with z_3

representing the highest ability level) and five states for labor productivity θ (with θ_5 representing the highest ability level). For example, if the debt to GDP ratio is zero, all agents with the median value of the entrepreneurial ability and the lowest value of the labor productivity (z_2, θ_1), who own assets above 0.141 become entrepreneurs. Thus, as the debt to GDP ratio increases, two things happen: i) for a given combination of shocks (θ, z) the new entrepreneurs will have less assets a, and ii) for a given level of asset holdings a the new entrepreneurs will have lower entrepreneurial ability z.

Since the agents that change their occupation at low levels of the debt ratio have relatively high entrepreneurial ability and assets, the increase in production of the entrepreneurial sector from these new businesses partly offsets the fall in the production in the corporate sector. But as the debt ratio continues to increase, the agents that are forced to change their occupation have much lower entrepreneurial productivity and assets. Hence, the marginal increase in the production of the entrepreneurial sector becomes smaller as the debt rises.

4.2. Long run welfare consequences

I define the long run welfare change from the increase in the debt to GDP ratio as the permanent percentage increase in the consumption of all agents Δ^x, holding leisure unchanged, that would result in the same average utility in the economy with a debt to GDP ratio of x percent as in the economy with no debt, when outlays in transfers and other non-interest spending as a share of GDP are identical in both economies:

$$\int v^x(a, \theta, z, \Delta^x) \partial \mu^x(a, \theta, z) = \int v^0(a, \theta, z)\, \partial \mu^0(a, \theta, z) \quad (26)$$

Where $v^x(a, \theta, z, 0)$ and $v^0(a, \theta, z)$ are the equilibrium value functions, and $\mu^x(a, \theta, z)$ and $\mu^0(a, \theta, z)$ are the stationary distributions, associated with the steady states of the economies that have debt to GDP ratios of x and 0 percent, but the same spending in transfers and other non-interest spending as a share of GDP. $v^x(a, \theta, z, \Delta^x)$ is the equilibrium value function in the economy with a debt ratio of x percent, where the equilibrium consumption of each agent has been increased by the percentage Δ^x while leisure remains unchanged.

The welfare consequences of changes in the debt to GDP ratio computed for the benchmark model with this utilitarian welfare criterion are presented in **Figure 6**. I find that increasing the debt to GDP ratio has non-linear effects in welfare. The average welfare change that results from increasing the debt ratio from 0 to 100 percent of GDP would be equivalent to a permanent fall in consumption of 2.6 percent, but further increasing the debt ratio to 200 percent of GDP would be equivalent to an additional fall of 12 percent in consumption. The non-linearity is explained by the diminished effectiveness of occupation switching as a response to declining wages. When the debt is low, the occupation switching works reasonably well because the agents that change their occupation are sufficiently productive and have enough assets to make a reasonable profit, which explains why the average

welfare loss is not too big. But as the debt continues to rise, new entrepreneurs operate small and unproductive firms, and the welfare costs of the debt become very large.

4.3. Heterogeneity and entrepreneurship

Since heterogeneity and entrepreneurship are not sine qua non elements for computing the macroeconomic and welfare consequences of a higher debt to GDP ratio, I assess the importance of these features by repeating the above experiment with a non-stochastic representative agent model (without heterogeneity and entrepreneurship), and with an Aiyagari model (with heterogeneity but without entrepreneurship).

Qualitatively, the effects of a rising debt to GDP ratio on equilibrium prices, real variables and welfare, presented in **Figure 2**, **Figure 3**, and **Figure 6**, are similar across the three models. The capital to labor ratio decreases as the debt ratio rises, and thus the equilibrium interest rate increases and wages fall. Due to the fall in the factors of production, output and consumption fall, and ultimately welfare is reduced. But quantitatively, there are large variations between models.

To better understand the differences, **Figure 7** presents the determination of the equilibrium interest rate across models. In the representative agent model, the equilibrium interest rate net of taxes R_0 equals the inverse of the subjective discount factor. Thus, in this model, the net interest rate is neutral with respect to an increase in the government's debt as presented in **Figure 2**. In the models with heterogeneity, the equilibrium interest rate net of taxes R_1 is determined by the interaction between the supply and demand for assets.

The heterogeneity that results from the idiosyncratic shocks and the incomplete markets assumption implies that all agents have some possibility of reaching a state with low income. Thus, they choose to hold more assets than would be optimal if markets were complete, and so in the models with heterogeneity the equilibrium interest rate is always below the interest rate that would prevail if markets were complete or if there were no idiosyncratic shocks $R_1 < R_0$. Most importantly, in these models as the debt rises and the interest rate approaches the inverse of the subjective discount factor from below, the aggregate asset holdings A tend to infinity.

The main difference for the determination of the interest rate between the Aiyagari model and the model with entrepreneurship is that in the latter there is an additional sector that demands capital. As a result, for every debt level there is less capital available for the corporate sector and the equilibrium interest rate is higher ($R_1 > R_2$). As explained above, as the debt ratio increases, due to the fall in wages some agents find it optimal to change their activity and become entrepreneurs. For the individuals that can change their activity this decision provides a partial hedge against the fall in wages. However, as the entrepreneurial sector grows its financing needs become larger and as a result the consequences from the increase in the debt ratio are much

larger in the model with entrepreneurship. In particular, if the debt to GDP ratio rises from 0 to 200 percent of GDP, the rise in the interest rate in the model with entrepreneurship would be almost three times larger than in the Aiyagari model.

The welfare implications of the rise in the debt to GDP ratio are presented in **Figure 6**. In the representative agent model, the government debt is purely distortionary because it crowds out private savings and forces the government to increase its distortionary taxation. As a result, the welfare costs rise monotonically as the debt to GDP ratio increases, and the representative person would prefer to be born in an economy without debt. Moreover, the welfare costs for the representative agent rises linearly with the debt ratio, and the optimal fiscal policy would be for the government not only to repay all its debt but to accumulate sufficient assets to finance its spending from the proceeds of its investments without recurring to distortionary taxation.

In the models with heterogeneity, as explained in Aiyagari and McGrattan (1998), the debt is still distortionary but it also has a positive welfare effect as it enhances the liquidity in the economy by providing an additional instrument for smoothing consumption. As the debt ratio increases, the rise in the interest rate reduces the opportunity cost of saving. As a result, the agents choose to hold more assets in equilibrium. At the same time, as the return on their assets is higher, the agents become better insured against the stochastic variations in income. This liquidity effect explains why in the Aiyagari model the welfare costs of the rise in the debt ratio are smaller than in the representative agent model.

In the model with entrepreneurs, as the debt ratio begins to rise some agents with a relatively high entrepreneurial ability change their occupation and are able to partially circumvent the fall in wages. This explains why when the debt ratio is low the welfare costs of the increase in the debt are lower than in the models without entrepreneurship. However, as the debt ratio continues to rise, the workers that switch their occupation on the margin have less entrepreneurial ability and savings. As a result, the aggregate consequences of higher debt grow more severe.

In **Figure 8** I decompose the welfare effects of higher debt by wealth percentiles. For the Aiyagari model, I find that the rise in the debt ratio has a bigger adverse effect on rich people. In particular, if the debt to GDP target was raised from 0 to 200 percent, the welfare cost for the average person from the lowest wealth percentile would be equivalent to a permanent fall of 6 percent in consumption, compared to 9 percent in average for those in the highest wealth percentile.

On the contrary, in the model with entrepreneurs the rise in the debt ratio is very costly for the poor, while if the debt ratio is not too high, a higher debt might even be beneficial for the rich. For example, raising the debt ratio from 0 to 80 percent would entail an average welfare loss for those in the poorest percentile equivalent to a permanent fall of consumption of 5 percent, compared to a permanent increase of 3 percent on average for the richest 10 percent. However, if the debt ratio continues to rise the welfare changes become negative for all agents and are especially large for

the poorest agents. For example, raising the debt ratio from 0 to 200 percent would be equivalent on average to a permanent fall of 20 percent in the consumption of the agents of the poorest percentile and of 7 percent for those in the richest percentile.

The relative effects of the debt on rich and poor people differ across models, because the characteristics of the rich agents in the two models are not equivalent. In the Aiyagari model the rich persons are workers with a high working ability, whereas in the benchmark model they are entrepreneurs with high entrepreneurial ability. In both models the rise in the debt ratio lowers wages and raises the interest rate, but the fall in wages is larger. Thus, the change in prices due to the rise in the debt especially hurts the rich agents in the Aiyagari model because the rise in their capital income is not enough to outweigh the fall in their labor income.

In the model with entrepreneurship the rise in the interest rate reduces the profitability of entrepreneurship, but for low levels of debt this effect is more than compensated by the rise in profitability that arises from the fall in wages. However, as the debt continues to rise the distortions from the higher taxes far outweigh any positive effects. In both models the poor agents do not have much working ability or assets, and thus their welfare is highly dependent on the level of the public transfers. Since the fall in GDP is larger in the model with entrepreneurs, the fall in the level of transfers (which are assumed to be fixed as a share of GDP) and in the welfare of the poor are much larger in the model with entrepreneurs.

Overall, based on my experiments, eliminating heterogeneity and entrepreneurship from the model would result in a lower estimate of the costs of a higher debt ratio, once the debt exceeds 120 percent of GDP. Restricting the occupational choice by eliminating the entrepreneurial sector would reduce the estimated costs of the rise in the debt, because it would eliminate the additional distortions that arise from the agents that switch their occupation to start low quality entrepreneurial activities, which compete for financing with the government and more productive firms.

4.4. Consequences with transitional dynamics

Although the steady state comparisons are informative on the long run costs of delaying the adjustment of the fiscal imbalance, in order to have a complete picture of the consequences of different policy alternatives, the transitions to the steady states must be computed. In particular, because the benefits from the adjustment might be over-stated by only looking at the long run result, as this kind of analysis ignores the short run pain from the adjustment.

Given the projected rise in the imbalance between revenues and expenditures (presented in **Figure 1**), it is evident that the US requires a change in fiscal policy to stabilize its debt ratio. However, although the adjustment is unavoidable, it can be delayed if the government temporarily finances its additional spending needs by issuing more bonds and thereby increasing its indebtedness. Thus, in the dynamic experiments I assume that the adjustment of the fiscal imbalance is delayed until the

debt to GDP ratio reaches the level where at which the government wishes to stabilize its debt. Consequently, to stabilize the debt ratio at a lower level the government needs to adjust earlier.

The simulations begin in 2011, after the Great Recession, where three things change compared with the initial steady state in 2007 (used to calibrate the model): 1) the debt to GDP rose from 36 to 69 percent, 2) other non-interest spending jumped from 5.9 to 9.5 percent of GDP, and 3) the cost of transfers increased from 12 to 13.2 percent of GDP. Since CBO projects an ever-increasing primary spending as a share of GDP due to population aging and the rising costs of health care, for the simulations I assume that after twenty years (in 2030) the primary spending stabilizes as a fraction of GDP (as presented in **Figure 1**).

At the beginning of the period, the government credibly announces its new fiscal policy, which includes its selected debt to GDP target, the paths for the non-interest spending, tax rates, and lump sum transfers for all future periods. Thus, all the tax rates remain fixed at their initial steady state levels until the debt ratio reaches the desired target, and at that point the government adjusts its income tax as required to stabilize the debt. As soon as the agents learn the new policies they re-optimize their behavior, considering the announced paths of the government's policies and prices. Given this behavior, the economy eventually reaches the steady states presented above, depending on the debt to GDP target selected by the government, in which the distribution of agents over states is invariant.

Since GDP is an endogenous variable, to match the sequence of CBO projected values for transfers and other non-interest spending as a share of GDP from 2011 to 2030, I follow an iterative process: (1) I fix the target debt to GDP ratio, (2) I guess the sequence for the real values of transfers and other non-interest spending, (3) I iterate over the sequence of equilibrium wages, interest rates, until the labor and capital markets clear every period, (4) when the debt to GDP ratio reaches the selected target, I iterate over the personal income tax in order to satisfy the government's budget and stabilize the debt ratio at the specified level, (5) I compare the resulting spending sequence as a share of GDP with the desired targets and adjust the guess as required, (6) I repeat the process as required until obtaining a match.

I compute the transitional dynamics for four different fiscal scenarios (presented in **Figure 9**). In a benchmark scenario, I assume that the government immediately stabilizes its debt ratio at 69 percent of GDP (its level in 2011). In a second scenario the government delays the adjustment for ten years until the debt ratio reaches 100 percent of GDP (in 2020). In the third scenario the delays lasts twenty years until the debt reaches 150 percent of GDP (in 2030). In the last scenario the adjustment is postponed for twenty-five years until the debt ratio reaches 200 percent of GDP (in 2035). As in the CBO projections (**Figure 1**), the model simulations (**Figure 9**) confirm that without a fiscal adjustment the debt ratio follows an explosive path as the revenues are insufficient to cover the increasing financing needs.

The pats for the income tax associated with the alternative scenarios are also presented in **Figure 9**. In the simulations, since the debt ratio only reaches 150 and 200 percent of GDP after 2030 (where I assume the primary spending as a fraction of GDP becomes stationary), the income tax is only adjusted once in these scenarios. On the contrary, for the scenarios where the debt is stabilized at 69 and 100 percent of GDP, the income tax is adjusted every year to preserve the debt ratio at the desired target until the primary expenditures stabilize in 2030 (as a percentage of GDP).

A steady state comparison of the main fiscal variables in the initial steady state and in the alternative scenarios is presented in **Table 4**. As expected, the fiscal adjustment required to stabilize the debt ratio rapidly grows as the delay increases. For example, compared to the scenario where the government immediately stabilizes its debt ratio, delaying the adjustment for ten years would only require an additional effort of 1.2 percent of GDP, after twenty years the correction would need to be 3.1 percent of GDP, and after twenty-five years it would augment to 7.3 percent of GDP.

The transition paths of the main macroeconomic variables under the four alternative scenarios are presented in **Figure 10**. As explained in the long-run analyses, as the debt ratio increases, the interest rate and the percentage of entrepreneurs rises; while wages, GDP and aggregate consumption fall, due to the crowding out. In **Figure 11** and **Figure 12** are presented the transition paths for the main variables of the corporate and non-corporate sectors. As expected, as the debt ratio increases, the size of the corporate sector falls and the entrepreneurial sectors grows as some agents choose to switch their occupation to shield from the negative effects of the crowding out. However, since the marginal entrepreneurs are less productive and have lower assets, their production is not enough to compensate the fall of production in the corporate sector and thus GDP falls.

Comparing the transitions from different scenarios, it is clear that adjusting the imbalance earlier entails an era of restraint that eventually pays off in the medium term as the economy converges to a steady state with a lower debt ratio, and higher output and consumption per-capita. Alternatively, delaying the consolidation involves a period of macroeconomic excess that is unsustainable (where the economy lives beyond its means by accumulating public debt), that eventually leads to a steady state with a higher debt ratio, and a lower level of output and consumption per-capita. Thus, given the short run costs of the consolidation, is it optimal to delay as much as possible the adjustment of the fiscal imbalance?

I define the welfare effect from the fiscal policy that stabilizes the debt to GDP ratio at $x\%$, as the permanent percentage change in the consumption of all agents Δ^x, holding leisure unchanged, starting from the first period of the transition to the new steady state, that would result in the same average discounted utility as that associated with the transitional dynamics to the new steady state in the benchmark scenario (where the debt ratio is immediately stabilized at 69 percent of GDP):

$$\int v^x(a,\theta,z,\Delta^x)\partial\mu^x(a,\theta,z) = \int v^{69}(a,\theta,z)\,\partial\mu^{69}(a,\theta,z) \qquad (27)$$

Where $v^x(a,\theta,z,0)$ and $v^{69}(a,\theta,z)$ are the value functions, and $\mu^x(a,\theta,z)$ and $\mu^{69}(a,\theta,z)$ are the distributions associated with the first period of the transition to the new steady states of the economies that have a debt to GDP target ratio of x and 69 percent. $v^x(a,\theta,z,\Delta^x)$ is the equilibrium value function in the first period of the transition for the economy with a debt target ratio of x percent, where the equilibrium consumption of each agent has been increases by Δ^x percent while leisure remains unchanged in all period of the transition to the new steady state.

To separate the long run consequences from the effects of the transition to the new steady state, I also compute the long run welfare change from these four scenarios using the same welfare criteria from equation (26), but this time taking as benchmark the economy where debt is stabilized at 69 percent instead of an economy without debt. The welfare consequences from the different policies computed for the benchmark model are presented in **Figure 13**.

I find that in the long run: 1) delaying the adjustment for ten years and allowing the debt ratio to increase from 69 to 100 percent of GDP would be equivalent in the long run to a permanent fall in consumption of 0.8 percent; 2) postponing the correcting for twenty years and allowing the debt ratio to rise to 150 percent of GDP is equivalent to a permanent fall in consumption of 7.3 percent; and 3) deferring the change for twenty-five years and allowing the debt to reach 200 percent of GDP is equivalent to a fall in consumption of 13 percent. As explained earlier, in the long run increasing the debt ratio always has negative welfare effects and the cost rise non-linearly with debt.

When the transition to the new steady state is considered I find that: 1) delaying the adjustment for ten years would be equivalent to a permanent increase in consumption of 0.1 percent; 2) postponing for twenty years is equivalent to a fall in consumption of 2.5 percent; and deferring the change for twenty-five years would be equivalent to a change in consumption of 3.6 percent. Thus, if the adjustment is postponed less than ten years, and consequently the debt ratio is stabilized at a level that is lower than 100 percent of GDP, the short run costs from the adjustment outweigh the long run benefits. However, when the debt ratio exceeds 100 percent of GDP, the distortions from further increases in the debt ratio outweigh the short run gains from deferring the adjustment.

Based on my results it is possible to conclude that the current policy of the US government of deferring the adjustment is optimal as the debt ratio is still not high enough and thus not too distortionary. Although it should be stressed that the deferral is only beneficial for the current generation which benefits from the period of macroeconomic excess, while future generations would prefer to be born in a country with a lower debt burden.

5. Conclusions

In this paper I compute the macroeconomic and welfare costs for the US of the higher debt to GDP ratio that would result from delaying the policy changes required to correct its medium-term budgetary imbalance. I find that the stakes are high, given the continuous increase in the federal debt that the current policies entail. Based on my simulations, if the US government fails to adjust its medium term fiscal imbalance for twenty-five years the debt to GDP ratio would rise from 69 percent in 2011 to 200 percent by 2035, the average growth during the transition to the steady state would only be 0.9 percent compared to 1.8 percent in a scenario where the debt ratio is immediately stabilized at 69 percent of GDP, and would eventually result in a permanent output loss of 22 percent. Furthermore, a delay of twenty-five years would be equivalent to a permanent fall of 3.6 percent in consumption even after considering the short run welfare gains from delaying the fiscal adjustment. Thus, I conclude that even if it might not be optimal for the US government to immediately correct its medium-term imbalance, in a few years it will unavoidably need to implement a large fiscal adjustment to avoid the harsh consequences from further delays.

In the model I assumed that the economy is closed and that the government never defaults, and these simplifications could potentially alter the results. If default was explicitly modeled, the reaction of the equilibrium interest rate to changes in the stock of debt would increase. On the contrary, if I had modeled the US as a small open economy the world interest rate would not be affected by its borrowing needs. Although the US has a high component of foreign financing, I believe my assumptions are sufficiently realistic to provide an idea of the importance of the policy choices that the US government will need to make in the near future. After all, if the US indebtedness were to reach the high levels implicit in this paper the world interest rate would invariably increase.

Annexes Chapter 1:

Revenue and Expenditure Gaps - A Cross Country Analysis

Appendix

The dataset contains a full decomposition of public revenues and expenditures (as a share of GDP) from 2005 to 2016 for 168 countries (96% of world's GDP). The list of countries is presented in Table 1.1. Whenever possible, the information corresponds to the general government. However, 75 countries in the sample only report statistics for the central government (presented on Table 1.2).

The dataset combines information from various sources to maximize the number of countries covered. The main source is the submission by country desks to WEO in April 2017. The information was then corrected and completed with the latest available information for the country from IMF country reports (Article IV and program reviews). When information was still missing, it was completed with revenue statistics from the OECD.

The government's revenues are decomposed into seven categories:
1) *taxes on income profits and capital gains* (excluding taxes to oil and gas companies),
2) *other taxes* (mainly property taxes),
3) *payroll taxes* (all social security contributions for pensions, health, and unemployment insurance),
4) *taxes on goods and services* (excises and VAT),
5) *taxes on international trade and transactions* (tariffs and duties),
6) *grants*, and
7) *non-tax revenues* (royalties, capital income, and commodity related income).

Social security contributions are assumed to be part of the government's revenues. Whenever possible, tax revenues directly related to natural resources (e.g. oil, gas, minerals) are included as non-tax revenues to make tax revenues comparable among countries. Proceeds from privatizations are not included as revenues.

The government's expenditures are decomposed into four categories:
1) *government consumption (*wages, and purchase of goods and services),
2) *interest payments*,
3) *transfers and subsidies* (social security benefits, grants, subsidies, and other expenses), and
4) *gross acquisition of nonfinancial assets* (public investment including depreciation costs).

The explanatory variables are:
1) Gross National Income per capita in nominal USD, as reported by the World Bank using the Atlas Method.
2) Expected years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrollment rates persist throughout the child's life, as reported by the UNESCO.
3) The growth gap estimated as the difference between observed GDP growth and its projection for 2021 as reported in WEO (used as a proxy for potential growth).
4) Old-age dependency ratio, the ratio of population older than 65 to the population aged 15-64, as reported by the United Nations Population Division.
5) Net oil and gas exports (as a percentage of GDP), as reported in WEO.
6) Imports (as a percentage of GDP), as reported in WEO.

7) Political participation index, as reported in the Democracy Index of the Economist Intelligence Unit.
8) Gross public debt (as a percentage of GDP), as reported in WEO.
9) Gross minimum annual wage (nominal USD), as reported in the Doing Business report of the World Bank.

