How Costly Are Borrowing Costs?: An Analysis of Alternative Fiscal Policies During Crises

Inci Gumus*
Sabanci University
August 2014

Abstract

Financial crises lead to substantial declines in output and consumption in emerging market economies. The fact that fiscal policy is procyclical in these countries shows that the effects of a crisis are exacerbated by spending cuts and tax increases, which are usually attributed to borrowing constraints that they face in bad times. This paper quantitatively analyzes the costs of reduced borrowing in crisis episodes, by studying the effects of expansionary fiscal policies that would have been possible to implement, had the government been able to borrow more. The model shows that a proportional 25% reduction of taxes on labor income, capital income and consumption during the 1997 Korean crisis would have required an additional borrowing of 4.10% of GDP, while increasing output and consumption by 5.23 and 5.92 percentage points, respectively. When the effects of each tax rate are analyzed separately, labor income tax reduction turns out to be more effective than the other policies.

JEL Classification: E32; E62; F32; F41
Keywords: Fiscal policy, Financial crises, Business cycle fluctuations

*I would like to thank the participants at the Midwest Macroeconomics Conference (Nashville, 2011), the IEA Sixteenth World Congress (Beijing, 2011), the SNDE Conference (Istanbul, 2012), the ICMAIF Conference (Rethymno, 2013), the third ISCEF (Paris, 2014), and two anonymous referees for helpful comments. All errors are my own. Correspondence: Sabanci University, Faculty of Arts and Social Sciences, Orhanli, Tuzla, 34956, Istanbul, Turkey. Tel: +90-216-4839318; Fax: +90-216-4839250; Email: incigumus@sabanciuniv.edu.
1 Introduction

Financial crises have drastic effects on an economy and these effects are especially severe in emerging market economies, where output and consumption decline substantially during crises. A large empirical literature has found that fiscal policy in developing countries is procyclical.\(^1\) Along with the contraction in economic activity during a crisis, governments resort to spending cuts and tax increases, exacerbating the effects of the crisis. This fact has been explained by many papers as being due to credit constraints that developing countries face in bad times.\(^2\) In crisis episodes, these countries experience current account surpluses associated with capital outflows. Figure A1 in the appendix shows output and the current account-to-GDP ratio for a group of emerging market economies. The figure illustrates the current account surpluses these countries experience in crisis episodes, which shows how the foreign borrowing of the economy decreases during an economic downturn.\(^3\)

With interest rates increasing to very high levels, the cost of borrowing increases substantially during crises, leading to reduced borrowing, and this reduction entails some costs of its own. Since engaging in expansionary fiscal policy requires additional borrowing, the government’s inability to borrow reduces its capability of using expansionary fiscal policy to stimulate the economy. Hence, the costs of reduced borrowing can be measured in terms of foregone increases in output and consumption that could have been attained through a fiscal stimulus. This paper quantitatively analyzes the costs of reduced borrowing in crisis episodes in terms of the effects of expansionary fiscal policy that would have been possible, had the government been able to borrow more.

The paper uses a small open economy version of the neoclassical growth model to

---


\(^3\) The crisis dates covered in the sample are December 2001 for Argentina, July-November 1997 for Indonesia, Korea and Thailand, December 1994 for Mexico and February 2001 for Turkey. Annual HP-filtered series are used.
quantitatively analyze the effects of expansionary fiscal policy during a financial crisis if the government had access to additional borrowing. The question is analyzed in the context of the 1997 financial crisis in Korea. First, the standard open economy neoclassical model, extended to incorporate distortionary taxes on consumption, labor income and capital income, is used to generate the cyclical fluctuations around the 1997 crisis in Korea. In this benchmark model, the actual tax rates that come from the data are used. Then, tax rates are lowered during the year following the crisis so that the government borrowing increases. By reducing the tax rates and consequently increasing the foreign borrowing of the government by a certain amount, it is possible to see the effects that a borrowing decline imposes on the economy. The results of the analysis show how much of an expansion can be achieved if the government borrowing does not decline and an expansionary fiscal policy is implemented. In the analysis, all tax rates are reduced proportionally first, and the implications of the model in terms of output, consumption and factors of production are analyzed. Then, the tax rates are reduced one by one to disentangle the effect of a tax cut for each tax rate and see which one of these tax declines is more effective for an economic expansion.

