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Budget Deficits, Public Spending and Interest Rates in Thailand

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I. Introduction

Even before the mid-1980's, Thailand had experienced impressive economic growth. But beginning in 1987, growth accelerated, averaging 9% a year through 1994. During that period, Thailand was one of the fastest growing economies in the world. Export earnings took off and the manufacturing sector expanded rapidly. Foreign capital flowed liberally into the country. Along with Indonesia and Malaysia, Thailand became part of a second wave of newly industrialized economies (Dixon 1999).

Many factors probably contributed to that growth, but one that stands out was the rise in investment. The ratio of investment to GDP rose from 27% in 1982 to 40% by 1990. Private investment increased especially dramatically. In the 1970's and early 1980's it averaged 18%. By 1990, the ratio had ballooned to 34% (Jansen 1997). All of this is important because economic growth rates seem to be strongly correlated with investment rates in developing countries.

Concurrently, the Thai government turned its budget deficit into a budget surplus. Beginning in 1985, stricter limits were placed on government spending. State enterprise external borrowing was curtailed. The policy of allowing government agencies to carry over unspent money into future years was also tightened. At the same time, tax revenue climbed. Income tax revenue rose sharply due to the rapidly growing economy and progressive rates. Tax collection also became more efficient. The result was that the Thai government went from running a deficit of 3.7% of GDP in 1985 to a surplus of 5.0% in 1990 (Jansen 1997).

This raises the question of whether Thai fiscal policy may have contributed to this wave of investment. There are many avenues through which fiscal policy could have

influenced private investment. Public and private capital can be complements, so more public investment could raise private investment (Blejer and Khan 1984). Fiscal policy may also affect real interest rates which, studies show, influence private investment (e.g., Greene and Villanueva 1991). Keynesian theory suggests that expansionary fiscal policy boosts real interest rates. Contractionary fiscal policy, therefore, in the form of either rising taxes or falling government spending, could help lower real rates.

This paper attempts to measure the impact of public spending and budget deficits on real interest rates in the Thai economy during the period 1980-94. We test both the Keynesian theory just mentioned and an alternative Neoclassical theory that only government spending affects real interest rates. We break government spending down into consumption, equipment, and construction expenditures to see whether they impact interest rates differently. We find evidence in favor of the Neoclassical theory that only government spending affects real interest rates. We also discover that this effect differs depending upon the type of public spending. Higher public consumption and construction expenditures have the predicted effect of raising real interest rates. Increased public equipment expenditures, however, appear to lower interest rates, the opposite of what theory suggests.

We test to see whether this negative relationship might spring from counter-cyclical government equipment spending. We find mixed evidence for this. We then expand our closed-economy model to allow for external financing of government spending. External financing can increase the economy's supply of loanable funds, depressing interest rates. Empirically we find that public equipment investment is significantly correlated with government foreign borrowing during our sample period,

and that the magnitude of the relationship is large. A conclusion summarizes our findings and discusses their implications.

II. Literature

The closed-economy IS-LM model (Mankiw 2003) suggests that greater government spending will boost real interest rates and discourage private investment. Greater government spending raises planned aggregate expenditure, which stimulates output, increases the real demand for money, and reduces the demand for bonds, which depresses bond prices and elevates interest rates. The simple IS-LM model makes no distinction between government spending on consumption versus investment.

The open economy Mundell-Fleming model (Mankiw 2003) typically assumes that countries are small relative to the world economy and that capital is perfectly mobile. Then each country's interest rate must equal the world interest rate and fiscal policy in any one country is incapable of changing the world interest rate. Under floating exchange rates, as soon as greater government spending raises interest rates, foreign capital rushes in. This increases the demand for the domestic currency, causes the currency to appreciate, lowers net exports and aggregate demand, reduces output, and curtails real money demand, bringing interest rates back down to their original level. Under fixed exchange rates, as soon as government spending raises interest rates foreign capital inflows boost the money supply, which again brings interest rates down to their initial level.

In fact, during the period we examine, Thailand had a fixed exchange rate. From 1970-84 the baht was pegged to the US dollar, and after that it was pegged to a basket of

currencies, of which the dollar was the most important. However, the assumption of perfect capital mobility did not hold for Thailand. Domestic interest rates could move independently of world rates. For example, world rates fell after 1982, but Thailand kept their rates high to attract foreign investment. The presence of imperfect capital mobility allowed the Bank of Thailand to exert independent control over monetary policy despite its commitment to pegging the exchange rate. In general during these years, the Bank pursued conservative policies designed to keep inflation low (Jansen 1997). In the presence of imperfect capital mobility, the Mundell-Fleming model predicts that increased public spending will raise real interest rates, though less than in the closed economy case.

Barro (1981) works with a Neoclassical model (similar to Hall 1980) and allows government spending to provide consumers with direct utility (e.g., parks) and to serve as an input into private production processes (e.g., a legal system). He then compares the effects of temporary versus permanent increases in government purchases (G). Consumers realize that a temporary rise in G has virtually no impact on their lifetime income. It does, though, provide them with utility services equivalent to a fraction θ (assumed less than 1) of their own consumption expenditures. Consumption smoothing therefore leads to consumption falling by θ times the increase in public spending. When this is combined with the change in G , aggregate demand increases by $(1-\theta)$ times the rise in public spending. As a production input, the rise in public spending raises output by the marginal product of government services (MPG). Barro argues that $MPG < 1-\theta$ is most likely, which implies that aggregate demand increases more than aggregate supply. To clear the commodity market, the real interest rate rises. This boosts aggregate supply

through intertemporal labor substitution, and reduces consumption and aggregate demand.

Permanent increases in public spending, however, have no effect on interest rates. Consumers realize that permanent increases in G must lead to equivalent permanent increases in taxes. This negative income effect is partially offset by the positive income effect of permanently higher output resulting from the MPG. Hence consumption falls by only $(1-MPG)$ times the rise in G and aggregate demand rises by the MPG times the increase in public spending. This exactly matches the rise in aggregate supply, so the commodity market continues to clear and interest rates don't change.