The countries in the dummy variables *EUR*, *AFR*, *APD*, *WHD* and *AFR* correspond to area departments in the IMF and are detailed in Table 1.3.

Table 1.1: List of countries by income level (GNI per capita)

Low income countries		
Afghanistan	Gambia, The	Nepal
Benin	Guinea	Niger
Burkina Faso	Guinea-Bissau	Rwanda
Burundi	Haiti	Senegal
Cent Afr Republic	Liberia	Sierra Leone
Chad	Madagascar	Tanzania
Comoros	Malawi	Togo
Congo, Dem	Mali	Uganda
Ethiopia	Mozambique	Zimbabwe

Low middle income countries		
Armenia	Guatemala	Nigeria
Bangladesh	Honduras	Pakistan
Bhutan	India	Philippines
Bolivia	Indonesia	São Tom and Prín
Cabo Verde	Kenya	Sri Lanka
Cambodia	Kosovo	Sudan
Cameroon	Kyrgyz Republic	Swaziland
Congo, Rep	Lao PDR	Tajikistan
Cote d'Ivoire	Lesotho	Tonga
Djibouti	Mauritania	Tunisia
Egypt	Moldova	Ukraine
El Salvador	Morocco	Vanuatu
Ghana	Nicaragua	Zambia

High middle income countries		
Albania	Fiji	Montenegro
Algeria	Gabon	Namibia
Angola	Georgia	Palau
Argentina	Grenada	Panama
Azerbaijan	Guyana	Paraguay
Belarus	Iran	Peru
Belize	Iraq	Romania
Bosnia and Herz	Jamaica	Russia
Botswana	Jordan	Serbia
Brazil	Kazakhstan	South Africa
Bulgaria	Lebanon	St. Lucia
Colombia	Macedonia, FYR	St. Vin and Gren
Costa Rica	Malaysia	Thailand
Dominica	Maldives	Turkey
Dom Republic	Marshall Isl	Tuvalu
Ecuador	Mauritius	
Equ Guinea	Mexico	

High income countries		
Antigua and Barb	Greece	Portugal
Australia	Hungary	Qatar
Austria	Ireland	San Marino
Bahamas, The	Israel	Saudi Arabia
Bahrain	Italy	Seychelles
Barbados	Japan	Singapore
Belgium	Korea	Slovak Republic
Brunei Dar	Kuwait	Slovenia
Canada	Latvia	Spain
Chile	Lithuania	St. Kitts and Nevis
Croatia	Luxembourg	Sweden
Cyprus	Macao	Switzerland
Czech Republic	Malta	Trin and Tobago
Denmark	Netherlands	United Arab Em
Estonia	New Zealand	United Kingdom
Finland	Norway	United States
France	Oman	Uruguay
Germany	Poland	

Table 1.2: List of countries that only report central government statistics

Low income countries		
Afghanistan	Guinea	Niger
Benin	Guinea-Bissau	Rwanda
Burkina Faso	Haiti	Senegal
Burundi	Liberia	Sierra Leone
Cent Afr Republic	Madagascar	Tanzania
Chad	Malawi	Togo
Congo, Dem	Mali	Uganda
Gambia, The	Nepal	Zimbabwe

Low middle income countries		
Armenia	Guatemala	Sri Lanka
Bangladesh	Kenya	Sudan
Cabo Verde	Lesotho	Swaziland
Cameroon	Mauritania	Tonga
Congo, Rep	Morocco	Tunisia
Djibouti	Nicaragua	Vanuatu
Ghana	São Tom and Prín	Zambia

High middle income countries		
Albania	Gabon	Maldives
Algeria	Grenada	Marshall Isl
Angola	Iran	Mauritius
Belize	Iraq	Namibia
Botswana	Jamaica	Palau
Dominica	Jordan	Russia
Dom Republic	Lebanon	St. Lucia
Equ Guinea	Macedonia, FYR	St. Vin and Gren
Fiji	Malaysia	Tuvalu

High income countries		
Antigua and Barb	New Zealand	Singapore
Bahamas, The	Oman	St. Kitts and Nevis
Brunei Dar	Qatar	Trin and Tobago
Korea	Saudi Arabia	Uruguay

Table 1.3: List of countries by area department in the IMF

European (EUR)		
Albania	Hungary	Portugal
Austria	Ireland	Romania
Belarus	Israel	Russia
Belgium	Italy	San Marino
Bosnia and Herz	Kosovo	Serbia
Bulgaria	Latvia	Slovak Republic
Croatia	Lithuania	Slovenia
Cyprus	Luxembourg	Spain
Czech Republic	Macedonia, FYR	Sweden
Denmark	Malta	Switzerland
Estonia	Moldova	Turkey
Finland	Montenegro	Ukraine
France	Netherlands	United Kingdom
Germany	Norway	
Greece	Poland	

African (AFR)		
Angola	Gabon	Nigeria
Benin	Gambia, The	Rwanda
Botswana	Ghana	São Tom and Prín
Burkina Faso	Guinea	Senegal
Burundi	Guinea-Bissau	Seychelles
Cabo Verde	Kenya	Sierra Leone
Cameroon	Lesotho	South Africa
Cent Afr Republic	Liberia	Swaziland
Chad	Madagascar	Tanzania
Comoros	Malawi	Togo
Congo, Dem	Mali	Uganda
Congo, Rep	Mauritius	Zambia
Cote d'Ivoire	Mozambique	Zimbabwe
Equ Guinea	Namibia	
Ethiopia	Niger	

Middle East & Central Asia(MCD)	
Afghanistan	Kyrgyz Republic
Algeria	Lebanon
Armenia	Mauritania
Azerbaijan	Morocco
Bahrain	Oman
Djibouti	Pakistan
Egypt	Qatar
Georgia	Saudi Arabia
Iran	Sudan
Iraq	Tajikistan
Jordan	Tunisia
Kazakhstan	United Arab Em
Kuwait	

Western Hemisphere (WHD)	
Antigua and Barb	Guatemala
Argentina	Guyana
Bahamas, The	Haiti
Barbados	Honduras
Belize	Jamaica
Bolivia	Mexico
Brazil	Nicaragua
Canada	Panama
Chile	Paraguay
Colombia	Peru
Costa Rica	St. Kitts and Nevis
Dominica	St. Lucia
Dom Republic	St. Vin and Gren
Ecuador	Trin and Tobago
El Salvador	United States
Grenada	Uruguay

Asia and Pacific (APD)	
Australia	Maldives
Bangladesh	Marshall Isl
Bhutan	Nepal
Brunei Dar	New Zealand
Cambodia	Palau
Fiji	Philippines
India	Singapore
Indonesia	Sri Lanka
Japan	Thailand
Korea	Tonga
Lao PDR	Tuvalu
Macao	Vanuatu
Malaysia	

Table 2.1: Revenues in 2016 of low income countries (percent of GDP)

	total revenues	income taxes	other taxes	payroll taxes	taxes goods & services	taxes to int. trade	grants	non-tax revenues
Afghanistan	26.9	2.8	0.5	0.4	2.2	2.4	15.9	2.7
Benin	15.2	2.1	1.2	0.0	3.6	5.7	0.5	2.1
Burkina Faso	22.0	3.7	0.5	0.1	8.9	2.5	3.8	2.5
Burundi	15.0	2.8	0.0	0.0	7.1	1.3	2.9	0.9
Cent Afr Republic	14.1	1.8	0.0	0.0	3.8	1.9	6.0	0.6
Chad	13.0	3.3	0.9	0.0	1.3	1.9	3.8	1.8
Comoros	22.7	3.0	0.1	0.0	7.4	1.6	8.4	2.2
Congo, Dem	10.1	2.2	0.0	0.0	2.6	1.3	1.9	2.1
Ethiopia	16.0	4.7	0.0	0.0	3.7	4.1	0.9	2.6
Gambia, The	19.7	4.3	0.1	0.0	7.0	5.0	1.7	1.6
Guinea	21.1	3.3	0.0	0.0	9.3	3.4	1.6	3.5
Guinea-Bissau	16.4	3.0	0.0	0.0	3.8	2.8	3.8	3.0
Haiti	18.5	3.1	1.8	0.0	4.4	4.2	4.3	0.7
Liberia	30.1	7.5	0.3	0.0	1.3	8.6	9.5	2.9
Madagascar	14.7	2.5	0.0	0.0	3.0	5.3	3.4	0.5
Malawi	25.2	9.1	0.1	0.0	7.4	1.6	5.0	2.0
Mali	21.6	3.6	0.0	0.0	7.8	1.9	1.6	6.7
Mozambique	24.7	9.1	0.8	0.0	7.6	1.8	1.4	4.0
Nepal	23.3	5.1	1.8	0.0	7.1	4.9	1.9	2.5
Niger	20.0	3.5	1.3	0.0	5.7	4.0	4.7	0.8
Rwanda	23.6	6.6	0.0	0.0	7.9	1.3	5.1	2.7
Senegal	26.8	5.9	0.4	0.3	11.0	2.7	2.8	3.7
Sierra Leone	15.2	5.3	0.0	0.0	3.6	1.6	3.0	1.6
Tanzania	15.9	4.8	1.9	0.0	5.2	0.9	0.9	2.2
Togo	21.7	5.1	0.0	0.0	3.9	7.9	2.9	1.9
Uganda	14.4	4.6	0.1	0.0	6.8	1.3	1.0	0.6
Zimbabwe	24.7	7.6	2.0	0.0	11.3	1.9	0.0	1.9
median	20.0	3.7	0.1	0.0	5.7	2.4	2.9	2.1

Table 2.2: Revenues in 2016 of low-middle income countries (percent of GDP)

	total revenues	income taxes	other taxes	payroll taxes	taxes goods & services	taxes to int. trade	grants	non-tax revenues
Armenia	21.4	9.0	2.0	0.3	7.9	1.1	0.6	0.5
Bangladesh	10.4	2.5	1.1	0.0	2.9	2.2	0.1	1.5
Bhutan	29.5	8.0	0.0	0.0	5.0	0.3	12.3	3.9
Bolivia	32.4	5.6	4.4	1.4	11.7	1.6	0.2	7.5
Cabo Verde	27.8	6.3	0.4	0.0	9.2	3.3	3.9	4.7
Cambodia	19.4	3.7	0.0	0.0	9.0	2.4	1.9	2.4
Cameroon	16.6	4.8	0.2	0.3	6.6	2.0	0.4	2.3
Congo, Rep	27.4	7.5	0.4	0.0	6.9	2.7	0.9	9.0
Cote d'Ivoire	19.9	3.9	0.0	2.1	3.8	5.4	1.4	3.3
Djibouti	32.5	7.9	1.4	0.0	7.7	1.8	4.5	9.2
Egypt	20.9	4.0	0.4	0.0	5.1	1.1	0.2	10.1
El Salvador	20.7	5.4	0.1	2.4	9.0	0.8	0.2	2.9
Ghana	17.1	5.4	0.0	0.2	7.3	2.6	0.7	0.9
Guatemala	10.9	3.9	1.3	0.0	4.6	0.4	0.0	0.7
Honduras	26.8	6.6	0.4	3.1	11.1	0.8	0.8	4.0
India	21.3	6.4	0.0	0.0	9.8	1.4	0.0	3.7
Indonesia	14.3	5.4	1.4	0.0	4.5	0.3	0.0	2.7
Kenya	20.2	8.8	0.0	0.0	6.8	1.2	0.5	2.9
Kosovo	26.4	3.9	-0.6	0.0	20.3	0.0	0.0	2.8
Kyrgyz Republic	38.0	5.8	0.5	5.7	12.5	2.9	4.4	6.2
Lao PDR	18.4	2.3	1.8	0.0	6.8	1.5	2.3	3.7
Lesotho	42.1	11.8	0.5	0.0	8.2	14.9	2.5	4.2
Mauritania	28.1	4.7	0.2	0.0	8.9	2.8	2.1	9.4
Moldova	34.2	4.9	1.6	9.9	14.2	1.1	1.0	1.5
Morocco	26.2	8.3	2.0	0.0	10.3	0.9	1.0	3.7
Nicaragua	25.6	6.9	0.8	5.7	9.0	0.7	1.1	1.4
Nigeria	4.8	1.4	0.6	0.0	0.9	0.5	0.0	1.5
Pakistan	15.5	4.1	1.9	0.0	5.2	1.4	0.2	2.7
Philippines	19.5	6.5	1.2	2.4	6.5	0.5	0.0	2.4
São Tom and Prín	28.0	5.7	0.6	0.0	1.2	4.8	13.5	2.2
Sri Lanka	13.2	2.4	1.1	0.1	6.2	1.3	0.1	1.9
Sudan	9.3	0.6	0.0	0.0	3.5	1.4	0.3	3.5
Swaziland	25.6	7.8	0.0	0.0	6.3	9.3	1.4	0.8
Tajikistan	27.9	4.2	0.4	2.5	12.0	1.2	2.5	5.1
Tonga	33.0	4.5	0.0	0.0	16.4	2.2	5.8	4.1
Tunisia	22.9	8.4	3.3	0.3	8.1	0.7	0.1	2.0
Ukraine	38.4	8.4	3.9	5.5	14.5	0.9	0.0	5.2
Vanuatu	24.2	0.0	0.1	0.0	12.6	3.7	5.8	2.0
Zambia	17.9	6.6	0.0	0.0	5.3	0.9	0.3	4.8
median	22.9	5.4	0.4	0.0	7.7	1.4	0.7	2.9

Table 2.3: Revenues in 2016 of high-middle income countries (percent of GDP)

	total revenues	income taxes	other taxes	payroll taxes	taxes goods & services	taxes to int. trade	grants	non-tax revenues
Albania	26.6	4.0	3.8	5.3	11.3	0.4	0.8	1.4
Algeria	29.0	6.3	0.5	0.0	5.0	2.4	0.0	14.8
Angola	19.6	4.6	1.0	1.0	1.7	0.8	0.0	10.5
Argentina	33.7	5.4	2.8	6.6	14.5	1.6	0.0	2.8
Azerbaijan	34.5	6.3	1.1	1.2	8.2	1.1	0.1	16.6
Belarus	38.1	7.0	2.5	12.1	10.7	3.5	0.0	2.3
Belize	30.4	7.5	3.5	0.0	9.8	5.7	1.3	2.6
Bosnia and Herz	42.9	3.7	0.0	15.0	18.0	0.8	0.7	4.7
Botswana	32.0	6.2	0.2	0.0	3.4	6.8	0.1	15.4
Brazil	32.7	5.5	2.3	5.5	12.0	0.7	0.0	6.7
Bulgaria	35.4	5.4	1.0	6.6	14.6	0.2	3.1	4.5
Colombia	24.9	6.6	1.8	3.5	9.0	0.7	0.1	3.3
Costa Rica	26.8	4.5	0.9	9.3	8.4	1.3	0.0	2.4
Dominica	37.5	4.9	0.5	0.0	14.8	5.4	1.0	10.9
Dom Republic	14.4	4.1	0.6	0.0	7.8	1.0	0.0	0.9
Ecuador	30.7	4.2	1.9	4.8	6.9	1.8	0.0	11.1
Equ Guinea	15.8	2.8	0.3	0.0	0.9	0.2	0.0	11.6
Fiji	28.8	6.3	0.0	0.0	10.7	9.3	0.2	2.3
Gabon	17.1	3.6	1.4	0.0	2.6	3.3	0.0	6.2
Georgia	28.6	10.5	1.2	0.0	14.1	0.2	0.8	1.8
Grenada	27.1	4.6	0.9	0.0	8.8	7.4	3.6	1.8
Guyana	28.6	8.5	0.8	2.6	9.7	2.4	1.1	3.5
Iran	15.1	3.2	0.2	0.0	2.2	1.2	0.0	8.3
Iraq	26.5	1.7	0.0	0.0	0.4	0.3	0.0	24.1
Jamaica	27.9	7.3	0.3	0.0	8.2	9.8	0.3	2.0
Jordan	25.5	3.4	1.6	0.0	10.5	1.1	3.0	5.9
Kazakhstan	18.0	5.6	0.7	1.2	3.3	2.1	0.0	5.1
Lebanon	18.7	3.9	2.2	4.1	4.7	2.7	0.0	1.1
Macedonia, FYR	27.8	4.0	0.4	8.6	11.5	0.8	0.8	1.7
Malaysia	20.4	7.6	0.6	0.0	4.3	0.2	0.0	7.6
Maldives	34.6	6.1	2.4	0.0	11.9	4.6	0.9	8.7
Marshall Isl	66.2	6.4	0.1	0.0	6.2	4.0	37.2	12.3
Mauritius	23.4	5.7	1.8	0.3	11.8	0.3	1.2	2.3
Mexico	23.2	7.3	0.2	3.6	6.2	0.3	0.0	5.7
Montenegro	43.9	5.3	2.9	11.2	18.3	0.6	0.4	5.2
Namibia	31.5	10.7	0.2	0.0	8.1	9.3	0.1	3.1
Palau	39.6	3.2	3.1	0.5	7.8	5.0	14.8	5.2
Panama	20.5	4.6	0.5	6.0	4.2	0.6	0.0	4.6
Paraguay	23.3	2.8	0.3	4.9	8.4	1.1	0.2	5.6
Peru	18.7	5.6	1.7	2.2	6.4	0.2	0.1	2.5
Romania	29.1	5.9	1.6	8.1	10.4	0.1	0.5	2.5
Russia	32.8	6.7	1.4	7.0	6.9	0.6	0.0	10.2
Serbia	42.4	5.6	1.6	11.0	17.1	0.9	0.2	6.0
South Africa	29.4	14.9	1.1	1.0	9.0	1.1	0.0	2.3
St. Lucia	27.7	6.5	0.3	0.0	6.7	11.8	1.3	1.1
St. Vin and Gren	29.2	6.5	0.2	0.0	7.7	10.3	2.6	1.9
Thailand	21.9	6.4	0.4	1.0	9.7	0.7	0.0	3.7
Turkey	31.2	6.5	2.7	6.8	11.6	1.7	0.0	1.9
Tuvalu	124.5	9.3	0.0	3.3	4.6	3.2	32.9	71.2
median	28.6	5.6	0.9	1.0	8.4	1.1	0.1	4.6

Table 2.4: Revenues in 2016 of high income countries (percent of GDP)

	total revenues	income taxes	other taxes	payroll taxes	taxes goods & services	taxes to int. trade	grants	non-tax revenues
Antigua and Barb	25.6	1.9	0.5	0.0	8.0	6.8	0.0	8.4
Australia	34.6	19.1	1.3	1.4	5.8	0.5	0.1	6.4
Austria	49.6	12.5	3.8	18.2	10.0	1.7	0.1	3.3
Bahamas, The	21.7	0.0	11.3	2.9	1.8	5.7	0.0	0.0
Bahrain	17.6	0.1	0.0	0.0	0.0	0.6	2.0	14.9
Barbados	37.9	7.3	2.3	5.9	15.6	2.6	0.1	4.1
Belgium	51.0	16.3	5.1	16.1	6.8	1.8	0.0	4.9
Brunei Dar	17.9	1.2	0.2	0.0	0.2	0.6	0.0	15.7
Canada	38.8	15.3	4.3	4.8	7.5	0.3	0.0	6.6
Chile	23.3	6.1	0.1	1.4	10.0	1.2	0.5	4.0
Croatia	45.5	5.9	0.4	11.8	20.2	0.1	2.1	5.0
Cyprus	38.7	9.0	1.9	8.5	13.6	0.0	0.7	5.0
Czech Republic	40.5	7.8	1.0	14.9	10.9	0.6	0.7	4.6
Denmark	52.7	26.4	4.8	0.3	13.3	1.4	0.0	6.5
Estonia	40.7	7.8	0.9	11.9	13.5	0.7	1.7	4.2
Finland	54.2	15.5	1.2	13.1	13.0	1.5	0.2	9.6
France	53.2	10.7	7.0	18.9	9.4	1.5	0.1	5.6
Germany	45.1	11.9	1.4	16.7	9.1	0.9	0.2	4.9
Greece	50.3	8.9	1.5	14.2	12.2	5.2	2.7	5.6
Hungary	45.8	6.9	0.0	14.2	13.9	4.3	1.7	4.8
Ireland	27.2	10.9	0.1	4.6	7.6	1.4	0.2	2.4
Israel	37.5	10.3	3.3	7.1	12.6	0.3	1.1	2.8
Italy	47.2	14.3	3.3	13.2	9.5	2.9	0.2	3.8
Japan	32.6	10.1	2.6	12.5	7.2	0.2	0.0	0.1
Korea	22.1	7.2	1.7	4.0	5.4	0.6	0.0	3.2
Kuwait	51.9	0.4	1.0	2.3	0.0	0.0	0.0	48.2
Latvia	36.3	7.5	0.8	8.7	11.3	1.0	3.0	3.9
Lithuania	34.3	5.7	0.3	12.5	10.9	0.0	0.8	4.1
Luxembourg	43.1	13.4	0.6	12.0	9.8	2.5	0.2	4.6
Macao	27.5	1.9	0.0	0.0	1.2	0.0	0.0	24.4
Malta	38.1	13.3	0.3	6.8	14.1	0.0	0.4	3.2
Netherlands	44.1	10.2	2.5	14.8	9.3	1.8	0.0	5.5
New Zealand	35.1	18.0	0.0	1.0	10.0	1.1	0.0	5.1
Norway	53.1	19.0	1.1	8.9	9.5	0.8	0.0	13.8
Oman	29.9	1.6	1.0	3.4	0.0	1.1	0.9	21.9
Poland	38.8	7.2	2.3	14.0	10.7	0.3	0.0	4.3
Portugal	43.5	10.3	1.8	11.7	11.2	1.8	0.0	6.7
Qatar	30.3	5.5	0.0	0.0	0.0	0.5	0.0	24.3
San Marino	40.2	6.6	1.0	12.2	8.6	0.2	0.0	11.7
Saudi Arabia	21.4	1.2	0.0	0.0	0.0	1.1	0.0	19.1
Seychelles	37.9	10.9	3.3	0.0	16.7	1.9	1.3	3.8
Singapore	22.1	7.2	3.7	0.0	2.4	0.8	0.0	8.0
Slovak Republic	39.7	7.5	0.4	14.2	9.3	1.3	2.3	4.7
Slovenia	39.4	6.7	0.8	14.4	12.0	1.9	1.2	2.4
Spain	37.9	9.7	1.5	12.2	9.7	1.2	0.5	3.1
St. Kitts and Nevis	33.9	5.2	0.7	0.0	8.6	6.1	2.8	10.5
Sweden	48.9	18.1	0.4	12.8	11.2	1.0	0.1	5.3
Switzerland	32.7	12.2	1.6	6.6	5.0	1.4	0.0	5.9
Trin and Tobago	23.5	5.4	2.6	0.0	6.6	1.7	0.2	7.0
United Arab Em	26.3	0.7	0.0	0.3	0.0	0.8	0.0	24.5
United Kingdom	36.3	11.6	3.5	7.8	10.4	1.4	0.0	1.5
United States	31.4	12.5	2.6	6.8	4.3	0.2	0.0	5.0
Uruguay	28.6	6.6	0.2	7.3	10.7	1.0	0.0	2.8
median	37.9	7.8	1.1	7.3	9.5	1.1	0.1	5.0