The benchmark model, which uses the actual tax rates, generates the output and consumption patterns observed in the data reasonably well. The implications of the benchmark model are compared with the counterfactual case in which all tax rates are adjusted down 25%, which leads to an increase in the government borrowing by 4.10% of output. This model generates higher output, consumption and labor due to lower taxes. The increase in output with the proportional tax cut is 5.23 percentage points from a reduction of 12.96% to 7.73% during the crisis year and the increase in consumption is 5.92 percentage points. In order to analyze how each tax rate have contributed to this expansion, tax rates are reduced one at a time as an additional policy experiment. The results show that a reduction in the labor income tax rate is the most effective among the tax cuts, reducing output decline by 3.01 percentage points and consumption decline by 3.22 percentage points. The
consumption tax cut by itself increases output and consumption by 2.14 and 2.53 percentage points, respectively. The effects of these policies on the public debt-to-GDP ratio, on the other hand, are a 1.64 percentage point increase for the labor tax cut and a 1.72 percentage point increase for the consumption tax cut, making the labor tax cut less costly in terms of additional borrowing. Reducing the capital tax rate alone leads to only a very small increase in all variables, making this tax cut the least effective.

All of the tax cuts lead to an improvement in welfare by reducing the economic contraction experienced during the crisis. The proportional tax reduction induces an increase in welfare equal to a permanent 0.078% increase in consumption. When the tax cuts are considered separately, a reduction in the labor income tax leads to the highest increase in welfare among the three tax cuts.

In terms of the model used, this paper follows the literature that aims at explaining large contractions in output using growth accounting and the neoclassical growth model as in Cole and Ohanian (1999, 2002), the collection of papers edited by Kehoe and Prescott (2002), Bergoeing et al. (2002), Conesa, Kehoe and Ruhl (2007) among others. Meza and Quintin (2007) use a small open economy version of the same model to explain the behavior of output and inputs during the 1994 Mexican crisis. Given that the model can account for the dynamics in crisis episodes quite well, it is used in this paper to quantitatively analyze the effects of expansionary fiscal policy during a crisis.

Using a similar model, Meza (2008) analyzes the effects of an increased consumption tax and reduced government spending during the 1994 Mexican crisis. He shows that fiscal policy changes account for 20.7% of the contraction of output, and the increase in the consumption tax rate accounts for most of this contraction. While this paper also analyzes the effects of fiscal policy changes during a crisis, the link between external borrowing and changes in fiscal policy has not been explored. In this sense, the current paper makes a contribution by quantifying the costs of borrowing difficulties experienced in crisis episodes through the effects of fiscal policy changes. Another paper close to the current paper in
terms of the method used is Ohanian (1997). He evaluates quantitatively the economic effects of the different policies used by the U.S. government to finance World War II and the Korean War, which were primarily financed by issuing debt and increasing taxes, respectively. Instead of analyzing the effects of financing war expenditures through borrowing versus taxes, this paper compares these two options in the context of a financial crisis.

2 The Model

Consider a small open economy model with an infinitely lived representative household. The household maximizes the utility function

$$\sum_{t=0}^{\infty} \beta^t \left( c_t - \psi l_t \right)^{1-\sigma}$$  \hspace{1cm} (1)

where $c_t$ denotes consumption, $l_t$ denotes labor supply, $0 < \beta < 1$ is the discount factor, $\nu > 1$ determines the labor supply elasticity and $\psi > 0$ measures the disutility from working. This preference specification, introduced by Greenwood et al. (1988), has been commonly used in small open economy business cycle models.\(^4\)

Households supply labor, rent out capital and borrow/lend in international financial markets. They trade a one-period risk-free asset with an exogenous time-$t$ return $r_t$ in international markets.

Households pay three types of taxes. In period $t$, consumption is taxed at rate $\tau_t^c$, labor income is taxed at rate $\tau_t^l$, and capital income is taxed at rate $\tau_t^k$. They also receive a transfer $T_t$ from the government.

