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The Determinants of Economic Growth after a Currency Crisis

A Cross-Country Analysis

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Abstract

This paper analyzes the determinants of economic growth after a currency crisis by performing pooled OLS regressions on a panel data set consisting of 65 developing countries and corresponding to 84 currency crisis episodes from 1970-2000. Pre-crisis growth levels are found to most significantly affect post-crisis growth. In addition, my empirical results regarding the 1997 Asian currency crisis support research by Hong and Tornell(2005), suggesting that V-pattern recoveries correspond to high short-term debt levels.

1. INTRODUCTION

There have been over 160 currency crisis episodes since 1970. Most recently, the Asian currency crisis in 1997 significantly reduced growth at a time when the East-Asian economies were booming. Most empirical literature focuses on the causes of a currency crisis. However, this paper attempts to analyze the main determinants of economic growth after a currency crisis. In particular, I attempt to study what factors affect the rate of recovery after a crisis.

This paper is divided into seven sections. Section 2 reviews the theoretical framework and previous literature on the determinants of output growth after a currency crisis. Section 3 covers the conceptual model. Section 4 provides a brief description of the ideal data set for this analysis. Section 5 explains the data and measurements used in this paper. Section 6 reports the empirical models and the findings. Finally, in section 7, we conclude the study and provide recommendations for further research.

2. LITERATURE REVIEW

2.1 Theoretical Background

Previous literature is relied on to list the theoretical determinants of post-crisis growth. Literature describes post-crisis growth to be related to a mirage of currency crisis and growth theoretic factors. The currency crisis factors include (1) Initial pre-crisis variables, such as investment booms, the magnitude of foreign short-term debt and openness to trade (2) Domestic policies during the post-crisis period and (3) the External environment during the post-crisis period. The growth theoretic factors include the level of GDP per capita during the crisis year and the pre-crisis investment rate.

Currency crises are often preceded by a period of massive investment (lending boom) resulting form capital inflows into the economy. This causes excessive liquidity in the banking and corporate sectors during the pre-crisis period. The resulting effect is a higher level of non-performing loans, causing a greater reversal in capital flows and a more severe currency crisis.[1]

Capital inflows during the pre-crisis period are largely in the form of foreign short-term debt. Capital outflows in the post-crisis period reduce the level of liquid assets while the devaluation resulting from the crisis increases the value of externally held debt. Therefore, the relative level of short-term external debt to liquid assets in the pre-crisis periods is directly related to the depth of the post-crisis recession. (Rodrik and Velasco, 1999).

Basic theory tells us that more open economies should benefit more relative to less open economies through a quicker improvement in the current account resulting from the devaluation. Net Exports is one of the key variables in the income equation (Y=C+I+G+NX), implying more open economies should recover faster from the devaluation of a crisis.

The effects of domestic monetary and fiscal policies on post-crisis growth are ambiguous. Contractionary monetary policy is correlated with the central banks concern that high interest rates will worsen the financial situation of highly indebted banks and corporations. Monetary tightening often leads to corporate and banking bankruptcies, which would further increase illiquidity. On the other hand, monetary expansion would

[1] Basic macroeconomic theory describes the relationship. Capital outflows and lower investment as a result of non-performing loans cause currency depreciation. The extent of the depreciation is positively correlated to the severity of the post-crisis recession. See Edwards (1985). In addition, the effect of a reversal on capital flows during a crisis is negative. See Hutchinson and Noy (2004).

cause a further depreciation, worsen the burden of foreign currency denominated liabilities and encourage further capital outflows. Expansionary fiscal policy should theoretically lead to higher interest rates while fiscal tightening should result in a greater currency devaluation, resulting in the same concerns regarding monetary policies. The ambiguity of fiscal and monetary effects has also brought into question the role of the IMF in post-crisis growth. The IMF, known for implementing tight monetary and fiscal policies, has its critics and adversaries for the very reasons described above. Stiglitz (2001) claims IMF policies enforcing strict monetary and fiscal policies in return for funding have exacerbated post-crisis recessions.[2]

Theoretically, higher interest rates abroad generate greater capital outflows, which would exacerbate the credit crunch problem in crisis-hit countries. Lower levels of GDP (recessions) abroad would reduce the demand for exports from the crisis country, thus diminishing the positive effects resulting from the devaluation. Therefore, higher foreign interest rates and lower levels of foreign growth are likely to slow-down the recovery process.

The initial level of GDP per capita should theoretically affect the pace of recovery. Growth theory tells us the greater the difference between the initial level of GDP per capita and the steady state level (normal trend), the faster the growth rate of GDP per capita. The more a country is offset from its steady state level of GDP per capita the greater the rebound effect during the recovery process. Growth theory relating to

[2] Stiglitz (2001) claims IMF rules required funding to be used to bail out foreign investors, instead of on expansionary fiscal policies. The resulting contraction in GDP resulting from contractionary policies decreases imports and in turn hurts exports as well. Thus Stiglitz believes IMF policies did not abide by their philosophy to improve the current account (increase exports) in the post-crisis period.

investment following a random walk also predicts investment booms to be followed by a contraction in growth and investment in the short-run.[3]

2.2 Empirical Literature Review

2.2.1 Defining a Currency Crisis

One of the central issues in studying the effects of a currency crisis is how one defines such an event. This section will state the methodologies used in previous literature to describe a currency crisis. The general consensus is that a currency crisis corresponds to a large devaluation in the domestic currency or a huge loss of reserves. Previous literature defines a crisis using one or both forms of the definition.

Feretti and Razin (1998), Park and Lee(2001) and Barro (2001) define a crisis to be any year where a country experiences a nominal depreciation of at least 25 percent in any quarter of the year and the depreciation rate exceeds the previous quarter's change in the exchange rate by at least 10 percent.[4] On the other hand, Rodrik and Velasco (1999) and Sachs and Radele (1998) define the crisis year to occur when there is a turnaround of net foreign capital flows of 5% pf GDP or more[5]. Hong and Tornell (2005) use two common methods for defining crises. The first method involves the weighted average of the depreciation of the real exchange rate and reserve losses, where situations where the

[3] If the capital stock follows a random walk then $\Delta K=\varepsilon_{t.}$ Thus $\Delta I=\varepsilon_t-\varepsilon_{t.-1}(1-\delta)$. This implies a larger amount of investment in period t-1 results in a contraction in investment in period t. Since basic income equation tells us ΔY is related to ΔI, an investment boom in period t-1 should result in lower growth in period t.
[4] Fertti and Razin (1998) also require the rate of depreciation to double from the previous year and arate pf depreciation in the previous year below 40 percent.
[5] Rodrick and Valasco (1999) and Sachs and Radelet (1998) use this definition in studying the probability of an occurrence in a currency crisis.

average exceeded the sample mean by two standard deviations was defined as a crisis. The second method is identical to that used by Park and Lee (2001) and Barro (2001).[6]

2.2.2 Data Types and Techniques

This section describes the types of data and regression techniques used in previous studies. A majority of the previous empirical work use panel data to perform cross-country (pooled) regressions.