Table 3.1: Expenditures in 2016 of low income countries (percent of GDP)

	total expend.	gov. consump.	interest payments	transfers and subsidies	public invest.
Afghanistan	26.7	17.1	0.1	6.2	3.4
Benin	21.3	9.0	1.2	5.2	5.9
Burkina Faso	24.5	9.3	0.7	5.1	9.4
Burundi	21.2	9.8	1.1	5.0	5.3
Cent Afr Republic	12.4	7.3	0.6	1.6	2.9
Chad	14.3	7.9	2.1	1.5	2.8
Comoros	29.9	13.4	0.2	5.6	10.7
Congo, Dem	10.9	7.0	0.2	1.3	2.4
Ethiopia	18.4	3.7	0.5	4.8	9.4
Gambia, The	29.9	11.6	7.7	4.2	6.4
Guinea	21.4	9.7	1.9	3.9	5.9
Guinea-Bissau	20.1	7.5	0.9	5.8	5.9
Haiti	18.5	10.5	0.3	1.7	6.0
Liberia	36.0	22.7	0.5	4.4	8.4
Madagascar	16.0	9.4	0.9	0.5	5.2
Malawi	33.0	13.5	4.9	8.7	5.9
Mali	25.6	8.0	0.7	8.0	8.9
Mozambique	30.7	14.6	2.9	3.4	9.8
Nepal	22.0	5.6	0.4	10.5	5.5
Niger	26.5	8.9	0.9	4.6	12.1
Rwanda	26.0	6.9	1.0	7.5	10.6
Senegal	31.0	10.3	2.2	6.0	12.5
Sierra Leone	23.1	12.4	0.8	1.4	8.5
Tanzania	19.6	11.3	1.6	0.0	6.7
Togo	31.4	10.8	2.4	4.2	14.0
Uganda	18.0	8.7	2.3	0.0	7.0
Zimbabwe	35.0	18.7	1.5	8.7	6.1
median	23.1	9.7	0.9	4.6	6.4

Table 3.2: Expenditures in 2016 of low-middle income countries (percent of GDP)

	total expend.	gov. consump.	interest payments	transfers and subsidies	public invest.
Armenia	27.0	8.4	1.9	13.5	3.1
Bangladesh	13.8	3.4	1.9	3.4	5.1
Bhutan	31.6	13.5	1.5	7.3	9.3
Bolivia	38.9	14.4	1.0	9.0	14.5
Cabo Verde	31.0	16.7	2.6	7.4	4.3
Cambodia	22.3	11.1	0.4	3.0	7.8
Cameroon	21.3	10.4	1.1	3.0	6.8
Congo, Rep	44.6	21.9	0.7	0.2	21.8
Cote d'Ivoire	23.8	11.1	1.7	4.3	6.7
Djibouti	48.3	21.6	1.4	1.2	24.1
Egypt	32.9	9.1	8.3	12.4	3.1
El Salvador	21.5	13.5	2.7	2.8	2.5
Ghana	25.4	10.5	6.4	3.7	4.8
Guatemala	11.9	5.5	1.5	2.7	2.2
Honduras	28.1	14.2	2.4	5.0	6.5
India	27.9	2.6	4.9	15.8	4.6
Indonesia	16.8	7.6	1.5	4.1	3.6
Kenya	27.5	10.0	3.2	6.6	7.7
Kosovo	27.9	12.3	0.3	8.1	7.2
Kyrgyz Republic	42.5	18.6	1.2	12.7	10.0
Lao PDR	24.3	12.0	1.3	3.0	8.0
Lesotho	49.8	29.2	0.9	9.7	10.0
Mauritania	28.1	10.9	1.1	4.7	11.4
Moldova	36.3	15.3	1.3	16.0	3.7
Morocco	30.2	14.5	2.7	7.3	5.7
Nicaragua	27.3	10.0	0.9	10.8	5.6
Nigeria	9.3	3.5	1.0	3.0	1.8
Pakistan	19.9	3.5	4.3	8.6	3.5
Philippines	19.9	8.1	2.1	5.3	4.4
São Tom and Prín	30.9	12.0	0.4	4.8	13.7
Sri Lanka	18.8	6.9	5.0	4.1	2.8
Sudan	11.1	5.1	0.6	4.1	1.3
Swaziland	37.8	19.8	1.5	6.9	9.6
Tajikistan	38.5	11.8	0.6	11.1	15.0
Tonga	32.6	25.2	0.9	4.6	1.9
Tunisia	28.6	16.5	2.2	4.6	5.3
Ukraine	40.6	16.0	4.1	17.4	3.1
Vanuatu	32.6	16.8	0.9	6.1	8.8
Zambia	24.0	11.1	3.4	5.9	3.6
median	27.9	11.8	1.5	5.3	5.6

Table 3.3: Expenditures in 2016 of high-middle income countries (percent of GDP)

	total expend.	gov. consump.	interest payments	transfers and subsidies	public invest.
Albania	28.3	7.4	2.4	14.8	3.7
Algeria	40.6	11.7	0.3	14.1	14.5
Angola	23.7	12.8	3.0	3.4	4.5
Argentina	39.5	15.4	0.8	19.6	3.6
Azerbaijan	35.9	16.5	0.9	5.1	13.4
Belarus	42.7	14.5	2.0	21.5	4.7
Belize	34.0	18.2	2.9	6.9	6.0
Bosnia and Herz	42.8	20.6	0.9	17.4	3.9
Botswana	33.9	17.8	0.4	6.9	8.8
Brazil	41.6	23.0	8.7	8.4	1.5
Bulgaria	33.8	10.2	0.8	18.7	4.1
Colombia	28.3	8.4	3.6	10.5	5.8
Costa Rica	31.3	16.9	2.8	9.8	1.8
Dominica	38.8	18.2	2.1	6.0	12.5
Dom Republic	17.6	6.0	2.9	5.5	3.2
Ecuador	37.3	14.8	1.6	10.3	10.6
Equ Guinea	32.2	8.7	0.4	4.9	18.2
Fiji	34.5	17.3	2.9	12.1	2.2
Gabon	21.7	11.6	2.3	2.8	5.0
Georgia	30.2	9.3	1.2	15.7	4.0
Grenada	24.7	12.9	3.0	4.5	4.3
Guyana	33.0	13.6	0.9	11.9	6.6
Iran	17.9	6.7	0.7	8.3	2.2
Iraq	40.1	18.9	0.7	9.9	10.6
Jamaica	28.8	16.7	7.9	1.8	2.4
Jordan	28.9	6.6	3.0	15.6	3.7
Kazakhstan	22.4	9.3	1.5	8.7	2.9
Lebanon	26.8	9.8	9.0	6.9	1.1
Macedonia, FYR	30.5	8.4	1.1	18.2	2.8
Malaysia	23.4	8.7	2.3	8.2	4.2
Maldives	43.0	21.5	3.1	6.5	11.9
Marshall Isl	63.9	36.3	0.7	17.9	9.0
Mauritius	26.7	9.0	2.6	13.0	2.1
Mexico	26.0	8.4	3.1	10.3	4.2
Montenegro	49.2	15.8	2.3	25.2	5.9
Namibia	39.4	21.6	2.4	11.3	4.1
Palau	41.6	22.2	0.3	7.8	11.3
Panama	22.8	7.8	1.7	6.3	7.0
Paraguay	24.3	13.2	1.2	5.8	4.1
Peru	21.0	12.1	1.0	3.2	4.7
Romania	31.5	12.9	1.3	14.8	2.5
Russia	36.4	8.0	1.0	23.1	4.3
Serbia	43.6	16.5	3.1	20.7	3.3
South Africa	33.0	16.3	3.5	9.5	3.7
St. Lucia	31.9	15.1	4.8	6.9	5.1
St. Vin and Gren	30.5	16.6	2.2	6.9	4.8
Thailand	21.5	13.0	0.9	5.3	2.3
Turkey	33.5	11.5	2.1	16.2	3.7
Tuvalu	127.3	69.0	0.1	58.0	0.2
median	32.2	13.2	2.1	9.8	4.2

Table 3.4: Expenditures in 2016 of high income countries (percent of GDP)

	total expend.	gov. consump.	interest payments	transfers and subsidies	public invest.
Antigua and Barb	24.6	12.8	2.6	6.2	3.0
Australia	37.3	20.1	1.5	12.2	3.5
Austria	51.0	17.2	2.2	28.8	2.8
Bahamas, The	25.2	11.2	3.1	7.6	3.3
Bahrain	35.4	15.9	3.0	11.1	5.4
Barbados	44.8	13.2	6.7	22.2	2.7
Belgium	53.7	16.5	2.7	30.9	3.6
Brunei Dar	39.8	24.4	0.0	7.8	7.6
Canada	40.8	20.7	2.9	13.3	3.9
Chile	26.2	9.5	0.8	11.8	4.1
Croatia	47.0	19.2	3.4	20.9	3.5
Cyprus	39.0	16.1	2.6	18.2	2.1
Czech Republic	39.9	15.1	1.0	20.4	3.4
Denmark	53.6	25.0	1.4	24.3	2.9
Estonia	40.4	18.8	0.1	16.8	4.7
Finland	56.1	24.5	1.1	27.1	3.4
France	56.5	17.9	1.9	33.1	3.6
Germany	44.3	12.3	1.4	28.5	2.1
Greece	50.3	17.3	3.3	24.9	4.8
Hungary	47.6	18.9	3.2	22.7	2.8
Ireland	28.1	11.1	2.4	12.9	1.7
Israel	40.1	18.8	3.1	16.6	1.6
Italy	49.6	15.3	4.0	28.0	2.3
Japan	36.8	9.3	1.6	22.1	3.8
Korea	21.8	4.1	0.7	15.3	1.7
Kuwait	55.5	27.7	0.3	19.3	8.2
Latvia	36.7	13.2	1.2	19.6	2.7
Lithuania	34.3	14.6	1.7	15.1	2.9
Luxembourg	41.4	12.1	0.4	25.1	3.8
Macao	22.7	8.3	0.0	11.1	3.3
Malta	38.7	18.7	2.1	14.1	3.8
Netherlands	44.6	14.9	1.1	25.3	3.3
New Zealand	33.8	12.3	1.4	17.0	3.1
Norway	50.2	22.7	1.1	21.6	4.8
Oman	51.7	17.3	0.5	22.0	11.9
Poland	41.3	16.1	1.7	20.2	3.3
Portugal	45.8	17.1	4.2	22.6	1.9
Qatar	34.4	9.6	0.7	9.8	14.3
San Marino	44.1	20.8	0.2	20.9	2.3
Saudi Arabia	38.6	27.5	0.2	2.3	8.6
Seychelles	39.0	23.6	3.6	7.0	4.8
Singapore	20.0	9.1	0.0	5.5	5.4
Slovak Republic	41.6	14.5	1.5	22.3	3.3
Slovenia	41.2	15.5	2.8	21.3	1.6
Spain	42.4	15.9	2.8	21.8	1.9
St. Kitts and Nevis	30.1	17.9	1.7	6.0	4.5
Sweden	49.1	20.2	0.4	26.3	2.2
Switzerland	32.8	11.2	0.6	17.9	3.1
Trin and Tobago	37.5	11.9	2.1	20.4	3.1
United Arab Em	30.2	8.9	0.2	18.4	2.7
United Kingdom	39.4	18.1	2.5	17.1	1.7
United States	35.7	14.7	2.5	18.0	0.5
Uruguay	32.6	11.1	3.2	15.9	2.4
median	39.9	15.9	1.7	19.3	3.3

Table 4: List of countries with IMF programs during 2005 - 2016

EUR	
Albania	Latvia
Belarus	Macedonia, FYR
Bosnia and Herz	Moldova
Cyprus	Portugal
Greece	Romania
Hungary	Serbia
Ireland	Turkey
Kosovo	Ukraine

AFR		
Algeria	Gabon	Niger
Benin	Gambia, The	Rwanda
Burkina Faso	Ghana	São Tom and Prín
Burundi	Guinea	Senegal
Cameroon	Guinea-Bissau	Seychelles
Cent Afr Republic	Kenya	Sierra Leone
Chad	Lesotho	Tanzania
Comoros	Liberia	Togo
Congo, Dem	Madagascar	Uganda
Congo, Rep	Malawi	Zambia
Cote d'Ivoire	Mali	
Ethiopia	Mozambique	

MCD	
Afghanistan	Jordan
Armenia	Kyrgyz Republic
Azerbaijan	Mauritania
Djibouti	Pakistan
Egypt	Tajikistan
Georgia	Tunisia
Iraq	

APD
Bangladesh
Maldives
Nepal
Sri Lanka

WHD	
Antigua and Barb	Guyana
Argentina	Haiti
Bolivia	Honduras
Costa Rica	Jamaica
Dominica	Nicaragua
Dom Republic	St. Kitts and Nevis
Grenada	Uruguay

Note: Colombia, Mexico, and Poland are not included even though they have a Flexible Credit Line (FCL), because the FCLs do not entail automatic disbursements.

Table 5: Determinants of government's revenues (percent of GDP)

	Total Revenues	Income Taxes	Payroll Taxes	Other Taxes	Taxes Goods & Services	Taxes Internat. Trade	Grants	Non-tax Revs.	Domestic Tax Revs.
log (GNI per capita thousands of usd)	1.0***	0.7***	0.07***	-0.03	-0.5***	-0.06**	-0.2***	0.4***	0.5***
	(0.17)	(0.07)	(0.02)	(0.02)	(0.07)	(0.02)	(0.02)	(0.07)	(0.12)
	0.07	0.02	0.00	0.01	0.06	0.00	0.08	0.00	0.00
Old-age dependency ratio (+65/15-64)	0.4***	0.2***	0.04***	0.02***	0.1***	-0.01	-0.001	-0.1***	0.6***
	(0.04)	(0.02)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.02)	(0.03)
	0.08	0.12	0.00	0.06	0.01	0.04	0.01	0.01	0.09
Political particip. (Democracy index)	0.8***	0.7***	0.05***	0.04***	0.2***	-0.04**	-0.06***	0.2**	1.1***
	(0.11)	(0.05)	(0.01)	(0.01)	(0.05)	(0.02)	(0.01)	(0.05)	(0.08)
	0.10	0.14	-0.01	0.06	0.05	0.07	0.03	0.01	0.08
Net oil and gas exports (% of GDP)	0.2***	-0.04***	0.003**	-0.005***	-0.08***	-0.01***	-0.01***	0.3***	-0.1***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
	0.07	0.07	0.00	0.03	0.11	0.04	0.06	0.00	0.04
Imports (% of GDP)	0.04***	0.007***	-0.002***	-0.006***	0.004	0.003***	0.003***	0.02***	0.005
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	0.00	0.04	0.00	0.03	0.00	0.02	0.03	0.00	0.00
Growth gap	0.04	0.05***	-0.002	0.006	0.05***	-0.01*	-0.003	-0.01	0.1***
	(0.04)	(0.02)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.02)	(0.03)
	0.021	0.004	0.000	0.004	0.000	0.022	0.000	0.002	-0.001
Constant	3.8***	-6.3***	-0.8***	0.8**	6.3***	1.7***	1.6***	1.5***	-3.1***
	(1.5)	(0.6)	(0.2)	(0.2)	(0.6)	(0.2)	(0.2)	(0.6)	(1.0)
Dummy for IMF Program	0.20	-0.3	-0.002	-0.03	0.2	0.2**	0.4***	-0.6***	-0.2
	(0.44)	(0.17)	(0.04)	(0.05)	(0.2)	(0.06)	(0.05)	(0.17)	(0.31)
Dummy for EUR (Omitted: Asia/Pacific)	11.9***	-1.3***	11.1***	0.3***	4.6***	0.3***	0.6***	0.7***	9.9***
	(0.7)	(0.3)	(0.1)	(0.1)	(0.3)	(0.1)	(0.1)	(0.3)	(0.5)
Dummy for AFR (Omitted: Asia/Pacific)	3.4***	2.0***	0.1	-0.4***	0.4	0.9***	0.6***	-1.7***	2.5***
	(0.7)	(0.3)	(0.1)	(0.1)	(0.3)	(0.1)	(0.1)	(0.3)	(0.5)
Dummy for MCD (Omitted: Asia/Pacific)	6.2***	0.5*	0.1	0.1	1.5***	0.4***	0.3***	1.2***	2.9***
	(0.7)	(0.3)	(0.1)	(0.1)	(0.3)	(0.1)	(0.1)	(0.3)	(0.5)
Dummy for WHD (Omitted: Asia/Pacific)	3.9***	-0.6**	2.8***	0.1	2.6***	0.2*	0.1	0.1	3.7***
	(0.6)	(0.2)	(0.1)	(0.1)	(0.3)	(0.1)	(0.1)	(0.2)	(0.4)
Number of Observations	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691
Adjusted R-squared	0.73	0.68	0.98	0.28	0.62	0.85	0.36	0.92	0.87

***, **, *: statistically significant at 1, 5, or 10 percent.

Numbers below the standard errors correspond to the marginal R2 of each variable when added to a regression that only includes fixed effects and dummies.

Table 5.1: Cyclicality of government's revenues (percent of GDP)

	Total Revenues	Income Taxes	Payroll Taxes	Other Taxes	Taxes Goods & Services	Taxes Internat. Trade	Grants	Non-tax Revs.	Domestic Tax Revs.
Growth gap	0.04	0.05***	-0.002	0.006	0.05***	-0.01*	-0.003	-0.01	0.10***
	(0.04)	(0.02)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.02)	(0.03)
Growth gap x low income	0.12	0.07**	-0.001	0.006	0.11***	0.01	-0.007***	0.02	0.20***
	(0.08)	(0.03)	(0.01)	(0.00)	(0.03)	(0.01)	(0.01)	(0.03)	(0.06)
Growth gap x middle-income	0.05	0.06***	0.006	0.006	0.05**	-0.01*	-0.001	-0.01	0.10***
	(0.05)	(0.02)	(0.01)	(0.00)	(0.02)	(0.01)	(0.01)	(0.02)	(0.04)
Growth gap x high-income	-0.10	0.03	-0.02**	0.006	-0.02	-0.03***	0.01	-0.08**	-0.06
	(0.08)	(0.03)	(0.01)	(0.00)	(0.03)	(0.01)	(0.01)	(0.03)	(0.05)

***, **, *: statistically significant at 1, 5, or 10 percent.

Table 5.2: Correlation of estimated residuals

	Income Taxes	Payroll Taxes	Other Taxes	Taxes Goods & Services	Taxes Internat. Trade	Grants	Non-tax Revs.
Income Taxes	1						
Payroll Taxes	-0.1***	1					
Other Taxes	0.1***	0.01	1				
Taxes Goods & Services	0.1***	0.01	0	1			
Taxes Internat. Trade	-0.03	0.06***	0.06**	-0.2***	1		
Grants	-0.02	0.01	-0.15***	-0.04	0	1	
Non-tax Revs.	0.03	0.01	-0.06**	0.00	-0.05**	0.03	1

Table 6: Determinants of government's expenditures (percent of GDP)

	Total Expenditures	Government Consumption	Interest Payments	Transfers and Subsidies	Public Investment	Primary Expenditures
log(GNI per capita thousands of usd)	1.2***	0.2*	0.1***	0.3***	0.06	1.0***
	(0.20)	(0.13)	(0.03)	(0.12)	(0.07)	(0.20)
	0.09	0.08	0.00	0.03	0.00	0.09
Old-age dependency ratio (+65/15-64)	0.2***	0.02	-0.01	0.4***	-0.03**	0.3***
	(0.04)	(0.03)	(0.01)	(0.02)	(0.01)	(0.04)
	0.06	-0.02	0.03	0.09	0.05	0.04
Political particip. (Democracy index)	0.9***	0.4***	0.02	0.6***	-0.2***	0.7***
	(0.12)	(0.08)	(0.02)	(0.07)	(0.04)	(0.12)
	0.6	0.4	0.4	0.7	0.5	0.6
Net oil and gas exports (% of GDP)	0.1***	0.03***	-0.01***	0.02***	0.06***	0.2***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
	0.03	-0.01	0.03	0.01	0.10	0.03
Growth gap	0.03	0.01	-0.002	0.02	0.06***	0.07*
	(0.04)	(0.03)	(0.01)	(0.02)	(0.01)	(0.04)
	-0.01	-0.04	0.00	0.01	0.04	-0.02
Gross debt (% of GDP)	0.05***	0.01***	0.03***	0.01***	-0.005***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	0.6	0.3	0.7	0.7	0.5	0.6
log(gross min. wage thousand usd)	1.1***	0.6***	-0.01	0.3**	-0.06	1.3***
	(0.21)	(0.14)	(0.03)	(0.13)	(0.07)	(0.21)
	0.07	0.09	0.01	0.03	0.02	0.07
Constant	-5.3***	-1.0	-0.3	-5.1***	5.4***	-5.8***
	(1.6)	(1.02)	(0.2)	(1.0)	(0.5)	(1.6)
Grants (% of GDP)	1.0***	0.2***	-0.1***	0.1**	0.5***	1.2***
	(0.05)	(0.03)	(0.01)	(0.03)	(0.02)	(0.05)
Dummy for EUR	12.9***	5.7***	-0.01	6.2***	0.3	11.8***
	(0.7)	(0.5)	(0.10)	(0.4)	(0.2)	(0.7)
Dummy for AFR	2.4***	3.1***	0.0	-0.5	0.5**	2.3***
	(0.7)	(0.4)	(0.09)	(0.4)	(0.2)	(0.7)
Dummy for MCD	7.0***	3.3***	-0.3**	2.7***	-0.4	6.7***
	(0.7)	(0.4)	(0.1)	(0.4)	(0.2)	(0.7)
Dummy for WHD	3.5***	2.8***	0.2***	-0.1**	-0.04	2.7***
	(0.6)	(0.4)	(0.1)	(0.4)	(0.2)	(0.6)
Number of Observations	1,511	1,511	1,511	1,511	1,511	1,511
Adjusted R-squared	0.74	0.47	0.71	0.81	0.64	0.74

Omitted: Asia/Pacific

***, **, *: statistically significant at 1, 5, or 10 percent.

Numbers below the standard errors correspond to the marginal R2 of each variable when added to a regression that only includes fixed effects and dummies.

