# Fiscal Sustainability and Contingent Liabilities from Recent Credit Expansions in South Korea and Thailand*

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While South Korea and Thailand had relatively sustainable fiscal policies prior to the Asian crisis, the long-term cost of the bailout of their financial sectors amounted to an estimated 30 to 40 percent of output, which was largely financed by public borrowing. The recent credit expansions in South Korea and Thailand have created new contingent liabilities for the governments of the two countries. This paper evaluates the impact of these rapid credit expansions on the sustainability of fiscal policy in South Korea and Thailand. In Thailand, a rapid credit expansion preceded the currency collapse that heralded the Asian crisis. Fiscal policy in South Korea appears to be consistent with its long-run budget constraint, while fiscal policy in Thailand is not consistent with its long-run budget constraint. A loss in international confidence may considerably tighten their borrowing limit very rapidly, regardless of the long-run sustainability of fiscal policy.

## 1. Introduction

In the decades before the 1997–1998 Asian financial crisis, South Korea and Thailand experienced sustained economic growth attributable to investment growth and productivity gains. The investment underlying this economic expansion was financed by relatively high levels of private savings as well as by foreign borrowing. During the crisis, international creditors lost confidence in these countries, prompting higher costs of borrowing, and leading to a wave of bankruptcies by many seemingly sound firms. This further undermined international investor confidence and led to a rapid outflow of short-term capital and a sharp depreciation of domestic currencies, a phenomenon termed a *sudden stop* by Calvo (1998) and (Calvo and Reinhart 1999). The ensuing crisis led to the collapse of the financial sector and of economic activity.

The rapid expansion of foreign credit is seen by many as the primary cause of the Asian financial crisis. Calvo has argued in many papers that traditional theories of emerging market crises that identify poor fiscal performance as the direct cause of instability are not sufficient to explain the sudden stop episodes. Instead, he argues that weaknesses in the financial sector, particularly those due to a large portion of foreign exchange-denominated liabilities in the domestic financial sector, make emerging markets particularly prone to crises.

In line with Calvo's arguments, South Korea and Thailand had relatively sustainable fiscal policies prior to the Asian crisis.[1] However, the long-term bailout cost of their financial sectors amounted to an estimated 30 to 40 percent of output in both countries. This was financed largely by public borrowing. This large increase in public debt deteriorated the countries' fiscal accounts. Governments in both countries were forced to increase taxes and cut social spending to free resources to repay the debt.

The global economic slowdown of 2000–2002 restrained export growth and limited the amount of foreign funds available to South Korea and Thailand. Moreover, to limit further vulnerability to capital flow reversals, these countries were reluctant to rely on additional foreign funds and thus instituted capital controls and began paying off foreign loans. With foreign financing precluded, both countries sought to stimulate their economies by expanding domestic demand. However, the governments were restrained from boosting domestic demand through expansionary fiscal policy because policies recommended by the International Monetary Fund (IMF) encouraged greater fiscal austerity. Consequently, South Korean and Thai policymakers encouraged domestic demand by increasing public credit and encouraging commercial banks to increase credit to private firms and domestic consumers. Led by private consumption, both economies expanded. In

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1. For the purposes of this paper, a policy is sustainable if it is consistent with the long-run government budget constraint if maintained indefinitely.

South Korea, output grew by over 6 percent in 2002, and consumption grew by 6.7 percent. In Thailand, output grew by 5.4 percent in 2002 and by 6.7 percent in 2003, and consumption grew by 4.9 percent and 6.2 percent, respectively.

The recent credit expansions in South Korea and Thailand create new contingent liabilities for the governments of each of these countries as the probability of a banking crisis (and its size) increases if private credit grows very rapidly above trend. Indeed, one factor that can weaken a financial sector and often leads to a sudden stop episode is a rapid expansion of credit to the private sector. Examining historical evidence on the cost of deflating credit expansions in emerging markets, a study by the IMF (2004) finds that if private credit expands too rapidly above a historical trend, termed a *credit boom,* the expansion usually deflates under its own weight, just as stock market bubbles eventually burst. The IMF study finds that private credit booms in emerging markets are associated with consumption and investment booms (with a 70 percent probability), followed by banking crises (75 percent) and currency crises (85 percent).

Credit expansions create contingent liabilities that are not directly measured by the government's debt position. These contingent liabilities include both explicit liabilities, created by bank insurance funds and government ownership of government banks, and implied liabilities created by possible bailouts of the financial system. The IMF estimates that, for 60 emerging market banking crises, the average added debt was 14 percent of GDP (IMF 2003). For South Korea and Thailand, the increase in public debt alone was in the order of 20 to 30 percent of GDP (He 2004).

The goal of this paper is to evaluate the sustainability of fiscal policy in South Korea and Thailand in the presence of contingent liabilities created by rapid credit expansion. First, I identify periods of rapid credit expansion in South Korea and Thailand using a methodology proposed by the IMF (2004). I show that both South Korea and Thailand have experienced rapid credit expansions in recent years. For Thailand, a rapid expansion preceded its currency collapse, which heralded the Asian crisis. The analysis shows that South Korea and Thailand have experienced periods of rapid credit growth that put them at risk of financial instability, which may in turn prove a threat to fiscal sustainability.

Second, I analyze the long-run sustainability of fiscal policy using an empirical test suggested by Bohn (1998). The test addresses the question of whether governments respond to larger public debt by increasing their primary surpluses. If governments respond in such a way, they can be shown, under mild conditions, to satisfy their long-run budget constraint. I find that fiscal policy in South Korea has been consistent with its long-run budget constraint. But in Thailand, especially for the 1990s, fiscal policy has not been consistent with its long-run budget constraint. Further, I ask whether, in the face of increasing contingent liabilities from recent credit booms, the governments of South Korea and Thailand are taking corrective actions. In particular, I augment the Bohn regressions by including variables to measure private credit expansion. The increase of credit to the private sector represents a contingent liability to the government. I find that, while South Korea has not been provisioning for increased contingent liabilities by increasing its fiscal surplus, Thailand has run larger *deficits* as private credit has grown.

Finally, I analyze the sustainability of fiscal policy by presenting the results of stress tests on the level of public debt. In particular, I estimate a debt limit proposed by Mendoza and Oviedo (2004) for South Korea and Thailand. Then, I ask how close these economies come to their debt limit if they are forced to increase public debt to bail out the financial system again. I also estimate how much tighter their borrowing limit would become if international investors lost confidence in those economies and demanded higher interest rates for lending funds to the government. The results for both countries show that a loss of confidence in their economies may tighten their borrowing limit considerably.

The rest of the paper is organized as follows. Section 2 presents the methodology that will be used to assess the sustainability of fiscal policy in South Korea and Thailand in the face of rapid credit expansions. Section 3 briefly describes some salient features of the data used in the paper. Section 4 presents the results of the analysis. Section 5 concludes.

