CHAPTER 4

THE EFFECTS OF CURRENCY IN CIRCULATION (*CU*) ON THE ECONOMY

l.1 The Effects of Changes of Currency in Circulation on Inflation Rate

The Total of *M1* has two components that is currency in circulation and lemand deposit. This section is to analyse the effect of change in currency in :irculation on inflation rate and the individual inflation rate of each component of *:PI.*

Currency in circulation is the amount of cash and coins at hand. In Malaysia, he currency in circulation is denominated by

- Coins – 1 sen, 2 sen, 5 sen, 10 sen, 20 sen and 50sen.
- Cash – RM1, RM2, RM5, RM10, RM20, RM50, RM100, RM500, RM1000.

The model is as follows:

$$\dot{P}_t = \beta_0 + \beta_1 \dot{CU}_t + \varepsilon_t \qquad (4.1)$$

where $\dot{P}_t$ = change in price level (inflation rate)

$\dot{CU}_t$ = change in currency in circulation

ε_t = white noise error term

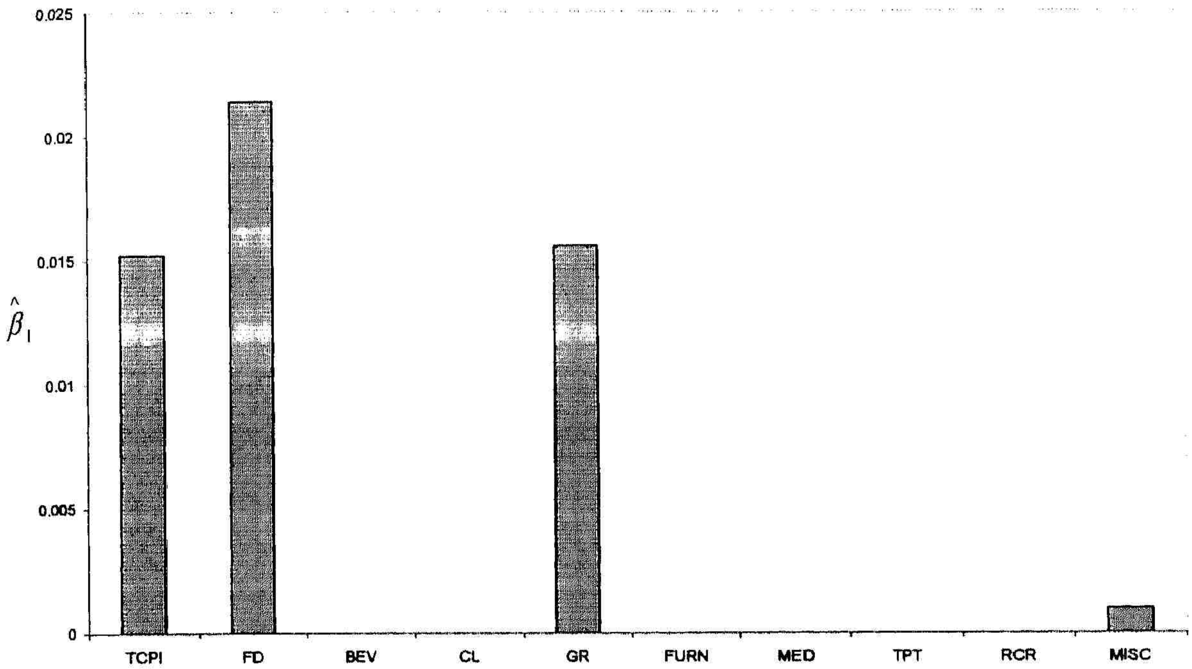
The analysis in Table 4.1 shows that at 5% significance level, only inflation ate of Total *CPI* has significant relationship with growth in *CU*. At 10% significance evel, the inflation rate of Food *CPI*, Gross Rent *CPI* and Miscellaneous *CPI* have ignificant relationship with growth in *CU*. The rest does not show any significant elationship with growth in *CU*. The coefficient of growth in *CU* for Food component ; the highest. That is a 1% increase in *CU* will cause a 0.02% increase in price level f Food component. The coefficient of growth in *CU* for Total *CPI*, Gross Rent *CPI* and Miscellaneous *CPI* are 0.015, 0.016 and 0.0001. The comparison of the coefficients of various *CPI* components are shown in Figure 4.1.

Table 4.1 Regression of $\dot{P}$ on $\dot{CU}$

Component of *CPI*	Coefficient $\hat{\beta}_0$	Coefficient $\hat{\beta}_1$
Total *CPI* (*TCPI*)	0.2768*	0.0152*
	(0.0000)	(0.0071)
Food (*FD*)	0.2943*	0.0214⁺
	(0.0000)	(0.0613)
Beverage (*BEV*)	0.4593*	− 0.004
	(0.0000)	(0.8658)
Clothing (*CL*)	0.1711*	− 0.001
	(0.0000)	(0.8908)
Gross Rent (*GR*)	0.2952*	0.0156⁺
	(0.0000)	(0.0922)
Furniture (*FURN*)	0.2048*	− 0.004
	(0.0000)	(0.3467)
Medical Care (*MED*)	0.3431*	0.0140
	(0.000)	(0.2069)
Transport (*TPT*)	0.2953*	0.0107
	(0.0000)	(0.1921)
Recreation (*RCR*)	0.1257*	0.0053
	(0.0000)	(0.3179)
Miscellaneous (*MISC*)	0.3411*	0.0001⁺
	(0.0345)	(0.0521)

Note: The *p-values* are in parentheses.
*Denotes statistical significance at 5% level
⁺Denotes statistical significance at 10% level.

Figure 4.1 Comparisons of Effects of $\dot{CU}$ on $\dot{P}$ of *CPI* Components



The above Figure 4.1 shows the estimated coefficients of those components, which has a significant relationship between inflation rate and growth in *CU*

4.1.1 Rolling Regression of $\dot{P}$ on $\dot{CU}$

Again rolling regression will be used here to analyse the effect of growth in currency in circulation to inflation rate of various components of *CPI* (this analysis will only be tested on the CPI components which have significant relationship with *CU*). The model of equation 4.1 will be used here.

$$\dot{P}_t = \beta_0 + \beta_1 \dot{CU}_t + \varepsilon_t \quad (4.1)$$

The results show that over the years the coefficient of *CU* has fallen for those components that have significant relationship with *CU*. The conclusion is the same as of the analysis of *M1*. The figures below show the downward trend of coefficient of *CU*.