Table 6.1: Cyclicality of government's expenditures (percent of GDP)

	Total Expenditures	Government Consumption	Interest Payments	Transfers and Subsidies	Public Investment	Primary Expenditures
Growth gap	0.03	0.01	-0.002	0.02	0.06***	0.07*
	(0.04)	(0.03)	(0.01)	(0.02)	(0.01)	(0.04)
Growth gap x low income	0.2***	0.05	0.006	0.16***	-0.07***	0.07***
	(0.08)	(0.05)	(0.01)	(0.05)	(0.03)	(0.04)
Growth gap x middle-income	0.02	0.03	-0.004	-0.01	0.09***	0.07***
	(0.05)	(0.03)	(0.01)	(0.03)	(0.02)	(0.04)
Growth gap x high-income	-0.2***	-0.09	-0.009	-0.17***	0.06***	0.07**
	(0.09)	(0.06)	(0.01)	(0.05)	(0.03)	(0.04)

***, **, *: statistically significant at 1, 5, or 10 percent.

Table 6.2: Correlation of estimated residuals

	Government Consumption	Interest Payments	Transfers and Subsidies	Public Investment
Government Consumption	1			
Interest Payments	0.01	1		
Transfers and Subsidies	-0.03	0.02	1	
Public Investment	0.2***	-0.1***	0.01	1

Table 7.1: Fiscal gaps in 2016 low income countries (percent of GDP)

	fiscalgap	taxgap	income taxes	payroll taxes	other taxes	taxes goods & services	primgap	gov. consump.	transfers and subsidies	public invest.
Benin	5.8	-4.7	-3.0	-0.1	0.7	-2.3	1.2	-1.3	1.2	1.3
Burkina Faso	0.5	2.2	-0.6	0.1	0.0	2.7	2.8	-1.3	1.4	2.7
Burundi	5.7	-0.5	-0.7	0.0	-0.4	0.6	5.2	2.3	3.5	-0.6
Cent Afr Republic	-6.8	-2.6	-0.2	0.0	-0.4	-2.1	-9.5	-2.3	-1.1	-6.1
Chad	-8.7	-0.4	1.7	0.0	0.7	-2.9	-9.2	-2.1	-1.0	-6.1
Comoros	5.5	-1.1	-1.9	0.0	-0.3	1.1	4.4	1.6	1.2	1.5
Guinea	-5.4	3.7	-0.2	0.0	-0.4	4.3	-1.7	-1.0	-0.2	-0.5
Guinea-Bissau	3.2	-3.3	-0.5	0.0	-0.4	-2.4	-0.1	-1.8	2.9	-1.1
Haiti	-0.1	-4.5	0.0	-2.9	1.2	-2.8	-4.7	0.3	-4.0	-0.9
Liberia	11.9	-3.5	2.1	0.0	0.3	-5.8	8.5	9.3	-0.5	-0.3
Madagascar	0.7	-6.7	-2.4	0.0	-0.5	-3.7	-5.9	-1.3	-3.7	-0.9
Malawi	0.8	5.3	5.0	0.0	-0.4	0.7	6.1	3.1	4.3	-1.2
Mali	2.9	1.3	-0.7	0.0	-0.4	2.3	4.1	-2.5	4.1	2.5
Mozambique	1.8	5.5	4.1	0.0	0.5	1.0	7.4	3.6	-1.5	5.3
Nepal	1.0	2.8	1.3	-0.1	0.9	0.7	3.8	-1.6	4.8	0.5
Niger	3.4	1.1	0.4	0.0	1.1	-0.3	4.5	-1.1	1.3	4.3
Senegal	2.0	5.3	0.4	0.3	-0.1	4.7	7.3	-0.7	1.6	6.4
Sierra Leone	1.3	3.0	4.0	0.0	-0.2	-0.8	4.3	2.5	-1.1	2.9
Tanzania	0.4	-1.9	-1.5	-0.1	1.3	-1.5	-1.5	0.8	-4.4	2.1
Togo	10.0	-0.9	1.5	0.0	-0.3	-2.0	9.2	0.7	1.0	7.4
Uganda	0.5	0.5	-0.1	0.0	-0.4	0.9	1.0	1.0	-2.0	2.0
Zimbabwe	6.3	8.8	2.5	0.0	1.6	4.8	15.1	8.3	5.0	1.8

Table 7.2: Fiscal gaps in 2016 low-middle income countries (percent of GDP)

	fiscalgap	taxgap	income taxes	payroll taxes	other taxes	taxes goods & services	primgap	gov. consump.	transfers and subsidies	public invest.
Armenia	-4.0	2.0	1.7	-0.4	0.6	0.1	-2.0	-3.0	1.8	-0.8
Bangladesh	0.2	-4.3	-1.5	-0.1	0.1	-2.8	-4.1	-3.2	-1.8	0.8
Bhutan	-1.1	3.6	4.7	0.0	-0.7	-0.5	2.5	3.2	1.0	-1.8
Bolivia	4.9	7.7	1.5	-2.3	3.5	4.9	12.5	2.6	1.2	8.7
Cabo Verde	0.3	4.1	0.6	-0.1	0.1	3.5	4.4	4.8	1.8	-2.2
Cameroon	1.3	-3.1	-3.0	0.0	-0.5	0.4	-1.8	-1.2	-2.9	2.4
Congo, Rep	14.3	5.5	2.5	-0.1	0.4	2.7	19.8	10.1	-5.1	14.7
Cote d'Ivoire	2.3	-0.6	-0.5	2.2	-0.4	-1.9	1.7	0.7	0.4	0.5
El Salvador	-2.6	-1.6	0.2	-1.3	-0.9	0.4	-4.2	2.5	-5.2	-1.4
Ghana	-5.6	1.5	-0.4	0.1	-0.3	2.2	-4.2	-1.1	-2.2	-0.8
Guatemala	-5.3	-5.6	0.1	-3.1	0.3	-2.9	-10.9	-5.5	-3.3	-2.2
Honduras	-2.5	5.2	1.8	-0.3	-0.3	4.0	2.7	2.4	-1.5	1.7
India	-0.1	1.6	-1.0	-0.4	-1.1	4.0	1.5	-6.9	7.3	1.1
Indonesia	-3.1	-1.8	-0.6	-0.3	0.3	-1.2	-4.9	-1.5	-3.3	-0.1
Kenya	0.7	1.4	1.5	-0.2	-0.6	0.7	2.0	-2.2	0.9	3.3
Kyrgyz Republic	3.1	11.6	1.3	5.6	-0.3	5.0	14.6	7.0	3.9	3.7
Lao PDR	2.2	3.5	0.2	0.0	1.3	1.9	5.7	4.8	-0.9	1.8
Lesotho	20.7	5.0	3.8	-0.1	0.2	1.1	25.7	17.2	3.6	5.0
Mauritania	-3.8	3.2	1.0	-0.1	-0.6	2.9	-0.6	-1.2	-4.6	5.1
Moldova	-0.5	2.9	-0.2	-1.0	0.7	3.5	2.4	1.4	1.2	-0.2
Morocco	-4.5	5.8	2.5	-0.3	0.9	2.7	1.4	2.5	-2.6	1.5
Nicaragua	-1.5	7.1	3.8	2.6	-0.1	0.7	5.6	-0.4	5.2	0.8
Nigeria	-4.3	-6.8	-3.2	-0.1	0.1	-3.6	-11.1	-6.6	-0.5	-4.1
Pakistan	-6.8	0.1	1.3	-0.1	0.9	-1.9	-6.7	-7.2	1.1	-0.6
Philippines	-5.8	3.0	0.1	2.0	0.2	0.7	-2.8	-1.3	-2.3	0.9
Sri Lanka	-2.0	-4.8	-4.3	-0.5	0.1	-0.1	-6.8	-1.1	-4.7	-1.0
Sudan	-5.1	-7.6	-3.2	-0.1	-1.1	-3.2	-12.7	-5.8	-3.7	-3.2
Swaziland	13.4	3.6	3.0	0.0	-0.3	0.9	17.0	9.9	3.6	3.5
Tajikistan	7.1	9.7	2.2	2.6	-0.4	5.4	16.8	2.6	5.5	8.7
Tunisia	-3.7	1.6	0.3	-0.2	1.5	0.1	-2.1	3.3	-7.9	2.5
Ukraine	0.7	1.0	1.8	-6.2	2.7	2.8	1.7	1.9	-1.0	0.8
Zambia	-7.5	4.2	2.7	-0.2	-0.3	1.9	-3.3	-0.5	0.8	-3.6

Table 7.3: Fiscal gaps in 2016 high-middle income countries (percent of GDP)

	fiscalgap	taxgap	income taxes	payroll taxes	other taxes	taxes goods & services	primgap	gov. consump.	transfers and subsidies	public invest.
Albania	-5.3	-4.9	-1.8	-5.8	2.8	0.0	-10.2	-7.3	-2.4	-0.4
Algeria	12.4	0.3	1.4	-0.5	-0.5	-0.1	12.8	0.2	4.4	8.1
Angola	-4.8	-0.9	-1.0	0.7	0.6	-1.3	-5.7	0.1	-3.2	-2.5
Argentina	2.8	7.1	-2.5	2.3	1.4	5.8	9.8	2.1	7.6	0.2
Azerbaijan	0.7	7.3	2.5	0.8	0.3	3.6	8.0	4.8	-3.8	6.9
Belarus	3.1	3.6	1.6	0.5	1.6	0.0	6.7	0.9	5.0	0.9
Bosnia and Herz	0.0	5.5	-2.8	3.3	-1.3	6.3	5.5	6.3	-0.7	-0.1
Botswana	9.3	-0.5	-0.2	-0.4	-0.1	0.2	8.8	5.3	1.0	2.6
Brazil	0.6	7.3	-0.3	1.7	1.2	4.6	7.9	10.2	-0.3	-2.1
Bulgaria	0.4	-10.6	-5.5	-6.2	-0.6	1.7	-10.3	-5.6	-4.1	-0.6
Colombia	-3.7	4.5	2.1	-0.2	0.8	1.8	0.8	-3.3	2.8	1.2
Costa Rica	-0.4	2.7	-2.6	5.3	-0.2	0.2	2.3	4.1	0.3	-2.0
Dom Republic	-2.9	-5.6	-1.3	-3.5	-0.5	-0.4	-8.5	-5.6	-2.1	-0.9
Ecuador	10.9	0.9	-0.7	1.2	0.9	-0.5	11.8	3.1	2.6	6.1
Equ Guinea	4.8	0.2	-0.3	-0.3	0.3	0.5	5.0	-3.9	0.3	8.7
Gabon	-4.8	-2.7	-2.8	-0.5	0.9	-0.3	-7.5	-0.9	-4.9	-1.8
Georgia	-2.9	4.1	1.2	-1.1	0.1	3.9	1.1	-1.5	1.9	0.7
Guyana	6.7	3.1	3.0	-0.7	-0.1	0.9	9.8	2.2	5.0	2.7
Iran	-4.3	-5.9	-2.4	-0.4	-0.8	-2.4	-10.2	-6.4	-1.1	-2.7
Iraq	19.0	-9.3	-2.9	-0.2	-0.9	-5.2	9.7	5.1	0.1	4.6
Jamaica	1.0	-3.1	2.9	-3.6	-0.8	-1.6	-2.2	5.4	-6.8	-0.7
Jordan	-3.9	2.5	-1.6	0.0	0.8	3.3	-1.4	-6.0	6.0	-1.5
Kazakhstan	-3.7	-1.2	1.5	0.7	-0.4	-3.0	-4.9	-2.1	-0.7	-2.2
Lebanon	-8.0	-5.0	-5.8	3.2	1.0	-3.5	-13.1	-4.7	-7.3	-1.1
Malaysia	0.0	-0.8	0.6	-0.3	-0.2	-0.9	-0.8	-1.0	0.1	0.1
Mauritius	-2.6	1.0	-4.5	-0.3	1.1	4.6	-1.6	-3.3	4.1	-2.3
Mexico	0.4	-2.4	0.2	-0.1	-0.8	-1.7	-2.0	-4.2	1.5	0.6
Panama	0.2	-4.6	-2.3	2.2	-0.6	-3.9	-4.4	-4.8	-2.8	3.2
Paraguay	1.2	-0.7	-1.9	1.5	-0.6	0.3	0.5	1.7	-1.2	0.1
Peru	-1.4	-2.8	-0.4	-1.5	0.6	-1.5	-4.1	0.3	-5.2	0.7
Romania	-1.1	-7.3	-2.2	-4.2	0.1	-1.1	-8.4	-1.9	-5.0	-1.6
Russia	4.1	-5.9	0.9	-4.5	0.0	-2.3	-1.8	-7.0	5.6	-0.4
Serbia	1.3	0.6	-3.3	-1.2	0.2	4.9	1.9	1.6	-0.1	0.4
South Africa	-4.0	8.5	4.9	0.5	0.4	2.7	4.6	3.0	1.5	0.0
Thailand	-1.9	1.6	-0.8	0.4	-0.6	2.6	-0.4	4.6	-3.8	-1.3
Turkey	-3.6	1.1	1.4	-3.7	1.7	1.7	-2.6	-3.5	1.6	-0.7

Table 7.4: Fiscal gaps in 2016 high income countries (percent of GDP)

	fiscalgap	taxgap	income taxes	payroll taxes	other taxes	taxes goods & services	primgap	gov. consump.	transfers and subsidies	public invest.
Australia	0.5	4.6	4.9	0.1	0.0	-0.4	5.1	7.8	-3.3	0.5
Austria	-2.1	5.9	0.4	5.3	2.1	-1.8	3.8	-0.8	4.5	0.1
Belgium	-1.2	9.1	6.2	3.7	3.7	-4.6	7.8	-0.4	8.0	0.2
Canada	-1.3	5.5	3.9	0.1	2.5	-1.1	4.2	5.7	-2.3	0.7
Chile	-1.1	-0.9	0.1	-2.9	-1.0	2.8	-2.1	-2.7	1.7	-1.1
Croatia	-2.5	2.2	-4.6	-0.7	-1.1	8.6	-0.3	2.6	-1.9	-1.0
Cyprus	-5.2	1.1	0.4	-3.0	0.7	3.1	-4.1	-1.0	-1.4	-1.7
Czech Republic	-0.8	-1.8	-2.7	2.4	-0.4	-1.1	-2.6	-0.9	-1.3	-0.4
Estonia	0.7	-2.2	-2.6	-0.5	-0.5	1.4	-1.5	3.1	-5.0	0.3
Finland	6.2	2.8	2.3	0.3	-0.6	0.8	9.0	6.7	1.7	0.6
France	2.2	6.8	-1.3	5.8	5.0	-2.6	9.0	0.0	8.1	0.9
Germany	-1.9	-1.1	-0.7	3.3	-0.3	-3.4	-3.0	-5.4	3.2	-0.8
Greece	1.5	-1.8	-2.5	1.0	-0.2	0.0	-0.3	-0.2	-0.7	0.6
Hungary	3.0	1.7	-1.0	2.1	-1.3	1.9	4.7	3.9	2.5	-1.7
Ireland	-4.4	-13.8	-0.7	-7.2	-1.2	-4.7	-18.2	-6.9	-8.5	-2.8
Israel	-3.5	0.0	1.9	-4.5	1.8	0.8	-3.4	1.5	-3.1	-1.8
Italy	-1.3	-0.6	1.4	0.2	1.2	-3.4	-1.8	-2.8	1.3	-0.3
Japan	-2.4	0.8	-4.2	7.3	0.6	-2.9	-1.6	-2.8	-1.2	2.4
Korea	-2.4	-0.4	-0.5	2.5	0.4	-2.8	-2.8	-5.6	4.0	-1.2
Kuwait	27.0	-2.3	-3.3	2.1	0.5	-1.6	24.7	13.5	10.1	1.1
Latvia	0.4	-7.7	-2.3	-4.0	-0.7	-0.7	-7.4	-2.6	-2.5	-2.3
Lithuania	-1.3	-6.8	-4.6	0.2	-1.1	-1.2	-8.1	-1.0	-6.4	-0.7
Luxembourg	-2.1	1.9	2.6	0.4	0.2	-1.2	-0.2	-5.2	4.9	0.1
Malta	-2.5	-3.1	2.0	-5.8	-0.8	1.5	-5.6	2.5	-8.3	0.2
Netherlands	0.9	-1.7	-2.2	2.1	1.0	-2.6	-0.8	-2.6	1.5	0.4
New Zealand	-3.3	4.7	4.2	-0.4	-1.6	2.6	1.4	0.2	1.0	0.3
Norway	-0.1	1.4	6.3	-3.8	-0.5	-0.6	1.3	3.0	-2.8	1.2
Oman	21.9	-0.7	-1.5	3.3	0.4	-3.0	21.2	4.2	12.7	4.3
Poland	-0.1	0.5	-1.7	2.0	0.9	-0.7	0.4	0.2	0.3	-0.2
Portugal	1.1	-3.6	-1.1	-1.3	0.1	-1.4	-2.5	0.2	-1.8	-0.8
Saudi Arabia	16.6	-6.2	-2.1	-0.1	-0.7	-3.3	10.5	14.0	-5.6	2.0
Slovak Republic	0.4	0.0	-0.5	2.7	-0.6	-1.5	0.4	-1.3	3.5	-1.8
Slovenia	-2.5	-2.3	-3.9	2.0	-0.6	0.2	-4.8	-1.4	-1.1	-2.2
Spain	0.1	-4.5	-1.5	-0.3	-0.2	-2.5	-4.4	-1.4	-1.7	-1.3
Switzerland	-0.1	-12.2	0.3	-6.2	0.1	-6.5	-12.2	-6.7	-5.6	0.0
Trin and Tobago	10.0	-3.3	-1.0	-4.1	1.6	0.2	6.7	-0.9	9.5	-1.9
United Kingdom	-3.4	-3.7	0.6	-5.0	1.8	-1.0	-7.1	0.7	-6.4	-1.4
United States	0.2	-0.6	1.5	1.9	1.0	-4.9	-0.4	0.1	2.3	-2.8
Uruguay	-0.5	1.5	-1.4	2.4	-1.2	1.8	1.0	-1.1	3.2	-1.2

Table 8: Selected correlations between estimated revenue and expenditure gaps

	Income and Payroll	Income and Goods & Services	Payroll and Goods & Services	Transfers & Subsidies and Government Consumption	Government Consumption and Public Investment	Transfers & Subsidies and Public Investment
Georgia	-0.96					
Finland	-0.93					
Russia	-0.81					
Armenia	-0.81					
Lithuania	-0.80					
Hungary		-0.91				
Uruguay		-0.81				
Tanzania		-0.71				
Netherlands			-0.88			
Korea			-0.83			
Costa Rica			-0.82			
Brazil			-0.80			
Uruguay			-0.76			
Armenia				-0.96		
Russia				-0.86		
Chad				-0.80		
Kenya				-0.75		
El Salvador				-0.71		
India					-0.79	
Chad					-0.74	
Croatia					-0.74	
Togo					-0.63	
Cabo Verde					-0.62	
Pakistan					-0.59	
Panama						-0.92
Peru						-0.91
Cyprus						-0.77
Mauritius						-0.73

Table 9: Projected increase in age-related spending in the next decade (percent of GDP)

Low income countries			
Benin	0.2	Mozambique	0.2
Burkina Faso	0.3	Nepal	0.2
Chad	0.1	Niger	0.2
Congo, Dem	0.2	Rwanda	0.6
Ethiopia	0.2	Senegal	0.2
Guinea	0.2	Tanzania	0.3
Haiti	0.1	Uganda	0.2
Madagascar	0.5	Zimbabwe	0.0
Mali	0.0		

Low middle income countries					
Bangladesh	0.2	Honduras	0.7	Nicaragua	1.3
Bolivia	-0.4	India	0.1	Nigeria	0.1
Cambodia	0.2	Indonesia	0.3	Pakistan	0.1
Cameroon	0.1	Kenya	0.3	Philippines	0.3
Congo, Rep	0.2	Kyrgyz Republic	3.7	Sri Lanka	1.1
Cote d'Ivoire	0.0	Lao PDR	0.2	Sudan	0.2
Egypt	1.9	Moldova	3.2	Tajikistan	0.6
Ghana	0.3	Morocco	1.6	Ukraine	1.7
				Zambia	1.5