## 2. Methodology

This section presents the basic tools to evaluate the sustainability of fiscal policies in South Korea and Thailand in the face of rapid credit expansions. First, a measure is presented that identifies episodes of rapid credit expansion, termed credit booms, in each country. The aim of the analysis is mostly descriptive. Credit booms are important to isolate because they have often been associated with periods of subsequent economic collapse, particularly in developing economies (IMF 2004). Then, I introduce two basic measures of fiscal sustainability. The first, by Bohn (1998), tests whether governments respond to an increase in public debt by running larger primary surpluses to maintain their long-run budget constraint. The second, by Mendoza and Oviedo (2004), estimates a borrowing limit that ensures that governments repay their debt under the most adverse conditions while maintaining a minimum

level of expenditures. Thus, the Bohn test is a long-run test of sustainability, while the Mendoza-Oviedo debt limit ensures that the government has enough short-term (period-by-period) liquidity to service debt obligations.

### *2.1. Identifying Credit Booms*

Two recent papers by Gourinchas et al. (2001) and the IMF (2004) present alternative ways to measure credit booms. In Gourinchas et al. (2001), the authors use the deviation of the ratio of private credit to nominal GDP from a rolling stochastic trend as the relevant measure of credit. Private credit is measured from the IMF's International Financial Statistics (IFS) as claims on the nonbanking private sector from banking institutions. Boom episodes are identified as periods when the deviation from the trend is larger than a given absolute threshold (a fixed percent deviation from trend) common for a set of countries. In IMF (2004), the authors choose a similar measure of private credit. Where possible, they add claims on the private sector by other financial entities to claims on the nonbanking private sector from banking institutions, deflated by the consumer price index. They define a credit boom as a credit expansion that exceeds a given threshold equivalent to 1.75 times the standard deviation of that country's credit fluctuation around trend. Thus, for a country that has more volatile credit, the percentage deviation from trend will have to be larger for an episode to constitute a credit boom than for a country with less volatile credit.

To obtain a measure of private credit for this article, I add claims on the private sector by other financial entities (IFS, line 42d) to claims on the nonbanking private sector from banking institutions (IFS, line 22d). I then deflate this measure of nominal private credit by the consumer price index. Since this is a stock variable, I average it across consecutive periods. I call this variable CRHP.

The second measure of private credit I use, closer in spirit to Gourinchas et al. (2001), divides the average private credit over two consecutive periods by the GDP in the second period. I call this variable CRVAR. CRHP has the advantage of isolating the evolution of real credit independently of the evolution of output. This is important because, as the IMF (2004) study found, credit booms are frequently associated with output booms. The CRVAR measure of private credit would probably be low during output booms, as it is based on a credit-to-GDP ratio. However, the CRHP measure would still capture an abnormally high real credit figure, regardless of the evolution of output. CRHP measures the *absolute* size of private credit, while CRVAR measures the size of private credit *relative* to GDP.

I give two definitions of a credit boom. First, I define a credit boom as a credit expansion that exceeds 1.64 times the standard deviation of that country's credit fluctuation around trend. The trend is estimated using a Hodrick and Prescott (1980) (HP) filter. This threshold results in credit booms occurring approximately 5 percent of the time if real credit is Normally distributed. This threshold is dependent on the volatility of the underlying private credit series, and I thus call it a *relative threshold.* One drawback of such a threshold is that, given a certain volatility, every country is expected to be in a credit boom approximately 5 percent of the time. The second definition of a credit boom I use gives the threshold as 5 percent above trend. This *absolute threshold* implies that countries that have more volatile series will experience more credit booms.

### *2.2. Measuring Fiscal Sustainability*

I present two measures of government fiscal sustainability. The first, by Bohn (1998), assesses whether a government reacts to increasing private debt by running larger primary surpluses, thus ensuring the long-run sustainability of its fiscal accounts. The second, by Mendoza and Oviedo (2004), gives what the authors call a natural debt limit (NDL) that ensures that a government will have enough liquidity to service its debt if revenue falls to its observed minimum for an extended period of time. This differs from the sustainability test proposed by Bohn (1998) in that it focuses on the government's ability to repay debt at *each point in time,* whereas Bohn's test focuses on the *long-run* sustainability of fiscal accounts.

The strategy proposed by Bohn (1998) to assess the sustainability of fiscal policy is to test whether a government acts to increase surpluses in response to increases in government debt in order to ensure long-term government solvency. Bohn suggests using the primary surplus, $s_t$, as the instrument of government policy because the primary surplus does not include interest payments, which can change due to changes in interest rates that are not controlled by the government. Exogenous interest rate shocks can make the overall government deficit and debt increase contemporaneously, even if the government is responding to the shock by improving the primary surplus.

Bohn (1998) suggests running the following regression:

$$(1) \quad s_t = \alpha_0 + \alpha_d d_t + \alpha_G \,\mathrm{GVAR}_t + \alpha_Y \,\mathrm{YVAR}_t + \epsilon_t,$$

where $s_t$, which represents the primary surplus (as a fraction of GDP), is the dependent variable; $d_t$ is the debt-to-GDP ratio; $\epsilon_t$ is the regression error; and GVAR and YVAR are noninterest determinants of surplus taken from a gov-

Box 1
EVOLUTION OF GOVERNMENT DEBT

The evolution of government debt through time can be written as

$$D_{t+1} = D_t(1 + r_t) - S_t,$$

which states that next period's government debt ($D_{t+1}$) is derived from the maturing debt, $D_t$, plus payments on principal and interest, $r_t D_t$, minus the primary surplus, $S_t$. The primary surplus is given by the difference of total real government revenue, $T_t$, and current real outlays, $G_t$, $S_t = T_t - G_t$. To rewrite the evolution of debt in terms of ratios-to-GDP ($Y_t$) and the real interest rate ($r_t$),

$$(1 + \gamma_t)d_{t+1} = d_t(1 + r_t) - s_t,$$

where lowercase letters represent the variable as a fraction of GDP; that is, $d_t \equiv \frac{D_t}{Y_t}$ and $s_t \equiv \frac{S_t}{Y_t}$, and the growth rate of output $\gamma_t \equiv \frac{Y_{t+1}}{Y_t} - 1$.

ernment revenue-smoothing model by Barro (1979). (See Box 1 for a simple derivation of the relationship between the primary surplus and the evolution of government debt.) These variables capture unusual increases in government expenditures (GVAR) and output (YVAR). The variables are constructed as in Barro (1986) except that the trend is estimated using an HP filter. If the estimated coefficient on debt, $\alpha_d$, is positive, then primary surpluses increase when government debt increases. Bohn shows that, under mild conditions, this implies that fiscal policy is sustainable in the sense that maintaining such a policy for an indefinite period of time would satisfy a nation's long-run government budget constraint. In practice, I will use a measure of lagged debt, $d_{t-1}$, instead of contemporaneous debt to take into account possible policy lags due to the political cycle.[2]

### 2.3. Fiscal Sustainability in the Presence of Credit Expansions

I extend the basic Bohn regression for the determination of government fiscal policy given by equation (1) to include a measure of private credit expansion, CREDIT:

$$(2)\quad s_t = \alpha_0 + \alpha_d d_t + \alpha_G \,\mathrm{GVAR}_t + \alpha_Y \,\mathrm{YVAR}_t + \alpha_{CR}\,\mathrm{CREDIT}_t + \epsilon_t.$$

In practice, I use one of two measures of credit to determine credit booms, CRHP or CRVAR. The goal of this exercise is to test whether governments tend to run larger primary surpluses in the face of credit expansions. While the specification given in equation (1) tests whether a government responds to an increase in explicit liabilities, equation (2) also tests whether it responds to an increase in contingent liabilities that do not show up on the government's public debt figures. Of course, some of the movement in credit may be either direct credit by the government to the private sector (e.g., through government-owned banks) or a result of government policy (e.g., because of financial liberalization or relaxed lending standards) which raises the issue of endogeneity of credit.