Feretti and Razin (1998), Gupta et al. (2001), Park and Lee (2001) and Hong and Tornell (2005) perform cross-country regressions on panel data sets whereas Barro (2001) performs a panel analysis incorporating the effect of time. Feretti and Razin (1998) perform OLS regressions for 138 crises on annual data from 1970-1996, whereas Gupta et al. (2001) perform OLS regressions for 195 currency crisis episodes, using annual data from 1970-1988. Somewhat differently, Hong and Tornell (2005) use quarterly data indexed annually to perform robust and median regressions. While Feretti and Razin (1998) study post-crisis growth for low and middle income countries, Hong and Tornell (2005) study developing countries.

Barro (2001) performs a panel data analysis on annual data from 80 countries observed over 5 year periods from 1965-2000. Three-stage least squares regressions were used, with mainly lagged values of independent variables used as instruments. Park and Lee (2001) use the Seemingly Unrelated regression technique on monthly data over the period from 1970-1995 to study a 160 currency crisis episodes. The three-stage least squares and SUR techniques are advanced techniques well beyond the knowledge of this research.

[6] Hong and Tornell (2005) use quarterly data on the exchange rate and reserves to construct an annual crisis index.

2.2.3 Results and Dependent Variables

This section provides and overview of the general results of previous empirical work on post-crisis growth. The most robust predictors of post-crisis growth are the pre-crisis growth rate and openness to trade.

Using average growth rate for three years after a crisis as a deviation from the OECD average during the same period, Feretti and Razin (1998) find openness to trade and the level of GDP before the crisis to both significantly increase post-crisis growth in middle and low income countries. The average pre-crisis investment rate was found to negatively effect growth only in middle-income countries. The study by Hong and Tornell (2005) on developing countries finds pre-crisis openness to trade to positively affect output only 1 year after a crisis. In addition, the pre-crisis level of illiquidity was found to negatively effect growth for 1 year after a crisis, while the extent of pre-crisis investment was sound to negatively effect output for up to 3 years after a crisis. Similar to Hong and Tornell (2005), Gupta et al.(2001) also find significant positive coefficient on openness to trade and significant negative coefficients on pre-crisis levels of growth, illiquidity and investment. In addition, the enforcement of capital controls in the pre-crisis period was found to positively affect recovery. Gupta et al.(2001) and Hong and Tornell (2005) both use the change in output growth following a crisis to study post crisis recovery. Gupta et al. (2001) use the difference between the average real GDP growth rate two years after a crisis and the average real GDP growth rate 3 years before the crisis as a measure of the pace of recovery. Somewhat differently, Hong and Tornell (2005) measure post crisis recovery by computing the deviation of the GDP growth rate from the tranquil period average.

Panel data analyses by Barro (2001) and Park and Lee (2001) both use the average growth rate of real per capita GDP 5 years after a crisis as a measure of recovery. Similar to other empirical work, Park and Lee (2001) find greater levels of openness and lower levels of initial GDP per capita to increase the speed of post-crisis recovery. They also find expansionary fiscal policy and higher levels of world growth to positively influence post-crisis growth.

Barro (2001) focuses his analysis on the difference in post-crisis recovery between Asian and East Asian countries. Using dummy variables to separate Asian (Indonesia, Malaysia, South Korea , Philippines and Thailand) from East Asian(Singapore, Japan, Hong Kong and Taiwan) countries, Barro (2001) finds the pre-crisis investment rate to be higher and the post-crisis investment rate to be lower for the Asian countries. The study shows a strong rebound in economic growth within two years of the post-crisis period for the East Asian countries while the Asian countries did not recover as quickly.

The result is similar to that of Hong and Tornell (2005) as countries that suffered from a greater pre-crisis lending boom (Asian) recovered slower in comparison to countries that didn't experience such a boom (East-Asian). In accord with other empirical work, openness to trade is found to increase post-crisis recovery. However, in contrast to Park and Lee (2001), Barro (2001) finds expansionary fiscal policy to negatively effect post-crisis recovery. In addition, expansionary monetary policy also significantly reduces post-crisis growth.

2.2.4 Control Variables

Hong and Tornell (2005) study the affects of illiquidity by measuring pre-crisis short-term debt and reserves to M2 ratio for up to three years prior to the crisis while Gupta et. al (2001) use the ratio of short-term debt to international reserves as their measure whereas Feretti and Razin (1998) use the external debt to GNP ratio during the year before the crisis.

Various measures of openness to trade exist amongst the literature. Park and Lee (2001) use the average value of an interactive term between the trade share and real exchange rate 4 years after a crisis to study the differential impact of openness to trade, at different exchange rate levels, on output growth. Gupta et al.(2001) and Feretti and Razin(1998) use the trade share of GDP one year prior to the crisis while Barro (2001) uses the trade share of GDP during the crisis year to study the effect of openness. Somewhat differently, Hong and Tornell (2005) use the ratio of Exports to GDP for up to 3 years prior to the crisis to analyze the same phenomenon.

External variables such as the pre-crisis World per capita GDP growth (Park and Lee, 2001), growth rate in G71 countries (Gupta et al., 2001), U.S. federal funds rate(Gupta et al.,2001), U.S. prime lending rate (Feretti and Razin, 1998) and foreign growth/interest rates during the crisis year were used to analyze the affect of the global environment on recovery.

Monetary and fiscal policies should also theoretically affect recovery. Park and Lee (2001) use the average public consumption growth in the post-crisis period as a measure of fiscal policy, while Gupta et al. (2001) measure the post-crisis budget deficit. They also both use the post-crisis real money supply growth for a monetary policy

analysis. Barro (2001) looks at the average post-crisis ratio of government consumption to GDP as a measure of fiscal policy and the average inflation rate for monetary policy.

2.2.5 IMF Policies

The IMF is known to enforce strict monetary and fiscal policies on program countries. Dicks-Mireaux et al. (2000) and Hutchinson (2001) perform General Evaluation Estimate regressions to provide empirical evidence on the affect of IMF program intervention on real GDP growth.[7] Hutchinson (2001) finds that in general currency crises tend to induce about an 11% credit expansion while the coincidence of a currency crisis and current IMF program intervention is associated with a credit contraction of about 15% annually. Using panel data from 1986-1991 along with the general evaluation estimator technique, Dicks-Mireaux et al.(2000) find that IMF program intervention positively effects real GDP growth[8]. Using panel data from 1975-97, Hutchinson (2001) uses a model that includes an interactive term measuring the occurrence of an IMF-program that takes place at the time of or a year before the occurrence of a currency crisis. The study finds that coefficient on the interactive term to be insignificant. Using an IMF dummy variable, Park and Lee (2001) also find IMF program participation to be insignificant in describing output growth after a crisis.

[7] The GMM technique is an advanced econometric technique well beyond the knowledge of this research
[8] Similar to Park and Lee (2001), an IMF dummy variable was used in this technique. Dicks-Mireaux et al. (2000) admit to inefficient estimates due to signs of heteroschedastic residuals.