Aiyagari, Christiano, and Eichenbaum (1992) challenge Barro's claim that permanent increases in G should have no effect on interest rates, at least in the case of government consumption spending. They accept Barro's claim that a permanent rise in G should lower consumers' lifetime income through higher taxes. They argue, however, that if leisure is a normal good, individuals should respond to this income loss by working more hours. This will temporarily lower the capital-labor ratio, raising the marginal product of capital and interest rates. In their simulations, Aiyagari *et al.* find that permanent changes in government consumption can affect interest rates more than temporary changes.

Baxter and King (1993) too note that when labor supply increases in response to a permanent rise in government consumption, interest rates should rise. However they also consider changes in government investment. They assume that public investment augments the private marginal product of capital. This provides another avenue through which permanent changes in public spending can raise interest rates in the short-run.

On the empirical side, Barro (1987) examines the response of interest rates to military spending in Britain over the period 1729-1918. Military spending shows sharp swings during wars, which are transitory. Barro finds that interest rates and military spending move together, supporting his theory. Barro (1990), however, is unable to duplicate those results for the US.

Evans (1985, 1987a) looks at US interest rates over many sample periods, some dating back to the Civil War. Although the focus of his articles is on the effects of budget deficits on interest rates, he also finds that government spending often has a statistically significant positive effect on interest rates, both nominal and real.

As for international evidence, Evans (1987b) examines the effect of fiscal policy on nominal interest rates in 6 OECD countries between 1976 and 1985. In almost all of his regressions he estimates a positive coefficient on unexpected increases in government consumption, and several of those coefficients are statistically significant. Argimon, Gonzalez-Paramo, and Roldan (1997) provide indirect evidence on these effects in a panel of 14 OECD countries. Controlling for the size of the private capital stock, they find that public infrastructure spending has a significantly positive impact on the private marginal product of capital, suggesting it raises real interest rates.

Overall, theory suggests that government spending will either raise real interest rates or keep them constant. The most common empirical finding is that it boosts them. One limitation of these studies, however, is that they have been largely confined to industrialized countries. Developing countries such as Thailand may generate different results, as it is not clear whether the assumptions made in the theory apply to them. For instance, the Neoclassical model assumes a high degree of sophistication on the part of

the public. Consumers have to be forward-looking, capable of distinguishing between temporary and permanent changes in government spending, and able to understand the implications of those changes for their lifetime income.

The Neoclassical model also assumes that labor markets clear and the economy operates at full-employment. But in 1985, 12.6% of the workforce was either explicitly or seasonally unemployed (Wright 1985). Productivity statistics in agriculture also suggest that underemployment was significant. In 1980, the agricultural sector produced 23% of Thailand's GDP, but employed 70% of its labor force (Dixon 1999). In contrast, the Keynesian model does not make such strict demands on consumers and it functions fine in the presence of unemployed resources. So the outcome of a test between these two models in Thailand may differ from previous studies.

III. Theory

We first construct a simple closed-economy Neoclassical model based on Barro (1981). It is an AD-AS model with:

$$(1) \quad AD = C + I + G$$

As shown in the Appendix, there is strong evidence that fluctuations in spending during our sample period were only temporary. In this case, Neoclassical theory implies that taxes should not affect consumer spending. Government consumption spending (GC), however, and real interest rates (R), should affect consumer spending. So our Neoclassical consumption function is:

$$(2) \quad C = KC - \theta GC - \alpha R + \varepsilon_C$$

where KC is a constant, ε_C is the consumption equation error term, and $0 < \theta < 1$ because public consumer goods are less valuable than private consumer goods. Theory suggests that both higher government consumption expenditures and higher real interest rates reduce private consumption.

Investment is assumed negatively affected by real interest rates. Following Baxter and King (1993), we also allow for government investment spending (GI) to positively affect private investment by boosting the productivity of private capital:

$$(3) \quad I = KI - \delta R + \gamma GI + \varepsilon_I$$

where KI is a constant and ε_I is the investment equation's error term. Real government expenditure is just spending on consumption and investment:

$$(4) \quad G = GC + GI$$

Adding these equations up gives us our equation for AD :

$$(5) \quad AD = KC - \theta GC - \alpha R + KI - \delta R + \gamma GI + GC + GI + \varepsilon_{AD}$$

On the AS side of the model, higher real interest rates are assumed to boost employment and output through intertemporal substitution. Following Baxter and King (1993), greater government investment is also assumed to raise output by enhancing productivity. So:

$$(7) \quad AS = KAS + \beta R + \tau GI + \varepsilon_{AS}$$

where KAS is a constant and ε_{AS} is this equation's error term. In equilibrium $AD=AS$ so:

$$(8) \quad KC - \theta GC - \alpha R + KI + \delta R + \gamma GI + GC + GI + \varepsilon_{AD} = KAS + \beta R + \tau GI + \varepsilon_{AS}$$

Rearranging and isolating the real interest rate leaves us with:

$$(9) \quad R = K + [(1-\theta)/(\alpha+\beta+\delta)]GC + [(1+\gamma-\tau)/(\alpha+\beta+\delta)]GI + \varepsilon_R$$

where the constant (K) and the error term (ε_R) are combinations of earlier constants and error terms.

We then build a simple Keynesian model of interest rates, similar to the one presented by Evans (1985). Equilibrium in the goods market is given by the following familiar IS curve equation:

$$(10) \quad Y = KIS + \chi G - \lambda TAX - \sigma R + \varepsilon_{IS}$$

where KIS is the constant, TAX measures tax revenue, and ε_{IS} is the error term.

Equilibrium in the money market is given by the following LM curve equation:

$$(11) \quad R = KLM + \omega Y - \rho(M/P) - \pi^e + \varepsilon_{LM}$$

where KLM and ε_{LM} are the constant and error term, M/P is the real money supply, and π^e is the expected inflation rate. We don't observe π^e , but Evans hypothesizes that it is related to government spending, taxes, and the real money supply. So we assume:

$$(12) \quad \pi^e = K\pi^e + \eta G - \nu TAX + \psi(M/P) + \varepsilon_{\pi}^e$$

where $K\pi^e$ is a constant. Inserting equation (12) into equation (11) and rearranging, one obtains:

$$(13) \quad R = K + [(\chi\omega - \eta)/(1 + \sigma\omega)]G - [(\lambda\omega - \nu)/(1 + \sigma\omega)]TAX - [(\rho + \psi)/(1 + \sigma\omega)](M/P) \\ + \varepsilon_R$$

One can now compare these two models. Both models probably predict that greater (temporary) government spending boosts real interest rates. As long as θ is less than 1, greater public consumption spending will raise interest rates in the Neoclassical Model. The parameter τ measures the marginal product of public capital. Plausible estimates of it should be below one, implying that greater public investment spending also raises interest rates in the Neoclassical model. Finally, as long as inflation expectations react slowly to changes in G (η is small), a rise in G should raise interest rates in the Keynesian model.