The issue of missing variables arises in the specification of equation (2) because the government may provision for increased liabilities by accumulating foreign reserves. If this is the case, a larger stock of reserves may allow governments to run bigger deficits when credit expands rapidly.[3]

Another issue that arises in the specification of equation (2) is that I proxy for the size of the contingent liabilities with the overall amount of credit extended to the private sector by banks. Instead I could have used the size of bank liabilities to proxy for the government's contingent liabilities. Indeed, Aizenman and Marion (2001) argue that large increases in bank liabilities due to a restatement of bank balance sheets to take into account offshore activities were at the heart of the crises of South Korea and Thailand. However, banks may be more willing to misrepresent liabilities than assets, and so measuring assets may give a better picture of the size of the financial sector. Furthermore, it has also been argued that the source of the crisis was related to the rapid growth of credit to domestic agents. Some of this credit may be measured by the domestic bank's intermediation of capital inflows. Indeed, Dooley and Shin (2001) argue that implicit and explicit guarantees by the government in South Korea encouraged the rapid capital inflow that preceded the crisis there.

### 2.4. Mendoza and Oviedo's Natural Debt Limit

Mendoza and Oviedo (2004) propose a maximum level of debt that can be sustained by fiscal policy, called the natural debt limit (NDL). This level of debt ensures that, when

2. Empirical work by Barro (1986) also uses a lagged measure of government debt.

3. To account for this possibility, I include a measure of reserves as an additional term in equation (2). The results of the credit expansion are robust to the inclusion of reserves on the right-hand side. The results of those regressions are available from the author upon request.

a country faces low revenue, the governments will have enough liquidity to stay current with debt payments while maintaining government expenditures at some minimum level. This maximum level of debt is consistent with lenders ensuring repayment of their obligations under the worst conditions. After accounting for average output growth, $\gamma$, the Mendoza-Oviedo NDL, denoted by $\overline{d}$, is given by:

$$d_t \leq \overline{d} \equiv \frac{t_{\min} - g_{\min}}{r - \gamma}, \tag{3}$$

where $t_{\min}$ is the minimum government revenue-to-output ratio and $g_{\min}$ is the minimum government expenditures-to-output ratio. Equation (3) states that government debt, $d_t$, cannot exceed the NDL given by $\overline{d}$. In practice, the authors suggest setting the minimum government revenue-to-output ratio at two times the standard deviation below the mean revenue level. For setting the minimum government expenditure-to-output ratio, the authors use the lowest level of expenditures that would lead to the highest debt-to-output ratio observed in the sample. Thus, the NDL is actually chosen to match the maximum observed debt-to-output ratio. The indicator is then used to estimate changes in the NDL that would arise from either increases in international interest rates or domestic growth slowdowns. It also demonstrates how large a financial crisis would have to be to push a country to its NDL.

A commonly used alternative to the NDL is proposed by Blanchard (1990). The Blanchard debt limit is the level of debt that is consistent with the long-run average primary surplus. It is similar in spirit to the Bohn (1998) test of fiscal sustainability in that they both test the long-run government budget constraint. It differs from the Mendoza-Oviedo NDL in that the latter enforces enough government liquidity to service debt at all points in time. The Blanchard debt limit, denoted by $\hat{d}$, is given by

$$d_t \leq \hat{d} \equiv \frac{t - g}{r - \gamma}, \tag{4}$$

where $t$ is the average government revenue-to-output ratio and $g$ is the average government expenditures-to-output ratio. The results in Section 4 will report the Blanchard debt limit to get a sense of how different the Mendoza-Oviedo NDL is from a commonly used measure of sustainability.

## 3. Data

Data were mainly obtained from two sources. For South Korea, the data were obtained from the SourceOECD website. For Thailand, the data were obtained from the 2004 World Development Indicators CD-ROM, published by the World Bank. Additionally, the private credit data for both countries were obtained from the IFS CD-ROM, published by the IMF.[4]

Table 1
Summary Statistics

| Series | Mean | St. Dev. | Min. | Max. |
|---|---|---|---|---|
| South Korea (1975–2003) | | | | |
| Primary surplus | 0.0205 | 0.0136 | –0.0069 | 0.0506 |
| Public debt | 0.1351 | 0.0527 | 0.0554 | 0.2180 |
| Govt. revenue | 0.2215 | 0.0317 | 0.1746 | 0.2903 |
| Govt. expenditure | 0.1980 | 0.0204 | 0.1706 | 0.2434 |
| Interest payments | –0.0031 | 0.0042 | –0.0120 | 0.0015 |
| YVAR | –0.0088 | 0.0331 | –0.1546 | 0.0220 |
| GVAR | 0.0084 | 0.0281 | –0.0273 | 0.1155 |
| CRHP | –0.0010 | 0.0319 | –0.0775 | 0.0682 |
| CRVAR | –0.0022 | 0.0344 | –0.0776 | 0.0401 |
| Thailand (1972–2001) | | | | |
| Primary surplus | –0.0337 | 0.0389 | –0.1136 | 0.0332 |
| Public debt | 0.1925 | 0.0869 | 0.0370 | 0.3541 |
| Govt. revenue | 0.1558 | 0.0230 | 0.1145 | 0.1915 |
| Govt. expenditure | 0.1739 | 0.0279 | 0.1252 | 0.2502 |
| Interest payments | 0.0145 | 0.0082 | 0.0019 | 0.0309 |
| YVAR | 0.0008 | 0.0093 | –0.0192 | 0.0182 |
| GVAR | 0.0004 | 0.0175 | –0.0306 | 0.0396 |
| CRHP | 0.0097 | 0.1047 | –0.1979 | 0.2423 |
| CRVAR | 0.0086 | 0.0819 | –0.1343 | 0.2784 |