The budget constraint of the household in period $t$ is given by

$$\left(1 + \tau_t^c \right) c_t + k_{t+1} + a_{t+1} = \left(1 - \tau_t^l \right) w_t l_t + \left[1 + \left(1 - \tau_t^k \right) (q_t - \delta) \right] k_t$$

$$+ (1 + r_t) a_t + T_t - \Phi_k(k_{t+1}, k_t) - \Phi_a(a_{t+1}), \hspace{1cm} (2)$$

where \( k_t \) is the quantity of capital and \( a_t \) is net foreign assets held by the household, \( w_t \) is the wage rate, \( q_t \) is the return to capital and \( \delta \) is the depreciation rate. The function \( \Phi_k \) represents the cost of adjusting the capital stock. Capital adjustment costs are commonly used in small open economy business cycle models in order to prevent excessive volatility of investment. The function \( \Phi_a \) represents the adjustment costs for international assets. Adjustment costs on holdings of assets are used in order to induce stationarity in small open economy business cycle models.

Firms operate in a perfectly competitive market using a constant returns to scale technology. The production function is assumed to be Cobb-Douglas, which is given by

\[
y_t = z_t k_t^\alpha l_t^{1-\alpha},
\]

where \( z_t \) is total factor productivity (TFP), and \( 0 < \alpha < 1 \). Firms hire labor and rent capital from households so as to maximize their profits.

The government finances sequences of expenditures \( \{g_t\}_{t=0}^{\infty} \) and transfers \( \{T_t\}_{t=0}^{\infty} \) through tax revenues and borrowing in international financial markets. It issues one-period non-contingent debt, \( b_t \), with return \( r_t \) in period \( t \). Tax revenues are collected through taxes on consumption, labor income and capital income. The flow budget constraint of the government is

\[
g_t + T_t + (1 + r_t) b_t = \tau^c_t c_t + \tau^l_t w_t l_t + \tau^k_t (q_t - \delta) k_t + b_{t+1}.
\]

This budget constraint, imposing a No-Ponzi scheme condition, implies the following intertemporal budget constraint

\[
\sum_{t=0}^{\infty} p_t [g_t + T_t] + p_0 (1 + r_0) b_0 = \sum_{t=0}^{\infty} p_t [\tau^c_t c_t + \tau^l_t w_t l_t + \tau^k_t (q_t - \delta) k_t]
\]

where \( p_t \), defined as follows, is the discount factor

\[
p_t = \prod_{i=0}^{t} \frac{1}{1 + r_i}.
\]

An equilibrium can be defined under the simplifying assumption that agents perfectly foresee the path of TFP, taxes and the exogenous interest rate.
Given an initial stock of capital and initial international assets \((k_0, a_0, b_0)\) and a sequence of government purchases \(\{g_t\}_{t=0}^{\infty}\), a competitive equilibrium for this economy consists of sequences for factor prices \(\{w_t, q_t\}_{t=0}^{\infty}\), allocations \(\{c_t, l_t, k_{t+1}, a_{t+1}\}_{t=0}^{\infty}\) and transfers \(\{T_t\}_{t=0}^{\infty}\) such that, 1) given prices and transfers, the sequence of allocations solves the household’s problem, 2) given prices, the sequence of labor and capital allocations solves the firm’s problem and 3) transfers satisfy the government’s intertemporal budget constraint (4).

3 Data and Calibration

The model is solved using data from the Korean economy. Figure 1 shows per capita GDP, consumption and investment in Korea for the period 1990-2007. All series are linearly detrended by the average annual growth rate of output between 1980-2007, and they are normalized such that the values for the third quarter of 1997, which is the last quarter before the crisis, equal one.

During the crisis in 1998, the declines in output and consumption are quite large, and consumption falls more than output. Output decreases by 12.17% and consumption decreases by 17.96% annually from 1997 to 1998. The fact that consumption declines more than output shows the inability of consumers to smooth their consumption. This observation is consistent with the fact documented by Neumeyer and Perri (2005) and Aguiar and Gopinath (2007) that consumption volatility is greater than output volatility in emerging markets. Investment, being the most volatile of all series, falls by 25.05% in the same year. Even though all variables start increasing after a few quarters, they do not reach their pre-crisis levels and they have declining trends starting roughly in 2000.\(^5\)

\(^5\)The average annual growth rate of GDP is 5.33% for the 1980-1997 period and 4.61% for the 1999-2007 period. Therefore, linearly detrending the series with the average growth rate for the whole period results in declining trends after the crisis.
In order to solve the model, the paths of exogenous shocks $\{z_t, r_t, \tau^c_t, \tau^l_t, \tau^k_t\}_{t=0}^{\infty}$ are computed using quarterly data for the period 1995Q2 to 2007Q4. The analysis is started in 1995Q2 due to availability of the interest rate data.