Figure 4.2 Rolling Regression – Total *CPI*

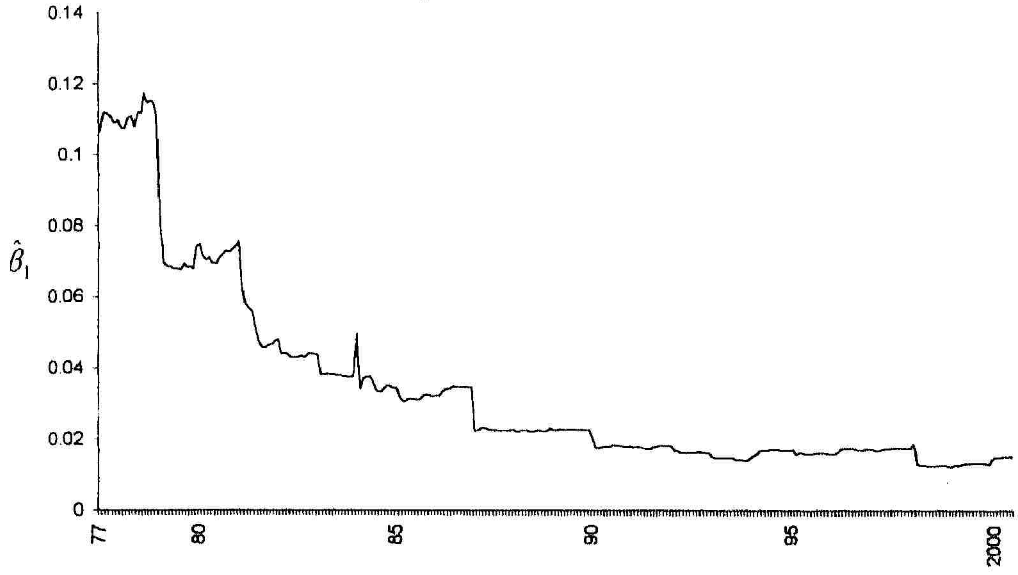


Figure 4.3 Rolling Regression – Food

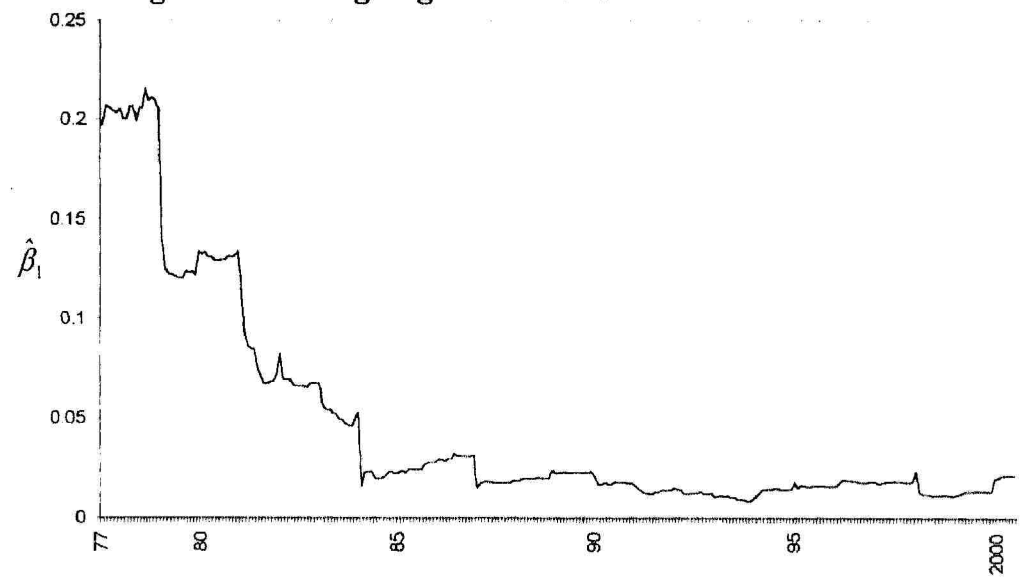


Figure 4.4 Rolling Regression – Gross Rent

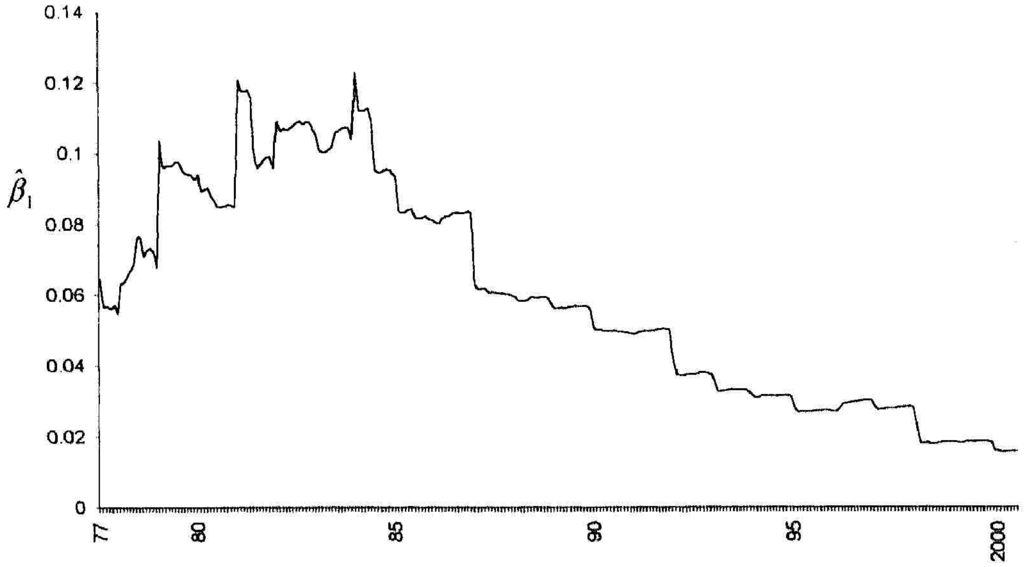
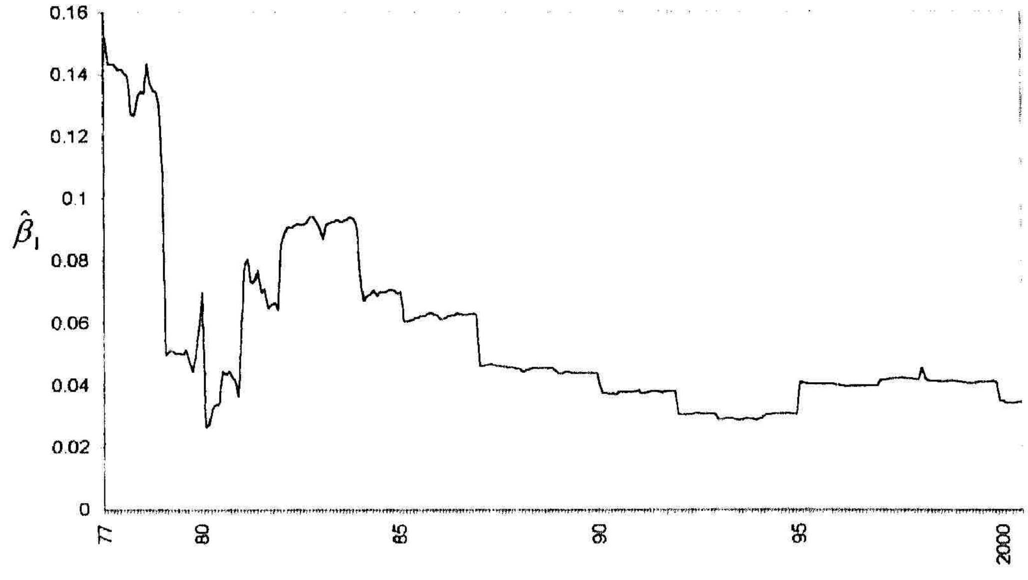


Figure 4.5 Rolling Regression – Miscellaneous



.1.2 Regression of $\dot{P}$ on Sum of Lags of $\dot{CU}$

In this section the Distributed Lag analysis will also be done with the same ɜason as in Chapter 3 that is to analyse if a change of currency in circulation takes a ɜw lag periods before it has an effect on the inflation rate and to find out if CU is a ɜading or a lagging variable. The model is as follows taking from 1-year lag period to -years lag periods:

$$\dot{P}_t = \alpha + \sum_{i=0}^{n} \beta_i \dot{CU}_{t-i} + \varepsilon_t \qquad (4.2)$$

The results of this analysis are shown in Table 4.2. At 5% and 10% level of ignificance the lags of the change in currency in circulation are significant for almost ll the components leaving only component Beverage *CPI* that has no significant ɜsults. Over the 1-year lag period to 5-years lag periods, there is a consistent ignificant relationship between *CU* and the individual components of Total *CPI*, 'ood *CPI* and Gross Rent *CPI*. Nevertheless for certain components of *CPI* (Clothing, 'urniture, Recreation and Miscellaneous) there are significant results from 1 year to nly 4-years lag period. With a 1% change in currency in circulation, component iross Rent *CPI*, Food *CPI*, Medical Care *CPI* has a higher change that is 0.88%, .79% and 0.70% respectively in 5 years. In a maximum lag period of 4 years, hanges in price level in component Clothing *CPI*, Furniture *CPI*, Recreation *CPI* and ⁄iscellaneous *CPI* are, 0.53%, 0.32%, 0.24% and 1.21% respectively.

Overall inflation rate of Miscellaneous *CPI* is the most responsive to change in *:U*, followed by Gross Rent *CPI*, Food *CPI* and Medical Care *CPI*. The comparisons f coefficient of sum of lags from 1 year to 5 years are shown in Figure 4.6 to Figure .10. Comparing the magnitude of coefficient sum of lags of 5 years, analysis shows ıat currency in circulation has a more significant impact on *CPI* compare to the total *4I*. But a change in currency in circulation only takes effects after a certain lag eriods. The diagram below shows the sum of lags of the currency in circulation for ıe various components of *CPI*. Thus the conclusion is *CU* does influence the ıflation rate of almost every component in *CPI* except Beverages *CPI* and *CU* might e a leading variable.