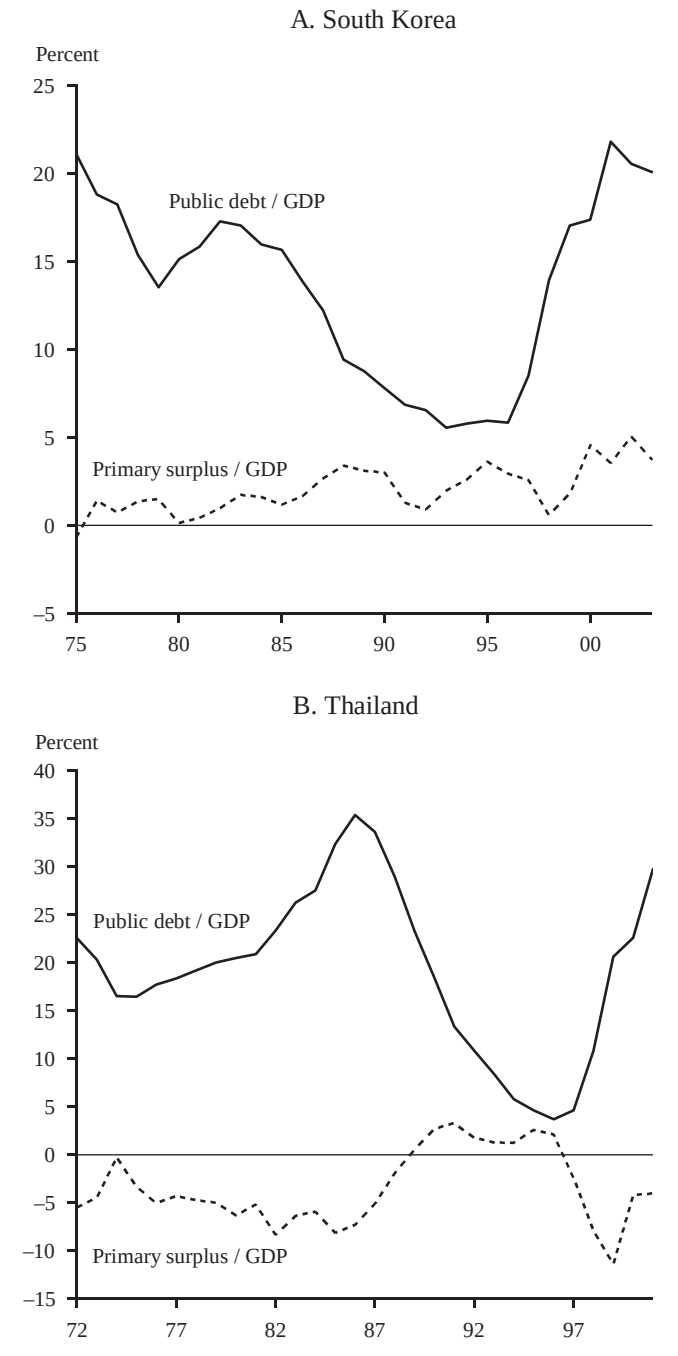
Sources: South Korea, OECD Economic Outlook No. 75, Vol. 2004 release 01; Thailand, World Development Indicators 2004.
Note: Variable definitions are available in the Appendix.

Table 1 gives summary statistics for each of the data series used in the paper. South Korea, between 1975 and 2003, has run an average primary surplus of 2 percent of GDP, with a standard deviation of 1.4 percent. Meanwhile, Thailand, between 1972 and 2001, has run an average deficit of 3.4 percent of GDP, with a standard deviation of 3.9 percent. Thus, Thailand has run deficits on average, while South Korea has run surpluses. Thailand's fiscal policy has been more volatile than South Korea's. Thailand's larger primary deficits are also reflected in its average public debt of 19.3 percent of GDP, against South Korea's 13.5 percent of GDP.

Figure 1 shows the evolution of the primary surplus, $s_t$, and public debt, $d_t$, both given as a percent of GDP, for South Korea and Thailand. Both countries show similar evolutions for their public debt. Beginning in the late 1980s, both South Korea and Thailand made efforts to reduce the burden of their public debt. Thailand began with a much larger debt, about 35 percent of GDP in 1986 compared with about 17 percent of GDP for South Korea before 1985. Thailand reduced its public debt to about

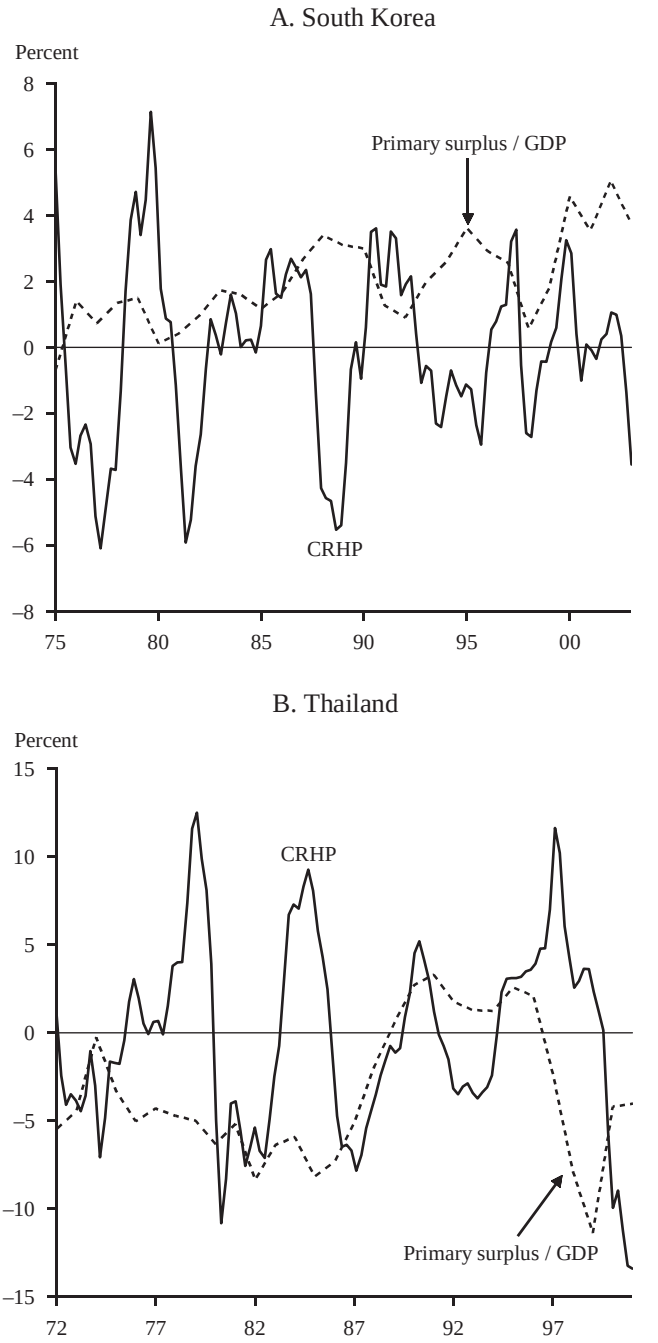
4. Details of the sources of each data series are available from the author upon request.

FIGURE 1
RATIO OF PRIMARY SURPLUS AND PUBLIC DEBT TO GDP




Sources: South Korea, OECD Economic Outlook No. 75, Vol. 2004 release 01; Thailand, World Development Indicators 2004.