However, beyond that, there are several key differences. First, in the Neoclassical model, taxes do not affect real interest rates. Consumers are savvy enough to realize that any level of government spending will eventually have to be financed by taxes.¹ The timing of those taxes is not important to consumers with long horizons. In the Keynesian model, higher taxes lower real interest rates because they reduce disposable income, consumer spending, and aggregate demand.²

This implies that in the Keynesian model budget deficits should have a significant impact on real interest rates. Higher budget deficits, caused by either increases in public

¹ This includes the “inflation tax” that results from printing money.

² This assumes that inflation expectations also react slowly to changes in taxes (ν is small).

spending or tax cuts, should raise aggregate demand and push up interest rates. In the Neoclassical model, however, only the level of government spending matters; the size of the deficit is irrelevant.

Another important difference is that in the Neoclassical model, the real money supply does not change real interest rates. Money is said to be neutral. In the Keynesian model, though, a larger real money supply unambiguously lowers real interest rates to clear the money market.

A final difference is that different types of government spending have different effects on interest rates in the Neoclassical model. Public investment spending, for instance, does not affect consumer spending directly, but does affect aggregate supply. Public consumption spending does just the opposite. These varied effects lead to different ultimate impacts on the real interest rate. In our Keynesian model, however, the form of government spending makes no difference, as each dollar of government spending boosts aggregate demand by a dollar.

A straightforward way, then, to test between these theories is to include the variables from both models in one regression. That regression takes the form:

$$(14) \quad R = K + \varphi GC + \kappa GI - \mu TAX - \xi(M/P) + \varepsilon$$

According to the Neoclassical theory, φ and κ should probably be positive but should also differ from each other, and both μ and ξ should equal zero. The Keynesian predictions are that φ and κ are positive and equal to each other, and that both taxes and the real money supply depress real interest rates.

Ordinary least squares (OLS) estimation of equation (14) will probably be inconsistent. The error term contains shocks to both private spending and real money demand, and those shocks could easily be correlated with our explanatory variables. An autonomous rise in private spending, for instance, could boost output which would increase tax revenue and potentially change government spending and the real money supply. This inconsistency might not be severe if shocks to the economy were transmitted quickly to interest rates through efficient financial markets, but took longer to affect output and our right-hand side variables. Our use of quarterly data should help in that regard. However, to be safe we rely primarily on two-stage least squares (2SLS) for the estimation.

IV. Data and Estimation

We use quarterly data from 1980:1 to 1994:4. The Comptroller-General's Department at the Ministry of Finance of Thailand publishes nominal data on tax revenue and government spending on capital and current expenditures. The government capital (investment) expenditure data is broken down into equipment and construction outlays (GIE and GIC). The Bank of Thailand provides data on the money supply, which is comprised of currency holdings plus demand deposits. All data are converted into real terms by the Thai government's general price index (1986=100). The nominal interest rate is a money market rate measuring the rate at which commercial banks accepted short-term deposits from other banks and financial institutions as reported in the International Financial Statistics (IFS). It is then adjusted for the ex-post annualized inflation rate from each quarter. A four-quarter moving average of this real rate is

displayed in Figure 1. In it one can see the dramatic drop in real interest rates between 1984 and 1987.

Our right-hand side variables are divided by an estimate of trend real GDP. We do this because it seems likely that same-sized changes in our explanatory variables will have a larger impact on interest rates the smaller the Thai economy is. So, for instance, a 10 million Baht rise in real government spending in 1980, when the economy was smaller, would probably affect interest rates more than an equal-sized change in 1994. Dividing by real GDP corrects for the growing size of the Thai economy. We use estimates of trend GDP because quarterly data on output are not available and we want to avoid introducing a correlation between our right-hand side variables and our error term, which contains business cycle shocks.³

There could easily be regular seasonal patterns to real interest rates and our explanatory variables. The real money supply in the US, for example, tends to rise around Christmas. Even if seasonal fluctuations in interest rates were independent of seasonal fluctuations in our explanatory variables, regression analysis would probably find a spurious correlation between them. To prevent that, three dummy variables (one each for spring, summer, and fall) are added to the regression.

Descriptive statistics of our data are displayed in Table 1. The annual real interest rate is generally high, averaging 5.7%, the mean budget deficit is only 0.1% of output, and government consumption, construction, and equipment spending average 13.8%, 5.8%, and 1.9% of GDP. Most variables fluctuate considerably over our sample, which should help to generate precise parameter estimates.

³ The trend output specification we used, based on the Akaike criterion, contained linear and quadratic time trends.

The next task is to verify that the data are stationary in levels.⁴ Because of evidence of serial correlation, we compute augmented Dickey-Fuller (ADF) and Phillips-Perron test statistics. The results of those tests are in Table 2. With the exception of our interest rate variable, which appears to be stationary, the two tests disagree. The ADF statistics suggest that most of our data are nonstationary while the Phillips-Perron tests suggest stationarity. Further ADF tests indicate that one cannot reject the null that first-differences of our data are stationary. Hence there is uncertainty as to whether most of our data are integrated of order 0 or 1.

If some of our data are nonstationary, we need to determine if they are cointegrated for our regressions to make sense. So the Johansen cointegration test was performed on two sets of variables: 1) R, GC, GI, DEF, and MS; and 2) R, GC, GIE, GIC, DEF, and MS. In both cases we could reject the null hypothesis of no cointegrating equations at the 1% level, but could not reject the null of one cointegrating equation at normal significance levels. Hence, if some of our data are nonstationary, they appear to be cointegrated and our regressions should be meaningful.

We start by estimating a stripped down version of equation (11) with just the budget deficit on the right-hand side. We use OLS. The results are in column 1 of Table 3.⁵ The budget deficit coefficient is positive and quite significant, with a t statistic of over 3.5. It is easy to understand this result if one glances at Figure 1. Real interest rates and the budget deficit relative to GDP generally move together.