Table 4.2 Regression of $\dot{P}$ on Sum of Lags of $\dot{CU}$

of Components *CPI*	Coefficients of Sum of lags						
	1 year	2 years	3 years	4 years	5 years	Minimum[1] Lag Period	Maximum[2] Lag Period
otal *CPI* (*TCPI*)	0.2086* (4.8941)	0.3334* (5.5675)	0.4171* (5.433)	0.5821* (6.7368)	0.6047* (6.0104)	1 year or <	5 years or >
ood (*FD*)	0.2655* (2.947)	0.4327* (3.343)	0.4691* (2.8046)	0.6863* (3.541)	0.7937* (3.591)	1 year or <	5 years or >
everages (*BEV*)	0.0774 (0.4513)	0.0887 (0.3489)	0.317 (0.9630)	0.6014 (1.5238)	0.7329 (1.5369)	Not significant	Not significant
lothing (*CL*)	0.1858* (3.6722)	0.3205* (4.3870)	0.4164* (4.3876)	0.5312* (4.6948)	0.4489 (3.5465)	1 year or <	4 years
ross Rent (*GR*)	0.1766* (2.3677)	0.3355* (3.2391)	0.5411* (4.1457)	0.7495* (5.0762)	0.8836* (5.2636)	1 year or <	5 years or >
urniture (*FURN*)	0.1086* (3.6246)	0.2191* (5.0985)	0.2740* (4.9146)	0.3157* (4.7697)	0.2731 (3.5256)	1 year or <	4 years
ledical Care (*MED*)	0.1399 (1.7506)	0.2397* (2.0390)	0.4605* (3.0035)	0.6072* (3.3159)	0.6998* (3.2034)	2 years	5 years or >
ransport (*TPT*)	0.2071* (3.0937)	0.2494* (2.5561)	0.2530* (1.9830)	0.2316 (1.5348)	0.1795 (0.9944)	1 year or <	3 years
ecreation (*RCR*)	0.0985* (2.2589)	0.1972* (3.0877)	0.2228* (2.6749)	0.2428* (2.4958)	0.2416 (2.0923)	1 year or <	4 years
liscellaneous (*MISC*)	0.4037* (2.7718)	0.6246* (2.9213)	0.9022* (3.2300)	1.2146* (3.6552)	0.5281 (2.4870)	1 year or <	4 years

Note: The *t-statistics* are in parentheses.

*Denotes statistical significance at 5% level

[1]The minimum lag period for the relationship of change in *M1* and inflation rate to be significant.

[2]This sequential procedure of continuously adding lag periods stops when the regression coefficients of the lagged variables start becoming statistically insignificant and/or the coefficient drops as the lag period increases and/or the coefficient of the lags changes signs from positive to negative or vice versa (see Gujarati, 1995).

Figure 4.6 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{P}$ (1 year)

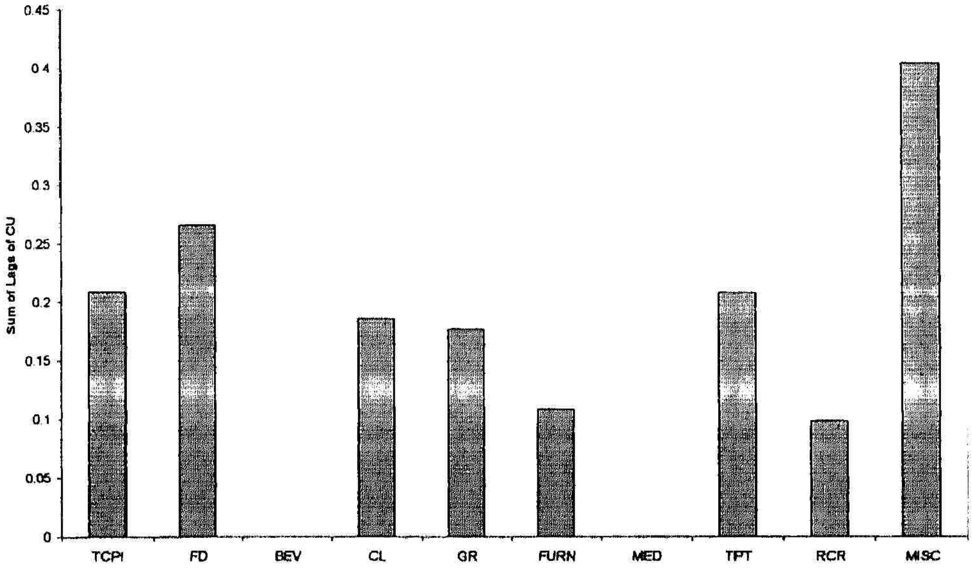


Figure 4.7 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{P}$ (2 years)

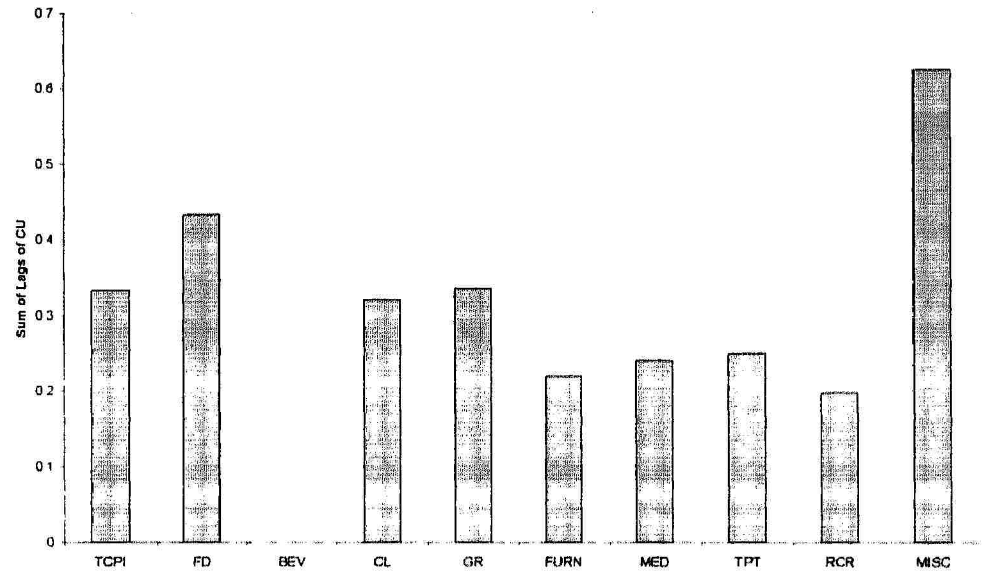


Figure 4.8 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{P}$ (3 years)

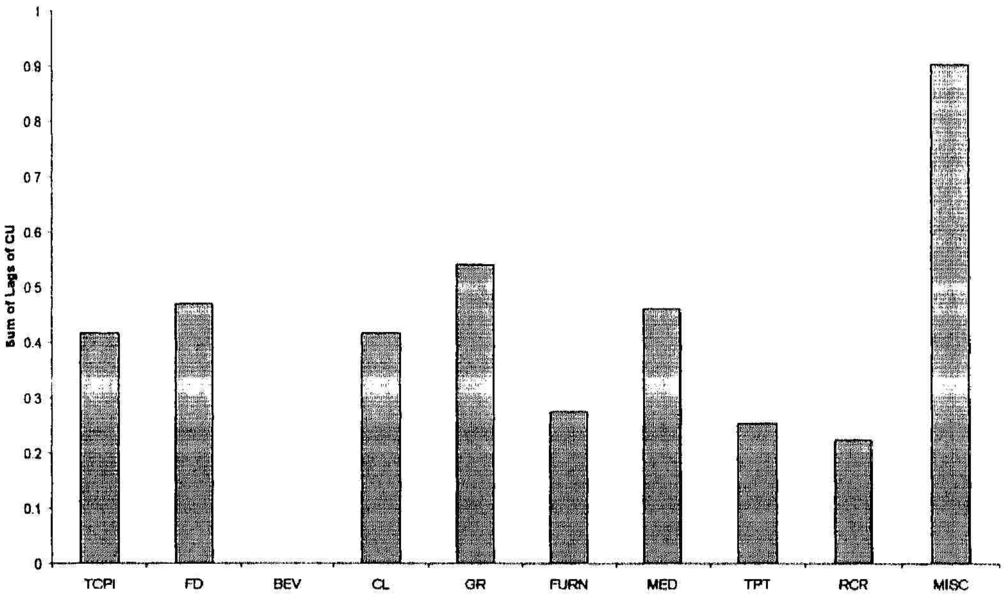


Figure 4.9 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{P}$ (4 years)