FIGURE 2
RATIO OF PRIMARY SURPLUS TO GDP AND DEVIATION FROM TREND REAL PRIVATE CREDIT (CRHP)




Sources: South Korea, OECD Economic Outlook No. 75, Vol. 2004 release 01; Thailand, World Development Indicators 2004.

3 percent of GDP in 1996. South Korea was able to reduce its public debt to about 5 percent of GDP at the same time. During the Asian crisis, public debt in both countries rose rapidly, as the government in each country borrowed to bail out its struggling financial system. The figure also shows that, for most of the sample, South Korea ran a primary surplus, which tended to increase through the sample. Thailand, on the other hand, ran primary deficits for most of the sample, except for the period between 1990 and 1995. The figure also shows that Thailand had a more volatile fiscal policy than South Korea.

Figure 2 shows the evolution of the primary surplus, as a percent of GDP, and the percent deviation of real credit from its historical trend, CRHP. South Korea has had regular periods of private credit expansion and contraction. Those periods do not seem to be related fundamentally to the primary surplus. Moreover, the private credit expansion of the late 1990s does not appear to be abnormally above trend. Thailand, on the other hand, has a much more volatile evolution of private credit (note the different scale in the axis). It also appears that the credit expansion that preceded the Asian crisis was abnormally high.

## 4. Results

### *4.1. Credit Booms*

The results of the credit boom analysis for the CRHP and CRVAR series are listed in Table 2. Using the quarterly CRHP series from 1970 to 2003 for both countries and the relative threshold, credit booms are identified in South Korea for eight quarters: 1973:Q3–Q4, 1974:Q4–1975:Q1, 1979:Q1, and 1979:Q3–1980:Q1. Interestingly, the methodology does not identify the period preceding the Asian crisis as a credit boom for South Korea. For Thailand, credit booms are identified for six quarters: 1979:Q1–Q3, 1985:Q1, and 1997:Q4–1998:Q1. So, the methodology does pick up the rapid credit expansion in Thailand that preceded the Asian crisis as a credit boom.

One could argue that, if there are structural changes in the time series using a relative threshold that is defined, then using a constant volatility for the entire sample may miss credit booms if the volatility changes across time. For example, South Korea and Thailand both experienced significant financial reforms during the late 1980s and early 1990s that made credit grow rapidly as policies that alleviated financial repression were implemented. To take into account this possibility I also use an absolute threshold to identify credit booms. Using the absolute threshold and the CRHP series results in fewer periods of credit boom in South Korea and more in Thailand. For South Korea, the period preceding the Asian crisis is still not captured as a credit boom. Noticeably, Thailand seems to have experienced a credit boom recently (2003:Q3–Q4), which may indicate trouble in the future.[5]

Using the relative threshold to identify credit booms, the CRVAR series paints a rather different picture of when credit booms occur in each country. For South Korea the methodology using CRVAR still does not pick up the period preceding the Asian crisis as a boom. However, the period during the crisis is now identified as a credit boom (1998:Q2–1999:Q1). This probably reflects the fall in GDP as much as an increase in credit. For Thailand, the only periods of boom occur *during* and *after* the Asian crisis.[6]

Table 2
Credit Booms

| Country | Series | Threshold | Credit boom periods | |
|---|---|---|---|---|
| South Korea | CRHP | Relative | 73:Q3–Q4, 79:Q1, | 74:Q4–75:Q1, 79:Q3–80:Q1 |
| | | Absolute | 73:Q3–Q4, 79:Q4–80:Q1 | 75:Q1, |
| | CRVAR | Relative | 92:Q4, | 98:Q2–99:Q1 |
| | | Absolute | 98:Q2 | |
| Thailand | CRHP | Relative | 79:Q1–Q3, 97:Q4–98:Q1 | 85:Q1, |
| | | Absolute | 78:Q4–79:Q4, 90:Q4, 03:Q3–Q4 | 84:Q1–85:Q3, 97:Q3–98:Q2, |
| | CRVAR | Relative | 98:Q1–Q3, | 99:Q1–Q2 |
| | | Absolute | 97:Q4–99:Q4 | |

Sources: IMF International Financial Statistics and author's calculations.
Notes: Variable definitions are in the Appendix. The relative threshold is set at 1.64 times the standard deviation of the deviation from trend in each credit series, and the absolute threshold is set at 5 percent over trend.

### *4.2. Fiscal Sustainability*

The results for the fiscal sustainability tests are presented for the three data series considered: South Korea's yearly and quarterly observations and Thailand's yearly observations. For each set of observations, I also report results for two subperiods that split each sample in half. The breaks I use are 1989:Q4 for South Korea and the end of 1986 for Thailand. I choose to split the sample in half for simplicity. However, I also performed Chow-type tests of parameter stability and found a strong rejection in the null hypothesis of equality of parameters for each sample subperiod.[7,8] Moreover, the dates I use roughly correspond to a period when important financial market reforms were implemented in both countries (for example, see Bekaert et al. 2003).

5. One caveat is that it is difficult to estimate the trend reliably using any filter near the beginning and end of the sample. In fact, using a band pass filter instead of the HP filter did not identify 2003:Q3–Q4 as a period of credit boom.

6. The variable CRVAR is not available on a quarterly frequency for Thailand before 1993.

7. The small size of the sample is a factor that may lead to overrejection of the null hypothesis of no parameter change.

8. The results of the Chow tests for stability are available from the author upon request.

For South Korea, the results of the two data frequencies present somewhat different information. The quarterly observations potentially present more information about the behavior of the time series because of their higher frequency.[9] One caveat, however, is that the government of South Korea may not be able to respond to changes in debt or to credit growth at that high frequency. The political cycle may be such that changes to fiscal policy that determine the primary surplus may need more than one quarter to take effect. Nevertheless, because a government does have the ability to issue supplementary budgets and impose taxes more rapidly than after a year in response to changes in economic conditions, the quarterly data may capture those higher frequency responses by the South Korean government. Additionally, the use of yearly observations allows for better comparisons with the results for Thailand, where only yearly data are available.

### *4.2.1. Bohn Tests*

First, I present the results of the original fiscal sustainability tests proposed by Bohn (1998) given by equation (1). Table 3 gives the results of the regression for South Korea using yearly and quarterly observations, and for Thailand using yearly observations. For each data set, I present two alternative specifications. The first, the benchmark specification, is given by equation (1). The second adds a term to capture nonlinearities in the response of primary surpluses to increases in public debt, 2nd Debt Diff. This term measures the squared deviation of debt from its mean. A positive coefficient on this term means that the primary surplus reacts more the larger the deviation of debt from its mean.

For South Korea, using the full sample and yearly observations, the coefficient on debt is positive (0.0677) but it is not statistically significant. The positive coefficient suggests that fiscal policy in South Korea is sustainable given its past economic record. It is interesting to note that the coefficient for debt is negative, albeit insignificant, in the first half of the sample, while it is significantly positive in the second half of the sample. This suggests that, for the period up until 1989, South Korea did not run a sustainable fiscal policy, while for the second half of the sample South Korea's fiscal policy was sustainable. The nonlinear regression is consistent with the benchmark regression. If anything, it finds stronger evidence that South Korea's fiscal policy was sustainable for the whole sample. Interestingly, the nonlinear term is statistically significant, representing a greater reaction of fiscal policy to larger deviations of debt from its long-term mean.

