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Does an Undervalued Currency Promote Growth? Evidence from China

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Does an Undervalued Currency Promote Growth?

Evidence from China

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Asbtract
Whether currency devaluation promotes growth remains an empirically open question. Coexistence of an undervalued currency and the world's largest trade surplus alongside a booming economy makes China a unique case study. Using annual data over 1977-2006 and the relatively recent "bounds-testing approach" to cointegration and error-correction modeling, we estimate a reduced form model to investigate the exchange rate sensitivity of China's real GDP. We find that currency devaluation is contractionary in China.

Key Words: Bounds-Testing Approach, China, Currency Devaluation.

JEL Classification: F41, F43

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I. Introduction

Within the Keynesian framework, currency devaluation boosts economic growth by promoting net exports, aggregate demand, and output through the multiplier effect. However, this is only a necessary condition for devaluation to be expansionary, not a sufficient one. For example, by making imported inputs more expensive, devaluation can contract the aggregate supply curve. For the same reason, it can also lower investment, a key component of aggregate demand. Thus, the net effect on output is theoretically ambiguous and remains an empirically open question. While there is a general impression that devaluations are contractionary in South America but expansionary in Asia, the results are specific to the sample, model, and technique employed. Accordingly, country-specific studies have received renewed interest.

The coexistence of an undervalued currency and the world's largest trade surplus alongside a booming economy makes China a unique case study. While Brada, Kutan and Zhou (1993) and Bahmani-Oskooee and Wang (2007) find that devaluation boosts Chinese trade, Zhang (1998, 1999) and Weixian (1999) come up with no such evidence. Amidst such mixed results, one wonders if China should keep the Yuan undervalued.[1] Recently, such concerns are also reinforced by the findings of Hsing and Hsieh (2004), and Shi (2006) who estimate a VAR model for China: the former authors find that devaluation hurts the economy in the short-run; the latter suggests that the Yuan's appreciation is contractionary in general, but given the scale of capital flows, shocks to the capital account likely play a much bigger role than the Yuan's exchange rate.

Using the latest data and the relatively recent "bounds-testing approach to cointegration and error-correction modeling" proposed by Pesaran, Shin, and Smith (2001), we investigate whether an

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[1] Although researchers disagree on the degree of the undervaluation of the Yuan, by and large they all agree that given the massive trade surplus and huge surge in China's foreign exchange reserves, the Yuan is indeed undervalued. Shi (2006) has a recent account of this literature.

undervalued Yuan promotes China's growth.[2] We use a reduced-form model to study the exchange rate sensitivity of real output. We find, using cointegration and error-correction modeling, that currency devaluation is contractionary in China. The rest of the paper is arranged as follows: A brief review of the literature is provided in Section II, followed by an outline of the model and methodology in Section III. Empirical results are reported in Section IV; Section V concludes. Data, definitions, and sources are cited in the Appendix.

II. Review of Related Literature

In order to boost net exports and the resulting growth, many of the developing countries often devalue their currency. This goal is best realized if a nominal devaluation also translates into a *real* depreciation of the currency. Even then, for net exports to increase, the demand elasticities for exports and imports must add to more than one – according to the Marshall-Lerner condition (ML condition, hereafter). Since short-run elasticities are usually smaller than their long-run counterparts, the ML condition may not hold in the short-run. Indeed, the expansionary effect may be dampened or even negated altogether. For example, in the early 1970s, the ML condition was met, the dollar was devalued yet the U.S. trade balance continued to deteriorate – a pattern that Magee (1973) explained in terms of a J-Curve effect. Bahmani-Oskooee and Ratha (2004) provide a comprehensive review of the J-Curve literature.