⁴ The ratio of government spending to GDP is naturally bounded between 0 and 1, so it would seem as though we can rule out nonstationarity. However, to be sure we conducted the standard tests.

⁵ In this and many other regressions, there was evidence of either heteroskedasticity or autocorrelation, so we routinely computed Newey-West consistent standard errors.

Because these estimates are probably contaminated by a correlation between our regressors and error term, we next run 2SLS. Our instruments are the budget deficit lagged one through four quarters. Two-stage least squares works best when one has good instruments (Nelson and Startz 1990), and a check shows that this was the case.⁶ The results of this estimation are in column 2. They are basically the same.

In the next column we add our three seasonal dummy variables. None of them enters significantly. The estimated deficit coefficient remains significant at the 5% level, though the point estimate shrinks and the standard error grows.

Finally, we add the real money supply. It enters negatively, consistent with the Keynesian theory, but is not statistically significant. The deficit coefficient, however, grows larger and remains significant. There is evidence of model misspecification from both the RESET and Chow tests. Those diagnostics notwithstanding, however, this first batch of regressions is generally supportive of the Keynesian hypothesis that real interest rates fell in Thailand in the mid-1980's because the government eliminated its budget deficit.

In Table 4 we examine the Neoclassical proposition that it was cuts in government spending, and not changes in the deficit, that caused real interest rates to fall. We divide our deficit variable up into government spending, *G*, and tax revenue, *TAX*. Doing OLS first, taxes are completely insignificant and actually have the wrong sign according to Keynesian theory. Government spending, however, enters with a positive coefficient, as predicted, and is significant at the 2% level. Two of the seasonal dummy variables also become marginally significant. The R^2 statistic indicates the model fits the data better.

⁶ A regression of the instruments on our deficit variable yielded an adjusted R^2 statistic of 0.79.

In column 2 we employ 2SLS, choosing as our instruments four lags of the real money supply, tax revenue, and government spending⁷. The results do not change much. There are signs of model misspecification and parameter instability. In the next column we drop the tax variable. This sharpens the estimated coefficient for government spending and slightly raises its significance level.

This evidence, therefore, is clearly in favor of the Neoclassical model. Government spending does appear to affect real interest rates, while the real money supply and tax revenue do not seem to matter. Some insight into these results can be found in Figure 2, which plots the real interest rate against government spending and tax revenue. The positive correlation between government spending and the real interest rate is apparent. But it is harder to see the hypothesized negative correlation between tax revenue and real interest rates. Both rose in the early 1980's, then fell in the mid 1980's, and rose again from 1988-1991. So it is not that surprising that our regressions fail to detect an inverse relationship between those two variables.

To examine the possibility that different types of government spending have different effects on interest rates, we break government spending down between consumption and investment spending. The results of this are shown in the last column.⁸ Interestingly, only government consumption seems to matter. The goodness of fit improves and there is no longer evidence of parameter instability.

⁷ The adjusted- R^2 statistics for the regressions of our explanatory variables on their instruments were all over 0.74.

⁸ The instruments were 4 lags of each of the non-constant explanatory variables.

In Table 5, investment is divided between equipment and construction expenditures.⁹ Government consumption continues to be important, but now, both public spending on equipment and on construction enter significantly. Surprisingly, equipment spending has a negative coefficient, suggesting that increases in public equipment spending lower real interest rates. Apparently, government investment did not enter significantly earlier because it was the sum of two separate effects from equipment and construction spending that largely offset each other. The real money supply continues to be insignificant.

In the last three columns of Table 5 we test for robustness. First, we include lagged inflation as a proxy for the unobservable inflation expectations that Keynesian theory suggests affect real interest rates. It did not enter significantly, suggesting that those expectations may already be satisfactorily captured by our monetary and fiscal variables.

Some authors (e.g., Hall 1988) have noted that instruments lagged more than once are less likely to be correlated with one's error term. So in column 3 we lag our instruments at least two quarters. The goodness of fit deteriorates, but none of the main results changes.

Finally, we experiment with a different real interest rate derived from a Thai nominal lending rate similar to the Prime Rate in the US. The real money supply enters significantly, while government spending on construction does not. The point estimates of our other spending variables shrink, but not their significance levels. Because this interest rate is sticky and was subject to loan rate ceilings, it is much less appropriate than

⁹ All of these regressions used 2SLS. The instruments were 4 lags of each of the explanatory variables. Regressions of these variables on their lags yielded R^2 statistics of over 55%.

the money market rate we use. Even so, it is reassuring that most of our results continue to hold.

Focusing on the results from the first column of Table 5, the coefficient on government consumption suggests that a one percentage point rise in government consumption as a fraction of GDP pushes up real interest rates by 2.1 percentage points. A one percentage point rise in the ratio of construction spending to GDP is estimated to boost real interest rates by 2.5 percentage points. Finally, a one percentage point rise in public equipment spending relative to GDP is estimated to push down real interest rates by 8.7 percentage points. This final estimate seems large, but one needs to keep in mind that public equipment spending is small, averaging just 1.9 percent of GDP in our sample. So it typically doesn't fluctuate by a single percentage point. Nonetheless, it is still puzzling why Thai interest rates appear to be so negatively correlated with public equipment investment.

The Neoclassical theory that we derived earlier provides one possible reason for this correlation. Equation (9) indicates that a high value for τ would tend to at least shrink the positive correlation between interest rates and equipment spending. The τ parameter measures the marginal product of public capital. That may be high for equipment investment. Temple (1998) estimates returns to equipment investment of over 50% in developing countries.¹⁰ However, even an estimate as big as 60% is insufficient to generate the large negative correlation we find in the data. So we need to consider additional factors. In the next two sections, we look at a couple.

¹⁰ Returns to other forms of investment, which would include construction spending, are much lower.

V. Countercyclical Public Equipment Spending

Government equipment spending may appear to depress real interest rates simply because the Thai government uses that spending to counter the business cycle. It could deliberately boost investment spending in periods of slow growth to spur growth and then reduce that spending during booms. If the Central Bank were loosening monetary policy during recessions and tightening it during booms, that could generate a spurious inverse relationship between investment spending and interest rates.