The quarterly observations for South Korea reflect the basic results of the yearly observations. For the full sample, using the benchmark specification, the coefficient on debt is negative (–0.0096) but statistically insignificant. The coefficient on debt for the first half of the sample is negative (–0.188) and statistically significant, while for the second half of the sample the coefficient is positive (0.112) and strongly significant. Again, the quarterly regressions reinforce the idea that South Korea's fiscal policy is sustainable, especially since 1990:Q1. As with the yearly data, the nonlinear regression has similar results to the benchmark regression, and the coefficient on debt for the whole sample is positive and statistically significant.

For Thailand, using yearly observations, I find that the coefficient on debt is negative (–0.107) and moderately significant. This result suggests that Thailand's fiscal policy is not sustainable indefinitely. However, the coefficients on debt for each of the subperiods is positive and insignificant, which somewhat weakens the evidence that Thailand's fiscal policy has been unsustainable. The nonlinear specification also suggests that Thailand's policy is inconsistent with long-run sustainability for the whole sample. It appears, though, that for the first half of the sample, fiscal policy was sustainable over the long run, given the positive and highly significant coefficient on debt (0.356).

### *4.3. Fiscal Sustainability and Private Credit*

I now present the results of the fiscal sustainability regression augmented to include private credit as one of the regressors, equation (2). Table 4 presents the results for South Korea using yearly and quarterly observations, and for Thailand using yearly observations. For each data series, the first column repeats the results for the benchmark specification without a credit variable. The second and third columns include two different measures of private credit, CRHP (real credit) and CRVAR (credit/GDP). The results for each data series are on a regression based on the benchmark regression, but they are robust to the inclusion of nonlinear terms in the regression.[10]

9. I also performed an additional robustness test that is not included here to conserve space. As stated in the methodology section, the variable for public debt is included with a lag to take into account the lag in government response given institutional considerations. This was also done by Bohn (1998) in his original study. However, I also ran all regressions presented in the paper with debt entering contemporaneously with the primary surplus. The results are consistent with this alternative specification.

10. The fiscal sustainability and credit expansion results including nonlinear terms are not presented to conserve space. They are available from the author upon request.

TABLE 3
FISCAL SUSTAINABILITY

| | South Korea | | | | Thailand | |
|---|---|---|---|---|---|---|
| | Yearly | | Quarterly | | Yearly | |
| | Benchmark | Nonlinear | Benchmark | Nonlinear | Benchmark | Nonlinear |
| Full Sample | (1975–2003) | | (1975:Q1–2003:Q4) | | (1972–2001) | |
| Debt/GDP | 0.0677 | 0.122*** | –0.0096 | 0.0185 | –0.107* | –0.0904* |
| | (0.0429) | (0.0342) | (0.022) | (0.021) | (0.0590) | (0.0460) |
| GVAR | –0.800*** | –0.654*** | –0.928*** | –0.974*** | –1.605*** | –1.711*** |
| | (0.150) | (0.123) | (0.145) | (0.1178) | (0.326) | (0.290) |
| YVAR | –0.447** | –0.276* | –0.812*** | –0.644*** | –1.450** | –1.525*** |
| | (0.170) | (0.146) | (0.161) | (0.160) | (0.550) | (0.410) |
| 2nd Debt Diff. | — | 2.653*** | — | 2.464*** | — | 1.346*** |
| | — | (0.572) | — | (0.408) | — | (0.309) |
| $R^2$ | 0.54 | 0.72 | 0.35 | 0.51 | 0.65 | 0.74 |
| Total Obs. | 28 | 28 | 114 | 114 | 29 | 29 |
| First Period | (1975–1989) | | (1975:Q1–1989:Q4) | | (1972–1986) | |
| Debt/GDP | –0.0448 | –0.00534 | –0.188*** | –0.224*** | 0.158 | 0.356*** |
| | (0.0856) | (0.0919) | (0.029) | (0.022) | (0.0892) | (0.0713) |
| GVAR | –0.489*** | –0.402*** | –0.461*** | –0.500*** | –1.568*** | –1.596*** |
| | (0.135) | (0.112) | (0.119) | (0.119) | (0.200) | (0.131) |
| YVAR | –0.274 | –0.126 | –0.434** | –0.426** | –1.073** | –0.140 |
| | (0.164) | (0.176) | (0.166) | (0.168) | (0.419) | (0.248) |
| 2nd Debt Diff. | — | 2.993 | — | 1.606** | — | –2.090*** |
| | — | (1.950) | — | (0.607) | — | (0.483) |
| $R^2$ | 0.73 | 0.80 | 0.57 | 0.61 | 0.89 | 0.96 |
| Total Obs. | 14 | 14 | 59 | 59 | 14 | 14 |
| Second Period | (1990–2003) | | (1990:Q1–2003:Q4) | | (1987–2001) | |
| Debt/GDP | 0.153*** | 0.160*** | 0.112*** | 0.117*** | 0.0593 | 0.0843 |
| | (0.0235) | (0.0240) | (0.013) | (0.011) | (0.105) | (0.122) |
| GVAR | –0.917*** | –0.895*** | –0.869*** | –0.903*** | –1.141* | –1.004 |
| | (0.192) | (0.195) | (0.103) | (0.091) | (0.616) | (0.711) |
| YVAR | –1.151*** | –1.063*** | –1.042*** | –0.849*** | –3.210*** | –3.626*** |
| | (0.150) | (0.157) | (0.124) | (0.101) | (0.812) | (1.000) |
| 2nd Debt Diff. | — | 1.019 | — | 1.663*** | — | –0.624 |
| | — | (0.705) | — | (0.412) | — | (0.784) |
| $R^2$ | 0.87 | 0.89 | 0.79 | 0.84 | 0.79 | 0.80 |
| Total Obs. | 14 | 14 | 55 | 55 | 15 | 15 |

Sources: South Korea, OECD Economic Outlook No. 75, Vol. 2004 release 01; Thailand, World Development Indicators 2004.
Notes: Robust Standard errors are in parentheses; ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Variable definitions are available in the Appendix.

For South Korea, using the full sample with yearly observations, the coefficient on debt is positive but statistically insignificant and of similar magnitude for each augmented specification and for the benchmark specification.[11] The coefficients on CRHP (0.0102) and CRVAR (0.0101) are positive and insignificant for the full sample. This indicates that, for the full sample, South Korea's fiscal policy was not related with private credit growth. However, this result is not robust to separating the sample into two subperiods. The coefficient on credit is negative and not significant for CRHP in the first half of the sample. The coefficient on credit is negative for CRHP and CRVAR, and slightly significant for CRHP in the second

11. This is the case for most results of credit-augmented regressions. This indicates that the basic relationship between debt and primary surpluses is unaffected by the inclusion of credit measures.