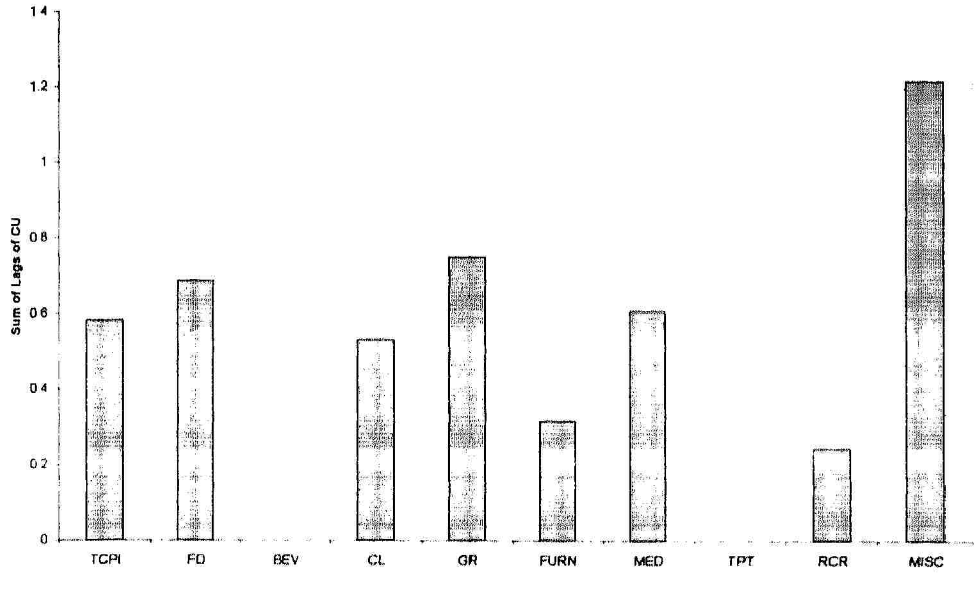
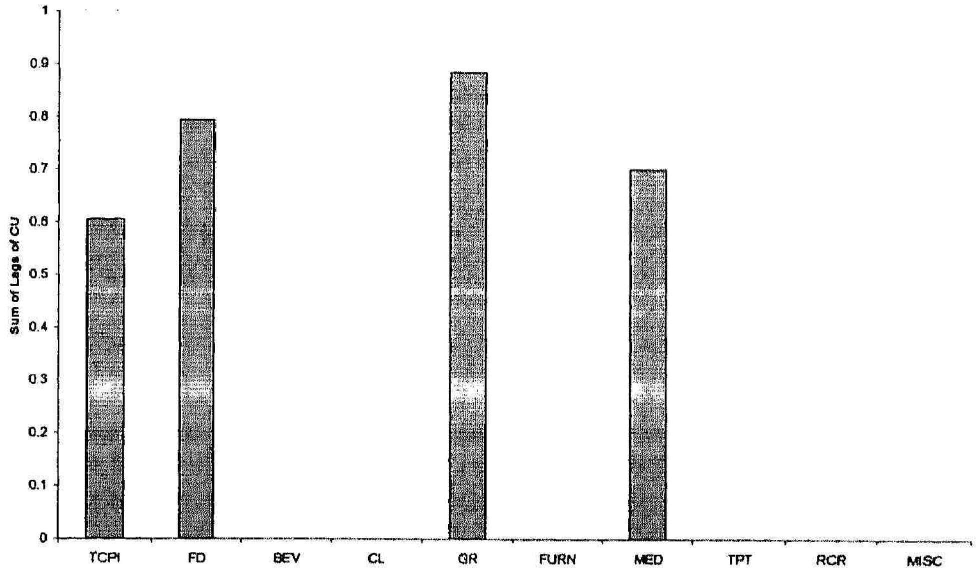


Figure 4.10 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{P}$ (5 years)



4.1.3 Granger Causality Test between $\dot{CU}$ and $\dot{P}$

This section estimate the Granger-Causality test to see if there is a bi-directional relationship between the components' inflation and currency in circulation.

The model is as follows:

$$\dot{P}_t = \sum_{i=1}^{n} \lambda_i \dot{CU}_{t-i} + \sum_{j=1}^{n} \delta_j \dot{P}_{t-j} + u_{1t} \tag{4.3}$$

$$\dot{CU}_t = \sum_{i=1}^{m} \alpha_i \dot{CU}_{t-i} + \sum_{j=1}^{m} \beta_j \dot{P}_{t-j} + u_{2t} \tag{4.4}$$

where it is assumed that the disturbance term u_{1t} and u_{2t} are uncorrelated.

Table 4.3 Granger Causality Test between $\dot{CU}$ and $\dot{P}$

5:01 2000:06 Currency in Circulation Obs:303			
esis	F-Statistic	Probability	Outcome
t Granger Cause $\dot{TCPI}$	8.79095	0.00020*	**Unidirectional**
ıot Granger Cause $\dot{CU}$	2.14609	0.11874	
: Granger Cause $\dot{FD}$	8.48532	0.00026*	Bi-directional
Granger Cause $\dot{CU}$	3.85077	0.02233*	
t Granger Cause $\dot{BEV}$	0.53260	0.58764	Unidirectional
›t Granger Cause $\dot{CU}$	3.46356	0.03258*	
t Granger Cause $\dot{CL}$	2.78073	0.06360^{+}	Unidirectional √
Granger Cause $\dot{CU}$	0.32364	0.72376	

Note: * There's granger causality relationship at the 5% level
$^{+}$ There's granger causality relationship at the 10% level
√ Those components that has the same Granger Causality relationship with the growth of CU as the Total CPI
Those components that show insignificant Granger Causality relationship are not reported.

From the analysis above, the Food *CPI* shows that there is a bi-directional relationship with currency in circulation. Other components like Clothing *CPI* and Total *CPI* have a unidirectional relationship with currency in circulation that is from changes in currency in circulation to inflation rate. On the other hand, Beverage *CPI* also has a unidirectional relationship with currency in circulation but the direction is from inflation rate to changes in currency in circulation. The inconsistent directions of Granger Causal relationship show that the relationship between inflation rate and *CU* are not stable. The rest of the components do not show any significant results.

In conclusion, from the above three analyses on the relationship of *CU* and *CPI* components, changes in *CU* does affect the inflation rate of *CPI* components after a certain lag period. *CU* affects most on Miscellaneous *CPI*, Gross Rent *CPI*, Food *CPI*, Medical Care *CPI* and Total *CPI*. Food is the only component that has significant results for the three analyses. On the other hand, inflation rate of Beverages *CPI* Granger causes changes in *CU*.

4.2 The Effects of Changes of Currency in Circulation on Output

This section intends to find out if changes in currency in circulation have an impact on changes in output of *IIP*.

The relationship between a change in *CU* and output is expressed in the model below.

$$\dot{IIP}_t = \beta_0 + \beta_1 \dot{CU}_t + \varepsilon_t \qquad (4.5)$$

where $\dot{IIP}_t$ = change in index of industrial production (output)

$\dot{CU}_t$ = change in currency in circulation

ε_t = white noise error term

From the regression above, the results in Table 4.4 shows that at 5% level of significance, there is a negative relationship between changes in *CU* and changes in individual component of *IIP* such as Mining *IIP*, Electricity *IIP*, Manufacturing *IIP*, Product Agriculture *IIP*, Tobacco *IIP*, Wood Product *IIP*, Electrical Product *IIP* and Transport *IIP*. This relationship shows that whenever there's an increase in currency in circulation the output of these components will fall. This result has shown the opposite sign (negative) of the ought be theoretical sign (positive) of coefficient of *CU*. Nevertheless, there are components, which are positively affected by the change in currency in circulation such as changes in Mining *IIP* (significant at 5%) and Beverages *IIP* (significant at 10%). For these two components, a 1% increase in currency in circulation will cause a 0.5% increase in output of mining and 0.36% output of beverages.