TABLE 1: Summary of Literature on the Determinants of Post-Crisis Growth

Paper	Technique	Dependent Variable	Main Control Variables	Coefficients/ Results
Hong and Tornell (2005)	Robust and Median	Avg Real GDP per capita growth rate (t+1)	Short term debt (t-1 – t-3) Investment Rate (t-1 – t-3)	-0.14* -0.34**
		Avg Real GDP per capita growth rate (t+2 – t+3)	Short term debt (t-1 – t-3) Investment Rate (t-1 – t-3)	-0.30* 0.20
Park and Lee(2001)	SUR	Avg Real GDP per capita growth rate (t+1 – t+5)	Real GDP per Capita (t) World GDP per Capita Growth (t+1 – t+5) Investment/GDP (t+1 – t+5)	-1.033* 0.371* 0.119*
Gupta et al.(2001)	Pooled OLS	Avg Real GDP per capita growth rate (t+1 – t+2) Avg Real GDP growth rate (t-1 – t-3)	Pre Crisis Capital Flows (t-1 – t-3) Short-term external debt/reserves (t-1) Short term External Debt to Reserves (t-1)	-0.77** -0.4** -0.11**
Barro (2001)	Three-Stage Least Squares	Avg Real GDP per capita growth rate(t+1-t+5)	Investment/GDP (t – t+5) Asia Dummy East Asia Dummy	Investment rates more variable for East Asia economies and economic recovery slower for East Asian countries
Feretti and Razin (1998)	Pooled OLS	Avg Growth Rate (t+1 – t+3) Avg OECD Growth rate (t+1 – t+3)	Lagged Dependent Variable (t-1 – t-3) EXP +IMP/GDP (t-1)	0.33* 0.074*

The pre-crisis growth rate and openness to trade are the most robust predictors of output growth in previous empirical research. In this paper, I specifically rely on the work by Park and Lee (2001), Gupta et al. (2001) and more recently, Hong and Tornell (2005) to study the determinants of post-crisis growth.

3. CONCEPTUAL MODEL

In this paper, we use a single equation model to study the significant determinants of post-crisis growth. The model is derived from the theoretical framework relating to currency crises described previously.

Post-Crisis Growth=f(Pre-Crisis Growth, Pre-Crisis Investment, Debt Burden, Openness to Trade, External Growth, Fiscal Policy, Monetary Policy)

The pre-crisis investment rate and the debt burden are theoretically negatively related to post-crisis growth while openness to trade, external growth and pre-crisis growth should positively affect post-crisis growth. Higher pre-crisis growth rates are related to countries with lower initial levels of GDP per capita, which should theoretically correlate with a faster recovery.[9] The effects of monetary and fiscal policies on the pace of recovery are ambiguous.

Table 2: Conceptual Model Overview

Rate of Recovery		
Variable	**Expected Sign**	**Explanation**
Pre-Crisis Growth	Positive	Solow growth model shows countries growing at higher rates should rebound more quickly after a shock to growth resulting from a crisis.
Pre-Crisis Investment Rate	Negative	Higher levels of pre-crisis investment increase the probability of poor investment/non-performing loans in the future
Debt Burden	Negative	The larger the relative share of short-term debt to liquid assets the greater the loss in investor confidence resulting from default loans
Openness to Trade	Positive	The more open the economy, the larger the benefit resulting from the currency devaluation
External Growth	Positive	Higher levels of growth in foreign economies increases the demand for domestic exports
Fiscal Policy	Ambiguous	Expansionary policy lowers the extent of the currency devaluation but raises interest rates
Monetary Policy	Ambiguous	Expansionary policy lowers interest rates but causes a more severe currency devaluation

[9] The theory behind this relationship is derived from the Solow Growth model.

4. IDEAL DATA

Ideally, we would like to measure the speed of recovery from a currency crisis using a measure that incorporates the difference between the post-crisis and tranquil period growth rates. This would account from how quickly a country is recovering from a crisis. Unfortunately, tranquil period growth rates are not easily available for all countries in the sample. Similarly, the pre-crisis growth rate should also be measured as a deviation from the tranquil or steady-state level of growth.

An ideal measure for pre-crisis investment should incorporate the performance of investment projects resulting from greater levels of capital in the pre-crisis period. Additionally, a measure of corruption in the distribution of additional capital to investment projects would also ideally be accounted for. Unfortunately, such concepts cannot be measured.

The ideal measure of the level of a countries debt burden should incorporate all assets that could be used in avoiding foreign debt defaults as well as factors such as investor confidence and country risk premiums that also affect the debt level. However, distinguishing between what assets could be used for repayment (liquid assets) is an arbitrary measure. Additionally, measures of investor confidence and country risk should be factored as a weighted average of the countries that invest in the domestic economy.

Ideal measures for openness to trade should not only incorporate the level of exports and imports, but also other factors such as trade restrictions, country size, geographical distance to trade partners and the influence of the black market. The external growth variable should include a weighted average of GDP growth levels for the country's trading partners and incorporate the effect of interest rates in other countries.

Fiscal and monetary variables should capture any policy that affects interest rates or the exchange rate in the economy.

5. ACTUAL DATA

The panel data set used for the purposes of this study involves 65 developing countries corresponding to 84 currency crisis episodes.[10] The countries that experienced crisis episodes mostly come from Africa, East Asia, Latin America and the Caribbean regions. This paper uses the same definition to identify a crisis year as that used by Park and Lee (2001), Barro (2001) and Hong and Tornell (2005).[11]

We use the average three-year growth rate after the crisis year as a measure of the pace of recovery after a crisis. The pace of recovery is only studied in the short-term period as long-run growth levels are determined by growth factors such as technical productivity and accumulation of labor and capital. The average growth is studied for three years after a crisis, in line with empirical work by Gupta et al. (2001) and Hong and Tornell (2005).The average growth rate for up to three years before a crisis is used to measure the level of pre-crisis growth. The three-year time period is chosen to stay consistent with the length of the post-crisis time period.

Pre-crisis investment is measured using the average three-year pre-crisis investment rate. Since data for the percentage of non-performing loans is unavailable for most countries, the pre-crisis investment rate is used as a measure of investment performance. The basis for using this measurement is deduced theoretically and

[10] See Appendix for information on the countries and crisis years analyzed
[11] A crisis year is defined to be any year where a country experiences a nominal depreciation of at least 25 percent in any quarter of the year and the depreciation rate exceeds the previous quarter's change in the exchange rate by at least 10 percent.

explained previously in section 2. To recap, higher rates of investment during the pre-crisis period increase the probability of misinvestment and overlending, thus reducing investment performance and post-crisis growth.

The Debt burden is measured using the average three-year pre-crisis foreign short-term debt to reserves ratio. Capital inflows in pre-crisis periods are largely in the form of short-term debt. Additionally, reserves are the largest group of liquid assets available in avoiding loan defaults. Thus, the ratio is a good measure of the debt burden or liquidity constraints of a country.[12]

Openness to trade is measured using the average three-year post-crisis trade share of GDP (Exports+Imports/GDP) to incorporate the effect of the currency devaluation on exports and GDP growth. The average 3-year World GDP growth rate in the post-crisis period is used to measure the effect of external growth on post-crisis recovery. To measure the effect of fiscal and monetary policies, the average of government expenditure to GDP ratio and the average growth rate of money supply (M1+M2) in the post crisis period are used respectively. Data for the above variables are obtained from the World Bank's *World Development Indicators* and the *Penn World Tables* from 2005.

[12] As stated in Hong and Tornell (2005), Frankel and Rose (1996) and Sachs et al. (1996) find that the ratio of short term debt and liquid assets can explain both the probability and depth of a crisis.