Table 4
Fiscal Sustainability and Credit Expansion

| | South Korea | | | | | | Thailand | | |
|---|---|---|---|---|---|---|---|---|---|
| | Yearly | | | Quarterly | | | Yearly | | |
| | Benchmark | Real Credit | Credit/GDP | Benchmark | Real Credit | Credit/GDP | Benchmark | Real Credit | Credit/GDP |
| Full Sample | | (1975–2003) | | | (1975:Q1–2003:Q4) | | | (1972–2001) | |
| Debt/GDP | 0.0677 | 0.0680 | 0.0640 | –0.0096 | –0.0094 | –0.0089 | –0.107* | –0.252*** | –0.267*** |
| | (0.0429) | (0.0439) | (0.0497) | (0.022) | (0.0221) | (0.0237) | (0.0590) | (0.0735) | (0.0554) |
| GVAR | –0.800*** | –0.816*** | –0.804*** | –0.928*** | –0.931*** | –0.910*** | –1.605*** | –1.356*** | –1.275*** |
| | (0.150) | (0.191) | (0.151) | (0.145) | (0.149) | (0.196) | (0.326) | (0.361) | (0.213) |
| YVAR | –0.447** | –0.463** | –0.462** | –0.812*** | –0.809*** | –0.793*** | –1.450** | –1.167** | 0.232 |
| | (0.170) | (0.181) | (0.169) | (0.161) | (0.159) | (0.243) | (0.550) | (0.441) | (0.562) |
| CRHP | — | 0.0102 | — | — | 0.0064 | — | — | –0.160** | — |
| | — | (0.0676) | — | — | (0.0449) | — | — | (0.0765) | — |
| CRVAR | — | — | 0.0101 | — | — | –0.0117 | — | — | –0.281*** |
| | — | — | (0.0582) | — | — | (0.0707) | — | — | (0.0509) |
| $R^2$ | 0.54 | 0.54 | 0.54 | 0.35 | 0.35 | 0.35 | 0.65 | 0.70 | 0.81 |
| Total Obs | 28 | 28 | 28 | 114 | 114 | 114 | 29 | 29 | 29 |
| First Period | | (1975–1989) | | | (1975:Q1–1989:Q4) | | | (1972–1986) | |
| Debt/GDP | –0.0448 | –0.0518 | –0.134 | –0.188*** | –0.0511 | 0.0349 | 0.158 | 0.171* | 0.188** |
| | (0.0856) | (0.0740) | (0.0777) | (0.0286) | (0.0247) | (0.0289) | (0.0892) | (0.0867) | (0.0748) |
| GVAR | –0.489*** | –0.479** | –0.554*** | –0.461*** | –0.459*** | –0.517*** | –1.568*** | –1.589*** | –1.562*** |
| | (0.135) | (0.165) | (0.116) | (0.119) | (0.116) | (0.162) | (0.200) | (0.208) | (0.198) |
| YVAR | –0.274 | –0.270 | –0.472*** | –0.434** | –0.507*** | –0.471** | –1.073** | –1.249** | –1.075** |
| | (0.164) | (0.183) | (0.113) | (0.166) | (0.184) | (0.181) | (0.419) | (0.455) | (0.394) |
| CRHP | — | –0.0075 | — | — | –0.194*** | — | — | –0.0349 | — |
| | — | (0.0477) | — | — | (0.0328) | — | — | (0.0282) | — |
| CRVAR | — | — | 0.0957* | — | — | –0.189*** | — | — | –0.180 |
| | — | — | (0.0446) | — | — | (0.0691) | — | — | (0.105) |
| $R^2$ | 0.73 | 0.74 | 0.80 | 0.57 | 0.60 | 0.58 | 0.89 | 0.90 | 0.91 |
| Total Obs | 14 | 14 | 14 | 59 | 59 | 59 | 14 | 14 | 14 |
| Second Period | | (1990–2003) | | | (1990:Q1–2003:Q4) | | | (1987–2001) | |
| Debt/GDP | 0.153*** | 0.162*** | 0.156*** | 0.112*** | –0.0462 | –0.207*** | 0.0593 | –0.239** | –0.113*** |
| | (0.0235) | (0.0208) | (0.0251) | (0.013) | (0.0128) | (0.0114) | (0.105) | (0.102) | (0.0328) |
| GVAR | –0.917*** | –0.659** | –0.927*** | –0.869*** | –0.836*** | –0.788*** | –1.141* | –0.795* | –0.883*** |
| | (0.192) | (0.209) | (0.224) | (0.103) | (0.103) | (0.0986) | (0.616) | (0.403) | (0.180) |
| YVAR | –1.151*** | –0.855*** | –1.129*** | –1.042*** | –1.049*** | –0.451** | –3.210*** | –2.185*** | –1.169*** |
| | (0.150) | (0.228) | (0.191) | (0.124) | (0.128) | (0.221) | (0.812) | (0.561) | (0.274) |
| CRHP | — | –0.133* | — | — | 0.114*** | — | — | –0.274** | — |
| | — | (0.0647) | — | — | (0.0516) | — | — | (0.0929) | — |
| CRVAR | — | — | –0.0120 | — | — | 0.118*** | — | — | –0.247*** |
| | — | — | (0.0527) | — | — | (0.0681) | — | — | (0.0255) |
| $R^2$ | 0.87 | 0.89 | 0.87 | 0.79 | 0.79 | 0.83 | 0.79 | 0.87 | 0.94 |
| Total Obs. | 14 | 14 | 14 | 55 | 55 | 55 | 15 | 15 | 15 |

Sources: South Korea, OECD Economic Outlook No. 75, Vol. 2004 release 01; Thailand, World Development Indicators 2004.
Notes: Robust standard errors are in parentheses; ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Variable definitions are available in the Appendix.

half of the sample. These results give weak evidence that South Korea ran larger deficits in response to the expansion of private credit. These seemingly contradicting results may be due to the small sample size.

The results for South Korea using the quarterly observations are somewhat different than the results using yearly observations. For the full sample, the coefficients on debt are negative and insignificant, as they were on the quarterly benchmark specification. For the first half of the sample, the coefficients on debt are insignificant when I control for credit and positive for one credit measure (Credit/GDP). For the second half of the sample, the coefficients on debt are now negative and significant for the specification with Credit/GDP. Thus, the results of the quarterly specification weaken the earlier results that South Korea had unsustainable fiscal policy in the first half of the sample and sustainable fiscal policy in the second half of the sample. The coefficients for credit now give stronger evidence that South Korea ran larger primary deficits in the face of credit expansions in the first half of the sample but that it did provision for increased contingent liabilities by running larger primary surpluses in the second half of the sample. For the full sample, the coefficients on debt are insignificant.