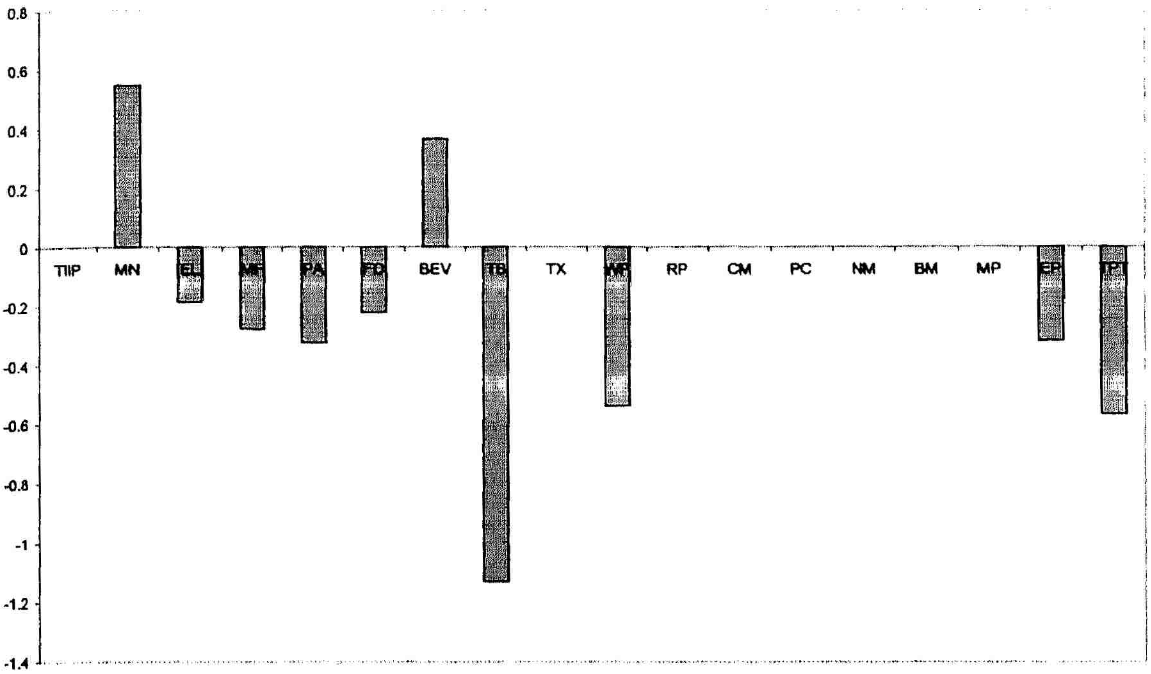
The overall results is not too convincing for the role of *CU* in the change of output. It shows that output is countercyclical towards changes in currency in circulation rather than procyclical. Perhaps, output might be the leading variable, which helps to explain the negative relationship of *CU* and output. It means that when output fall, monetary policy makers will increase the money supply in order to stimulate growth of output.

Table 4.4 Regression of $\dot{IIP}$ on $\dot{CU}$

Component of *IIP*	Coefficient $\hat{\beta}_0$	Coefficient $\hat{\beta}_1$	Component of *IIP*	Coefficient $\hat{\beta}_0$	Coefficient $\hat{\beta}_1$
Total *IIP* (*TIIP*)	1.0106*	–0.0606	Wood Product (*WP*)	2.3131*	–0.5374*
	(0.0070)	(0.4447)		(0.0138)	(0.0072)
Mining (*MN*)	0.4949	0.5468*	Rubber Product (*RP*)	1.8734*	–0.2420
	(0.5114)	(0.0007)		(0.0079)	(0.1055)
Eelctricity (*EL*)	1.1740*	–0.1877*	Chemical (*CM*)	1.3513*	–0.0265
	(0.0032)	(0.0264)		(0.0500)	(0.8561)
Manufacturing (*MF*)	1.4314*	–0.2779*	Petrol and Coal (*PC*)	1.7025$^+$	0.1372
	(0.0036)	(0.0077)		(0.0555)	(0.4671)
Product Agriculture	1.7489*	–0.3249*	Non-Metallic Product	1.2961$^+$	–0.0110
(*PA*)	(0.0132)	(0.0303)	(*NM*)	(0.0547)	(0.9389)
Food (*FD*)	1.0460$^+$	–0.2224$^+$	Basic Metal (*BM*)	1.9642*	–0.2027
	(0.0537)	(0.0537)		(0.0239)	(0.2715)
Beverages (*BEV*)	1.3480	0.3649$^+$	Metal Product (*MP*)	2.3550*	–0.2075
	(0.1572)	(0.0721)		(0.0149)	(0.3113)
Tobacco (*TB*)	2.9364*	–1.1304*	Electrical Product (*EP*)	2.1835*	–0.3168*
	(0.0111)	(5.48E-06)		(0.0008)	(0.0214)
Textiles (*TX*)	1.4068*	–0.2121	Transport (*TPT*)	2.9731*	–0.5648*
	(0.0235)	(0.1076)		(0.0055)	(0.0130)

Note: The *p-values* are in parentheses.
*Denotes statistical significance at 5% level
$^+$Denotes statistical significance at 10% level.

Figure 4.11 Comparisons of the Effects of $\dot{CU}$ on $\dot{IIP}$ of *IIP* Components



The above Figure 4.11 shows those components' changes in output that has significant relationship with growth in *CU*.