Table 3: Variable Description

Concept	Variable	Construction of Variable	Source
Recovery Rate	*Real GDP growth Rate*	*Average Real GDP growth rate (t+1 –t+3)*	*WDI*
Pre-Crisis Growth	*Real GDP Growth rate*	*Average Real GDP growth rate (t-1 – t-3)*	*WDI*
Openness to Trade	*Exports+Imports/GDP*	*Average EXP+IMP/GDP (t+1 – t+3)*	*WDI*
Pre-Crisis Investment	*Pre-Crisis Investment Rate*	*Average Investment/GDP (t-1 – t-3)*	*Penn*
Debt Burden	*Foreign Short Term Debt/Reserves*	*Average foreign short-term debt/reserves (t-1- t-3)*	*WDI*
Monetary Policy	*Money Supply Growth*	*Average Annual M1+Quasi Money growth (t+1 – t+3)*	*WDI*
Fiscal Policy	*Government Expenditure/GDP*	*Average Government Expenditure/GDP (t+1 - t+3)*	*Penn*
External Growth	*World GDP Growth*	*Average World GDP growth rate (t+1 – t+3)*	*WDI*

6. EMPIRICAL MODELS AND RESULTS

The following four regressions are performed to study the main determinants of recovery after a currency crisis. A pooled OLS technique is used on currency crises from 1970-2000. Regional dummy variables are used to identify differences in recovery rates across regions and an IMF dummy variables is included to analyze the effect of participating in an IMF program on post-crisis growth.

1. GGDP = B0 + B1 PGDP + B2 TRADEGROWTH + B3 DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH

2. GGDP = B0 + B1 PGDP + B2 TRADEGROWTH + B3 DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH + B8 ASIA97

3. GGDP1 = B0 + B1 PGDP + B2 TRADEGROWTH + B3 DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH + B8 LA

4. GGDP = B0 + B1 PGDP + B2 TRADEGROWTH + B3DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH + B8 IMF

where

GGP=Average Real GDP growth rate (t+1-t+3),

PGDP=Avg Real GDP growth rate (t-1 – t-3),

Tradegrowth=Avg EXP+IMP/GDP (t+1 – t+3),

DEBTR= Avg Short-term Foreign Debt/Reserves (t-1 – t-3),

PINVRATE=Avg Investment/GDP (t-1- t-3),

GOVAV=Government Expenditure/GDP (t+1 – t+3),

MONEYGROWTH= Avg growth M1+quasi money (t+1 – t+3),

WORLDGROWTH=Avg world GDP growth (t+1 – t+3),

LA=Latin America Dummy, Asia97=1997 Asian Currency Crisis Dummy, IMF=IMF involved Dummy

The results of the four regressions are shown in Table 4 below:

Table 4: Summary

Dependent Variable: Real GDP growth rate (t+1 – t+3)

Variable	Coefficient (t-statistic in parentheses)			
	Regression 1	**Regression 2**	**Regression 3**	**Regression 4**
Intercept	-3.222 (-0.990)	-4.60 (-1.202)	-4.405 (-1.210)	-2.828 (-0.716)
Pre-Crisis Growth (t-1…t-3)	0.552** (2.052)	0.595** (2.231)	0.633** (0.275)	0.5797** (2.141)
(Exports+Imports)/GDP (t+1…t+3)	0.0406 (1.036)	0.0551** (1.348)	0.0606 (1.444)	0.0423 (1.068)
Short-term External Debt/Reserves (t-1…t-3)	0.00215** (1.392)	0.00188* (1.272)	0.00198 (1.329)	0.00204 (1.324)
Investment /GDP (t-1…t-3)	-0.207* (-1.82)	-0.1052 (-0.918)	-0.1685 (-1.410)	-0.2166* (-1.788)
Government Expenditure/GDP (t+1…t+3)	0.0432 (0.272)	0.00488 (0.0304)	0.00819 (0.0515)	0.0327 (0.205)
Money Supply Growth (t+1...t+3)	-0.000325 (-0.0927)	-0.00114 (-0.406)	-0.00219 (-0.8064)	-0.00033 (-0.0952)
World GDP Growth (t+1…t+3)	1.776 (1.741)	2.0639 (1.833)	1.712 (1.569)	2.1243 (1.613)
’97 Asian Crisis Dummy	-	-7.2503* (-1.817)	-5.924 (-1.559)	-
Latin America Dummy	-	-	2.487* (1.681)	-
IMF Dummy	-	-	-	-0.7092 (-0.354)
Adjusted R-Squared	**0.265**	**0.384**	**0.399**	**0.266**
Sample Size	**64**	**64**	**64**	**64**
F-Statistic	**4.246918**	**4.279**	**3.987**	**3.804**
Sum of squared residuals	**2085.703**	**1968.054**	**1918.299**	**2020.742**

White Hetereoskedactic Standard Errors are used

*significant at the 5% level, **significant at the 10% level

The first regression shows that the coefficient on the pre-crisis growth is significantly positive while the coefficient on the pre-crisis investment rate is significantly negative. The result suggests a 1 percent increase in the average pre-crisis growth rate correlates to about a 0.55 percent increase in the average post-crisis growth rate while a 1 percent increase in the average pre-crisis investment rate causes about a 0.21 percent decrease in the average post-crisis growth rate.

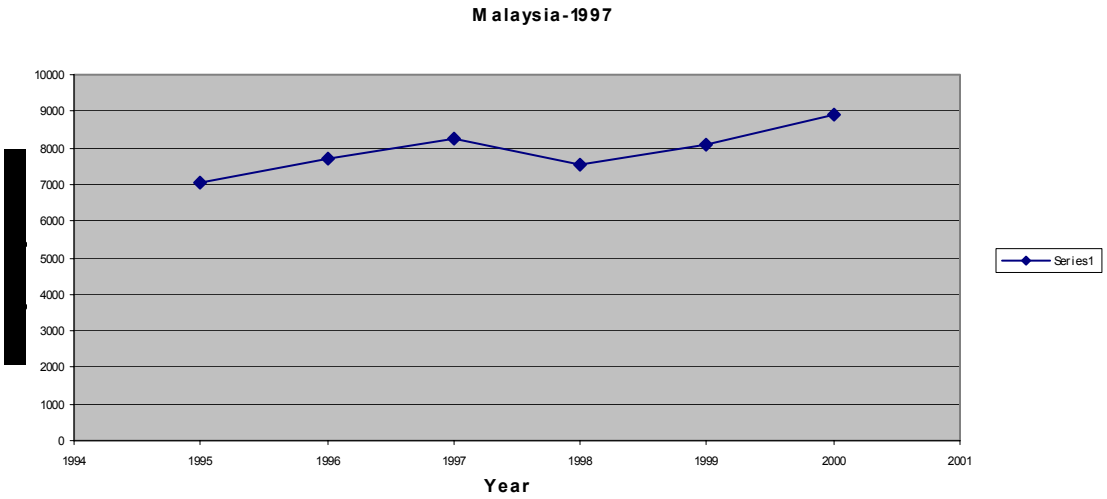
These results are in accord with theoretical predictions and suggest that countries with higher initial levels of GDP growth recover faster in the aftermath of a currency crisis. Additionally, the fact that higher pre-crisis levels of investment negatively affect post-crisis growth suggests higher pre-crisis investment rates are correlated with over investment in the domestic economy, thus reducing investment performance and economic growth in the post-crisis period.