To test this, we try to measure how countercyclical equipment spending is in our sample. We first regress public equipment spending as a percentage of GDP on a variable, YRATIO, that measured the ratio of output to trend output. The data are annual and time trends are added to account for long-run swings in equipment spending. Column 1 in Table 6 shows the results. YRATIO enters negatively, suggesting that when output is high relative to trend output, government equipment spending is low. But the estimate is not statistically significant. There is also evidence of model misspecification.

So we add a variable equal to a dummy variable times our output measure. The dummy variable equals zero before 1987 and one afterwards. The results are much more satisfactory. The new variable enters significantly at the 5% level and is negative. It indicates that after 1987, there was significant countercyclical spending on equipment by the government. The goodness of fit improves markedly. The only problem with this evidence is that it uses annual data and our earlier regressions use quarterly data.

Although quarterly data are not available for GDP, they are for employment, so we also try them. We experiment with a variable measuring the ratio of employment to

trend employment. The results in column 3 again indicate an inverse relationship between employment and equipment spending, but not a significant one. There is, however, strong evidence of parameter instability. So we add a variable equal to our 1987 dummy variable times our employment variable. This new variable is significant at the 10% level, but is positive. When combined with our other employment variable, the two coefficients practically offset each other, suggesting that after 1987, government equipment purchases were acyclical.

The evidence on the countercyclicality of government equipment investment is therefore mixed. One possible reason for this is that the Thai government adjusted equipment purchases to the state of the economy with a lag. If the lag were longer than a quarter but less than a year, countercyclical equipment spending might show up in annual data, but not quarterly. In any case, we think it likely that countercyclical spending is at least one of the reasons that real interest rates were so negatively correlated with public equipment investment in our sample.

VI. External Financing

Another potential reason derives from the possibility of external financing. Increased borrowing need not push up domestic interest rates to the extent that it taps foreign funds. In the private sector, more qualified customers routinely borrow from abroad when Thai loan rates are high (Jansen 1997). The public sector, too, has access to foreign capital, so that could attenuate the relationship between its spending and interest rates.

To consider this hypothesis, we expand the Neoclassical model to allow for foreign trade and borrowing. In an open economy:

$$(15) \quad AD = C + I + G + NX$$

where NX is real net exports. We then assume that fluctuations in net exports are equal and opposite to fluctuations in net foreign borrowing (NFB):

$$(16) \quad NX = KNX - NFB + \varepsilon_{NX}$$

where KNX is just a constant and ε_{NX} is the error term. Balance of payments equilibrium would imply this equal and opposite relationship in the long-run. In the short-run, this relationship could occur under fixed exchange rates if capital inflows were used to finance import purchases. In fact, there is evidence that the foreign investment boom that commenced in 1987 significantly boosted the import intensity of the Thai economy (Jansen 1997, p. 178).

We test this assumption by first regressing the capital account in Thailand on a linear time trend, a constant, and net exports. We could not obtain quarterly data, so we use annual IFS data. Column 1 of Table 7 contains the results. The estimated coefficient on NX is -1.11 and is quite significant. We cannot reject the null that it is equal to -1.0. However, there is mild evidence of a structural break in the data.

To address that, we add two interactive dummy variables. The first, $TIMEDUM$, is the product of our linear time trend with a dummy variable equal to one after 1986. The second, $NXDUM$, is the product of our NX variable with a dummy variable equal to one after 1986. The results, in column 2, show that it is the time trend dummy variable

that enters significantly. It is positive, suggesting that after 1986 the trend toward larger capital inflows accelerated. The estimated coefficient on net exports shrinks but stays significant, and we still cannot reject the hypothesis that it equals 1.0.

In column 3 we drop the insignificant NX dummy variable. The NX coefficient jumps to 0.99 and becomes significant at the 1% level. Finally we add a quadratic time trend. The net export coefficient falls slightly, but the results are basically unchanged. We conclude that the assumption that short-run changes in net exports are equal and opposite to changes in net foreign borrowing is acceptable for our sample period.

The last assumption is that increases in government spending are partly financed from net capital inflows:

$$(17) \quad NFB = KNFB + \varpi_1 GC + \varpi_2 GIE + \varpi_3 GIC + \varepsilon_{NFB}$$

We allow for different forms of government spending to receive different levels of external financing. Combining this with our previous Neoclassical equations for C, I, G, and AS, and rearranging, one can derive the following:

$$(18) \quad R = K + [(1-\theta-\varpi_1)/(\alpha+\beta+\delta)]GC + [(1+\gamma-\tau-\varpi_2)/(\alpha+\beta+\delta)]GIE + \\ [(1+\gamma-\tau-\varpi_2)/(\alpha+\beta+\delta)]GIC + \varepsilon_R$$

Public investment spending here is divided up between equipment and construction expenditures.

Note that the degree of external financing, as measured by the ϖ parameter, reduces the coefficients on our public spending variables. Increases in public spending depress net exports, AD rises less, and real interest rates don't need to go up as much to

close the gap between AD and AS. In fact, if ϖ is large enough, increases in public spending can lead to a situation where $AS > AD$ and real interest rates fall.

Intuition for these results can be found in the loanable funds framework which compares the demand for funds with the supply of funds.¹¹ The condition for higher interest rates in this framework is $I > S + NFB$, where I (Investment) represents the demand for funds and S (domestic savings) plus NFB constitute the supply of funds. In the closed-economy version of this model with no NFB , increases in public spending reduce domestic savings, creating a gap between I and S that forces interest rates up. But in an open economy, foreign capital inflows in response to a rise in G augment the pool of loanable funds, so the gap between the demand for funds and the supply of funds is smaller or even negative.

To test this hypothesis we regress each government spending variable on government net foreign borrowing. Data availability restrict our sample period to 1980-1991. There is a potential simultaneity problem in that shocks to government foreign borrowing could affect output and our explanatory variables. So we use 2SLS again, employing the same instruments we used before. The results are in Table 8.

All three coefficients of our public spending variables enter significantly at the 5% level. However, their point estimates are quite different. The estimated coefficient on public equipment investment is very high, over 90%. The coefficient on public consumption is about 30% and the estimate for public construction is negative.

To test for robustness, in column 2 we restrict our instruments to those lagged at least twice. The coefficient estimates are less significant, but their magnitudes do not

¹¹ This framework is a mirror image of the AD-AS framework and the $AD=AS$ condition is equivalent to the condition that the demand for funds equals the supply of funds.

change much. In column 3, we add tax revenue to see if it matters, but it does not. Our previous results stay essentially the same.