High-middle-income countries			
Algeria	2.7	Kazakhstan	1.4
Angola	0.4	Malaysia	1.7
Argentina	1.1	Mexico	0.9
Azerbaijan	3.3	Peru	0.8
Belarus	3.1	Romania	0.5
Brazil	5.8	Russia	3.0
Colombia	0.1	South Africa	0.7
Dom Republic	0.8	Thailand	3.0
Ecuador	1.5	Turkey	0.5
Iran	2.0		

High-income countries					
Australia	1.6	Hungary	-0.6	Oman	0.9
Austria	1.2	Ireland	1.5	Poland	0.3
Belgium	1.5	Israel	0.7	Portugal	2.1
Canada	1.6	Italy	0.7	Qatar	0.9
Chile	0.2	Japan	0.5	Saudi Arabia	2.0
Croatia	0.2	Korea	2.8	Slovak Republic	0.2
Cyprus	0.1	Kuwait	5.2	Slovenia	0.8
Czech Republic	0.5	Latvia	-0.6	Spain	0.7
Denmark	-0.2	Lithuania	1.3	Sweden	-0.2
Estonia	-0.2	Luxembourg	2.4	Switzerland	2.3
Finland	2.3	Malta	0.1	United Arab Em	0.8
France	0.6	Netherlands	2.3	United Kingdom	1.5
Germany	1.5	New Zealand	2.2	United States	3.6
Greece	0.0	Norway	1.8	Uruguay	0.5

Table 10.1: Adjustment needs low income countries (percent of GDP)

	necessary adjustment	observed primary balance	required primary balance	nominal potential growth	implicit nominal int. rate	gross debt (% GDP)
Benin	2.9	-4.9	-2.0	8.3	2.9	42.8
Burkina Faso	-0.2	-1.8	-2.0	8.3	2.0	35.8
Burundi	-3.0	-5.1	-8.1	14.9	5.2	104.8
Cent Afr Republic	-3.3	2.3	-1.0	9.2	1.9	15.6
Chad	-2.6	0.8	-1.8	7.3	2.0	36.8
Comoros	5.5	-7.0	-1.5	6.4	1.1	30.1
Guinea	-4.0	1.6	-2.4	9.3	2.1	37.0
Guinea-Bissau	0.5	-2.8	-2.3	7.9	1.3	37.8
Haiti	-2.2	0.3	-1.9	8.2	1.4	31.4
Liberia	2.3	-5.4	-3.1	9.0	1.8	47.7
Madagascar	-2.7	-0.4	-3.1	10.3	2.5	46.1
Malawi	-1.2	-2.9	-4.1	13.9	3.7	47.8
Mali	1.9	-3.3	-1.4	6.1	2.0	38.5
Mozambique	-8.7	-3.1	-11.8	21.3	2.7	79.0
Nepal	-3.4	1.7	-1.7	10.6	1.8	21.6
Niger	2.7	-5.6	-2.9	8.9	1.9	46.7
Senegal	0.4	-2.0	-1.6	8.4	4.6	50.9
Sierra Leone	2.8	-7.1	-4.3	14.8	3.5	45.6
Tanzania	-0.5	-2.1	-2.6	11.8	4.6	43.1
Togo	4.7	-7.3	-2.6	7.7	2.4	54.9
Uganda	-0.4	-1.3	-1.7	13.7	8.0	42.9
Zimbabwe	7.6	-8.8	-1.2	4.7	3.0	82.3

Table 10.2: Adjustment needs low-middle income countries (percent of GDP)

	necessary adjustment	observed primary balance	required primary balance	nominal potential growth	implicit nominal int. rate	gross debt (% GDP)
Armenia	1.3	-3.7	-2.4	8.2	2.8	51.0
Bangladesh	-0.2	-1.5	-1.7	13.0	6.4	33.0
Bhutan	-1.6	-0.6	-2.2	10.7	6.5	70.1
Bolivia	3.3	-5.5	-2.2	8.7	3.4	48.3
Cabo Verde	-3.7	-0.6	-4.3	6.3	2.0	111.6
Cambodia	-0.4	-2.5	-2.9	9.7	0.6	35.2
Cameroon	2.2	-3.6	-1.4	7.4	2.6	33.8
Congo, Rep	16.2	-16.5	-0.3	1.8	1.2	52.6
Cote d'Ivoire	0.5	-2.2	-1.7	8.6	4.1	45.4
Djibouti	13.5	-14.4	-0.9	9.2	4.7	25.6
Egypt	-0.4	-3.7	-4.1	13.0	6.3	79.8
El Salvador	-0.6	1.9	1.2	4.6	6.2	69.0
Ghana	-0.1	-1.9	-2.0	11.8	6.9	55.5
Guatemala	-1.0	0.5	-0.5	8.6	6.0	27.5
Honduras	-2.5	1.1	-1.4	8.5	4.7	45.4
India	-0.8	-1.7	-2.5	12.6	6.9	59.3
Indonesia	0.1	-1.0	-0.9	9.7	5.9	29.3
Kenya	1.8	-4.1	-2.3	11.8	5.7	47.4
Kyrgyz Republi	-0.3	-3.3	-3.6	8.5	1.4	56.6
Lao PDR	-0.7	-4.6	-5.3	10.1	2.4	78.2
Lesotho	3.9	-6.8	-2.9	10.6	2.1	38.9
Mauritania	-5.9	1.1	-4.8	7.5	1.3	84.1
Moldova	-1.5	-0.8	-2.3	9.1	3.2	45.6
Morocco	-0.1	-1.3	-1.4	6.3	3.4	57.1
Nicaragua	-1.9	-0.8	-2.7	12.0	2.8	34.6
Nigeria	2.1	-3.5	-1.4	16.5	8.5	24.9
Pakistan	-1.2	-0.1	-1.3	11.3	7.8	57.1
Philippines	-3.2	1.7	-1.5	10.2	4.3	29.3
São Tom and Pr	-2.4	-2.5	-4.9	8.2	0.8	71.6
Sri Lanka	-1.2	-0.6	-1.8	10.6	6.8	66.3
Sudan	-3.1	-1.2	-4.3	15.4	2.3	39.2
Swaziland	12.5	-10.7	1.8	5.6	7.6	79.2
Tajikistan	6.1	-10.0	-3.9	12.4	3.0	48.2
Tunisia	1.1	-3.5	-2.4	7.9	3.7	64.7
Ukraine	-4.0	1.9	-2.1	10.2	5.7	60.2
Vanuatu	5.4	-7.5	-2.1	6.0	2.1	59.1
Zambia	0.1	-2.7	-2.6	10.4	5.2	61.3

Table 10.3: Adjustment needs high-middle income countries (percent of GDP)

	necessary adjustment	observed primary balance	required primary balance	nominal potential growth	implicit nominal int. rate	gross debt (% GDP)
Albania	-2.6	0.7	-1.9	7.9	3.5	50.1
Algeria	10.9	-11.3	-0.4	5.9	2.3	13.5
Angola	-1.0	-1.1	-2.1	9.3	5.2	61.8
Argentina	1.2	-5.0	-3.8	12.7	2.8	44.8
Azerbaijan	-0.7	-0.5	-1.2	9.1	4.1	28.9
Belarus	2.3	-2.6	-0.3	8.1	6.9	60.4
Belize	0.0	-0.7	-0.7	4.3	3.2	79.0
Bosnia and Herz	-2.1	1.0	-1.1	5.9	2.4	35.3
Botswana	1.5	-1.5	0.0	6.1	6.1	5.7
Brazil	1.6	-0.2	1.4	7.1	8.3	87.8
Bulgaria	-2.5	2.4	-0.1	4.7	3.9	20.4
Colombia	0.1	0.2	0.3	6.7	7.1	38.8
Costa Rica	2.4	-1.7	0.7	7.7	8.4	57.8
Dominica	-1.3	0.8	-0.5	3.3	2.6	81.3
Dom Republic	0.7	-0.3	0.4	9.2	9.3	43.9
Ecuador	7.0	-5.0	2.0	2.9	9.1	31.1
Equ Guinea	16.0	-16.0	0.0	3.3	3.1	25.6
Fiji	2.3	-2.8	-0.5	6.8	5.4	51.4
Gabon	1.6	-2.3	-0.7	6.2	4.5	50.1
Georgia	-2.0	-0.4	-2.4	8.7	2.8	44.8
Grenada	-6.3	5.4	-0.9	4.8	2.9	51.4
Guyana	2.3	-3.5	-1.2	5.1	2.4	50.9
Iran	2.0	-2.1	-0.1	13.3	10.8	16.2
Iraq	11.1	-12.9	-1.8	6.3	2.2	48.7
Jamaica	-7.9	7.0	-0.9	8.4	6.6	75.1
Jordan	-0.4	-0.4	-0.8	5.6	4.3	77.0
Kazakhstan	2.3	-2.9	-0.6	7.3	4.3	24.4
Lebanon	4.8	0.9	5.7	5.0	8.2	165.4
Macedonia, FYR	0.6	-1.6	-1.0	6.1	3.5	43.9
Malaysia	-0.4	-0.7	-1.1	7.9	5.0	46.8
Maldives	4.2	-5.3	-1.1	6.9	5.1	84.9
Mauritius	-0.6	-0.7	-1.3	7.2	4.1	51.2
Mexico	0.2	0.3	0.5	6.3	6.8	54.1
Montenegro	2.6	-3.0	-0.4	5.0	4.2	73.4
Namibia	4.7	-5.5	-0.8	9.7	7.4	56.4
Panama	-0.5	-0.6	-1.1	8.4	4.3	31.0
Paraguay	0.2	0.2	0.4	7.7	8.4	28.5
Peru	0.8	-1.3	-0.5	6.6	4.6	28.5
Romania	0.0	-1.1	-1.1	5.9	3.3	44.9
Russia	2.7	-2.6	0.1	5.4	5.8	18.5
Serbia	-3.4	1.9	-1.5	7.1	4.0	57.8
South Africa	0.1	-0.1	0.0	7.9	7.4	53.7
St. Lucia	3.3	0.6	3.9	3.1	7.0	97.7
St. Vin and Gren	-1.3	0.9	-0.4	4.3	3.5	67.4
Thailand	-1.8	1.3	-0.5	5.6	4.1	41.8
Turkey	0.8	-0.2	0.6	10.3	11.4	29.0
Tuvalu	2.5	-2.7	-0.2	3.5	0.8	8.2

Table 10.4: Adjustment needs high income countries (percent of GDP)

	necessary adjustment	observed primary balance	required primary balance	nominal potential growth	implicit nominal int. rate	gross debt (% GDP)
Australia	0.8	-1.2	-0.4	5.2	3.9	36.6
Austria	-1.4	0.8	-0.6	3.2	2.2	69.8
Belgium	-1.0	0.0	-1.0	3.6	2.5	99.4
Canada	-1.0	0.9	-0.1	3.9	3.7	82.7
Chile	1.5	-2.1	-0.6	6.4	4.1	31.2
Croatia	-1.8	1.9	0.1	4.2	4.2	75.8
Cyprus	-3.2	2.3	-0.9	3.9	2.7	86.7
Czech Republic	-2.1	1.6	-0.5	4.0	2.2	29.6
Estonia	-0.8	0.4	-0.4	6.2	0.8	8.2
Finland	0.0	-0.8	-0.8	3.6	2.2	59.9
France	0.2	-1.4	-1.2	3.5	2.1	90.4
Germany	-3.0	2.2	-0.8	3.1	1.4	50.9
Greece	-3.7	3.3	-0.4	2.7	2.4	162.8
Hungary	-2.0	1.4	-0.6	4.9	3.7	69.7
Ireland	-2.5	1.5	-1.0	4.6	2.8	61.2
Israel	-0.1	0.5	0.4	5.0	5.4	63.6
Italy	-0.5	1.6	1.1	2.3	3.1	121.3
Japan	-0.2	-2.6	-2.8	1.7	0.5	232.4
Korea	-1.4	1.0	-0.4	5.2	3.8	36.0
Kuwait	2.7	-3.3	-0.6	6.7	4.4	31.2
Latvia	-1.5	0.8	-0.7	6.4	3.2	26.6
Lithuania	-1.7	1.7	0.0	5.6	5.3	32.0
Luxembourg	-2.9	2.1	-0.8	5.0	1.5	22.9
Malta	-2.0	1.5	-0.5	5.1	3.8	49.1
Netherlands	-1.1	0.6	-0.5	3.0	1.9	50.1
New Zealand	-2.3	2.7	0.4	4.9	7.7	12.4
Norway	-4.3	4.0	-0.3	4.4	3.2	33.2
Oman	21.5	-21.3	0.2	4.6	4.9	49.3
Poland	-0.2	-0.8	-1.0	5.2	3.0	51.7
Portugal	-0.6	1.9	1.3	2.7	3.7	122.9
Saudi Arabia	17.7	-17.0	0.7	2.5	5.0	26.4
Slovak Republic	-0.5	-0.4	-0.9	5.4	3.2	44.9
Slovenia	-1.2	1.0	-0.2	3.9	3.4	77.9
Spain	1.5	-1.7	-0.2	3.4	3.1	93.9
Switzerland	-1.0	0.5	-0.5	2.7	1.2	38.7
Trin and Tobago	10.0	-11.9	-1.9	5.8	3.8	112.7
United Kingdom	-0.3	-0.6	-0.9	3.9	2.7	83.2
United States	1.7	-1.8	-0.1	3.8	3.6	117.4
Uruguay	-1.4	-0.8	-2.2	9.5	5.3	64.0

Table 11.1: Fiscal adjustment gaps selected low income countries (percent of GDP)

	fiscal gap (baseline)	necessary adjustment	fiscal consolidation gap	fiscal gap (optimistic)	necessary adjustment	fiscal consolidation gap
Benin	5.8	2.9	3.0	5.8	2.9	3.0
Comoros	5.5	5.5	0.0	5.5	5.5	0.0
Guinea-Bissau	3.2	0.5	2.7	3.3	0.5	2.8
Liberia	11.9	2.3	9.6	11.9	2.3	9.6
Mali	2.9	1.9	1.0	4.1	1.9	2.3
Niger	3.4	2.7	0.7	4.5	2.7	1.8
Senegal	2.0	0.4	1.6	7.3	0.4	6.9
Sierra Leone	1.3	2.8	-1.5	4.3	2.8	1.4
Togo	10.0	4.7	5.3	10.0	4.7	5.3
Zimbabwe	6.3	7.6	-1.3	15.1	7.6	7.5

Table 11.2: Fiscal adjustment gaps selected low-middle income countries (percent of GDP)

	fiscal gap (baseline)	necessary adjustment	fiscal consolidation gap	fiscal gap (optimistic)	necessary adjustment	fiscal consolidation gap
Armenia	-4.0	1.3	-5.3	0.0	1.3	-1.3
Bolivia	4.9	3.3	1.6	12.5	3.3	9.3
Cameroon	1.3	2.2	-0.8	3.1	2.2	1.0
Congo, Rep	14.3	16.2	-1.9	19.8	16.2	3.6
Cote d'Ivoire	2.3	0.5	1.8	2.3	0.5	1.8
Kenya	0.7	1.8	-1.1	2.0	1.8	0.3
Lesotho	20.7	3.9	16.8	25.7	3.9	21.8
Nigeria	-4.3	2.1	-6.4	6.8	2.1	4.7
Swaziland	13.4	12.5	0.9	17.0	12.5	4.5
Tajikistan	7.1	6.1	1.0	16.8	6.1	10.7
Tunisia	-3.7	1.1	-4.8	0.0	1.1	-1.1
Zambia	-7.5	0.1	-7.6	0.0	0.1	-0.1

Table 11.3: Fiscal adjustment gaps selected high-middle income countries (percent of GDP)

	fiscal gap (baseline)	necessary adjustment	fiscal consolidation gap	fiscal gap (optimistic)	necessary adjustment	fiscal consolidation gap
Algeria	12.4	10.9	1.6	12.8	10.9	1.9
Argentina	2.8	1.2	1.6	9.8	1.2	8.6
Belarus	3.1	2.3	0.9	6.7	2.3	4.5
Botswana	9.3	1.5	7.8	9.3	1.5	7.8
Brazil	0.6	1.6	-1.0	7.9	1.6	6.3
Costa Rica	-0.4	2.4	-2.8	2.3	2.4	-0.1
Dom Republic	-2.9	0.7	-3.6	5.6	0.7	5.0
Ecuador	10.9	7.0	4.0	11.8	7.0	4.8
Equ Guinea	4.8	16.0	-11.2	5.0	16.0	-11.0
Gabon	-4.8	1.6	-6.4	2.7	1.6	1.1
Guyana	6.7	2.3	4.5	9.8	2.3	7.6
Iran	-4.3	2.0	-6.2	5.9	2.0	4.0
Iraq	19.0	11.1	7.9	19.0	11.1	7.9
Kazakhstan	-3.7	2.3	-6.0	1.2	2.3	-1.1
Lebanon	-8.0	4.8	-12.9	5.0	4.8	0.2
Peru	-1.4	0.8	-2.2	2.8	0.8	1.9
Russia	4.1	2.7	1.4	5.9	2.7	3.2
Turkey	-3.6	0.8	-4.4	0.0	0.8	-0.8

Table 11.4: Fiscal adjustment gaps selected high income countries (percent of GDP)

	fiscal gap (baseline)	necessary adjustment	fiscal consolidation gap	fiscal gap (optimistic)	necessary adjustment	fiscal consolidation gap
Australia	0.5	0.8	-0.3	5.1	0.8	4.3
Chile	-1.1	1.5	-2.7	0.9	1.5	-0.6
Kuwait	27.0	2.7	24.3	27.0	2.7	24.3
Oman	21.9	21.5	0.4	21.9	21.5	0.4
Saudi Arabia	16.6	17.7	-1.1	16.6	17.7	-1.1
Spain	0.1	1.5	-1.4	4.5	1.5	3.0
Trin and Tobago	10.0	10.0	0.0	10.0	10.0	0.0
United States	0.2	1.7	-1.5	0.6	1.7	-1.1

Table 12: Fiscal gaps in 2016 full and restricted samples

Restricted sample: only high- middle and high-income countries

high-middle income		
	full	**restrict**
Albania	-5.3	-7.3
Algeria	12.4	10.6
Angola	-4.8	-5.7
Argentina	2.8	3.8
Azerbaijan	0.7	-2.2
Belarus	3.1	1.1
Bosnia and Herz	0.0	-1.1
Botswana	9.3	8.5
Brazil	0.6	0.1
Bulgaria	0.4	1.2
Colombia	-3.7	-4.4
Costa Rica	-0.4	0.3
Dom Republic	-2.9	-2.3
Ecuador	10.9	10.5
Equ Guinea	4.8	-5.4
Gabon	-4.8	-5.7
Georgia	-2.9	-1.9
Guyana	6.7	6.6
Iran	-4.3	-5.4
Iraq	19.0	16.3
Jamaica	1.0	-0.9
Jordan	-3.9	-5.7
Kazakhstan	-3.7	-5.9
Lebanon	-8.0	-8.4
Malaysia	0.0	-2.6
Mauritius	-2.6	0.4
Mexico	0.4	0.9
Panama	0.2	0.8
Paraguay	1.2	0.7
Peru	-1.4	-0.8
Romania	-1.1	-0.8
Russia	4.1	2.7
Serbia	1.3	1.0
South Africa	-4.0	-0.5
Thailand	-1.9	-3.5
Turkey	-3.6	-3.9

high income		
	full	**restrict**
Australia	0.5	1.2
Austria	-2.1	-1.2
Belgium	-1.2	-2.5
Canada	-1.3	-0.3
Chile	-1.1	-1.8
Croatia	-2.5	-2.2
Cyprus	-5.2	-6.5
Czech Republic	-0.8	-0.5
Estonia	0.7	0.7
Finland	6.2	7.7
France	2.2	3.5
Germany	-1.9	-0.2
Greece	1.5	1.2
Hungary	3.0	1.4
Ireland	-4.4	-2.4
Israel	-3.5	-3.7
Italy	-1.3	0.0
Japan	-2.4	-2.6
Korea	-2.4	-4.0
Kuwait	27.0	22.5
Latvia	0.4	0.3
Lithuania	-1.3	-1.4
Luxembourg	-2.1	-5.7
Malta	-2.5	-3.4
Netherlands	0.9	1.6
New Zealand	-3.3	-2.3
Norway	-0.1	0.5
Oman	21.9	17.4
Poland	-0.1	0.3
Portugal	1.1	1.9
Saudi Arabia	16.6	13.6
Slovak Republic	0.4	-1.5
Slovenia	-2.5	-2.9
Spain	0.1	1.3
Switzerland	-0.1	0.9
Trin and Tobago	10.0	8.0
United Kingdom	-3.4	-2.3
United States	0.2	2.2
Uruguay	-0.5	0.5