The fiscal and monetary policy variables along with the trade share do not significantly affect post-crisis growth. However, as theoretically predicted, higher levels of the trade share of GDP increase the rate of post-crisis growth, as more open countries gain a greater advantage from the resulting currency devaluation of a crisis. Higher post-crisis levels of government expenditure relative to GDP and lower rates of monetary growth positively affect the rate of recovery. The coefficient on the post-crisis world growth rate is positive, as expected. Higher growth rates in foreign countries correlate to a greater demand for exports from the crisis hit country, thus causing a faster recovery.

Regression 3 includes a dummy variable for Latin American countries while regression 4 includes a dummy variable for countries participating in IMF programs during the post-crisis period. The results suggest that on average crises in Latin American countries recovered faster than other crisis episodes. Also the negative sign on the IMF dummy supports the view of Stiglitz (2001). However, the coefficient is highly insignificant.

The second regression suggests the countries that were part of the recent Asian currency crisis recovered slower on average relative to all other currency crisis episodes. The result however is biased due to our measurement of post-crisis growth. Countries that

were part of the recent crisis in 1997 have depicted a V-pattern of post-crisis GDP growth. The figure below shows this pattern Malaysia. (See Appendix for Korea, Thailand, Philippines and Indonesia).



These countries all experienced sharp initial declines in GDP per capita for about one year after the crisis, after which growth sharply appreciated. Since our measurement of post-crisis growth only incorporates growth three years after a crisis, the initial large contraction in growth 1 year after the crisis significantly reduces the three year average growth rate and does not fully account for the sharp appreciation in growth thereafter. If however, we used a five year average as our dependent variable, the coefficient on the dummy variable would probably have been positive.

It should be noted that the coefficient on the short-term foreign debt to reserves ratio in regression 1 is positive and significant, opposite to theoretical implications. This could be the case in crises such as the Asian crisis in 1997, where V-patterns of recovery are depicted. Empirical work by Hong and Tornell (2005) suggests that V-patterns of recovery are seen in liquidity crises where the negative impact of a loss in investor confidence is short lived. This would explain why these crises exhibit a sharp initial

contraction after a crisis and then show strong recovery once investor confidence is restored (Hong and Tornell, 2005).

The next two regressions test this claim by using a dummy variable for the ’97 Asian currency. The 97’ Asian crisis is characterized as a banking crisis, where liquidity constraints increased foreign short-term debt burdens and reduced investor confidence. In order to test the empirical results in the study by Hong and Tornell(2005), an analysis of the differential impact of foreign debt burdens over time in the ‘ 97 Asian crisis is performed. The results are shown in table 5.

5. GGDP1 = B0 + B1 PGDP + B2 TRADEGROWTH + B3 DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH + B8 ASIA97 + B9 DEBTASIA97

6. GGDP = B0 + B1 PGDP + B2 TRADEGROWTH + B3 DEBTR + B4 PINVRATE + B5 GOVAV + B6 MONEYGROWTH + B7 WORLDGROWTH + B8 ASIA97 + B9 DEBTASIA97

where

GGDP1= Real GDP per capita growth rate (t+1),

DEBTASIA97=DEBTR x ASIA97

Regression 5 uses the ’97 Asian crisis to analyze the impact of the debt burden on post-crisis growth after one year, while regression 6 analyzes the effect on growth up to three years after a crisis. Regressions 5 and 6 use an interactive term between the ’97 Asian crisis and the foreign debt burden. The results shown in table 4 somewhat support the claim by Hong and Tornell (2005). Regressions 5 and 6 show that in the case of the Asian currency crisis, high foreign debt levels negatively impacted recovery for only up to one year after a crisis. The coefficient on the interactive term in regression 5 is significantly negative, suggesting that a one unit increase in the ratio of short-term foreign debt to reserves causes a 0.063 unit decrease in the post crisis growth rate one

year after the crisis for the Asian countries. The coefficient on the interactive term changes sign in regression 6, suggesting that the negative impact of high levels of foreign debt during the Asian crisis was short-lived. The positive sign is an indication that in crises that depict a V-pattern of recovery, such as the ’97 Asian crisis, post-crisis growth returns to normal levels as soon as the contraction in investor confidence resulting from high levels of foreign debt to reserves is restored. It should be noted that regressions 5 and 6 imply that for all the crisis episodes, except the ’97 Asian crisis, high levels of foreign debt relative to reserves actually positively effect GDP growth for up to one and three years after a crisis. This finding is unexpected and theoretically inappropriate. The only explanation for this result is that other countries (other than the Asian countries) that experienced V-patterns of recovery might be influencing the sign of the coefficient.

Table 5: Summary

Dependent Variables:
Real GDP Growth Rate (t+1) and Real GDP Growth Rate (t+1 – t+3)

Dependent Variable	Real GDP Growth Rate (t+1)	Real GDP Growth Rate (t+1 – t+3)
Variable	**Coefficient (t-statistic in parentheses)**	
	Regression 5	**Regression 6**
Intercept	-1.874 (-0.658)	-4.678 (-1.172)
Pre-Crisis Growth (t-1…t-3)	0.313 (1.349)	0.588** (2.196)
(Exports+Imports)/GDP (t+1…t+3)	-0.00706 (-0.367)	0.0569 (1.234)
Short-term External Debt/Reserves (t-1…t-3)	0.000828* (1.831)	0.00184 (1.238)
Investment /GDP (t-1…t-3)	-0.31375** (-2.951)	-0.103 (-0.876)
Government Expenditure/GDP (t+1…t+3)	0.169** (0.2.978)	0.00258 (0.0158)
Money Supply Growth (t+1...t+3)	-0.00249 (-1.171)	-0.00106 (-0.361)
World GDP Growth (t+1…t+3)	1.621 (1.455)	2.062* (1.809)
’97 Asian Crisis Dummy	0.0263 (0.055)	-8.627 (-0.963)
Interaction term: ’97 Asia Dummy* Short-term External Debt/Reserves	-0.0638* (-1.72)	0.0133 (0.239)
Banking Crisis Dummy	-	-
Interaction Term: Banking Crisis Dummy*Short-term External Debt/Reserves	-	-
Adjusted R-Squared	**0.299**	**0.399**
Sample Size	**62**	**64**
F-Statistic	**3.889**	**3.987**
Sum of squared residuals	**1267.337**	**1918.299**

White Hetereoskedactic Standard Errors are used
*significant at the 5% level
**significant at the 10% level

Overall, all our regressions show that the most robust determinant of post-crisis growth is the pre-crisis rate of growth. The coefficient on the average pre-crisis growth rate is significantly positive in all regressions except regression 5. This result is similar to previous empirical work by Park and Lee (2001).