The series for TFP is computed as

$$z_t = \frac{y_t}{k_t^{1-\alpha}l_t^\alpha},$$

which requires data on $y_t$, $l_t$ and $k_t$. The details of the way these variables are constructed are explained in the appendix. The exponent of capital in the production function, $\alpha$, is set to 0.3, which is the standard value used in RBC studies. Otsu (2008), following Young (1995), uses 0.297 for the capital share parameter in a study of the Korean crisis.

The real interest rate is computed by subtracting expected inflation rate from the nominal interest rate. The nominal interest rate is the yield on treasury bonds with a 3-year maturity obtained from the Bank of Korea.\textsuperscript{6} Expected inflation is computed as the average of GDP deflator inflation in the current period and in the three preceding periods following Neumeyer and Perri (2005).

\textsuperscript{6}Since data on bond yields with a shorter maturity are available starting only in 2000, the yields on treasury bonds with a 3-year maturity are used in the model solution.
Figure 2. Exogenous Shocks
Tax rates on consumption, labor income and capital income are calculated using the method described by Mendoza, Razin and Tesar (1994). The calculated tax rates are average effective tax rates, defined as the ratio of tax revenue to the tax base. The details of the computation are given in the appendix. Since the data used in these computations are available on an annual basis, taxes are measured annually and they are assumed to remain constant throughout each year.

Figure 2 plots the paths of exogenous shocks for the period 1995Q2-2007Q4. The first panel shows the path of TFP, where the value for the third quarter of 1997 is normalized to one. The TFP reaches its lowest level in the first quarter of 1998, with a decline of 7.19% relative to its value in 1997Q3. In annual terms, the fall in average TFP is 5.98% from 1997 to 1998. For the same time period, output falls by 12.17%, labor falls by 9.62% and capital falls by 0.96%. Since the capital stock changes very slowly and labor falls less than output, the decline in TFP accounts for the remaining decline in output.

The real interest rate increases starting in 1996 before the crisis erupts. It remains high during 1997 and 1998 before it declines in the third quarter of 1998. The highest level it reaches during this period is 8.6% in annual terms in 1997Q4.

The capital and labor income tax rates have increasing trends, starting roughly in 1998. The labor income tax rate increases from 11.6% to 13.6% in 1998, while capital tax rate slightly increases from 19.1% to 19.7%. The consumption tax rate does not change much throughout this period and remains around 13%. In 1998 it decreases from 13.1% to 12.2%.

The parameters of the model are calibrated using data for the period 1980-2007 and the parameter values are summarized in Table 1. The discount factor, $\beta$, is set to match the average annual real interest rate of 4.25% for the period. The parameter that measures the disutility from working, $\psi$, is set to match an average time spent working of 28% of total discretionary time before 1998. The curvature of labor in the GHH preference specification, $\nu$, is set to 1.5 following Mendoza (1991). The curvature of the period utility, $\sigma$, is set to five following Neumeyer and Perri (2005). The value of the depreciation rate, $\delta$, is set by
the perpetual inventory method used to construct the series for the capital stock following Conesa, Kehoe and Ruhl (2007). It is chosen to be consistent with the average ratio of depreciation to GDP, which equals 11.46% in the data.

Table 1. Parameters of the benchmark model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.9896</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Utility curvature</td>
<td>5</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Labor curvature</td>
<td>1.5</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Labor weight</td>
<td>2.0663</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Capital income share</td>
<td>0.3</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.0108</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Ratio of government purchases to GDP</td>
<td>0.11</td>
</tr>
<tr>
<td>$\phi_a$</td>
<td>Bond holding cost</td>
<td>$10^{-4}$</td>
</tr>
<tr>
<td>$\phi_k$</td>
<td>Capital adjustment cost</td>
<td>1.65</td>
</tr>
<tr>
<td>$a_0$</td>
<td>Initial foreign assets of the household</td>
<td>$-6.43%$ of annual GDP</td>
</tr>
<tr>
<td>$b_0$</td>
<td>Initial foreign debt of the government</td>
<td>$-3.30%$ of annual GDP</td>
</tr>
</tbody>
</table>