Table 13: Fiscal gaps in 2016 with and without regional dummies

low income	IMF dummies	no dummies	regional dummies
Benin	5.8	4.8	3.9
Burkina Faso	0.5	-0.1	-0.7
Burundi	5.7	4.0	3.2
Cent Afr Republic	-6.8	-7.4	-4.4
Chad	-8.7	-9.1	-5.2
Comoros	5.5	4.6	5.9
Guinea	-5.4	-5.8	-6.5
Guinea-Bissau	3.2	2.5	1.2
Haiti	-0.1	-2.4	-1.7
Liberia	11.9	13.5	12.2
Madagascar	0.7	0.1	0.0
Malawi	0.8	0.3	-0.4
Mali	2.9	2.3	1.9
Mozambique	1.8	2.9	0.6
Nepal	1.0	0.0	2.2
Niger	3.4	2.8	2.2
Senegal	2.0	1.7	0.2
Sierra Leone	1.3	0.9	0.8
Tanzania	0.4	-0.8	-0.8
Togo	10.0	10.0	7.9
Uganda	0.5	-1.5	-1.7
Zimbabwe	6.3	6.3	5.0

low-middle income	IMF dummies	no dummies	regional dummies
Armenia	-4.0	-0.6	0.1
Bangladesh	0.2	-1.7	0.6
Bhutan	-1.1	-1.7	0.7
Bolivia	4.9	2.0	6.0
Cabo Verde	0.3	0.9	-2.1
Cameroon	1.3	0.0	3.3
Congo, Rep	14.3	14.4	18.0
Cote d'Ivoire	2.3	1.9	0.9
El Salvador	-2.6	-4.9	-3.3
Ghana	-5.6	-5.5	-6.9
Guatemala	-5.3	-8.2	-5.0
Honduras	-2.5	-4.4	-1.9
India	-0.1	-1.2	0.6
Indonesia	-3.1	-4.6	-1.5
Kenya	0.7	-0.1	0.2
Kyrgyz Republi	3.1	6.6	7.1
Lao PDR	2.2	1.9	3.4
Lesotho	20.7	21.6	20.3
Mauritania	-3.8	-0.6	-2.3
Moldova	-0.5	-0.2	-1.3
Morocco	-4.5	-1.3	-3.3
Nicaragua	-1.5	-3.8	-1.3
Nigeria	-4.3	-6.0	-5.1
Pakistan	-6.8	-4.0	-2.5
Philippines	-5.8	-6.8	-4.2
Sri Lanka	-2.0	-2.4	-1.7
Sudan	-5.1	-3.1	-4.8
Swaziland	13.4	12.9	13.4
Tajikistan	7.1	9.4	11.0
Tunisia	-3.7	0.2	-2.2
Ukraine	0.7	1.0	-1.2
Zambia	-7.5	-8.1	-6.6

high-middle income	IMF dummies	no dummies	regional dummies
Albania	-5.3	-5.1	-9.7
Algeria	12.4	14.8	15.8
Angola	-4.8	-5.6	-0.9
Argentina	2.8	0.1	3.3
Azerbaijan	0.7	2.9	6.7
Belarus	3.1	3.0	2.1
Bosnia and Herz	0.0	0.3	-4.1
Botswana	9.3	8.5	11.1
Brazil	0.6	-2.3	0.5
Bulgaria	0.4	0.3	-0.1
Colombia	-3.7	-6.7	-5.0
Costa Rica	-0.4	-2.9	-0.1
Dom Republic	-2.9	-5.8	-5.3
Ecuador	10.9	7.8	11.9
Equ Guinea	4.8	-2.6	11.7
Gabon	-4.8	-5.5	-0.3
Georgia	-2.9	0.8	0.3
Guyana	6.7	4.7	3.8
Iran	-4.3	-2.1	-2.5
Iraq	19.0	22.0	20.9
Jamaica	1.0	-0.1	-3.5
Jordan	-3.9	0.3	-3.5
Kazakhstan	-3.7	-1.6	1.3
Lebanon	-8.0	-3.5	-9.0
Malaysia	0.0	-0.1	1.8
Mauritius	-2.6	-2.2	-3.4
Mexico	0.4	-2.3	0.4
Panama	0.2	-2.4	0.5
Paraguay	1.2	-1.4	1.9
Peru	-1.4	-4.5	-0.8
Romania	-1.1	-1.6	-1.9
Russia	4.1	2.6	4.7
Serbia	1.3	1.5	-3.8
South Africa	-4.0	-4.6	-4.6
Thailand	-1.9	-2.0	-0.7
Turkey	-3.6	-4.8	-3.7

high income	IMF dummies	no dummies	regional dummies
Australia	0.5	0.0	1.4
Austria	-2.1	-1.6	-3.1
Belgium	-1.2	0.4	-2.0
Canada	-1.3	-2.9	-1.2
Chile	-1.1	-4.1	0.5
Croatia	-2.5	-2.4	-3.7
Cyprus	-5.2	-4.5	-6.3
Czech Republic	-0.8	-0.2	-1.3
Estonia	0.7	1.0	0.9
Finland	6.2	6.4	9.0
France	2.2	2.4	0.8
Germany	-1.9	-1.6	-2.8
Greece	1.5	2.2	-1.7
Hungary	3.0	4.0	1.8
Ireland	-4.4	-3.0	-5.2
Israel	-3.5	-4.0	-4.4
Italy	-1.3	-0.7	-3.4
Japan	-2.4	-0.7	-6.5
Korea	-2.4	-2.5	-2.2
Kuwait	27.0	29.2	14.4
Latvia	0.4	0.4	0.0
Lithuania	-1.3	-0.7	-2.0
Luxembourg	-2.1	1.9	0.3
Malta	-2.5	0.1	-2.8
Netherlands	0.9	1.7	0.4
New Zealand	-3.3	-3.7	-2.4
Norway	-0.1	-0.6	4.7
Oman	21.9	24.8	9.1
Poland	-0.1	-0.3	-1.0
Portugal	1.1	1.7	-1.4
Saudi Arabia	16.6	19.1	3.3
Slovak Republic	0.4	1.2	0.4
Slovenia	-2.5	-1.6	-3.4
Spain	0.1	0.1	-1.6
Switzerland	-0.1	0.2	0.1
Trin and Tobago	10.0	7.7	9.0
United Kingdom	-3.4	-3.4	-4.6
United States	0.2	-1.8	-0.3
Uruguay	-0.5	-2.8	-0.6

Table 14: List of countries by geographical region

North America	Latin America		Central America	Caribbean	
Canada	Argentina	Ecuador	Costa Rica	Antigua and Barb	Guyana
United States	Bolivia	Mexico	El Salvador	Bahamas, The	Haiti
	Brazil	Paraguay	Guatemala	Barbados	Jamaica
	Chile	Peru	Honduras	Belize	St. Kitts and Nevis
	Colombia	Uruguay	Nicaragua	Dominica	St. Lucia
			Panama	Dom Republic	St. Vin and Gren
				Grenada	Trin and Tobago

Central Asia	North Africa	West Asia	GCC
Armenia	Algeria	Iran	Bahrain
Azerbaijan	Djibouti	Iraq	Kuwait
Georgia	Egypt	Jordan	Oman
Kazakhstan	Mauritania	Lebanon	Qatar
Kyrgyz Republic	Morocco		Saudi Arabia
Tajikistan	Sudan		United Arab Em
	Tunisia		

Oceania	East Asia	South Asia	ASEAN	Pacific Islands
Australia	Japan	Afghanistan	Brunei Dar	Fiji
New Zealand	Korea	Bangladesh	Cambodia	Maldives
	Macao	Bhutan	Indonesia	Marshall Isl
	Singapore	India	Lao PDR	Palau
		Nepal	Malaysia	Tonga
		Pakistan	Philippines	Tuvalu
		Sri Lanka	Thailand	Vanuatu

Western Europe			Eastern Europe	Nordic	Balkans
Austria	Hungary	Poland	Belarus	Denmark	Albania
Belgium	Ireland	Portugal	Bulgaria	Finland	Bosnia and Herz
Croatia	Israel	San Marino	Moldova	Norway	Kosovo
Cyprus	Italy	Slovak Republic	Romania	Sweden	Macedonia, FYR
Czech Republic	Latvia	Slovenia	Russia		Montenegro
Estonia	Lithuania	Spain	Turkey		Serbia
France	Luxembourg	Switzerland	Ukraine		
Germany	Malta	United Kingdom			
Greece	Netherlands				

West Africa		Central Africa	East Africa	Southern Africa	
Benin	Liberia	Angola	Burundi	Botswana	Namibia
Burkina Faso	Mali	Cameroon	Ethiopia	Comoros	Seychelles
Cabo Verde	Niger	Cent Afr Republic	Kenya	Lesotho	South Africa
Cote d'Ivoire	Nigeria	Chad	Rwanda	Madagascar	Swaziland
Gambia, The	Senegal	Congo, Dem	Tanzania	Malawi	Zambia
Ghana	Sierra Leone	Congo, Rep	Uganda	Mauritius	Zimbabwe
Guinea	Togo	Equ Guinea		Mozambique	
Guinea-Bissau		Gabon			
		São Tom and Prín			

Table 15: Fiscal gaps in 2016 with and without all revenue and spending categories

low income		
	baseline	**all rev. and spend.**
Benin	5.8	3.2
Burkina Faso	0.5	-2.9
Burundi	5.7	4.6
Cent Afr Republic	-6.8	-9.5
Chad	-8.7	-4.0
Comoros	5.5	-1.8
Guinea	-5.4	-2.3
Guinea-Bissau	3.2	-1.4
Haiti	-0.1	-4.7
Liberia	11.9	0.4
Madagascar	0.7	-3.0
Malawi	0.8	1.6
Mali	2.9	1.6
Mozambique	1.8	1.1
Nepal	1.0	-4.4
Niger	3.4	1.0
Senegal	2.0	-1.9
Sierra Leone	1.3	3.2
Tanzania	0.4	0.7
Togo	10.0	3.7
Uganda	0.5	4.1
Zimbabwe	6.3	5.9

low-middle income		
	baseline	**all rev. and spend.**
Armenia	-4.0	1.6
Bangladesh	0.2	2.2
Bhutan	-1.1	-12.3
Bolivia	4.9	5.9
Cabo Verde	0.3	-6.5
Cameroon	1.3	3.3
Congo, Rep	14.3	14.7
Cote d'Ivoire	2.3	-0.2
El Salvador	-2.6	-1.7
Ghana	-5.6	6.3
Guatemala	-5.3	-0.9
Honduras	-2.5	-1.8
India	-0.1	2.1
Indonesia	-3.1	-0.6
Kenya	0.7	2.7
Kyrgyz Republi	3.1	-0.6
Lao PDR	2.2	0.7
Lesotho	20.7	17.9
Mauritania	-3.8	-6.5
Moldova	-0.5	1.7
Morocco	-4.5	-2.6
Nicaragua	-1.5	0.1
Nigeria	-4.3	2.7
Pakistan	-6.8	-1.5
Philippines	-5.8	-3.0
Sri Lanka	-2.0	1.7
Sudan	-5.1	-4.0
Swaziland	13.4	16.1
Tajikistan	7.1	5.6
Tunisia	-3.7	1.2
Ukraine	0.7	1.1
Zambia	-7.5	3.6

high-middle income		
	baseline	**all rev. and spend.**
Albania	-5.3	-1.2
Algeria	12.4	9.9
Angola	-4.8	1.6
Argentina	2.8	1.4
Azerbaijan	0.7	-1.0
Belarus	3.1	3.7
Bosnia and Herz	0.0	-2.1
Botswana	9.3	7.0
Brazil	0.6	4.6
Bulgaria	0.4	-3.2
Colombia	-3.7	0.6
Costa Rica	-0.4	1.9
Dom Republic	-2.9	1.3
Ecuador	10.9	5.1
Equ Guinea	4.8	15.5
Gabon	-4.8	2.7
Georgia	-2.9	0.4
Guyana	6.7	2.2
Iran	-4.3	-2.6
Iraq	19.0	26.7
Jamaica	1.0	-8.1
Jordan	-3.9	-6.0
Kazakhstan	-3.7	2.3
Lebanon	-8.0	-0.5
Malaysia	0.0	-0.2
Mauritius	-2.6	-1.8
Mexico	0.4	1.0
Panama	0.2	-0.3
Paraguay	1.2	-0.4
Peru	-1.4	0.9
Romania	-1.1	0.9
Russia	4.1	3.1
Serbia	1.3	-0.7
South Africa	-4.0	-0.3
Thailand	-1.9	-3.2
Turkey	-3.6	-0.4

high income		
	baseline	**all rev. and spend.**
Australia	0.5	-2.6
Austria	-2.1	-3.0
Belgium	-1.2	-2.4
Canada	-1.3	-3.2
Chile	-1.1	1.9
Croatia	-2.5	-3.9
Cyprus	-5.2	-5.7
Czech Republic	-0.8	-1.6
Estonia	0.7	-0.7
Finland	6.2	-2.0
France	2.2	-2.2
Germany	-1.9	-4.9
Greece	1.5	-10.6
Hungary	3.0	-1.4
Ireland	-4.4	-2.1
Israel	-3.5	-2.0
Italy	-1.3	-4.9
Japan	-2.4	-6.3
Korea	-2.4	-3.7
Kuwait	27.0	38.7
Latvia	0.4	-2.5
Lithuania	-1.3	-1.0
Luxembourg	-2.1	0.3
Malta	-2.5	0.3
Netherlands	0.9	-1.6
New Zealand	-3.3	-5.7
Norway	-0.1	-5.3
Oman	21.9	29.2
Poland	-0.1	0.4
Portugal	1.1	-3.4
Saudi Arabia	16.6	24.9
Slovak Republic	0.4	-1.0
Slovenia	-2.5	-2.4
Spain	0.1	-1.2
Switzerland	-0.1	-2.9
Trin and Tobago	10.0	12.7
United Kingdom	-3.4	-1.9
United States	0.2	-2.3
Uruguay	-0.5	0.3

Table 16.1: Countries with recessions

Countries where real GDP fell below its 2007 level				
Argentina	El Salvador	Haiti	Lithuania	Slovenia
Armenia	Estonia	Hungary	Luxembourg	Spain
Austria	Finland	Ireland	Mexico	Trin and Tobago
Belgium	France	Italy	Netherlands	Turkey
Botswana	Gabon	Jamaica	New Zealand	Ukraine
Canada	Georgia	Japan	Norway	United Kingdom
Croatia	Germany	Kuwait	Portugal	United States
Czech Republic	Greece	Latvia	Russia	Zimbabwe

Table 16.2: Countries with growth slowdowns

Countries where real GDP growth decelerated from its pre-crisis level				
Argentina	Cent Afr Republic	Guatemala	Lithuania	Romania
Armenia	Chile	Guyana	Luxembourg	Russia
Australia	Colombia	Honduras	Madagascar	Serbia
Austria	Costa Rica	Hungary	Mauritius	Slovak Republic
Belgium	Croatia	Indonesia	Mexico	Slovenia
Benin	Czech Republic	Ireland	Moldova	South Africa
Bolivia	Dom Republic	Israel	Netherlands	Spain
Bosnia and Herz	El Salvador	Italy	New Zealand	Sri Lanka
Botswana	Estonia	Jamaica	Nicaragua	Sudan
Brazil	Finland	Japan	Norway	Switzerland
Bulgaria	France	Kazakhstan	Panama	Tajikistan
Cambodia	Gabon	Kenya	Peru	Turkey
Cameroon	Georgia	Korea	Philippines	Ukraine
Canada	Germany	Kuwait	Poland	United Kingdom
Cabo Verde	Greece	Latvia	Portugal	United States

Table 17.1: Determinants of cumulative cost of the Great Recession (levels)

	cumulative cost crisis	cumulative cost crisis	size fiscal stimulus	cumulative cost crisis
Size of the Shock	4.6***	4.7***		4.7***
	(0.27)	(0.28)		(0.26)
Fiscal Stimulus	-0.6*			
	(0.35)			
Change Deficit		0.4		
		(0.36)		
Fiscal Gap in 2007			-0.3**	
			(0.12)	
Debt Ratio in 2007			-0.01	
			(0.02)	
Size Stimulus (hat)				-0.1*
				(0.04)
Constant	-6.0***	-5.2*	-0.1	-3.7
	(3.39)	(4.87)	(0.61)	(4.51)
Number of countries	40	40	40	40
R-squared	0.93	0.93	0.24	0.94

***, **, *: statistically significant at 1, 5, or 10 percent.

Table 17.2: Determinants of cumulative cost of the Great Recession (growth)

	cumulative cost crisis	cumulative cost crisis	size fiscal stimulus	cumulative cost crisis
Size of the Shock	2.4***	2.5***		2.1***
	(0.19)	(0.20)		(0.26)
Fiscal Stimulus	-0.4*			
	(0.22)			
Change Deficit		0.3		
		(0.21)		
Fiscal Gap in 2007			-0.4***	
			(0.07)	
Debt Ratio in 2007			0.02	
			(0.06)	
Size Stimulus (hat)				-0.1*
				(0.06)
Constant	0.3	1.0	-1.0	8.2
	(2.16)	(2.28)	(0.57)	(4.51)
Number of countries	75	75	75	75
R-squared	0.81	0.80	0.37	0.36

***, **, *: statistically significant at 1, 5, or 10 percent.

Annexes Chapter 2:

The Costs of Delaying the Fiscal Consolidation in the US

Table 1: Calibration initial steady state

1. Fixed a priori

		Repres.	Aiyagari	Entrep.	
Relative risk aversion	σ	1.5	1.5	1.5	Attanasio, Banks, Meghir, and Weber (1999)
External finance premium	ψ	.	.	2%	Spread (Baa - TR10) 1990-2007
Annual depreciation rate	δ	6%	6%	6%	Stokey and Rebelo (1995)
Capital income share	α	0.36	0.36	0.36	Kitao (2008)
Growth deterministic trend	γ	1.02	1.02	1.02	Long run growth in CBO projections
Share of output entrepreneurs	v	.	.	0.15	Atkensons and Kehoe (2005)
Curvature of the labor supply	ϕ	3	3	3	Chetty, Guren, Manoli and Weber (2011)
Persistence labor prod. shock	ρ_e	.	0.91	0.91	Floden and Lindé (2001)
Persistence entrep. ability shock	ρ_z	.	.	0.91	Floden and Lindé (2001)
St. dev. labor prod. shock	σ_e	.	0.206	0.206	Floden and Lindé (2001)

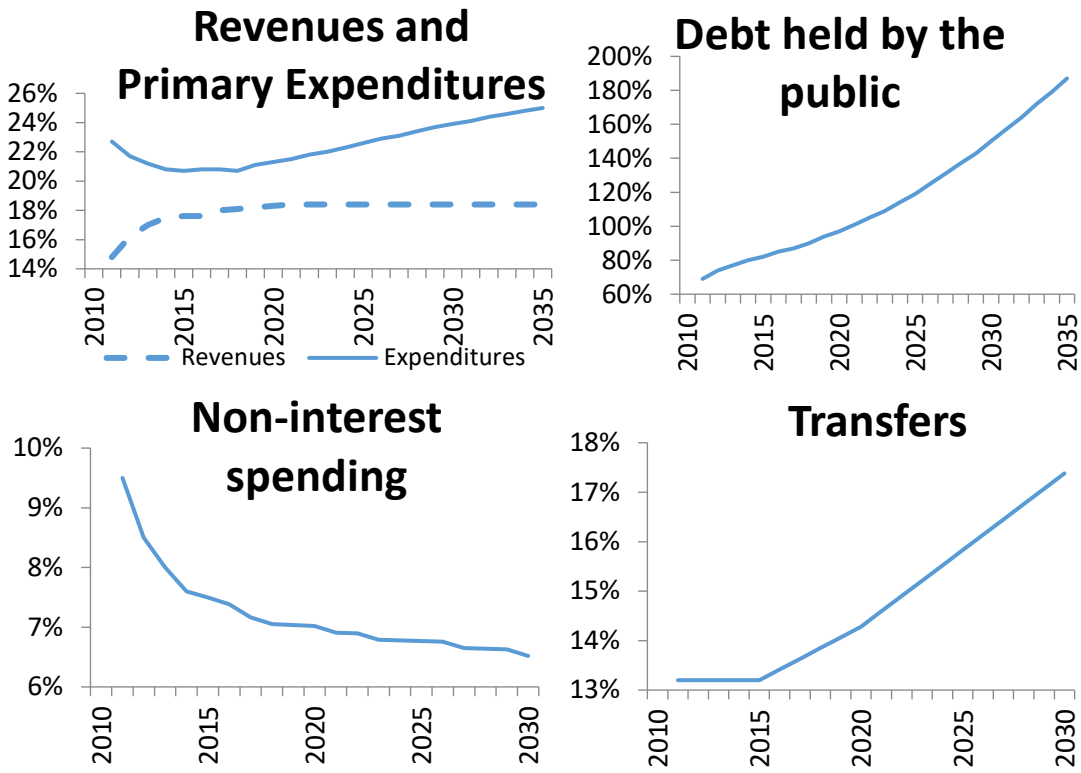
2. Calibrated to match selected targets

		Repres.	Aiyagari	Entrep.	
Other non-interest spending	g/GDP	5.9%	5.9%	5.9%	Spending defense, justice, science in 2007
Transfers	Tr/GDP	12%	12%	12%	Social spending in 2007
Debt to GDP ratio	B/GDP	36%	36%	36%	Debt in hands of the public in 2007
Consumption tax	τ^c	0.7%	0.7%	0.7%	Revenues excise taxes 0.47% in 2007
Payroll tax	τ^h	9.8%	9.8%	10.4%	Revenues payroll tax 6.26% in 2007
Income tax	τ^y	17.3%	17.8%	16.7%	Satisfy government's budget constraint initial ss
Relative value of leisure	ρ	0.142	0.411	0.451	Such that $\overline{h^w} = 1/3$ for workers initial ss
Subjective discount factor	β	0.976	0.958	0.951	Such that $r = 3\%$ initial ss
Tightness collateral constraint	λ	.	.	1.4	Leverage= 0.38 Non-Corp. sector 1990-2007
Mean labor prod. shock	x_θ	.	0.937	0.91	Such that $\bar{\theta}$ =1 for workers initial ss
Mean entrep. ability shock	x_z	.	.	0.004	Such that % of entrep. = 11.5% initial ss
St. dev. entrep. ability shock	σ_z	.	.	0.391	Corp. sector used 72% of capital 1990-2007

Table 2: Classification of the primary expenditures of the US federal government in 2007