4.2.1 Rolling Regression of $\dot{IIP}$ on $\dot{CU}$

Figure 4.12 Rolling Regression – Mining

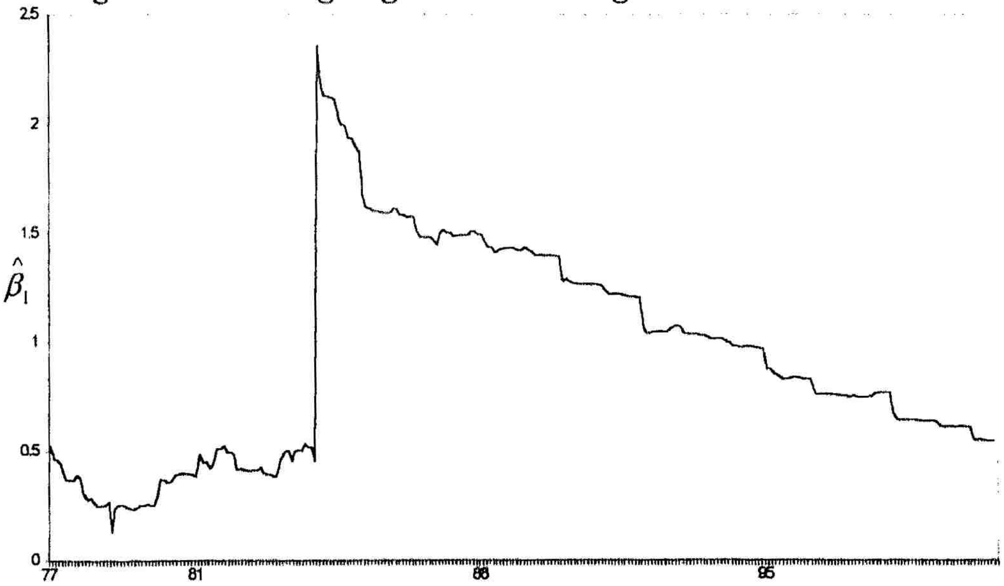


Figure 4.13 Rolling Regression – Electricity

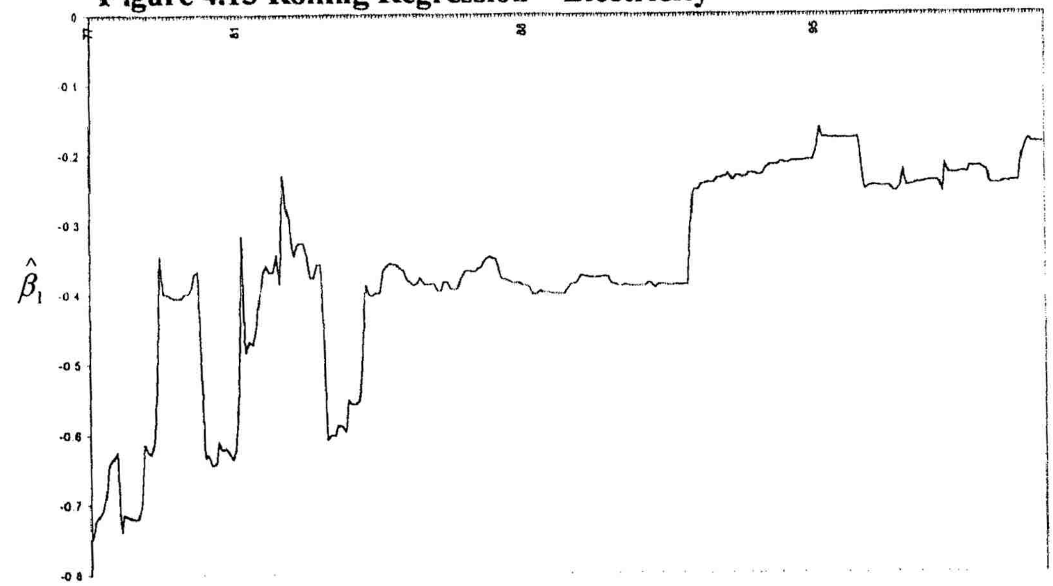


Figure 4.14 Rolling Regression – Manufacturing

Figure 4.15 Rolling Regression – Product Agriculture

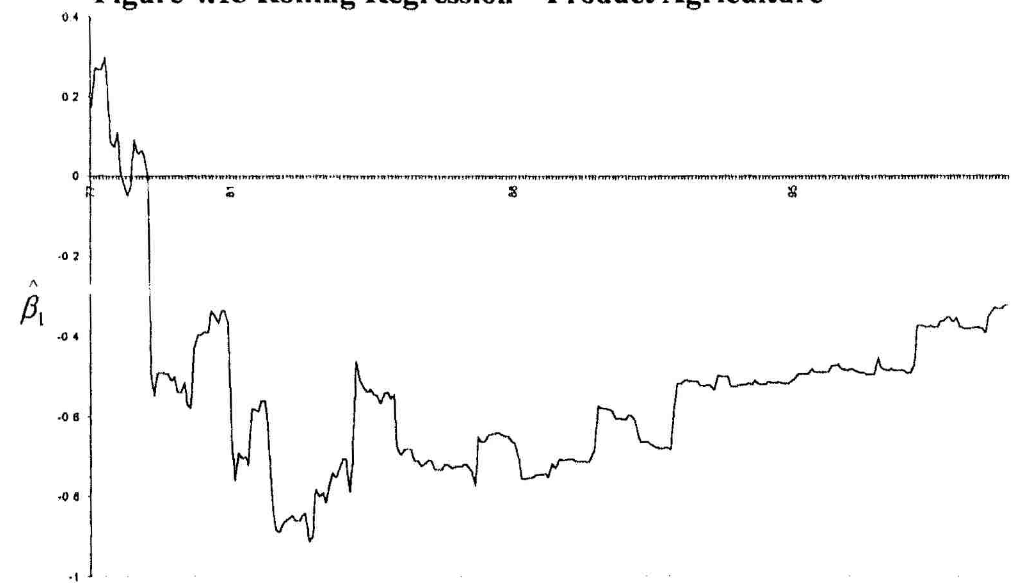


Figure 4.16 Rolling Regression – Food

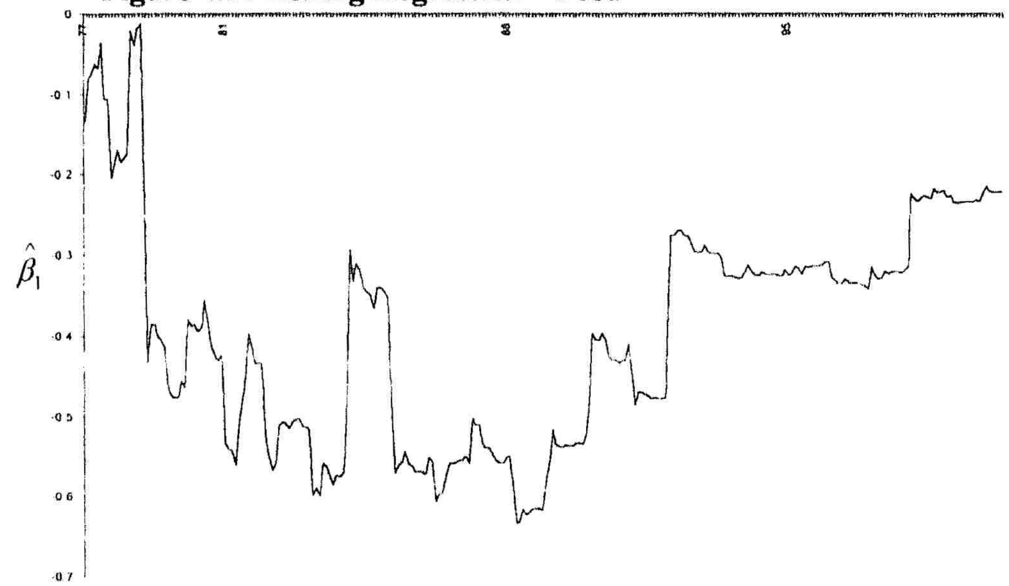


Figure 4.17 Rolling Regression – Beverages