7. CONCLUSION

This paper analyzes the determinants of recovery after a currency crisis by performing pooled OLS regressions on 65 developing countries corresponding to 84 currency crisis episodes from 1970-2000. The three year average real GDP growth rate after a crisis is used as a measure of the pace recovery. The pre-crisis level of growth most significantly effects post-crisis growth. Additionally, the empirical results by Hong and Tornell (2005) are applied to the Asian crisis in 1997. My results, relating to the Asian currency crisis, support his results suggesting that V-pattern recoveries after a crisis are due to the short-lived negative impact of high short-term debt levels.

One of the main drawbacks of this study lies in the pooled technique used to analyze growth after crises. Each currency crisis is unique and recovery after a crisis is dependent on many country specific factors that cannot be measured. For example, the effect of certain country-specific political factors would certainly affect growth in the post-crisis period.

Future research could attempt to perform a time series analysis for individual crisis episodes. This would provide a way of to omit bias resulting from country-specific factors and might lead to more confident results on the determinants of post-crisis growth. Additionally, the impact of growth theoretic factors such as total factor productivity or the accumulation of labor and capital on post-crisis growth could be studied.

Finally, I believe the determinants of post-crisis growth are very complex. My findings are similar to the results of previous empirical research showing that pre-crisis growth rates are one of the most significant predictors of post-crisis growth.

References

Aziz, Jahangir, Caramazza F., Salgado R. (2000). Currency crises: In search of common elements. *IMF Working Paper no. 00/67*

Barro R. (2001). Economic growth in East Asia before and after the financial crisis. *NBER Working Paper 8330*

Calvo, G. A. (1998). Capital flows and capital market crises: The simple economics of sudden stops. *Journal of Applied Economics, 1*, 35-54.

Corsetti G. , Pesenti P., Roubini N. (1998) What caused the Asian currency and financial crisis? Part 1: A macroeconomic overview. *NBER Working Paper 6833*

Dicks-Mireaux, L., Schadler.S. (2000) Evaluating the effect of IMF lending to low income countries. *Journal of Economic Development, 61*, 495-526.

Edwards S. (1999). How effective are capital controls? *The Journal of Economic Perspectives, 13*(4), 65-84.

Edwards S. (1997). The Mexican peso crisis: How much did we know? When did we know it? *NBER Working Paper 6334*

Edwards S. (1986). Are devaluations contractionary? *The Review of Economics and Statistics, 68*, 501-507.

Feretti G. ,Razin A. (1998). Current account reversals and currency crises: Empirical regularities. *NBER Working Paper 6620*

Frankel A. , Andrew R. Currency crashes in emerging markets: An empirical treatment. *Journal of International Economics, 41*, 351-366.

Gupta P., Mishra D., Sahay R. (2001). Output response to currency crises. *Journal of Economic Literature*

Hong and Tornell. (2005). Recovery from a currency crisis. *Journal of Development Economics, 76*, 71-96.

Hutchinson M. (2001). A cure worse than the disease? Currency crises and the output costs of IMF supported stabilization programs. *NBER Working Paper 8305*

Kaminsky, Graciela L., Reinhart C. (1999). The twin crises: The causes of banking and balance of payments problems. *The American Economic Review, 89*(3), 473-500.

Kaplan E., Rodrick D. (2001). Did the Malaysian capital controls work? *NBER Working Paper 8142*

Mishkin F. (1999). Lessons from the Asian crisis. *NBER Working Paper 7102*

Park Y., Lee J. (2001) Recovery and sustainability in East Asia. *NBER Working Paper 8373*

Stiglitz. (2000). What I learned at the world economic crisis: The insider. *The New Republic*

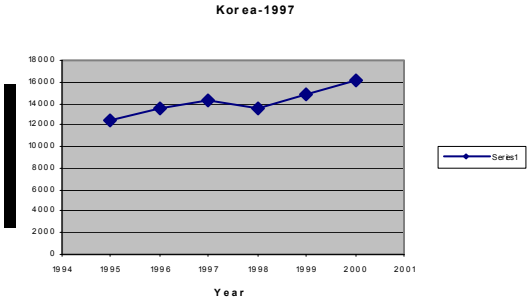
Stiglitz J. (2001). Failure of the fund. *Harvard International Review, 23*(2), 14-22.

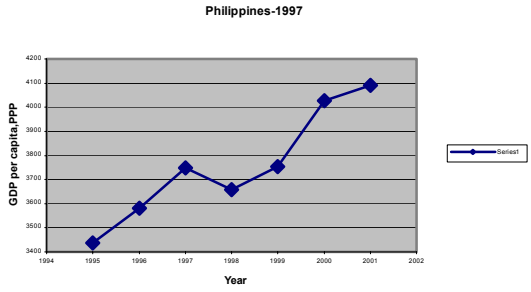
APPENDIX

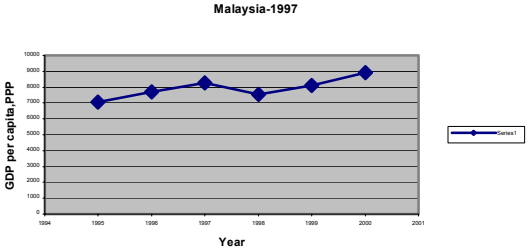
Table 6: DATES OF CURRENCY CRISES

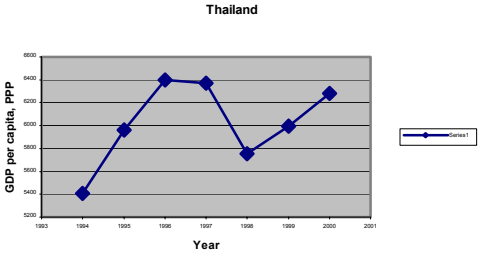
COUNTRY	CURRENCY CRISIS YEAR
Algeria	1990,1994
Argentina	1981,1987,1991
Benin	1994
Brazil	1983,1987,1999
Cameroon	1994
Central Africa Republic	1994
Chad	1994
Chile	1995
China	1989,1994
Comoros	1994
Congo, Republic of	1994
Costa Rica	1981
Cote d'Ivoire	1994
Dominican Republic	1985
Ecuador	1982.1992,1999
Egypt	1989
El Salvador	1986,1990
Ethiopia	1992
Figi	1998
Gabon	1994
Gambia	1984
Ghana	1983,1999
Guatemala	1986
Guinea	1986
Guyana	1984
Haiti	1991
Honduras	1990
Hungary	1991
Indonesia	1983,1997
Iran	1993
Jamaica	1983,1991
Jordon	1988
Kenya	1993
Korea	1997
Lao People's Dem. Republic	1985,1997
Lebanon	1985,1990
Lesotho	1984
Madagascar	1987,1991
Malawi	1992,1998
Malaysia	1997

Maldives	1987
Mali	1994
Malta	1992
Mauritania	1992
Mexico	1982,1994
Nicaragua	1985
Niger	1994
Nigeria	1986,1992,1999
Paraguay	1984
Peru	1984
Philippines	1983,1997
Romania	1990,1996
Rwanda	1990,1994
Samoa	1983
Sao Torne and Principe	1987,1991
Senegal	1994
Solomon Islands	1997
Swaziland	1984
Thailand	1997
Togo	1994
Turkey	1991
Uruguay	1982
Venezuela	1984,1994
Yemen	1995
Zimbabwe	1991,1997