Nunnenkamp and Schweickert (1990) suggest that a country's aggregate demand may actually contract by following a devaluation of its currency because it makes imports more expensive. The resulting inflation becomes a natural by-product of the devaluation. If the country's export sector relies heavily on imported inputs, then cost-push inflation will appear in

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[2] Since most of the older studies did not test for stationarity of the series, they likely suffered from spurious regressions. Moreover, recent studies that do test for stationarity have employed different unit roots tests. To the extent that different tests have different power and yield different outcomes, the reliability of their results is undoubtedly reduced. As the technique proposed here requires no unit-root testing, the results here are likely to be more reliable.

the export sector as well, and to that extent, diminish the competitiveness of a country's exports. If a country's export sector imports the majority of its inputs, a currency devaluation increases production costs and thereby undermines the competitiveness of the exports. Inflation also causes an adverse real balance effect as real wealth drops, leading to a further drop in spending. Likewise, aggregate demand contracts because of: (i) a redistribution of income towards entities with a lower marginal propensity to consume,[3] (ii) a decline in investment as imported inputs get more expensive, (iii) higher debt service payments for the country, and (iv) inflation and the accompanied increase in interest rates.

On the supply side, devaluation is clearly contractionary. Production suffers because imported inputs get costlier following a real devaluation (Edwards, 1986). Given the inflationary environment, factor prices including wages and interest rates rise and further reduce the aggregate supply.

Since devaluation impacts both the aggregate supply and the aggregate demand curves, the net effect depends on the relative shifts of these curves, and the issue has been of significant interest in academia as well as policy circles. Bahmani-Oskooee and Miteza (2003) review the related literature along the four broad-strands that it has taken:

(i) The *before-after literature* compares output growth before and after devaluation;

(ii) The *control-group approach* compares output growth in the devaluing countries with the same in a set of non-devaluing countries, called the control-group;

(iii) The *macro-simulation approach* involves theoretical models and/or simulations involving different transmission mechanisms; and finally,

(iv) The *econometric approach* estimates the effects of different stabilization policies.

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[3] Rajan and Shen (2002) find weak support in favor of the hypothesis that a country with a lower per capita income is more likely to suffer from a contractionary devaluation.

4

While there is no consensus as such, there seems to be ample evidence in favor of devaluation being (i) contractionary in Latin American countries, and (ii) expansionary in pre-1997 Asia but contractionary in post-1997 Asia. Some countries, especially those with heavy foreign currency liabilities, tend to lose credibility upon currency devaluation. With financial liberalization and advancement in information technology speeding up capital flights, as Kim and Ying (2007) note, these countries will likely suffer more from contractionary devaluation. While China has a huge external surplus, and therefore the above foreboding does not necessarily apply, an adverse reputation effect triggering capital flight cannot be ruled out. In fact Kim and Ying (2007) comment that devaluation can be contractionary in post-1997 East Asia just as well as in Mexico and Chile.

Since multi-country studies tend to overlook country-specific features, as mentioned earlier, country-specific studies have received renewed interest.[4] China, the country with the largest trade surplus, pegs its currency to that of the US, the country with largest trade *deficit*. While the US dollar keeps falling, so does the Chinese Yuan (instead of rising) vis-à-vis other major currencies of the world. Such undervaluation of the Yuan is justifiable if devaluation (undervaluation) is indeed expansionary in China. Empirical evidence on the Chinese trade balances and the value of its currency is quite sparse in the literature. Using the bounds-testing

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[4] For example, Solimano (1986) for Chile, Branson (1986) for Kenya, Roca and Priale (1987) for Peru, Kamin and Rogers (1997) for Mexico, and Taye (1999) for Ethiopia find evidence of contractionary devaluation whereas Taylor and Rosenweig (1984) for Thailand, and Bahmani-Oskooee and Rhee (1997) for Korea point to the contrary. Upadhyaya (1999) finds that devaluation is contractionary in Pakistan and Thailand but has no long-run effects in India, Sri Lanka, Malaysia, and the Philippines. See Domac (1997) for an overview of the empirical results.

approach to cointegration, this study contributes to the existing evidence by examining whether

currency devaluation is indeed expansionary in China.[5]

III. Outline of the Models and Methodology

We estimate a reduced form model where output depends on all three stabilization

policies: (fiscal, monetary, and exchange rate), as well as world income, ceteris paribus.[6] In line

with previous research (Edwards, 1986; Bahmani-Oskooee, Chomsisengphet and Kandil, 2002;

Narayan and Narayan, 2007), we specify the following long-run model[7]:

$$ln\ Y_t = a + b\ ln\ G_t + c\ ln\ M_t + d\ ln\ REER_t + e\ ln\ YW_t + \varepsilon_t\ \ ...(1a)$$

where the variables Y_t, G_t, M_t, $REER_t$, and YW_t are, respectively, China's GDP, government

expenditure, money supply, the Yuan's effective exchange rate, which is a trade-weighted

average of the indices of bilateral real exchange rates, and the world income, all in *real* terms.