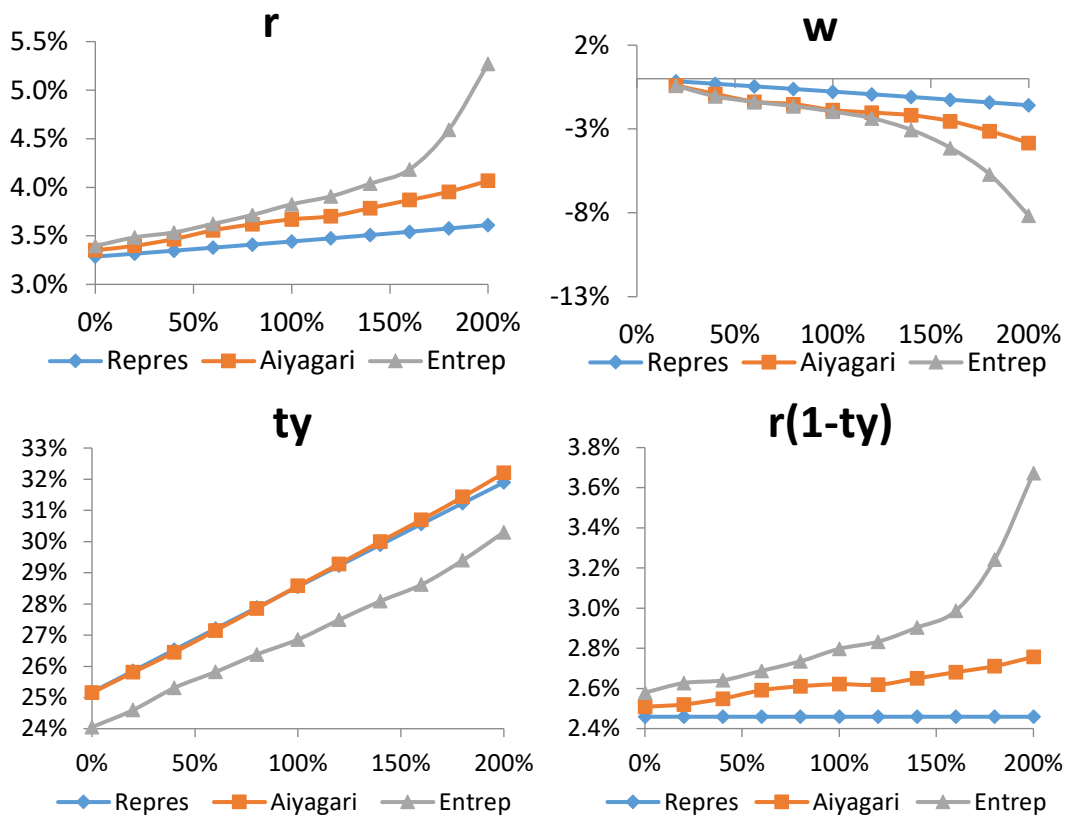
g 5.9%	National defense 4%	International affairs, administration of justice, and general government 0.6%	Energy, transportation, science, and technology 1.3%				
Tr 12%	Medicaid 1.9%	Medicare 2.7%	Social Security 4.2%	Veterans 0.5%	Non-mandatory income security 0.4%	General retirement and disability 0.1%	Federal employee retirement and disability 0.7%
	Food and nutrition assistance 0.4%	Unemployment compensation 0.2%	Supplemental security income 0.2%	Family and other support assistance 0.2%	Earned income tax credit 0.3%	Child tax credit 0.1%	Recovery rebate tax credit 0.1%

Figure 1: Long term projections from CBO



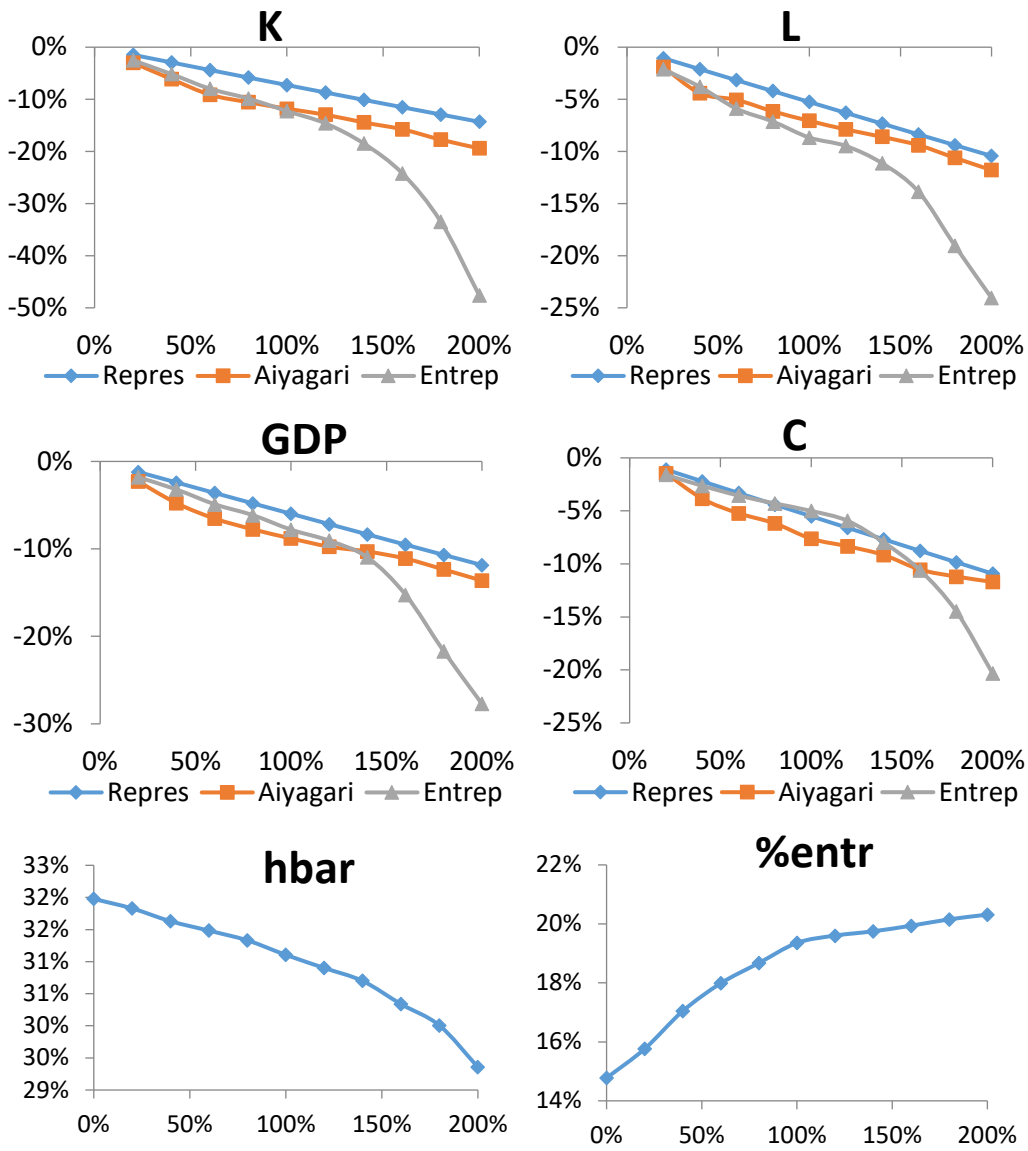
Note: The projections are taken from the Alternative Scenario in the 2011 Long Term Budget Outlook of CBO. The revenues and primary expenditures correspond to the federal government and are presented as a percentage of GDP. The classification of the primary expenditures between transfers and non-interest spending is presented in Table 2. Since the explosive path projected by CBO cannot be used for the simulations, I assume that in 2030 the ratio of primary spending to GDP becomes stationary.

Figure 2: Effect of debt in equilibrium prices



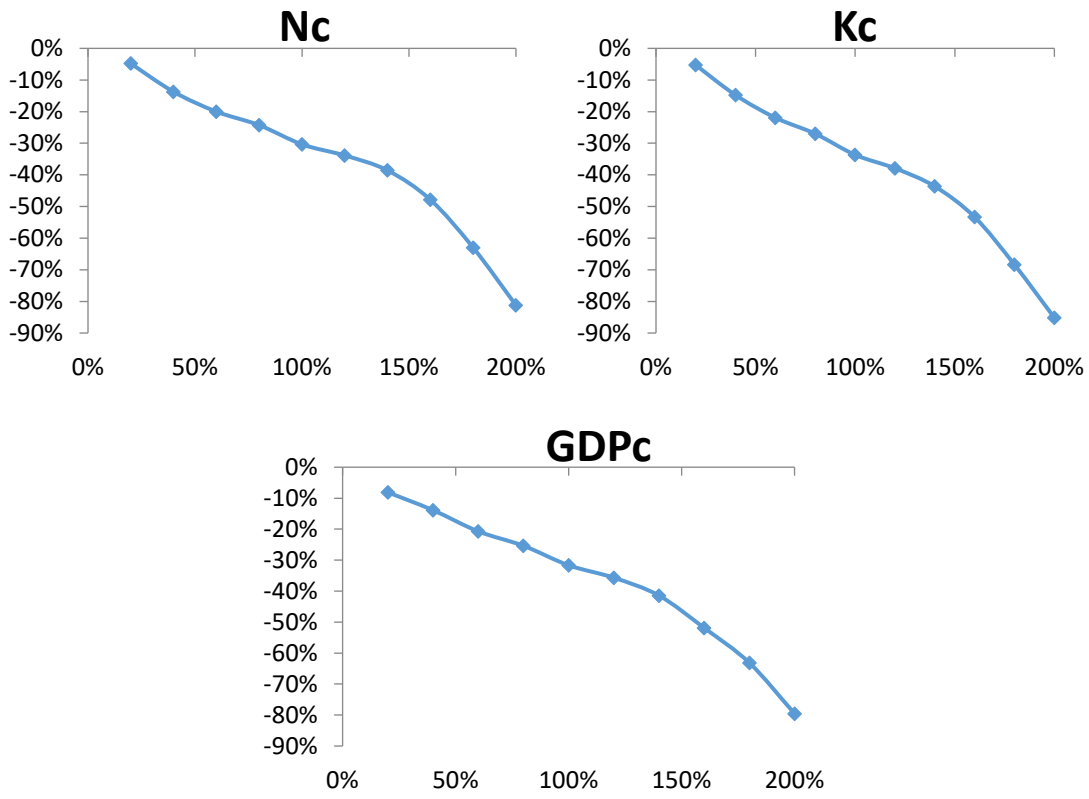
Note: The government's debt is expressed as a fraction of GDP in the horizontal axis. r is the gross risk-free rate, w is the gross wage rate per unit of labor efficiency, τ^y is the labor income tax, and $r(1-\tau^y)$ is the risk-free rate net of the income tax.

Figure 3: Effect of debt in real variables



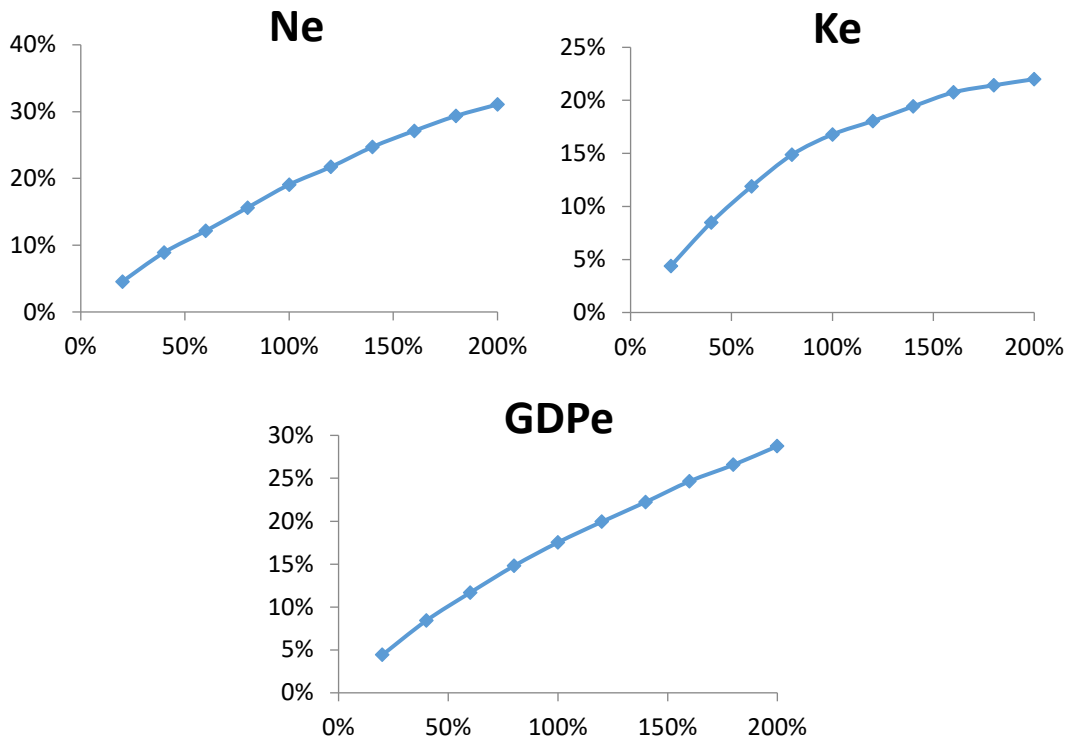
Note: The government's debt is expressed as a fraction of GDP in the horizontal axis. K is the aggregate stock of capital used for production, L is the aggregate labor efficiency units used for production, GDP is the aggregate production, and C is aggregate consumption. $\bar{h}$ is the average fraction of time spent working and $\%entr$ is the percentage of the agents that are entrepreneurs.

Figure 4: Effect of debt in the corporate sector



Note: The government's debt is expressed as a fraction of GDP in the horizontal axis. N^C is the labor efficiency units used for production in the corporate sector, K^C is the stock of capital used for production in the corporate sector, and GDP^C is the production from the corporate sector. Aggregate production GDP_t is the sum of the aggregate production from the entrepreneurial sector GDP_t^e and the corporate sector GDP_t^C.

Figure 5: Effect of debt in the entrepreneurial sector



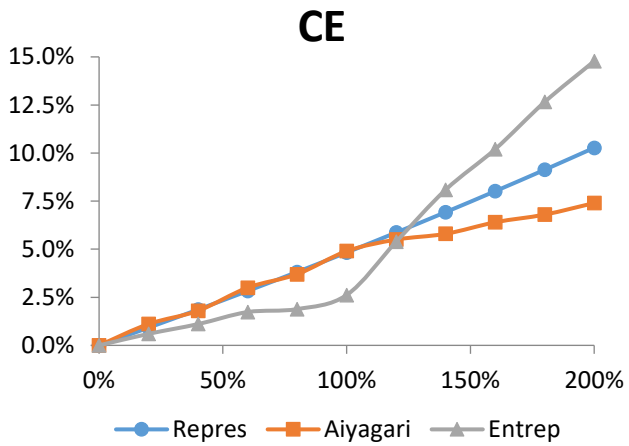
Note: The government's debt is expressed as a fraction of GDP in the horizontal axis. N^e is the aggregate labor efficiency units used for production in the entrepreneurial sector, K^e is the aggregate stock of capital used for production in the entrepreneurial sector, and GDP^e is the aggregate production from the entrepreneurial sector.

Table 3: Thresholds for the entrepreneurial decision

	B=0%	B=100%	B=200%
$z_{2\_}\theta_1$	0.141	0.121	0.081
$z_{3\_}\theta_1$	0.06	0.05	0.04
$z_{2\_}\theta_2$	0.383	0.322	0.201
$z_{3\_}\theta_2$	0.101	0.091	0.067
$z_{3\_}\theta_3$	0.181	0.161	0.121
$z_{3\_}\theta_4$	0.403	0.362	0.242
$z_{3\_}\theta_5$	1.349	1.148	0.631

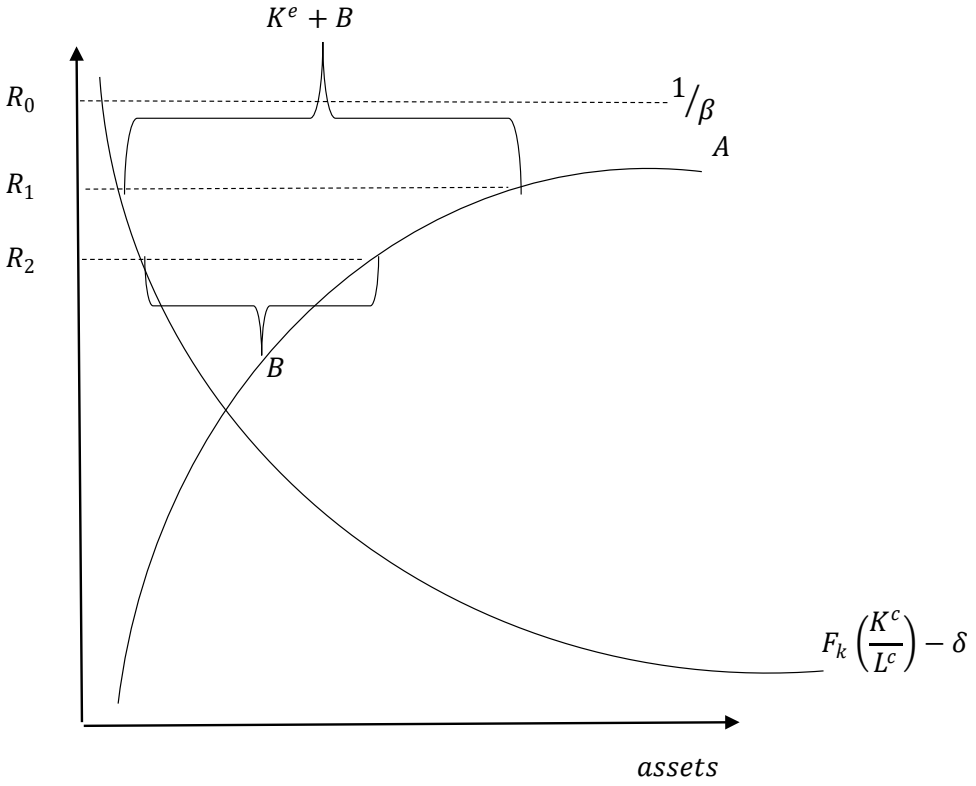
Note: This table shows the minimum asset holdings, for different combinations of the idiosyncratic shocks and debt to GDP ratios, such that the agent becomes an entrepreneur.

Figure 6: Effect of debt in welfare



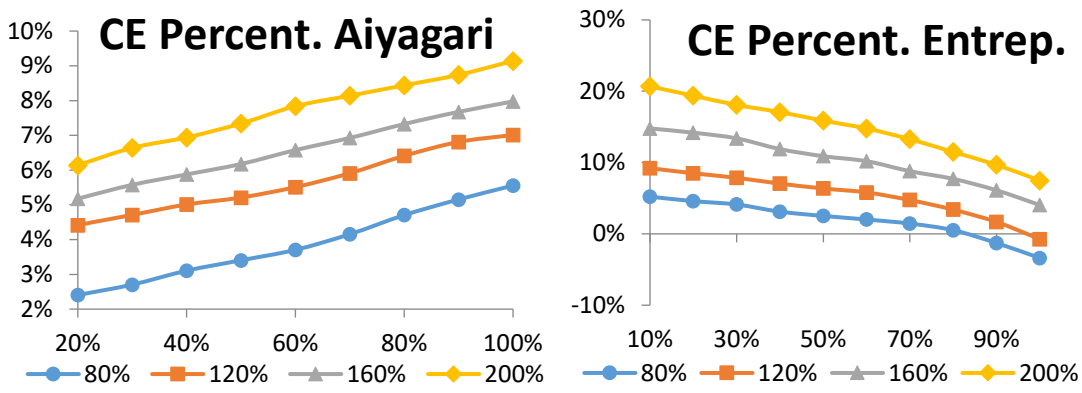
Note: The government's debt is expressed as a fraction of GDP in the horizontal axis. CE is defined as the permanent percentage increase in the consumption of all agents, holding leisure unchanged, that would result in the same average utility as in the economy where the government has not debt.

Figure 7: Interest rate determination



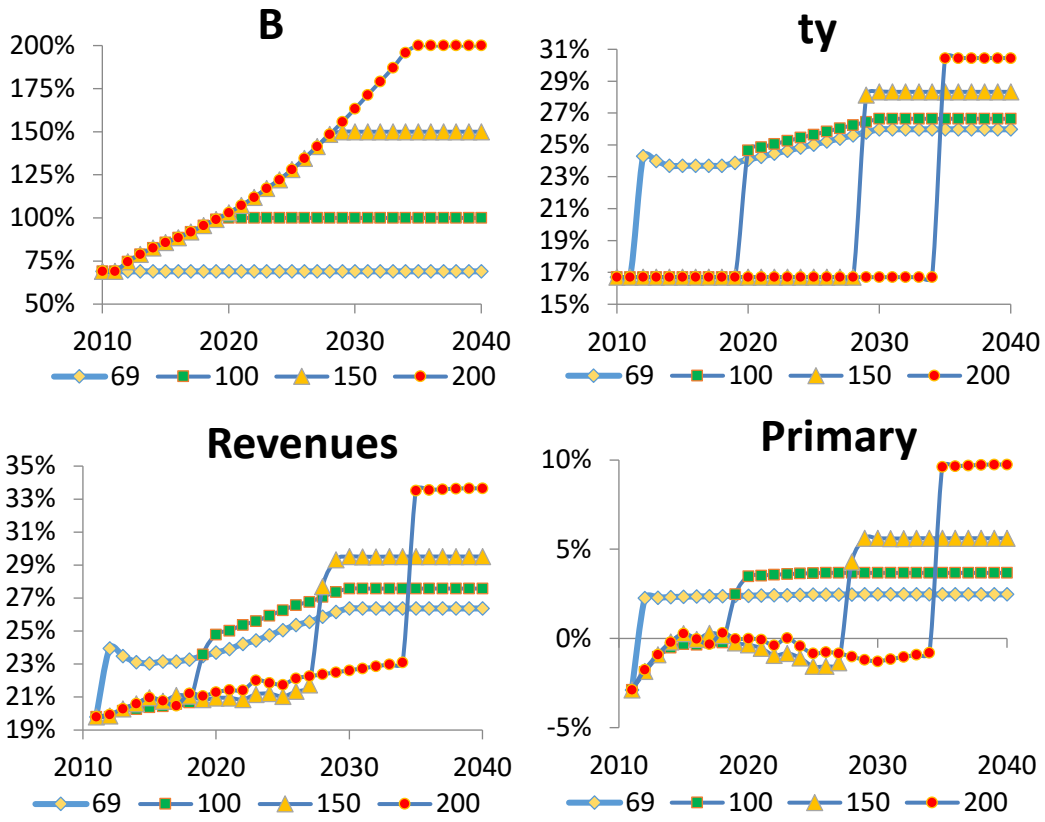
Note: The equilibrium net interest rate in the representative agent model R_0 equals the inverse of the subjective discount factor and is not a function of the the stock of debt. The equilibrium net interest rate in the model with heterogeneity and entrepreneurship R_1 is determined by the marginal product of capital in the corporate sector. The stock of capital used in the corporate sector K^C is the residual of the aggregate asset holdings A after the financing needs from the government B and the entrepreneurial sector K^e are covered. The equilibrium net interest rate in the model without entrepreneurship R_2 is determined by the marginal product of capital in the corporate sector (there is no entrepreneurial sector). The stock of capital used in the corporate sector K^C is the residual of the aggregate asset holdings A after the financing needs from the government B are covered. As the debt rises, the equilibrium interest rate in the incomplete markets economy increases. But the rise in the interest rate is bounded because as it approaches the interest rate of the complete markets economy from below, aggregate asset holdings tend to infinity.