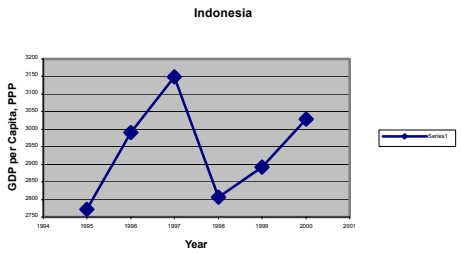
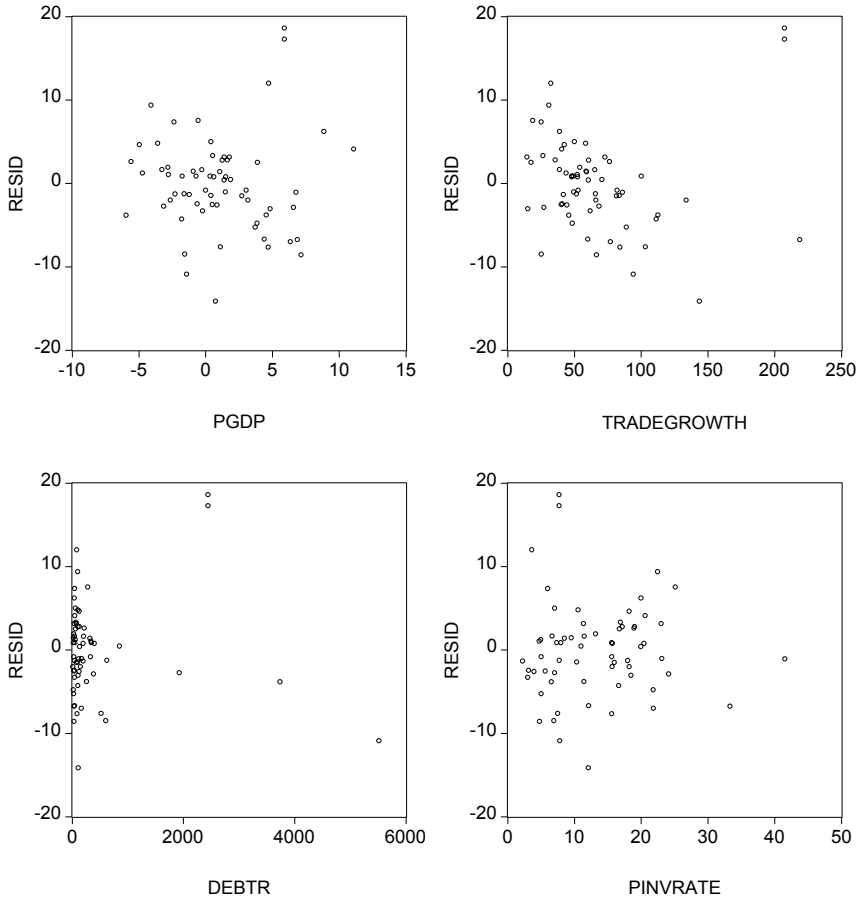


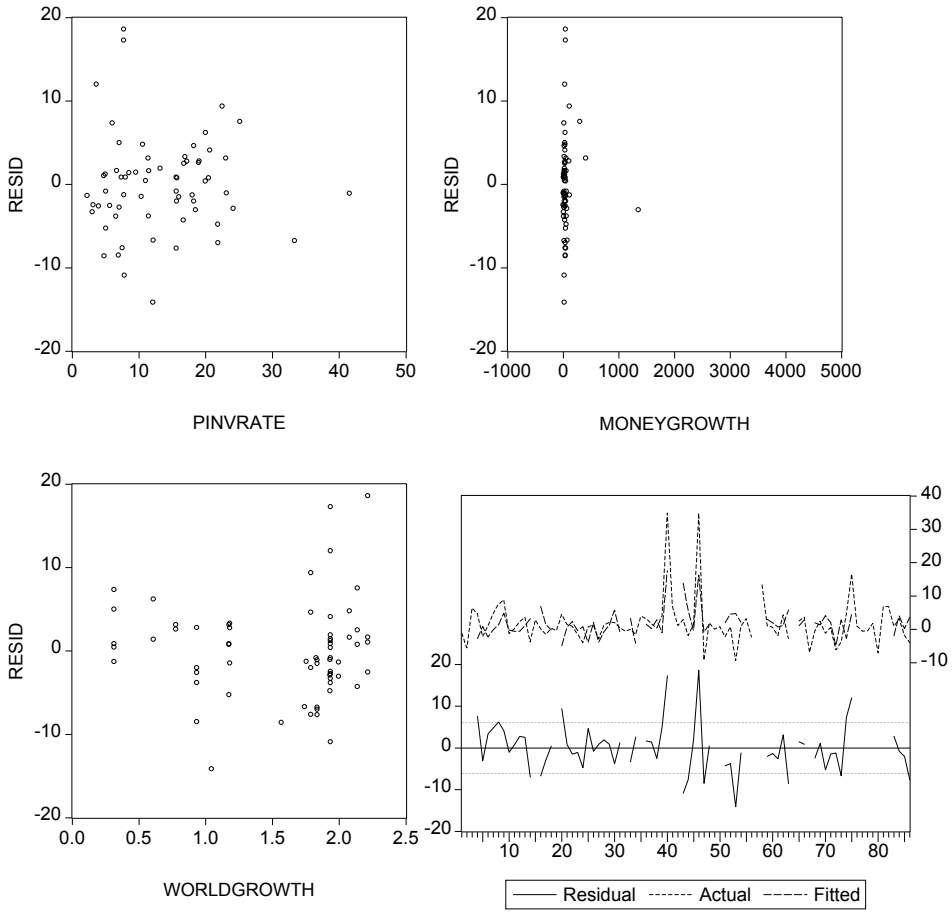
Table 7: CORRELATION MATRIX

	PGDP	TRADEGROWTH	DEBTR	PINVRATE	GOVAV	MONEYGROWTH
PGDP	1.000000	0.232759	-0.126806	0.348896	0.014144	0.138634
TRADEGROWTH	0.232759	1.000000	0.299921	0.023547	0.268158	-0.224582
DEBTR	-0.126806	0.299921	1.000000	-0.219384	-0.203386	-0.070106
PINVRATE	0.348896	0.023547	-0.219384	1.000000	0.007431	0.188759
GOVAV	0.014144	0.268158	-0.203386	0.007431	1.000000	0.082706
MONEYGROWTH	0.138634	-0.224582	-0.070106	0.188759	0.082706	1.000000

No signs of Multicollinearity. All correlations are below 0.5

RESIDUAL PLOT FOR REGRESSION 1





Regression 1:

Dependent Variable: GGDP
Method: Least Squares
Date: 05/04/06 Time: 10:53
Sample(adjusted): 1901 1986
Included observations: 64
Excluded observations: 22 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.221602	3.623918	-0.888983	0.3778
PGDP	0.552951	0.269501	2.051756	0.0449
TRADEGROWTH	0.040634	0.039234	1.035690	0.3048
DEBTR	0.002150	0.001544	1.392263	0.1693
PINVRATE	-0.206604	0.113534	-1.819752	0.0741
GOVAV	0.043182	0.159006	0.271577	0.7869
MONEYGROWTH	-0.000325	0.003503	-0.092746	0.9264
WORLDGROWTH	1.776119	1.020101	1.741120	0.0872