While the coefficients of the fiscal and monetary variables (i.e., *b* and *c*) are expected to be

positive, *d,* the coefficient of REER, can be positive or negative, depending on whether

devaluation is contractionary or expansionary. Likewise, *e*, the coefficient of YW_t, is expected to

be positive, implying rising world income raises the demand for China's exports. However, it

may be negative if the rise in world income stems, for example, mostly from increased

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[5] Using cross-section data from 23 LDCs, Agenor (1991) shows that anticipated devaluation is contractionary whereas unanticipated devaluation is expansionary. From his case study of Turkey (1960-1990), Domac (1997) finds no evidence of contractionary devaluation but confirms the expansionary effect of unanticipated devaluation. In their study of post-crisis Indonesia, South Korea, Malaysia, Philippines, and Thailand, Chou and Chao (2001) also find that exchange rate volatility is better than the real exchange rate level in explaining the impact of devaluations on real output. Since the Yuan remains perennially undervalued, there is no element of surprise here. Therefore, one wonders if undervaluation may in fact be contractionary for China.

[6] Nunnenkamp and Schweickert (1990) describe the state of empirical research on growth effects of real devaluation and the appeal of the econometric approach using reduced form equations.

[7] Absence of a supply side variable may be justified on three grounds: First, perhaps the most common supply side factor in similar context is the energy price which continues to be regulated by the Chinese government. Second, we are primarily interested in studying the output effect of currency devaluation, not the supply or demand side factors, so the model is adequate. This is also consistent with existing literature (Narayan and Narayan, 2007). Third, given the small size of the sample, there is a clear need to economize on the degrees of freedom. Despite that we added net foreign direct investment to the right hand side found the results consistent with the ones reported here.

production of import substitutes in the rest of the world, or if there have been growing trade barriers.

The sample is comprised of annual data over the 1977-2006 time period, reflecting the period of China's transition toward the market economy since the Cultural Revolution. The bounds-testing approach to cointegration and error correction modeling is employed for empirical analysis partly because it requires no unit roots testing, and partly because it is deemed appropriate for small sample sizes (Narayan and Narayan, 2007, p. 2593).[8] The error-correction mechanism for the long-run equation (1) is specified as:

$$\Delta \ln Y_t = a + \sum_{i=1}^{m} b_i \Delta \ln Y_{t-i} + \sum_{i=1}^{n} c_i \Delta \ln M_{t-i} + \sum_{i=1}^{p} d_i \Delta \ln G_{t-i}$$
$$+ \sum_{i=1}^{q} f_i \Delta \ln REER_{t-i} + \sum_{i=1}^{r} b_i \Delta \ln YW_{t-i} + \delta_1 \ln Y_{t-1} \qquad \ldots \quad (1b)$$
$$+ \delta_2 \ln G_{t-1} + \delta_3 \ln M_{t-1} + \delta_4 \ln REER_{t-1} + \delta_5 YW_{t-1} + v_t$$

where a linear combination of the lagged-level variables approximates the error-correction term. The estimation procedure consists of three-steps:

(i) An *F-Test* where the null of no cointegration (i.e., $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$) is tested against its alternative (i.e., $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$). Pesaran, Shin, and Smith (2001) provide a method of estimating the new critical values comprising of a lower bound and an upper bound for large samples, but for small samples such as ours, Narayan (2005) provides yet another set of critical values that we use: If the calculated F-statistic falls above the upper bound, the null hypothesis is rejected; if it falls below the lower bound the null hypothesis cannot be rejected; if it falls in-between the results are

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[8] Bahmani-Oskooee and Wang (2007) employ annual data over the 1978-2002 time period to study the exchange rate sensitivity of US exports to and import from China - a concept closely related to ours. Citing Hakkio and Rush (1991), they argue that cointegration being a long run concept requires a long span of data more than a large number of observation – so their sample of 25 annual observation was as good as 100 quarterly ones. In the exact same context as ours, Narayan and Narayan (2007) use 31 annual observations to investigate the impact of currency depreciation on Fiji's output. Our sample with 30 observations compares nicely to the preceding studies. To economize on the degrees of freedom, we impose no more than 3 lags in the estimation process.

inconclusive. Finally, a negative and significant error-correction term would indicate cointegration among the underlying variables. See for example, Kremers, Ericsson, and Dolando (1992).