The capital adjustment cost function is assumed to be of the form $\Phi_k(k_{t+1}, k_t) = \frac{\phi_k}{2} (k_{t+1} - k_t)^2$, where $\phi_k > 0$. The adjustment cost parameter $\phi_k$ is set so that the standard deviation of investment relative to output in the model matches the data. The bond holding costs have the form $\Phi_a(a_{t+1}) = \frac{\phi_a}{2} (a_{t+1} - a)^2$, where $a$ is the steady-state level of foreign assets and $\phi_a > 0$. The adjustment cost parameter $\phi_a$ is set to the minimum value that guarantees that the equilibrium solution is stationary. Since the model is solved using exogenous shocks that start in 1995Q2, the initial values of household’s net foreign assets, $a_0$, and government’s net foreign debt, $b_0$, are set at their respective levels at the end of the first quarter of 1995.

The exogenous sequence of government purchases $\{g_t\}_{t=0}^{\infty}$ is specified as a constant fraction of output, i.e. $g_t = \gamma y_t$ for all $t$. The fraction of output that is used by the government, $\gamma$, is set to 11% to match the average value of the ratio of government purchases to GDP in Korea for the period 1980-1997. The starting value of transfers is computed as the level that keeps the government’s starting value of foreign debt, $b_0$, constant in
the initial steady state given the taxes and the government purchases. Transfers are kept constant until the end of the sample period, i.e. 2007, and after this date they assume their new steady-state value and remain constant at this new level. The new steady-state value is calculated to make the intertemporal budget constraint of the government, equation (4), hold given the taxes and the government purchases.

4 Results

Following Meza and Quintin (2007) the model is solved under the assumption that agents foresee all shocks up to the third quarter of 1997, the last quarter before the crisis. After this date, they expect all shocks other than the interest rate to permanently assume their last values. As for the interest rate, households expect it to be constant at its initial steady state value, $\beta^{-1} - 1$, the only value compatible with zero long-run consumption growth. Therefore, agents do not expect a crisis to occur at the end of 1997 and they revise their expectations of future shocks when they observe the values of shocks in the last quarter of 1997. At this date, they update their expectations about the exogenous shocks to their actual values. This assumption is an approximation to a situation where households assign a positive but very small probability to the possibility of a crisis.

To compute the competitive equilibrium, the system of nonlinear equations that consists of the first-order conditions and the budget constraint of the government are solved numerically. This involves feeding in the exogenous shocks, government purchases and transfers, and solving for the allocations that satisfy the first-order conditions. In the benchmark model steady-state transfers are adjusted until the government’s intertemporal budget constraint is satisfied, for government purchases that equal $\gamma$ fraction of output and the given tax rates. In order to analyze the effects of additional borrowing during the crisis, the model is then solved with reduced tax rates for 1998. A tax cut of 25% is chosen as a baseline analysis and all of the tax rates are reduced by 25% of their 1998 levels while the government purchases are held the same as the benchmark model. The steady-
state transfers are again adjusted until the government’s intertemporal budget constraint is satisfied.

Figure 3 shows the paths of output, consumption, labor and capital-output ratio for the benchmark model and compares them to the data. Each time series is scaled by its respective value in the third quarter of 1997 to focus on the impact of the crisis. The annual changes in the variables from 1997 to 1998 in the data and the benchmark model are also reported in Table 3.

Output series generated by the model follows the data quite closely. Particularly, the model generates a fall in output very close to the data in the crisis episode, even though the path of output in the model stays below the data starting in 2000. In annual terms GDP falls by 12.17% in the data and by 12.96% in the model from 1997 to 1998. The fall in labor supply is also very close in the data and the model. The labor supply falls
by 9.62% in the data and 9.74% in the model in annual terms. The figure shows that the model generates a fall in labor input as soon as TFP falls during the crisis. However, the fall in labor input occurs with a slight lag in the data, and the recovery also occurs with a lag. The capital-output ratio generated by the model also closely follows the data.

The path of consumption generated by the model moves in the same direction as the data, however it is smoother, as would be expected in a standard model. The decline in consumption from 1997 to 1998 is 17.96% in the data, whereas it is 12.06% in the model. During the crisis, households reduce their consumption due to declining output and higher real interest rate, however, this decline is not as big as the decline in the data. Households increase their borrowing during the crisis in the model and consume more than in the data, at the cost of lower consumption in the future. However, the model still generates a sizable reduction in consumption—it falls by about the same percentage as output.