R-squared	0.346774	Mean dependent var	1.789145
Adjusted R-squared	0.265121	S.D. dependent var	7.119088
S.E. of regression	6.102843	Akaike info criterion	6.571855
Sum squared resid	2085.703	Schwarz criterion	6.841716
Log likelihood	-202.2994	F-statistic	4.246918
Durbin-Watson stat	1.675455	Prob(F-statistic)	0.000803

Regression 2:

Dependent Variable: GGDP
Method: Least Squares
Date: 05/04/06 Time: 11:49
Sample(adjusted): 1901 1986
Included observations: 64
Excluded observations: 22 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.600003	3.828488	-1.201519	0.2347
PGDP	0.594664	0.266493	2.231446	0.0297
TRADEGROWTH	0.055119	0.040891	1.347961	0.1832
DEBTR	0.001876	0.001476	1.271610	0.2089
PINVRATE	-0.105207	0.114612	-0.917943	0.3627
GOVAV	0.004878	0.160539	0.030386	0.9759
MONEYGROWTH	-0.001135	0.002794	-0.406118	0.6862
WORLDGROWTH	2.063889	1.126243	1.832544	0.0723
ASIA97	-7.250287	3.991104	-1.816612	0.0747

R-squared	0.383621	Mean dependent var	1.789145
Adjusted R-squared	0.293966	S.D. dependent var	7.119088
S.E. of regression	5.981872	Akaike info criterion	6.545044
Sum squared resid	1968.054	Schwarz criterion	6.848637
Log likelihood	-200.4414	F-statistic	4.278857
Durbin-Watson stat	1.581077	Prob(F-statistic)	0.000477

Regression 3:

Dependent Variable: GGDP
Method: Least Squares
Date: 05/04/06 Time: 11:17
Sample(adjusted): 1901 1986
Included observations: 64
Excluded observations: 22 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.404601	3.640096	-1.210023	0.2315
PGDP	0.633168	0.274690	2.305027	0.0250
TRADEGROWTH	0.060571	0.041952	1.443815	0.1546
DEBTR	0.001981	0.001491	1.329005	0.1894
PINVRATE	-0.168451	0.119437	-1.410378	0.1642
GOVAV	0.008186	0.158851	0.051533	0.9591
MONEYGROWTH	-0.002192	0.002718	-0.806358	0.4236
WORLDGROWTH	1.712342	1.091324	1.569051	0.1225
LA	2.486763	1.479741	1.680539	0.0986
ASIA97	-5.924094	3.798959	-1.559399	0.1247

R-squared	0.399204	Mean dependent var	1.789145
Adjusted R-squared	0.299071	S.D. dependent var	7.119088
S.E. of regression	5.960206	Akaike info criterion	6.550688
Sum squared resid	1918.299	Schwarz criterion	6.888014
Log likelihood	-199.6220	F-statistic	3.986750
Durbin-Watson stat	1.676405	Prob(F-statistic)	0.000601

F=test between regressions 1 and 3
F-Value =(1968.054-1918.299)/2/(1918.299/64 –10)=0.700
F-Critical: 3.168
Since F<F-Critical (regional dummy variables are not significant)

Regression 4:
Dependent Variable: GGDP
Method: Least Squares
Date: 05/04/06 Time: 11:10
Sample(adjusted): 1901 1985
Included observations: 63
Excluded observations: 22 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.828200	3.950724	-0.715869	0.4772
PGDP	0.579687	0.270716	2.141308	0.0368
TRADEGROWTH	0.042305	0.039606	1.068142	0.2902
DEBTR	0.002042	0.001542	1.323616	0.1912
PINVRATE	-0.216626	0.121161	-1.787920	0.0794
GOVAV	0.032685	0.159176	0.205341	0.8381
MONEYGROWTH	-0.000330	0.003470	-0.095158	0.9245
WORLDGROWTH	2.124301	1.316883	1.613128	0.1125
IMF	-0.709162	2.003738	-0.353920	0.7248

R-squared	0.360434	Mean dependent var	1.880128
Adjusted R-squared	0.265684	S.D. dependent var	7.138665
S.E. of regression	6.117283	Akaike info criterion	6.591677
Sum squared resid	2020.742	Schwarz criterion	6.897839
Log likelihood	-198.6378	F-statistic	3.804034
Durbin-Watson stat	1.672811	Prob(F-statistic)	0.001326

Regression 5:
Dependent Variable: GGDP1
Method: Least Squares
Date: 05/04/06 Time: 11:39
Sample(adjusted): 1901 1986
Included observations: 62
Excluded observations: 24 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.874461	2.849186	-0.657894	0.5135
PGDP	0.313392	0.232404	1.348478	0.1833
TRADEGROWTH	-0.007061	0.019234	-0.367129	0.7150
DEBTR	0.000828	0.000452	1.831376	0.0728
PINVRATE	-0.313746	0.106332	-2.950637	0.0047
GOVAV	0.168547	0.056599	2.977929	0.0044
MONEYGROWTH	-0.002492	0.002128	-1.171205	0.2469
WORLDGROWTH	1.621434	1.114097	1.455380	0.1516
ASIA97	0.263346	4.756827	0.055362	0.9561
ASIADEBT	-0.063756	0.037059	-1.720404	0.0913

R-squared	0.402306	Mean dependent var	-0.441647
Adjusted R-squared	0.298858	S.D. dependent var	5.895783
S.E. of regression	4.936787	Akaike info criterion	6.177996
Sum squared resid	1267.337	Schwarz criterion	6.521083

Log likelihood	-181.5179	F-statistic	3.888997
Durbin-Watson stat	2.538470	Prob(F-statistic)	0.000800

Regression 6:

Dependent Variable: GGDP
Method: Least Squares
Date: 05/04/06 Time: 10:57
Sample(adjusted): 1901 1986
Included observations: 64
Excluded observations: 22 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.676939	3.988973	-1.172467	0.2462
PGDP	0.588325	0.267923	2.195872	0.0324
TRADEGROWTH	0.056929	0.046123	1.234277	0.2224
DEBTR	0.001844	0.001489	1.238374	0.2209
PINVRATE	-0.102915	0.117510	-0.875801	0.3850
GOVAV	0.002580	0.163346	0.015793	0.9875
MONEYGROWTH	-0.001059	0.002937	-0.360511	0.7199
WORLDGROWTH	2.062446	1.140279	1.808720	0.0761
ASIA97	-8.626744	8.956381	-0.963195	0.3397
ASIADEBT	0.013348	0.055741	0.239464	0.8117

R-squared	0.384082	Mean dependent var	1.789145
Adjusted R-squared	0.281429	S.D. dependent var	7.119088
S.E. of regression	6.034751	Akaike info criterion	6.575547
Sum squared resid	1966.584	Schwarz criterion	6.912873
Log likelihood	-200.4175	F-statistic	3.741551
Durbin-Watson stat	1.575763	Prob(F-statistic)	0.001041

F-Test between regressions 1 and 6

F-value=(1966.584-1918.299)/2/(1918.299/54)=0.68
F-Critical=3.168 (Asia97 and ASIADEBT are not significant)