For Thailand, the coefficients on debt when credit measures are included are of the same sign as in the benchmark regression. Including the private credit terms, the evidence that Thailand's fiscal policy was unsustainable for the whole sample is strengthened, and there is also stronger evidence that it was sustainable during the first half of the sample and became unsustainable after 1987. In contrast to South Korea, the coefficients on credit measures are negative and strongly significant for the full sample and the second subperiod. For the first subperiod, the coefficients on private credit are negative but insignificant. This indicates that, after accounting for the response of the primary deficit to debt, GVAR and YVAR, Thailand has been running larger primary *deficits*. So, instead of provisioning for larger liabilities, Thailand seems to be experiencing worsening fiscal conditions when private credit expands.

### *4.4. Mendoza-Oviedo Tests*

The results for South Korea for the Mendoza-Oviedo NDL tests for the sample period of 1975–2002 are not applicable because the country's average rate of per capita output growth during that period, 5.92 percent, largely exceeded estimates of the long-run interest rate. I focus instead on South Korea's performance between 1990 and 2002, which roughly corresponds to the second subsample of the fiscal sustainability results. During that time, South Korea's growth rate was 5.28 percent. For simplicity, I assume that South Korea paid an average real interest rate of 6 percent on public debt during the time period. The NDL is set at South Korea's maximum level of public debt between 1975 and 2002, 21.8 percent (see Table 1). Given the NDL, I find that the minimum government expenditure-to-output ratio, $g_{\min}$, is approximately two times the standard deviation below mean government expenditures.

As of 2003, the debt-to-output ratio for South Korea was about 20 percent. Thus, South Korea is very close to its NDL. More importantly, if the long-term interest rate for South Korea were to increase to 7 percent, the resulting NDL would be 9.1 percent of GDP, which suggests that South Korea would move above its NDL. Given that the IMF (2003) estimates that the average financial crisis costs, on average, 14 percent of GDP in terms of increased public debt, South Korea could find itself in trouble accessing international capital markets in the event of a crisis.

A few caveats for the results on South Korea are in order. First, the NDL calculations are very sensitive to the assumptions on growth rate and the international interest rate. The average interest rate, $r$, and output growth rate, $\gamma$ are in the denominator of NDL calculated with equation (3). Second, given South Korea's rapid rate of growth and mostly prudent fiscal policy, it is very likely that South Korea's NDL is above the 21.8 percent maximum debt level observed. Given the results of South Korea's fiscal sustainability calculations, its NDL could very well be closer to the 50 percent of GDP observed in other emerging markets. Finally, for comparison, the Blanchard ratio of sustainable debt is 327 percent of GDP, which seems too high of a natural debt limit.

Thailand's average output growth rate between 1972 and 2001 was about 4.6 percent. For simplicity, assume that Thailand faced the same average real interest rate as South Korea (6 percent). The NDL is set at Thailand's maximum level of public debt between 1972 and 2001, 35.4 percent (see Table 1). Given the NDL, I find that the minimum government expenditure-to-output ratio, $g_{\min}$, is approximately 2.5 times the standard deviation below mean government expenditures.

As of 2001, the debt-to-output ratio for Thailand was about 29.8 percent. Thus, Thailand also appears to be close to its NDL. However, if the interest rate were to increase to 7 percent, the resulting NDL would be about 20.5 percent. Thus, a long-term increase in the interest rate would push Thailand much closer to its NDL. One caveat is in order for Thailand's results: the NDL depends on the assumption that its government would be able to reduce expenditures to about 10.5 percent of GDP. Thailand's minimum level of expenditures over the sample period are 12.5 percent of GDP, so the implied fiscal adjustment that supports its NDL could be very hard to achieve. A second caveat involves the sensitivity of the NDL to small changes in the

interest rate and the growth rate. Finally, even though Thailand has had a worse fiscal policy and larger public debt levels compared with South Korea, its NDL may still be closer to the mean for other developing economies. The calculations show how changes in economic conditions may sharply reduce the borrowing limit for the governments of Thailand and South Korea.

## 5. Conclusions

Given the results of this paper, it appears that South Korea's fiscal policy has historically been consistent with its long-run balanced budget constraint. Moreover, it appears that the sustainability of fiscal policy has strengthened in recent years. However, South Korea has not provisioned to cover implied liabilities created by rapid increases in real private credit. If those increases were to become booms, South Korea might be pushed against its borrowing limits. However, there is little evidence that South Korea is near a credit boom, so the probability of reaching its NDL is low.

Thailand, on the other hand, appears to be running a fiscal policy that is inconsistent with satisfying its long-run balanced budget constraint. Moreover, it appears that the quality of fiscal policy has weakened. Additionally, Thailand has tended to run larger primary deficits in response to private credit growth. While Thailand seems to be far away from its NDL, a worsening of conditions, such as a long-term increase in the interest rate caused by loss of confidence and subsequent fiscal costs of dealing with a distressed financial sector, may push Thailand above its NDL.

Thailand's current and continuing ability to borrow internationally may call into question the reliability of Bohn's test of fiscal sustainability. For one thing, Bohn's test of sustainability of fiscal policy is a test of the long-run budget constraint. So, creditors may be willing to extend credit temporarily as long as Thailand keeps current with its international obligations. Additionally, there may be an expectation on the part of agents that fiscal policy may strengthen in the future. However, the NDL results suggest that sudden changes in lenders' economic perceptions that may be reflected in increases in interest rates can quickly reduce the amount of borrowing Thailand may be able to tap. This is particularly worrying if this coincides with a drop in the rate of output growth, which would be the time that Thailand would need to access capital markets the most.

Two factors will help the governments of South Korea and Thailand avoid a crisis or limit its effects should one occur. First, the current expansions in South Korea and Thailand are mostly financed by domestic residents in the form of domestic currency-denominated debt. Thus, these countries are not as vulnerable to a rapid depreciation of the exchange rate that would inflate the real cost of making debt payments, as in a sudden stop episode. Second, the currencies of Thailand and South Korea have tended to appreciate against the dollar and their current accounts have recorded large surpluses. Thus, South Korea and Thailand have accumulated substantial stocks of foreign assets to pay off debts and recapitalize their banks in the event of a crisis.

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## Appendix

Variable definitions are as follows:

$$\text{GVAR} = (G - G^{tr})/y$$

$$\text{YVAR} = (1 - (Y^{tr}/Y))(G^{tr}/y)$$

$$\text{2nd Debt Diff.} = (d_t - \overline{d})^2$$

$$\text{CRHP} = \log[0.5 * (CR_t/CPI_t + CR_{t-1}/CPI_{t-1})] - [\log[0.5 * (CR_t/CPI_t + CR_{t-1}/CPI_{t-1})]]^{tr}$$

$$\text{CRVAR} = 0.5 * (CR_t + CR_{t-1})/(4 * GDP_t) - [0.5 * (CR_t + CR_{t-1})/(4 * GDP_t)]^{tr}.$$

The trend, represented by a *tr* superscript, is obtained using a Hodrick and Prescott (1980) filter with weighting terms of 1600 for quarterly data and 100 for yearly data; $\overline{d}$ represents the mean primary debt-to-output ratio, *d*.

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