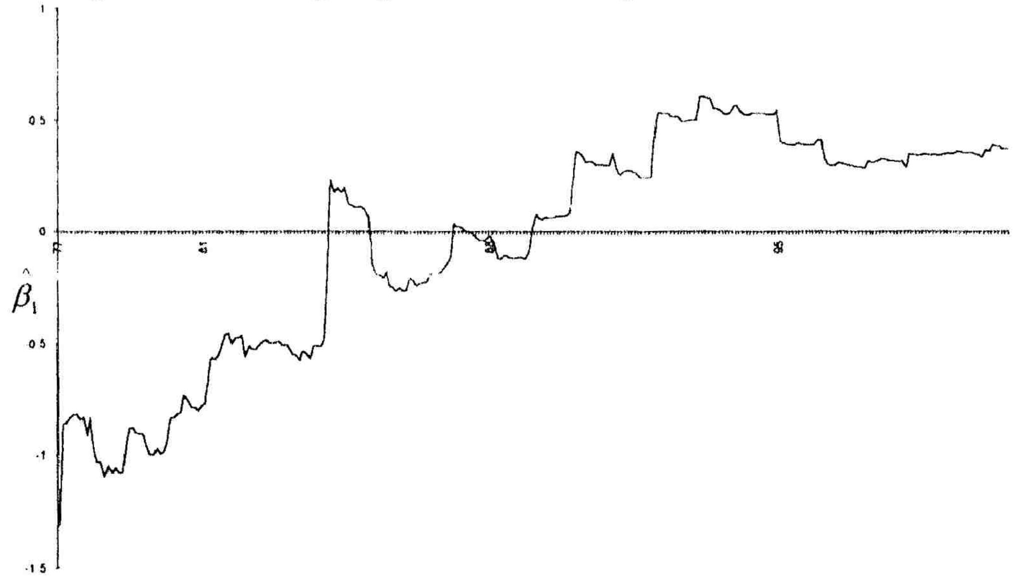


Figure 4.18 Rolling Regression – Tobacco

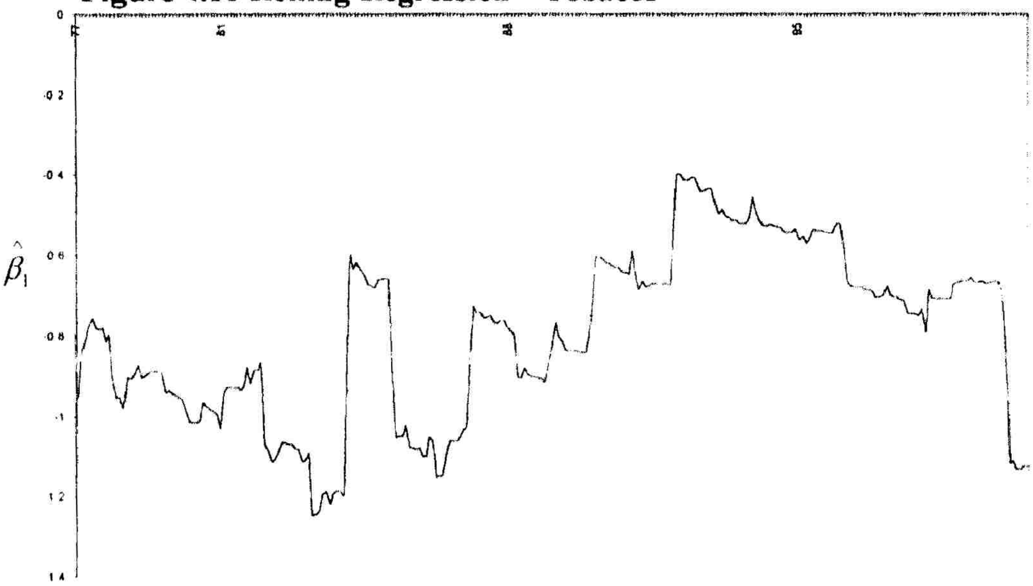


Figure 4.19 Rolling Regression – Wood Product

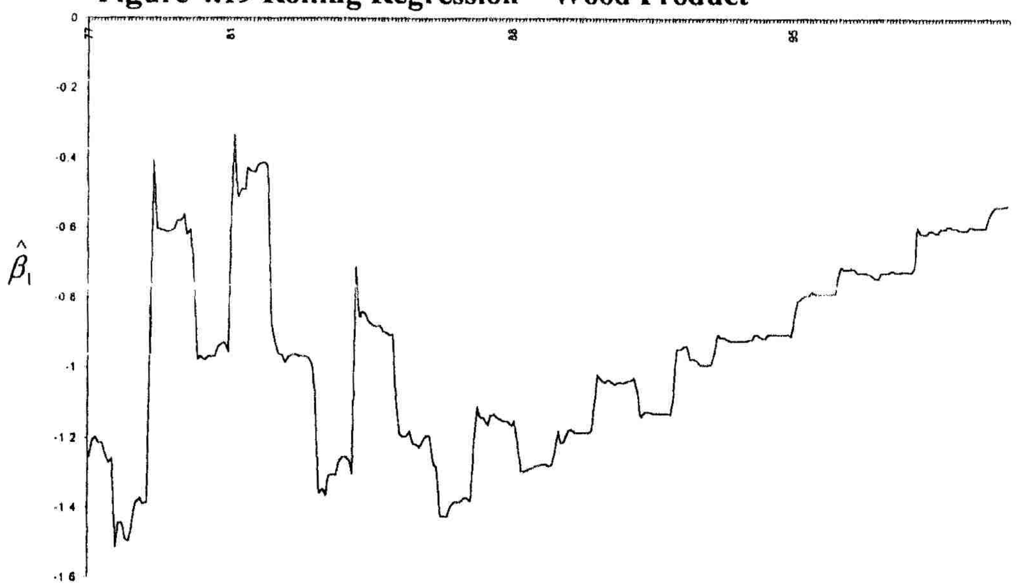


Figure 4.20 Rolling Regression – Electrical Product

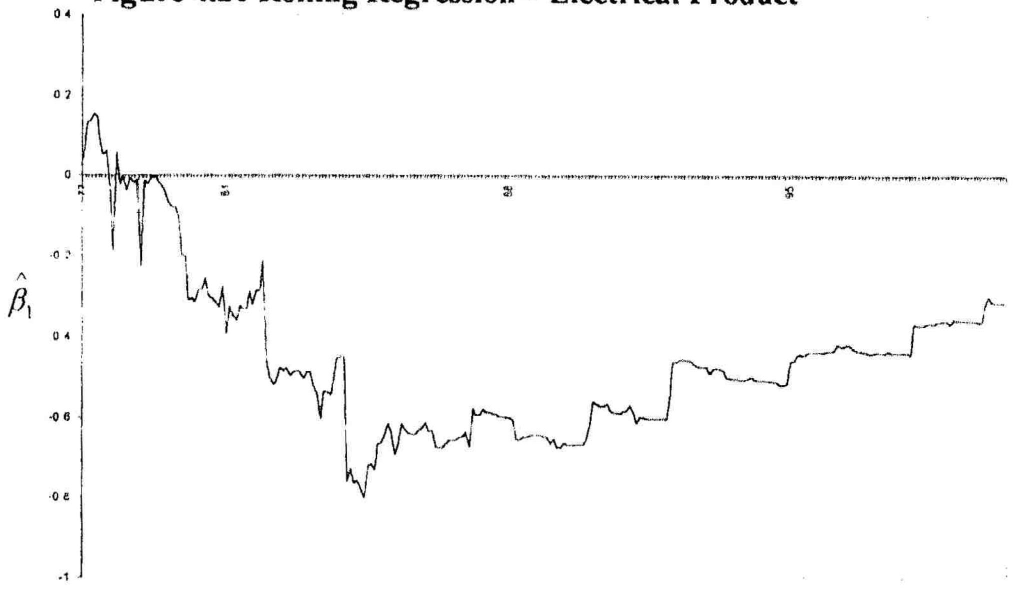
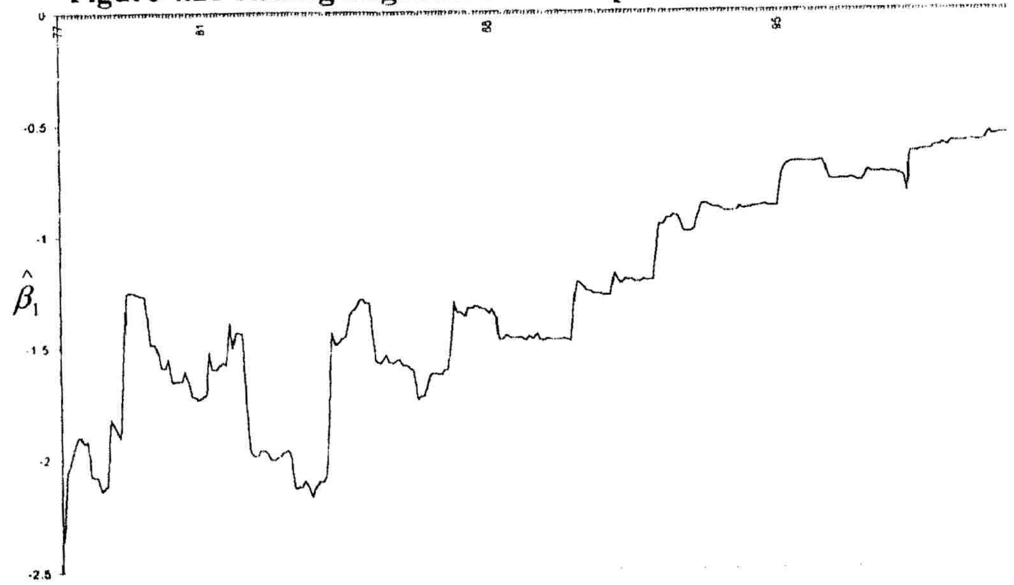


Figure 4.21 Rolling Regression – Transport



The overall rolling regression results show that the impact of CU on changes in output has fallen in its absolute magnitude.