These results therefore help to explain why increases in government equipment spending seem to lower real interest rates. Our estimates suggest that every 100 Baht increase in public equipment spending in our sample period coincided with a rise in government net foreign borrowing of roughly 90 Baht. That represents a very high level of foreign financing, and it makes it much less likely that higher public spending would push the demand for funds above the supply of funds and boost interest rates. It also reduces the likelihood that a sudden decrease in equipment spending, as occurred between 1985 and 1989, would exert much downward pressure on interest rates

VII. Conclusion

Thailand experienced remarkable growth starting in 1987. There were also big changes in government fiscal policy at that time. That makes Thailand a wonderful case for testing whether their fiscal policy contributed to their boom by lowering real interest rates and potentially spurring investment. Keynesian theory suggests that declining budget deficits pushed real interest rates down in the mid-1980's. Neoclassical theory asserts that falling government spending was the primary factor. Using data spanning 1980-94, we find evidence for the Neoclassical model. In general, decreases in government spending, and not higher taxes, appear to have contributed to the decline in real interest rates.

However, in the case of public equipment investment we obtain the unusual result that increases lower interest rates. We attribute this to three factors. First, government

equipment investment could be quite productive, significantly boosting aggregate supply. Second, there is some evidence that public equipment spending is countercyclical, which could generate a spurious negative correlation with procyclical real interest rates. Third, public equipment spending appears to fluctuate with government foreign borrowing. That would alleviate pressure on interest rates to rise when public equipment spending increases. When all three factors are combined, it is possible to generate a negative correlation between real interest rates and public equipment spending.

There are several conclusions to draw from this. First, the Neoclassical model assumes a very high degree of consumer rationality. For that model to be successful, it suggests that consumers in newly industrialized countries such as Thailand are fairly sophisticated. Second, it would appear that it is critical for governments to get their spending under control if they hope to maintain low real interest rates. Finally, short-term increases in government spending need not raise real interest rates if they receive some financing from abroad and significantly boost aggregate supply.

This could all be important information for developing countries considering public investment programs to stimulate growth. Thailand's Sixth National Economic and Social Development Plan is a good example. The plan dramatically boosted public infrastructure spending, especially in rural areas, in the late 1980s; between 1989 and 1994 public investment as a fraction of GDP doubled in Thailand. Our results suggest that, although such a rise in government spending could push up interest rates and depress private capital formation, it need not if it is at least partly externally financed (which it was) and significantly enhances the economy's productive potential. Of course, there are always costs and risks associated with borrowing from abroad, as the crisis of

1997 demonstrated. In addition, governments must constantly assess the opportunity cost of devoting resources to public spending.

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Appendix: Measuring the Permanence of Government Spending Fluctuations

We used the following procedure to measure how temporary or permanent changes in government spending were in our sample. First, we searched for the appropriate time series representation for changes in each type of government spending. Using the Akaike criterion, we arrived at the following (with standard errors in parentheses):

$$(12) \quad \Delta GC = \underset{(0.079)}{0.673\Delta GC(-4)} + e - \underset{(0.142)}{0.817e(-1)} - \underset{(0.136)}{0.481e(-4)}$$

$$(13) \quad \Delta GIC = \underset{(0.123)}{-0.814\Delta GIC(-1)} - \underset{(0.024)}{0.975\Delta GIC(-2)} - \underset{(0.118)}{0.760\Delta GIC(-3)} + e + \\ \underset{(0.031)}{0.192e(-1)} + \underset{(0.034)}{0.929e(-2)}$$

$$(14) \quad \Delta GIE = \underset{(0.139)}{-0.611\Delta GIE(-1)} - \underset{(0.144)}{0.935\Delta GIE(-2)} - \underset{(0.133)}{0.538\Delta GIE(-3)} - \\ \underset{(0.019)}{0.019\Delta GIE(-4)} + e + \underset{(0.007)}{0.264e(-1)} + \underset{(0.009)}{0.968e(-2)}$$

Then we calculated impulse response functions for each equation, simulating the effects over time of a temporary one-unit rise in the error term e . This generated a series of changes in government spending over time for each of our three spending components. If one assumes a zero initial level of public spending and then adds to it the changes in spending period by period one can generate levels of government spending over time for each component.

The last step was to calculate the present discounted value of these streams of future government spending. The present value should equal the present value of the

taxes needed to finance them, so it should measure the impact of government spending on consumers' lifetime income. That in turn should determine how consumption responds to changes in government expenditure. If fluctuations in government spending were permanent, government spending would rise to 1.0 in period 1 and stay there forever. Assuming a quarterly discount rate of one and a half a percent, the present value of this stream of higher government spending would equal 67.7. If fluctuations in government spending were temporary, government spending would rise to 1.0 in period 1, but then perhaps drop back to 0 in period 2 and stay there forever. The present value of this stream would just be 1. If increases in government spending were not only temporary, but elicited future decreases in government spending, the present value of that stream would be less than 1 and could be negative.

The present value calculations for our three public spending variables are below.

	GC	GIC	GIE
Present Value:	-0.706	0.602	0.724

All three of the present value numbers were tiny, ranging between -1 and 1. Hence fluctuations in these three government spending components appeared to be completely transitory; positive spending innovations seemed to be quickly followed by spending cuts that pushed levels slightly below where they started.

Figure 1: Four Quarter Moving Average of the Real Money Market Rate and Budget Deficit/GDP Ratio