In order to see the effects of additional borrowing during the crisis, the model is solved with a 25% tax cut in 1998. With the government outlays held constant for the crisis period, reduced tax rates result in an increase in government debt. This analysis, therefore, shows how much of an expansion would have been possible with such an increase in government’s debt level. A 25% tax cut amounts to a 3.34 percentage point decline in labor income tax, 4.93 percentage point decline in capital income tax and 3.05 percentage point decline in consumption tax, from their initial levels of 13.6%, 19.7% and 12.2% respectively. In order to compare the effects of tax cuts of the three taxes separately, the model is also solved for the cases where only one of the tax rates is reduced. The tax rates used in the different counterfactual analyses are presented in Table 2.

<table>
<thead>
<tr>
<th>Table 2. Tax rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data and Benchmark Model</td>
</tr>
<tr>
<td>( \tau^l )</td>
</tr>
<tr>
<td>( \tau^k )</td>
</tr>
<tr>
<td>( \tau^c )</td>
</tr>
</tbody>
</table>
The quantitative results in terms of the changes in the main macroeconomic variables during the crisis year for the proportional tax reduction are reported in Table 3 and presented together with the results from the benchmark model in Figure 4.

Figure 4. Predictions of the benchmark model and the proportional tax reduction

The last column in Table 3 shows the change in each variable in the proportional tax reduction case compared to the benchmark model, showing the effects of the tax cut. As a result of the proportional tax cut, output decline is reduced by 5.23 percentage points. In the benchmark model output decreases by 12.96%, whereas in the case of expansionary fiscal policy it decreases by 7.73%. The increase in output is mainly due to the change in labor supply, which increases substantially as a result of the tax cut on labor income. Labor only decreases by 1.93% compared to a 9.74% decline before the tax cut. Consumption increases both because the consumption tax rate is lower and the marginal utility of consumption is higher due to a higher labor effort. The decline in consumption goes from 12.06% to 6.14%,
resulting in a 5.92 percentage point increase. With the reduction in the capital income tax rate, households increase their investment. However, since capital accumulation occurs slowly and the tax cut lasts only one year, the capital stock increases only slightly by 0.07%.

The increase in the public debt-to-GDP ratio resulting from the proportional tax cut is 4.10 percentage points. Since the government outlays are held constant for the crisis period, reduced tax rates lead to an increase in government debt. However, the revenue loss of the government due to the tax cut has to be compensated in the long run. Therefore, the steady-state transfers are reduced so that the present value budget constraint of the government, equation (4), holds. The required reduction in transfers is 1.42% of the steady-state transfers used in the benchmark analysis. The change in welfare as a result of the implemented policy is also presented in the table. While there is an increase in output and consumption in the short run, the revenue loss of the government has a cost of lower consumption in the long run due to reduced transfers to the household. The results show that the tax reduction leads to a welfare gain, considering both of these effects together. The change in welfare is represented by the permanent change in consumption required to equate lifetime utility under the counterfactual policy to the lifetime utility under the baseline policy and the welfare gain equals a permanent 0.078% increase in consumption.

Table 3. Proportional tax reduction

<table>
<thead>
<tr>
<th>Annual change in</th>
<th>Data</th>
<th>Benchmark</th>
<th>Proportional tax reduction</th>
<th>Change relative to benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>-0.1217</td>
<td>-0.1296</td>
<td>-0.0773</td>
<td>0.0523</td>
</tr>
<tr>
<td>Consumption</td>
<td>-0.1796</td>
<td>-0.1206</td>
<td>-0.0614</td>
<td>0.0592</td>
</tr>
<tr>
<td>Labor</td>
<td>-0.0962</td>
<td>-0.0974</td>
<td>-0.0193</td>
<td>0.0781</td>
</tr>
<tr>
<td>Capital</td>
<td>-0.0023</td>
<td>-0.0232</td>
<td>-0.0225</td>
<td>0.0007</td>
</tr>
<tr>
<td>Change in debt-to-GDP ratio (% points)</td>
<td>4.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in the steady-state transfers</td>
<td>1.42%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in welfare (% consumption)</td>
<td>0.078%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the proportional tax reduction case, the results show the combined effect of tax cuts
on all types of taxes. In order to disentangle the effect of each tax rate, the same analysis is carried out for a 25% tax cut of each tax rate separately. When the tax rates are reduced one by one, the tax cut on labor income turns out to have contributed the most to reducing the declines in output, consumption and labor. The decline in output is reduced by 3.01 percentage points with a labor tax cut while it is reduced by 2.14 percentage points with a consumption tax cut. Consumption decline is reduced by 3.22 and 2.53 percentage points, respectively, for the two tax cuts making labor income tax cut more effective again. The decline in labor is lower with a labor income tax cut as well. A reduction in the capital tax rate is the least effective of all policies leading to a very small increase in all variables.