(ii) A *Choice of Optimal Lag-Structure* is necessary because the F-test results are sensitive to the lag-structure of the error-correction model. We employ the *Akaike Information Criterion* (AIC) as well as the *Schwartz-Bayesian Criterion* (SBC) to choose the optimal lag structure.

(iii) The *Long-run Model* is estimated by normalizing the coefficients of the lagged dependent variables in (2).

Finally, we test the stability of the estimated coefficients using the CUSUM and CUSUMSQ test proposed by Brown, Durbin and Evans (1975).

IV. Empirical Results

As shown in Table 1, the computed value of the F-statistic exceeds 4.223, the upper bound (at 5% levels) for rejecting the null hypothesis of non-cointegration. Thus, there is evidence of cointegration among the variables of our model, viz. *ln Y*, *ln G*, *ln M*, *ln REER*, and *ln YW*.[9] A maximum of 3 lags was imposed in each case, and the optimal lag-structure chosen by both AIC and SBC are reported in Table 1. The latter, being a parsimonious model, is the preferred model for small samples such as ours.[10] Interestingly, there is evidence of cointegration according to both criteria. Moreover, the error correction term in the short-run dynamics in Table 2 carries a negative and significant coefficient, further confirming existence of a long-run

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[9] The time subscripts are dropped for brevity's sake.

[10] Also, the coefficient-estimates based on SBC are stable according to both CUSUM and CUSUMSQ criteria.

relation amongst the variables of the model. Also there is evidence of fast convergence to the

long-run equilibrium in each case.[11]

<center>(Table 1 and 2 go about here)</center>

The negative coefficient of $\Delta \ln REER_{t-2}$ in the error correction model (under AIC) and $\Delta \ln REER_t$ (under SBC) indicate currency appreciation may have a contractionary effect in the

short-run, although the coefficient is insignificant in the latter case.

Table 3 summarizes the long run relations. While the monetary policy (M) instrument

carries the expected positive and significant coefficient, the fiscal policy instrument (G) is

insignificant. Both REER and YW carry the expected positive signs and are significant. Since a

increase in REER implies an appreciation of the Yuan, a positive and significant coefficient

means currency depreciation is contractionary in China. The coefficient is 0.10 according to

SBC, i.e., a 10% appreciation in Yuan's external value (REER) would boost China's real GDP

by 1%. In view of this, perhaps China should let the Yuan appreciate instead of keeping it

undervalued.[12] Likewise, real world income (YW) carries a significant coefficient 0.26, i.e., a

10% increase in world income increases China's real GDP by 2.6%. The US being China's

major trading partner, the impact of US GDP on China's GDP will likely be higher than this.

<center>(Table 3 goes about here)</center>

The significance of the foreign variables (REER and YW) is noteworthy in view of the

relative isolation of the Chinese economy from outside markets during 1977-93 reforms. In

reference to the Chinese reforms, Zhang (1999) writes, "the role of the RMB was limited to an

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[11] Only the coefficients of REER and the lagged error correction term are provided in Table 3 as these are central to the paper's main goal.

[12] This contrasts with what Chou and Chao (2001) found for the Indonesia, South Korea, Malaysia, Philippines, and Thailand: to boost output, currency devaluation may not work in the long run but it can cause a detrimental effect in the short run.

accounting tool and a means of planned resource allocation. It could neither respond flexibly to the change of price parities between China and the rest of the world, nor make prompt adjustments according to the changing supply and demand of foreign exchange." Our findings are also consistent those of the Bahmani-Oskooee and Wang (2007) who in their study of commodity trade between US and China confirmed the significant role played by real exchange rate and the trading partners' real GDPs. Perhaps the Chinese economy has become lot more integrated with today's global markets, and accordingly, external variables have come to play a bigger role. Moreover, the CUSUM and CUSUMSQ statistics plotted against their break points in figures 1 and 2 indicate that the coefficients estimates are stable in most cases.