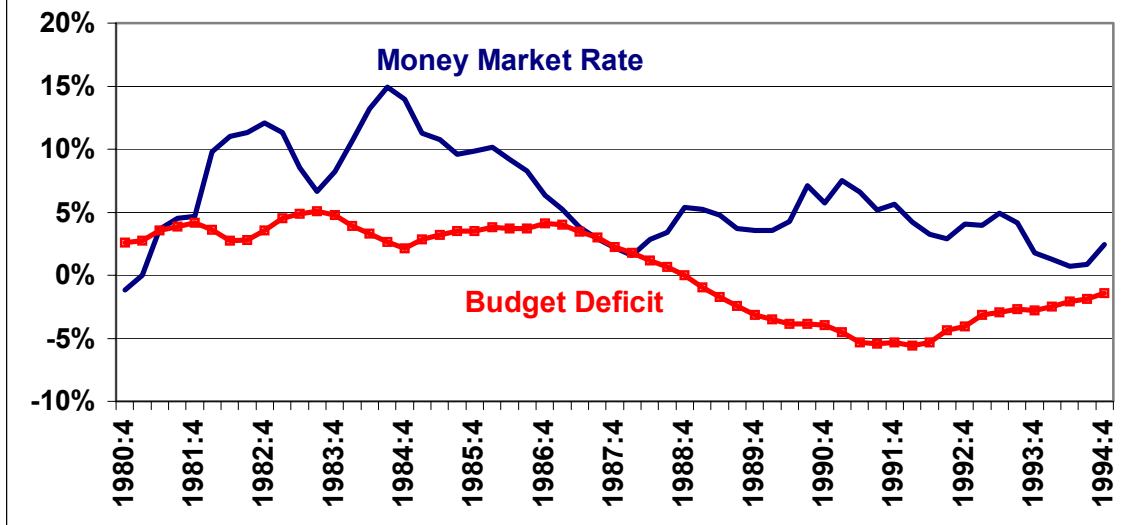


Figure 2: Four Quarter Moving Averages of the Real Interest Rate, Government Spending, and Tax Revenue over GDP

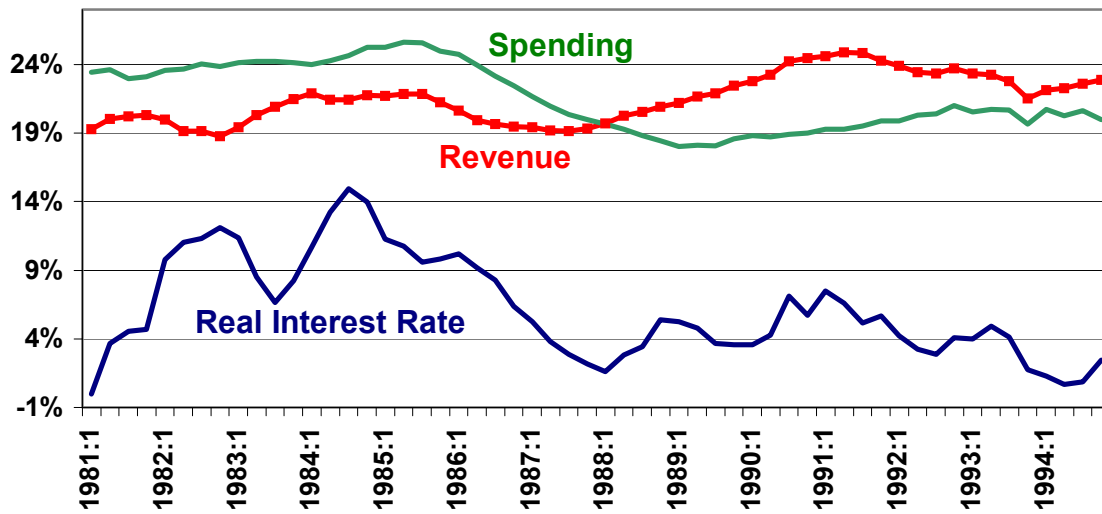


Table 1: Descriptive Statistics of the Data
Sample Period: 1980:1-1994:4

	Mean	Median	Maximum	Minimum	Std. Dev.
R	0.057	0.056	0.191	-0.127	0.059
MS	0.091	0.091	0.109	0.078	0.007
DEF	0.001	0.006	0.084	-0.092	0.043
TAX	0.215	0.212	0.274	0.160	0.030
G	0.216	0.216	0.280	0.168	0.029
GC	0.138	0.136	0.179	0.103	0.019
GI	0.077	0.079	0.111	0.042	0.017
GIE	0.019	0.020	0.032	0.009	0.005
GIC	0.058	0.058	0.087	0.033	0.013

Table 2: Unit Root Tests of the Data

	ADF Test Statistic	ADF Lags	Phillips-Perron Test Statistic
R	-5.47***	0	-5.44***
DEF	-0.86	4	-3.43**
MS	-1.77	6	-4.47***
G	-1.71	5	-3.56***
TAX	-1.76	4	-5.49***
GC	-0.21	3	-2.95**
GI	-2.57	8	-3.91***
GIE	-2.39	6	-4.26***
GIC	-2.57	8	-3.73***

*: rejects the null of a unit root at the 10% level

**: rejects the null of a unit root at the 5% level

***: rejects the null of a unit root at the 1% level

Table 3: Regressions of the Real Interest Rate with the Government Budget Deficit
1980:1-1994:4

	(4.1) OLS	(4.2) 2SLS	(4.3) 2SLS	(4.4) 2SLS
Constant	0.056*** (0.009)	0.056*** (0.009)	0.043** (0.019)	0.283 (0.260)
DEF	0.576*** (0.164)	0.634*** (0.174)	0.487** (0.226)	0.588** (0.236)
SPRDUM	-	-	0.009 (0.016)	-0.011 (0.026)
SUMDUM	-	-	0.008 (0.021)	-0.021 (0.028)
FALDUM	-	-	0.034 (0.021)	0.021 (0.026)
MS	-	-	-	-2.465 (2.763)
Adjusted R ²	0.17	0.16	0.17	0.20
ARCH test p-value (8 lags)	0.58	0.62	0.88	0.83
Ramsey RESET test p-value (2 fitted terms)	0.30	0.62	0.82	0.08*
Chow Breakpoint test p-value (1987:1)	0.36	0.23	0.16	0.01**

Newey-West consistent standard errors in parentheses (lag truncation=3). *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

Table 4: Regressions of the Real Interest Rate with Government Purchases
1980:1-1994:4