The increase in the debt-to-GDP ratio and the reduction in the steady-state transfers are lower with the labor income tax cut compared to the consumption tax cut. Since the reduction in the labor tax generates a higher economic expansion at a lower cost than the consumption tax cut, it also leads to a higher welfare gain. While the long-run cost of the capital tax cut is the lowest, since it has a very small effect on all variables during the crisis period, the welfare gain is the lowest under this policy.

Table 4. Increase relative to benchmark for each type of tax

<table>
<thead>
<tr>
<th>Annual change in</th>
<th>Benchmark Model</th>
<th>Prop. tax reduction</th>
<th>Labor tax reduction</th>
<th>Capital tax reduction</th>
<th>Cons. tax reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>-0.1296</td>
<td>0.0523</td>
<td>0.0301</td>
<td>0.0001</td>
<td>0.0214</td>
</tr>
<tr>
<td>Consumption</td>
<td>-0.1206</td>
<td>0.0592</td>
<td>0.0322</td>
<td>0.0001</td>
<td>0.0253</td>
</tr>
<tr>
<td>Labor</td>
<td>-0.0974</td>
<td>0.0781</td>
<td>0.0447</td>
<td>0.0001</td>
<td>0.0317</td>
</tr>
<tr>
<td>Capital</td>
<td>-0.0232</td>
<td>0.0007</td>
<td>0.0003</td>
<td>0.0002</td>
<td>0.0002</td>
</tr>
<tr>
<td>Change in debt-to-GDP (% points)</td>
<td>4.10</td>
<td>1.64</td>
<td>0.68</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>Reduction in the steady-state transfers</td>
<td>1.42%</td>
<td>0.52%</td>
<td>0.24%</td>
<td>0.58%</td>
<td></td>
</tr>
<tr>
<td>Change in welfare (% consumption)</td>
<td>0.078%</td>
<td>0.045%</td>
<td>0.003%</td>
<td>0.033%</td>
<td></td>
</tr>
</tbody>
</table>

In order to see how the results change depending on the magnitude of the tax cut, the model is solved for proportional tax reductions of 15% and 35% as additional counterfactual analyses. The results show that an increase in the government’s debt level by 2.44% of output and the resulting tax cut lead to a 3.10 percentage point increase in output. An
additional debt of 5.79% of output, on the other hand, increases output by 7.39 percentage points. With this policy, the labor supply actually increases during the crisis year by 1.35% compared to the 9.74% decline in the benchmark model without any tax cut. The welfare gain also increases with the magnitude of the tax cut.

Table 5. Different levels of proportional tax reduction

<table>
<thead>
<tr>
<th>Annual change in</th>
<th>15%</th>
<th>25%</th>
<th>35%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tax reduction</td>
<td>tax reduction</td>
<td>tax reduction</td>
</tr>
<tr>
<td>Output</td>
<td>0.0310</td>
<td>0.0523</td>
<td>0.0739</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.0348</td>
<td>0.0592</td>
<td>0.0847</td>
</tr>
<tr>
<td>Labor</td>
<td>0.0462</td>
<td>0.0781</td>
<td>0.1109</td>
</tr>
<tr>
<td>Capital</td>
<td>0.0004</td>
<td>0.0007</td>
<td>0.0009</td>
</tr>
<tr>
<td>Change in debt-to-GDP (% points)</td>
<td>2.44</td>
<td>4.10</td>
<td>5.79</td>
</tr>
<tr>
<td>Reduction in the steady-state transfers</td>
<td>0.82%</td>
<td>1.42%</td>
<td>2.06%</td>
</tr>
<tr>
<td>Change in welfare (% consumption)</td>
<td>0.049%</td>
<td>0.078%</td>
<td>0.105%</td>
</tr>
</tbody>
</table>