Our short-run results deviate from Chou and Chao (2001) and Hsing and Hsieh (2004) who found evidence of contractionary devaluation in the short-run. Likewise, our long run results differ from those of Shi (2006) who found that currency appreciation dampened economic growth in the long-run. This may have been because as the latter observes, given the scale of capital flows, shocks to the capital account likely play a much bigger role than the Yuan's external value.[13]

V. Summary and Concluding Remarks

Whether currency devaluation helps growth has intrigued economists and policy-makers alike for the last few decades. In a Keynesian economy, devaluation boosts net exports and economic growth via the multiplier effect. This channel, however, does not have much empirical support. For example, the Latin American experiments with currency devaluation have been far from successful. While currency depreciation helped improve trade balance and growth in many Asian countries before the Asian-Crisis; the same cannot be said of the same countries in the post-Asian crisis era. Experiences elsewhere can be characterized as mixed at the most, leaving

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[13] When we add (real) net foreign investment to the right hand of side of (1b), we find that it does play a significant role. Interestingly, however, the coefficient of REER went up in size (from 0.10 to 0.29).

no room for generalization. The results are sensitive to the model, time period, regions/countries, and methodology. There is considerable consensus, however, on the channels through which devaluation can affect the demand and supply conditions, and the subsequent outcomes. We make a case study of China where an undervalued currency coexists alongside the planet's biggest trade surplus, and the fastest growing economy. Interestingly, the devaluation literature is quite sparse when it comes to China. This is mainly because consistent data on China are hard to come by. At least part of the time-series data relate to the era of a centrally planned economy, wherein markets either did not exist or if they did (because of the market reforms since 1978 and through 1994), they did not respond well to price signals.

It is in this backdrop that we try to answer the question: Should China revalue the Yuan? Since the answer hinges at least partly, on whether currency devaluation is expansionary in China, we estimated a reduced form model linking Yuan's external value to China's GDP. We find that there exists a long run relation (cointegration) amongst the variables of our model, viz. China's GDP (Y), effective exchange rate ($REER$), government spending (G), money supply (M), and the world income (YW), all in real terms. Interestingly, we also find that currency devaluation is contractionary in China – i.e., revaluation of the Yuan will likely boost Chinese growth. Our findings reinforce those of Rajan and Shen (2002) who found weak support in favor of the hypothesis that a country with a lower per capita income is more likely to suffer from a contractionary devaluation. How would the revaluation of Yuan help Chinese economy? As suggested by Kwack, Ahn, Lee and Wang (2007), an appreciation of Chinese currency may increase its trading partners' GDP and prices. If so, the induced changes in foreign income and price may offer substantial benefit to China's future exports and trade balances.

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Appendix

Data, Definitions, and Sources

Annual data over the 1977-2006 period is collected on:

Y = China's real GDP in local currency. Nominal GDP at current dollars was obtained from United Nations Statistics Division (UNSD), converted into local currency units and deflated by China's GDP Deflator, collected from the World Development Indicators CD ROM (World Bank., 2008).

YW = Index of real World GDP. World GDP in current dollars was collected from World Development Indicators CD ROM (World Bank., 2008), deflated by US GDP deflator (Collected from the International Financial Statistics (published by the IMF), and converted into an Index with 2000 base year.

$REER$ = Real effective exchange rate of the Yuan, collected from International Financial Statistics (published by the IMF). An increase in $REER$ implies a real appreciation of the Yuan.

G = Real Government Expenditure. Government Expenditure was collected from United Nations Statistics Division (UNSD), converted into local currency units and deflated by China's GDP Deflator, collected from the World Development Indicators CD ROM (World Bank., 2008).

M = The real M2 measure of Money Supply. M2 data was collected from IFS CD-ROM, deflated by China's GDP Deflator, collected from the World Development Indicators CD ROM (World Bank., 2008).