	(5.1) OLS	(5.2) 2SLS	(5.3) 2SLS	(5.4) 2SLS
Constant	-0.049 (0.182)	-0.006 (0.321)	-0.044 (0.257)	0.071 (0.243)
TAX	0.199 (0.380)	0.187 (0.402)	-	-
MS	-1.670 (1.744)	-2.372 (2.777)	-1.340 (2.558)	-2.640 (1.862)
SPRDUM	-0.033 (0.024)	-0.040 (0.028)	-0.023 (0.025)	-0.020 (0.023)
SUMDUM	-0.050* (0.025)	-0.062** (0.029)	-0.041 (0.028)	-0.034 (0.026)
FALDUM	-0.035** (0.017)	0.031** (0.016)	0.033** (0.015)	0.033** (0.014)
G	1.055** (0.275)	1.187*** (0.368)	1.067*** (0.321)	-
GC	-	-	-	1.983*** (0.436)
GI	-	-	-	-0.557 (0.803)
Adjusted R ²	0.27	0.26	0.28	0.33
ARCH test p-value (8 lags)	0.58	0.75	0.82	0.93
Ramsey RESET test p-value (2 fitted terms)	0.18	0.06*	0.46	0.39
Chow Breakpoint test p-value (1987:1)	0.01***	0.01**	0.01**	0.19

Newey-West consistent standard errors in parentheses (lag truncation=3). *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

Table 5: 2SLS Regressions of the Real Interest Rate with Government Purchases
Components: 1980:1-1994:4

Instruments lagged: Dependent variable:	(6.1) 1-4 quarters MM rate	(6.2) 1-4 quarters MM rate	(6.3) 2-4 quarters MM rate	(6.4) 1-4 quarters Lending rate
Constant	0.000 (0.164)	0.029 (0.186)	-0.168 (0.214)	0.571*** (0.133)
SPRDUM	-0.016 (0.024)	-0.020 (0.026)	0.000 (0.030)	-0.056*** (0.020)
SUMDUM	-0.034 (0.038)	-0.039 (0.033)	-0.017 (0.038)	-0.069*** (0.024)
FALDUM	0.035* (0.018)	0.033 (0.020)	0.042* (0.021)	0.028 (0.020)
MS	-2.198 (1.577)	-2.510 (1.780)	-0.573 (1.938)	-6.150*** (1.191)
GC	2.065*** (0.347)	2.103*** (0.341)	2.098*** (0.490)	1.473*** (0.365)
GIE	-8.749*** (2.734)	-9.132*** (2.533)	-12.013** (4.862)	-6.236*** (1.265)
GIC	2.466** (1.009)	2.498** (0.975)	3.652** (1.670)	0.845 (0.507)
Lagged Inflation	-	0.000 (0.001)	-	-
Adjusted R ²	0.37	0.36	0.24	0.48
ARCH test p-value (8 lags)	0.58	0.68	0.28	0.07*
Ramsey RESET test p-value (2 fitted terms)	0.52	0.52	0.90	0.96
Chow Breakpoint test p-value (1987:1)	0.17	0.14	0.30	0.74

Newey-West consistent standard errors in parentheses (lag truncation=3). *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

Table 6: OLS Regressions of Government Equipment Purchases (GIE) with Output and Employment: 1980-1994

Data:	(7.1) Annual	(7.2) Annual	(7.3) Quarterly	(7.4) Quarterly
Constant	0.047* (0.026)	0.046** (0.020)	0.029*** (0.003)	0.032*** (0.004)
YRATIO	-0.018 (0.024)	-0.014 (0.019)	-	-
ERATIO	-	-	-0.029 (0.047)	-0.135 (0.082)
RATIOx87DUM ^a	-	-0.011** (0.005)	-	0.176* (0.099)
TIME	-0.003** (0.001)	-0.006** (0.002)	-0.003*** (0.001)	-0.003*** (0.001)
TIME2	1.4E-4** (0.6E-4)	0.0009** (0.0004)	1.1E-4** (0.4E-4)	1.5E-4*** (0.4E-4)
TIME3	-	-3.3E-5* (1.7E-5)	-	-
Adjusted R ²	0.25	0.64	0.32	0.36
ARCH test p-value (8 lags)	0.01***	0.66	0.01**	0.14
Ramsey RESET test p-value (2 fitted terms)	0.10	0.21	0.08*	0.16
Chow Breakpoint test p-value (1987:1)	0.25	N.A.	0.01***	N.A.

Newey-West consistent standard errors in parentheses (lag truncation=3). *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

^a YRATIO or ERATIO times a dummy variable equal to 1 starting in 1987 or 1987:1.

Table 7: OLS Regressions of the Capital Account with Net Exports
1980-1994

	(8.1)	(8.2)	(8.3)	(8.4)
Constant	-1631.72** (566.01)	253.39 (937.15)	-472.59 (548.43)	68.56 (1256.22)
NX	-1.06*** (0.145)	-0.76** (0.26)	-0.99*** (0.13)	-0.94*** (0.16)
TIME	397.17*** (83.43)	59.54 (114.91)	139.47* (72.89)	-9.05 (305.58)
TIMEDUM	-	196.32** (67.23)	203.41** (80.21)	192.29 (106.69)
NXDUM	-	-0.31 (0.39)	-	-
TIME2	-	-	-	10.39 (18.58)
Adjusted R ²	0.95	0.96	0.96	0.96
ARCH test p-value (2 lags)	0.95	0.76	0.91	0.48
Ramsey RESET test p-value (2 fitted terms)	0.76	0.40	0.78	0.51
Chow Breakpoint test p-value (1987 or 1987:1)	0.07*	N.A.	N.A.	N.A.

Newey-West consistent standard errors in parentheses. *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

Table 8: 2SLS Regressions of Government Net Foreign Borrowing with Government Equipment Purchases: 1980:1-1991:4

Instruments lagged:	(9.1) Once	(9.2) Twice	(9.3) Once
Constant	-0.047** (0.019)	-0.042** (0.018)	-0.058 (0.036)
SPRDUM	0.006** (0.003)	0.005** (0.002)	0.007* (0.004)
SUMDUM	0.002 (0.005)	0.001 (0.005)	0.003 (0.004)
FALDUM	0.007* (0.004)	0.007* (0.004)	0.008* (0.005)
GC	0.298** (0.146)	0.229* (0.132)	0.389** (0.174)
GIE	0.924** (0.439)	1.159* (0.609)	0.892** (0.398)
GIC	-0.347** (0.171)	-0.330 (0.208)	-0.465** (0.214)
TAX	-	-	0.019 (0.115)
Adjusted R ²	0.14	0.09	0.12
ARCH test p-value (8 lags)	0.62	0.58	0.70
Ramsey RESET test p-value (2 fitted terms)	0.22	0.40	0.12
Chow Breakpoint test p-value (1987:1)	0.83	0.64	0.46

Newey-West consistent standard errors in parentheses. *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level.

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