Figure 8: Decomposition of the effect of debt on welfare by wealth percentiles



Note: The wealth percentiles are presented in the horizontal axis. Each series represents the CE by wealth percentiles for different levels of the debt to GDP ratio. The CE by wealth percentiles is defined the permanent percentage increase in the consumption of all agents in a certain wealth percentile, holding leisure unchanged, that would result in the same average utility of the agents in the same wealth percentile in the economy where the government has not debt.

Figure 9: Model simulations – fiscal variables



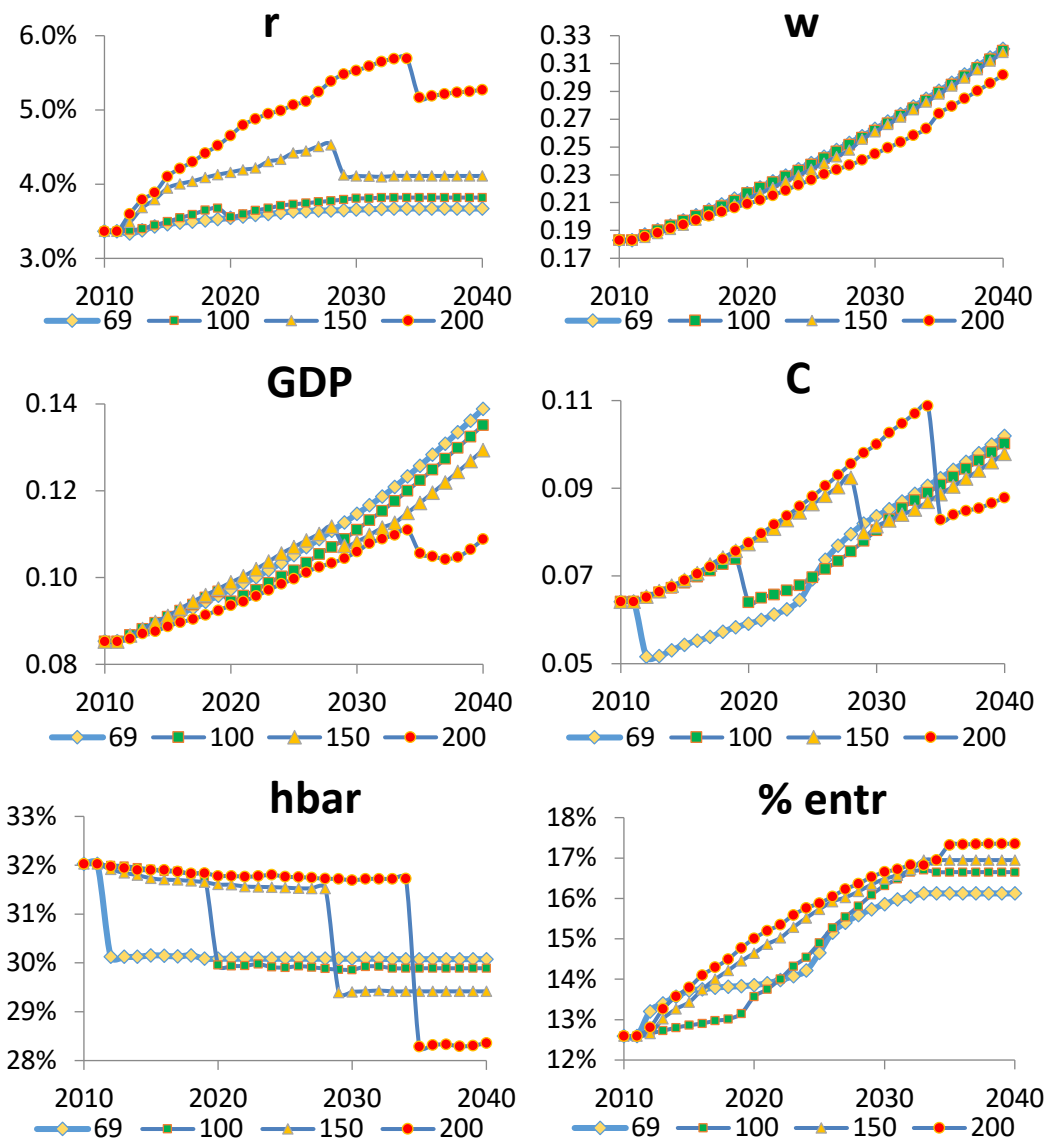
Note: $Expenditures$ corresponds to the primary spending projections from CBO, the model simulations assume that primary expenditures stabilize in 2030. B is the debt in the hands of the public as a percentage of GDP, τ^y is the income tax, $Revenues$ are the government's revenues expressed as a percentage of GDP and $Primary$ is the government's primary fiscal surplus or deficit (i.e. excluding the interest expenditures).

Table 4: Model simulations – steady state comparisons

	Initial SS	B=69%	B=100%	B=150%	B=200%
Debt to GDP	36%	69%	100%	150%	200%
Real interest rate	3.0%	3.7%	3.8%	4.1%	5.3%
Government revenues percent of GDP	18.9%	26.4%	27.6%	29.5%	33.6%
Transfers percent of GDP	12%	17.4%	17.4%	17.4%	17.4%
Other non-interest spending percent of GDP	5.9%	6.5%	6.5%	6.5%	6.5%
Primary expenditures percent of GDP	17.9%	23.9%	23.9%	23.9%	23.9%
Primary surplus percent of GDP	1.0%	2.5%	3.7%	5.6%	9.7%
Personal income tax rate	16.7%	26.0%	26.6%	28.3%	30.5%

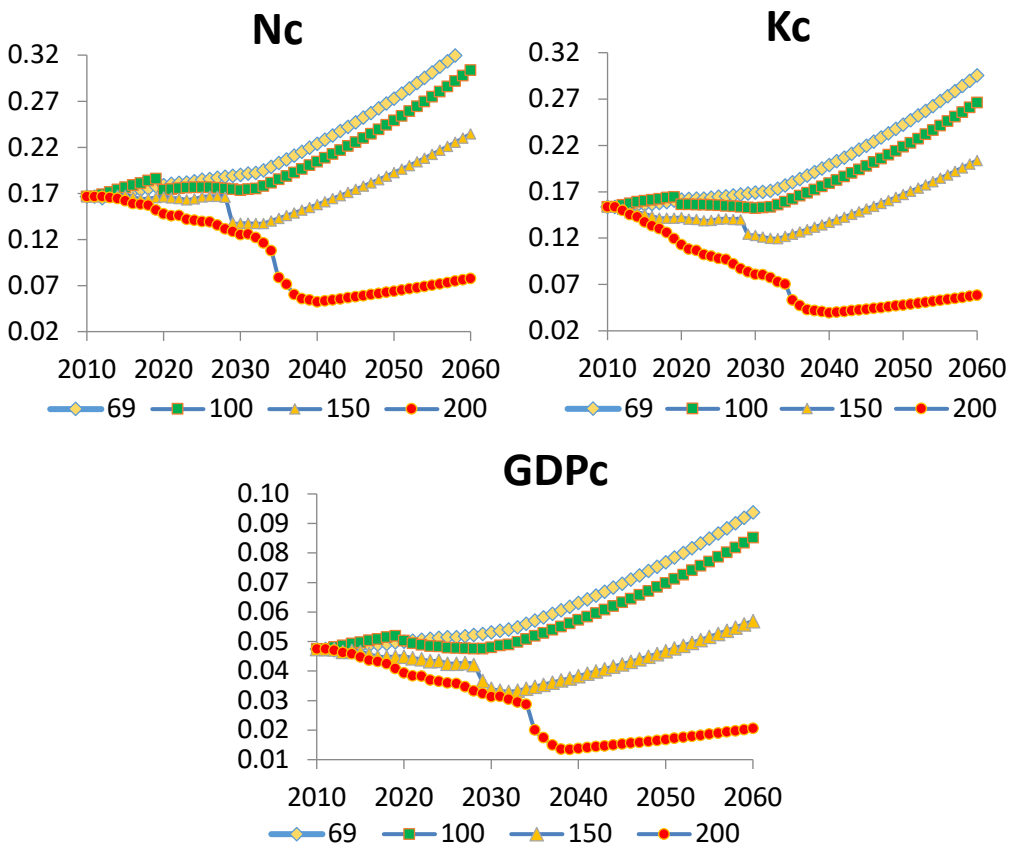
Note: This table shows a steady state comparison between the initial calibration and the steady states of the four alternative debt scenarios.

Figure 10: Model simulations – macroeconomic variables



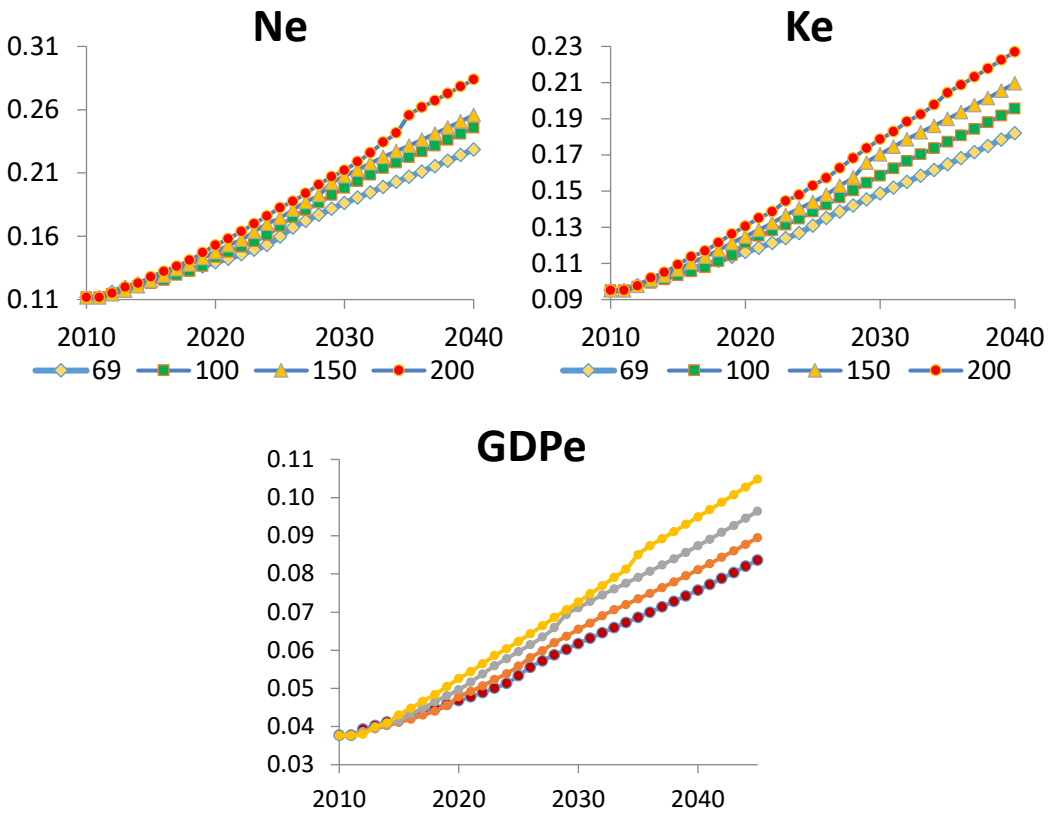
Note: r is the gross risk-free rate, w is the gross wage rate per unit of labor efficiency, Y is the aggregate production, and C is aggregate consumption. $\bar{h}$ is the average fraction of time spent working. $\%entr$ is the percentage of the agents that are entrepreneurs.

Figure 11: Model simulations – corporate sector



Note: N^C is the labor efficiency units used for production in the corporate sector, K^C is the stock of capital used for production in the corporate sector, and Y^C is the production from the corporate sector.

Figure 12: Model Simulations – entrepreneurial sector



Note: N^e is the aggregate labor efficiency units used for production in the entrepreneurial sector, K^e is the aggregate stock of capital used for production in the entrepreneurial sector, and Y^e is the aggregate production from the entrepreneurial sector.

Figure 13: Model simulations – welfare effects

Note: This figure shows the changes in welfare that result from stabilizing the debt to GDP ratio at different levels. LR is the permanent increase in consumption required such that the average welfare in the steady state from each scenario equals the average welfare when the debt to GDP is stabilized at 69% (its level in 2011). $Trans$ is the required permanent increase in consumption, starting from the first period of the transition to the new steady state, such that the average welfare associated from the dynamics of each scenario equals the average welfare from the dynamics of the scenario when the debt is immediately stabilized at 69%.

Appendix

i. Representative agent model

The production function of the representative firm in period t is:

$$F(K_t, N_t) = (K_t)^{\alpha}(\omega_t N_t)^{1-\alpha} \quad (1)$$

The aggregate productivity of labor ω evolves as a linear deterministic trend with growth rate γ:

$$\omega' = \gamma\omega \quad (2)$$

The utility for an agent in period t is:

$$u(c_t, h_t) = (c_t - \rho\omega_t {h_t}^{\phi})^{1-\sigma}/(1-\sigma) \quad (3)$$

The firm chooses its demand for inputs in order to maximize its profits:

$$max_{K_t N_t}\ F(K_t, N_t) - w_t N_t - (r_t + \delta)K_t \quad (4)$$

From the FOC, the factor prices satisfy the traditional marginal productivity conditions:

$$w_t = F_N(K_t, N_t) \quad (5)$$

$$r_t = F_K(K_t, N_t) - \delta \quad (6)$$

Since the problem has a deterministic trend, it is not stationary and requires the same transformation used for the benchmark model. However, to avoid complicating the notation I omit this transformation, although the problem can only be solved in its stationary form.

The recursive formulation of the consumer's problem for period t is:

$$V_t(A_t) = max_{a_{t+1}, h_t \geq 0}\ u(c_t, h_t) + \beta V_{t+1}(A_{t+1}) \quad (7)$$

$$s.t. \quad (1+\tau^c)c_t \leq (1-{\tau_t}^y)(1-\tau^h)w_t h_t + Tr_t + R_t A_t - A_{t+1} \quad (8)$$

$$R_t = 1 + (1-{\tau_t}^y)r_t \quad (9)$$

From the FOC of this problem:

$$u_c(t) = \beta R_t u_c(t+1) \quad (10)$$

$${h_t}^* = \left[\frac{(1-{\tau_t}^y)(1-\tau^h)w_t}{(1+\tau_t{}^c)\rho\phi}\right]^{1/(\phi-1)} \quad (11)$$

The aggregate supply of capital is defined as the residual from aggregate savings after the government's financing needs are covered. Then, equilibrium in the capital market requires that for every t:

$$K_t = A_t - B_t \quad (12)$$

Equilibrium in the labor market requires that for every t:

$$h_t^{\ *} = N_t \quad (13)$$

The government's budget constraint for period t is:

$$\tau^h w_t N_t + \tau_t{}^y (r_t A_t + (1-\tau^h) w_t N_t) + \tau^c C_t + B_{t+1} = (1+r_t)B_t + g_t + Tr_t \quad (14)$$

The parameterization of this model is presented in **Table 1**. As in the benchmark model the coefficient of relative risk aversion σ is 1.5, the annual depreciation rate δ is 6%, the capital income share α equals 0.36, the rate of growth of the deterministic trend γ is 1.02, and the curvature of the labor supply ϕ is 3 such that the Frisch elasticity is 0.5.

Other non-interest spending g is calibrated to be 5.9percent of GDP, the initial stock of debt B is calibrated to be 36percent of GDP, the value of government's lump-sum transfer Tr is calibrated to be of 12percent of GDP, the tax rate on consumption τ^c is and labor τ^h are calibrated to match the revenues of the federal government in 2007 from the excise taxes and the Social Security contributions. The income tax τ^y is selected to satisfy the government's budget constraint in the initial steady state. ρ is chosen such that on average workers spend $1/3$ of their time working in the initial steady state. The subjective discount factor β is selected, so that the equilibrium risk free rate r in the initial steady state is 3%.

ii. Aiyagari model

Agents are ex-ante identical. There is no aggregate uncertainty, but each period they receive idiosyncratic shocks to labor productivity θ_t. Markets are incomplete because the agents can only trade assets with returns that are not state contingent. As a result, no insurance is available for the idiosyncratic shocks and individuals accumulate assets a to partially self-insure. The shocks follow an autoregressive Markov processes of order one that evolves according to the transition matrix $\Gamma = Pr(\theta'|\theta)$. Ex-post, agents are heterogeneous with respect to their individual asset holdings a_t, their labor productivity θ_t.

The production function of the representative firm in period t is:

$$F(K_t, N_t) = (K_t)^{\alpha}(\omega_t N_t)^{1-\alpha} \quad (1)$$

The aggregate productivity of labor ω evolves as a linear deterministic trend with growth rate γ:

$$\omega' = \gamma\omega \quad (2)$$

The utility for an agent in period t is:

$$u(c_t, h_t) = (c_t - \rho\omega_t {h_t}^{\phi})^{1-\sigma}/(1-\sigma) \quad (3)$$

The firm chooses its demand for inputs in order to maximize its profits:

$$max_{K_t N_t}\ F(K_t, N_t) - w_t N_t - (r_t + \delta)K_t \quad (4)$$

From the FOC, the factor prices satisfy the traditional marginal productivity conditions:

$$w_t = F_N(K_t, N_t) \quad (5)$$

$$r_t = F_K(K_t, N_t) - \delta \quad (6)$$

Since the problem has a deterministic trend, it is not stationary and requires the same transformation used for the benchmark model. However, to avoid complicating the notation I omit this transformation, although the problem can only be solved in its stationary form.

The recursive formulation of the consumer's problem for period t is:

$$V_t(a_t, \theta_t) = max_{a_{t+1}, h_t \geq 0}\ u(c_t, h_t) + \beta \sum \Gamma V_{t+1}(a_{t+1}, \theta_{t+1}) \quad (7)$$

$$s.t. \quad (1+\tau^c)c_t \leq (1-{\tau_t}^y)(1-\tau^h)w_t h_t \theta_t + \mathrm{tr}_t + R_t a_t - a_{t+1} \quad (8)$$

$$R_t = 1 + (1-{\tau_t}^y)r_t \quad (9)$$

From the FOC of this problem:

$${h_t}^* = \left[\frac{(1-{\tau_t}^y)(1-\tau^h)w_t\theta_t}{(1+{\tau_t}^c)\rho\phi}\right]^{1/(\phi-1)} \quad (10)$$

The consumption-saving decision is determined by a policy rule $a_{t+1}(a_t, \theta_t)$, that together with the labor supply decision, and the transition probabilities of the labor productivity shock Γ, induce the distribution of agents in this economy $\mu_t(a_t, \theta_t)$.

Aggregate asset holdings A_t are computed by integrating over the asset holdings of each household**:**

$$A_t = \int a_t \, \partial\mu_t(a_t, \theta_t) \quad (11)$$

Likewise, aggregate consumption C_t, and transfers are Tr_t are found by integrating over all agents.

The aggregate labor supply L_t is found by integrating over the individual labor supplies in efficiency units:

$$L_t = \int h_t \theta_t \, \partial\mu_t(a_t, \theta_t) \quad (12)$$

The aggregate supply of capital is computed as the residual from aggregate savings after the government's financing needs are covered. Thus, equilibrium in the capital market requires that for every t:

$$K_t = A_t - B_t \quad (13)$$

Equilibrium in the labor market requires that for every t:

$$L_t = N_t \quad (14)$$

The government's budget constraint for period t is:

$$\tau^h w_t L_t + \tau_t{}^y (r_t A_t + (1 - \tau^h) w_t L_t) + \tau^c C_t + B_{t+1} = (1 + r_t) B_t + g_t + Tr_t \quad (15)$$

The parameterization of this model is presented in **Table 1**. As in the benchmark model the coefficient of relative risk aversion σ is 1.5, the annual depreciation rate δ is 6%, the capital income share α equals 0.36, the rate of growth of the deterministic trend γ is 1.02, and the curvature of the labor supply ϕ is 3 such that the Frisch elasticity is 0.5. The natural logarithm of the labor productivity process is approximated with a five state Markov process, with a persistence of 0.91, and a standard deviation of 0.21.

Other non-interest spending g is calibrated to be 5.9percent of GDP, the initial stock of debt B is calibrated to be 36percent of GDP, the value of government's lump-sum transfer Tr is calibrated to be of 12percent of GDP, the tax rate on consumption τ^c is and labor τ^h are calibrated to match the revenues of the federal government in 2007 from the excise taxes and the Social Security contributions. The income tax τ^y is selected to satisfy the government's budget constraint in the initial steady state. ρ is chosen such that on average workers spend $1/3$ of their time working in the initial steady state. The subjective discount factor β is selected, so that the equilibrium risk free rate r in the initial steady state is 3%. The median value of the grid for the labor productivity shock x_θ is calibrated such that average productivity of workers in the initial steady state is unity.

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