5 Conclusions

This paper quantitatively analyzes the costs of reduced government borrowing during a financial crisis by studying the effects of tax reductions that would have been possible if the government had access to additional borrowing, using a small open economy version of the neoclassical growth model. The question is analyzed in the context of the 1997 financial crisis in Korea. In the analysis, the tax rates on consumption, capital income and labor income are reduced 25% during the crisis, leading to an additional borrowing of 4.10% of GDP. Such a tax cut results in an increase in output of 5.23 percentage points and in consumption of 5.92 percentage points, showing how much of an expansion would have been possible with additional government debt of 4.10% of GDP. This policy is welfare improving with a welfare gain equal to a permanent 0.078% increase in consumption. When the tax rates are reduced one by one and the effects of each tax rate are analyzed separately, labor income tax reduction turns out to be more effective than the other policies in terms of reducing the economic contraction and leads to a higher welfare gain as well.
References


6 Appendix

Figure A1. Output and current account-to-GDP ratio in emerging market economies

Construction of the Series Used in the Paper

**GDP**: The data on GDP are obtained from IFS. To compute real GDP in constant 2005 prices, I multiplied the real GDP index by the nominal value of annual GDP in 2005.

**Capital Stock**: The capital stock is generated using a perpetual inventory method. The investment series used to compute the capital stock is the gross fixed capital formation series reported by IFS. To convert this nominal series into 2005 wons I took the ratio of nominal investment to nominal GDP, and then multiplied with the GDP series in 2005 prices. This series is then seasonally adjusted. For constructing the capital stock series with the perpetual inventory method, the capital stock at the beginning of the investment series
and a value for the depreciation rate, $\delta$, have to be determined. I follow Conesa, Kehoe and Ruhl (2007) in setting these values. The depreciation rate is chosen to be consistent with the average ratio of depreciation to GDP observed in the data over the 1980-2007 period, which equals 0.1146. The value of the capital stock is set such that the capital-output ratio in the initial period matches the average capital-output ratio over some reference period. The initial capital stock is therefore set so that the capital-output ratio in 1960 matches its average over 1961–70.

**Labor Input:** I first calculated total hours worked by multiplying average weekly hours with total employment. This series is scaled by total weekly discretionary time (divided by 98 as in Correia et al., 1995), and seasonally adjusted, which is then used as the measure of total hours worked to calculate total factor productivity as explained below.

To calibrate the parameter that measures the disutility from working, $\psi$, a measure of total hours per capita is needed. Therefore, I divide total hours worked by the total working age population, which is population of age 15 and higher. I then set $\psi$ so that the steady state labor supply equals average of total hours per capita as a fraction of total discretionary time. All data come from Statistics Korea (Korean Statistical Information Service).

**Total Factor Productivity:** The data on TFP have been constructed as

$$z_t = \frac{y_t}{k_t^{\alpha} l_t^{1-\alpha}}$$

where $y_t$ and $k_t$ are detrended output and capital series. Both series are linearly detrended by the average annual growth rate of real GDP between 1980-2007, which is 4.62%.

**Tax rates:** The tax rates have been computed using the method described by Mendoza, Razin and Tesar (1994).

The tax categories reported in OECD’s Revenue Statistics database are:
1100: Taxes on income, profits and capital gains of individuals
1200: Taxes on income, profits and capital gains of corporations
2000: Total social security contributions
2200: Employer’s contributions to social security
3000: Taxes on payroll and workforce
4100: Recurrent taxes on immovable property
4400: Taxes on financial and capital transactions
5110: General taxes on goods and services
5121: Excise taxes

The other data used in the computation of the tax rates come from the Bank of Korea and are categorized as follows:

C: Private Final Consumption Expenditure
G: Government final consumption expenditure
GW: Compensation of employees paid by government
W: Wages and salaries
HHOS: Household Operating Surplus
HHPI: Household Property Income
OS: Operating Surplus

Consumption tax rate:

\[ \tau_c = \frac{5110 + 5121}{C + G - GW - (5110 + 5121)} \]

In order to construct labor income and capital income tax rates, first the average tax rate on household’s total income is computed:

\[ \tau_h = \frac{1100}{W + HHOS + HHPI} \]
Tax rate on labor income:

\[ \tau_l = \frac{\tau_h W + 2000 + 3000}{W + 2200} \]

Tax rate on capital income:

\[ \tau_k = \frac{\tau_h (HHOS + HHPI) + 1200 + 4100 + 4400}{OS} \]