Table 1: Cointegration Test Results

Criterion	Lag-Structure	Calculated Value of the F-Statistic
AIC	(3,2,3,3,1)	6.26*
SBC	(3,3,0,1,1)	4.70*

Notes: * denotes significance at 5% levels; the corresponding critical value is 4.223.

Table 2: Short-run Results

Dependent Variable: $\Delta \ln Y_t$		
Explanatory Variable	Coefficient Estimate Based on *AIC*	Coefficient Estimate Based on *SBC*
$\Delta \ln REER_t$	0.01 (0.09)	-0.08 (1.43)
$\Delta \ln REER_{t-1}$	0.03 (0.69)	
$\Delta \ln REER_{t-2}$	-0.13* (3.75)	
ECM(-1)	-0.65* (2.27)	-0.99* (4.16)

Notes: *ECM(-1)* is the lagged error-correction term. Figures in parentheses indicate absolute values of the t-statistic; * denotes statistical significance at 5% levels.
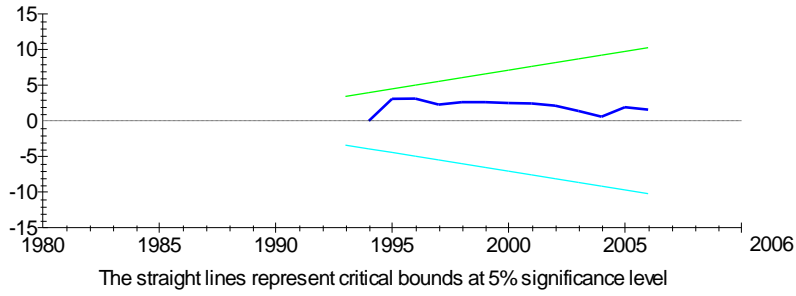
Table 3: Long-run Results

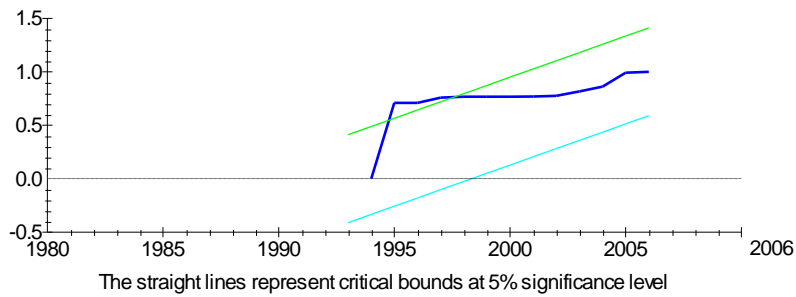| Dependent Variable: $\ln Y$		
Explanatory Variable	Coefficient Estimate Based on *AIC*	Coefficient Estimate Based on *SBC*
Intercept	6.42 (1.63)	10.80* (12.61)
$\ln M$	0.25 (0.85)	0.56* (8.03)
$\ln G$	0.48 (1.02)	0.018 (0.17)
$\ln REER$	0.094 (1.60)	0.10* (5.15)
$\ln YW$	0.41* (3.09)	0.26* (12.61)

Notes: Figures in parentheses indicate absolute values of the t-statistic; * denotes statistical significance at 5% levels.

Figure 1: Model 1 with lag-structure chosen by AIC
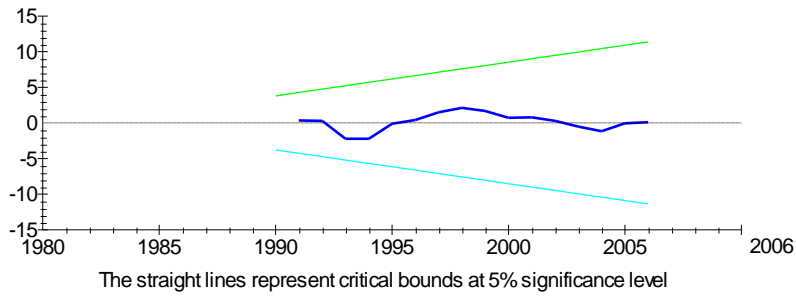
Plot of Cumulative Sum of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

Figure 2: Model 1 with lag-structure chosen by SBC

Plot of Cumulative Sum of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

18