4.2.2 Regression of $\dot{IIP}$ on Sum of Lags of $\dot{CU}$

The following model will be used to analyse the lag effect of changes in CU on changes in IIP. A lag period of 1-year, 2-years, 3-years, 4-years, and 5-years will be tested.

$$\dot{IIP}_t = \alpha + \sum_{i=0}^{n} \beta_i \dot{CU}_{t-i} + \varepsilon_t \qquad (4.6)$$

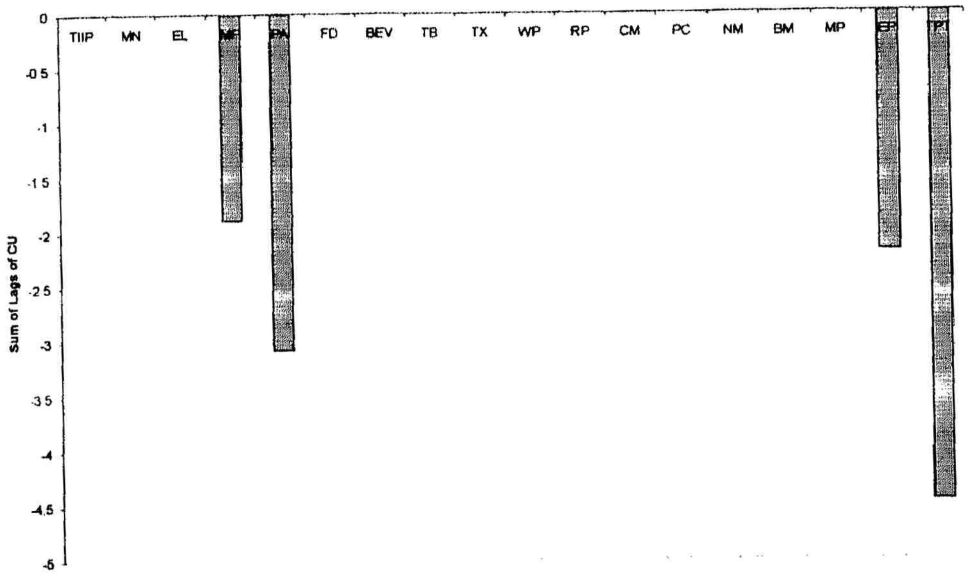
The results in Table 4.5 suggest that, there are only four components, which show significant relationship with CU at 1-year lag period. These components are Manufacturing IIP, Product Agriculture IIP, Electrical Product IIP and Transport IIP. The relationships between CU and the rest of IIP components of a sum of lag model are insignificant for all the sum of lag periods. These conclude that lags of changes in CU do not influence the level of changes in output. This might leads us to conclude that CU is not a leading variable in the relationship with output. CU might be a lagging variable.

Table 4.5 Regression of $\dot{IIP}$ on Sum of Lags of $\dot{CU}$

Component of *IIP*	Coefficients of Sum of lags				
	1 year	2 years	3 years	4 years	5 years
Total *IIP* (*TIIP*)	− 0.8332 (− 1.2844)	− 0.8134 (− 0.8565)	− 0.7656 (− 0.6188)	− 1.1742 (− 0.7943)	−1.4147 (− 0.8013)
Mining (*MN*)	1.5218 (1.1356)	1.6719 (0.8490)	1.0282 (0.3988)	0.4403 (0.1423)	1.8243 (0.4921)
Electricity (*EL*)	− 0.9602 (−1.3810)	− 0.5951 (− 0.5812)	− 0.8489 (− 0.6406)	− 0.1522 (− 0.0973)	− 0.2142 (− 0.1147)
Manufacturing (*MF*)	− 1.8908* (− 2.2012)	− 1.638 (− 1.2937)	−1.5382 (− 0.9298)	− 2.445 (− 1.2334)	− 2.6988 (− 1.1367)
Product Agrculture (*PA*)	− 3.0813* (− 2.5196)	− 1.8775 (− 1.0512)	− 0.9543 (− 0.4254)	− 1.9834 (− 0.7539)	− 1.7123 (− 0.5518)
Food (*FD*)	− 1.6823 (− 1.7787)	− 1.5155 (− 1.0933)	− 1.6350 (− 0.9050)	− 1.1844 (− 0.5544)	− 1.7919 (− 0.7128)
Beverages (*BEV*)	0.9212 (0.5659)	1.7912 (0.7583)	1.9727 (0.6465)	1.3801 (0.3801)	0.5268 (0.1216)
Tobacco (*TB*)	− 2.5485 (− 1.2171)	− 5.1846 (− 1.6913)	− 5.9116 (− 1.4711)	− 4.8483 (− 1.0033)	− 5.0167 (− 0.8641)
Textiles (*TX*)	− 1.6058 (− 1.5073)	− 1.1874 (− 0.7651)	− 1.1708 (− 0.5808)	− 2.1568 (− 0.9004)	− 2.0198 (− 0.7135)
Wood Product (*WP*)	− 3.1845 (− 1.9389)	− 2.9899 (− 1.2440)	− 4.2767 (− 1.3586)	− 4.9919 (− 1.3368)	− 5.8164 (− 1.3170)
Rubber Product (*RP*)	− 2.0511 (− 1.7238)	− 2.2876 (− 1.3262)	− 2.5668 (− 1.1450)	− 3.2308 (− 1.2123)	− 3.5967 (− 1.1392)
Chemical (*CM*)	− 0.6840 (− 0.5704)	− 0.5923 (− 0.3373)	− 0.1128 (− 0.0494)	− 1.1115 (− 0.4075)	− 1.7301 (− 0.5383)
Petrol and Coal (*PC*)	0.8539 (0.5506)	0.3707 (0.1642)	1.4638 (0.5072)	0.2352 (0.0686)	− 1.2145 (− 0.30160)
Non-Metallic Product (*NM*)	− 0.8717 (− 0.7428)	− 0.4940 (− 0.2889)	0.2311 (0.1063)	− 1.2693 (− 0.4887)	− 1.5217 (− 0.4931)
Basic Metal (*BM*)	− 2.5709 (− 1.8292)	− 1.3421 (− 0.7033)	− 1.0991 (− 0.4494)	− 1.9141 (− 0.6520)	− 1.2579 (− 0.3623)
Metal Product (*MP*)	− 1.4583 (− 0.8619)	0.4334 (0.1753)	− 0.7987 (− 0.2458)	1.3104 (- 0.3374)	2.2662 (0.4884)
Electrical Product (*EP*)	− 2.1860* (− 1.9693)	− 2.7524 (− 1.7124)	− 2.7756 (−1.3231)	− 2.5602 (− 1.0841)	− 3.7685 (− 1.3687)
Transport (*TPT*)	− 4.4683* (− 2.3988)	− 4.1843 (− 1.5331)	− 3.1654 (− 0.9125)	− 4.4429 (− 1.0794)	− 6.0517 (− 1.2498)

Note: The *t-statistics* are in parentheses.
*Denotes statistical significance at 5% level

Figure 4.22 The Effects of Sum of Lags of $\dot{CU}$ on $\dot{IIP}$ (1year)



4.2.3 Granger Causality Test between $\dot{CU}$ and $\dot{IIP}$

The following is an analysis done to test if there is a granger causal relationship between currency in circulation and *IIP* components.

$$\dot{IIP}_t = \sum_{i=1}^{n} \alpha_i \dot{CU}_{t-i} + \sum_{j=1}^{n} \beta_j \dot{IIP}_{t-j} + u_{1t} \quad (4.7)$$

$$\dot{CU}_t = \sum_{i=1}^{m} \lambda_i \dot{CU}_{t-i} + \sum_{j=1}^{m} \delta_j \dot{IIP}_{t-j} + u_{2t} \quad (4.8)$$

where it is assumed that u_{1t} and u_{2t} are uncorrelated.

The following Table 4.6 shows the results of the above analysis.

Table 4.6 Granger Causality Test between $\dot{CU}$ and $\dot{IIP}$

Sample: 1975:01 2000:06 Lag:2 Obs:303			
Null Hypothesis	*F*-Statistic	Probability	Outcome
$\dot{CU}$ does not Granger Cause $\dot{TIIP}$	21.9136	1.3E-09*	**Unidirectional**
$\dot{TIIP}$ does not Granger Cause $\dot{CU}$	0.43950	0.64478	
$\dot{CU}$ does not Granger Cause $\dot{EL}$	28.9636	3.2E-12*	Unidirectional √
$\dot{EL}$ does not Granger Cause $\dot{CU}$	1.30225	0.27346	
$\dot{CU}$ does not Granger Cause $\dot{MF}$	24.2074	1.8E-10*	Unidirectional √
$\dot{MF}$ does not Granger Cause $\dot{CU}$	0.73135	0.48212	
$\dot{CU}$ does not Granger Cause $\dot{PA}$	5.08184	0.00676*	Bi-directional
$\dot{PA}$ does not Granger Cause $\dot{CU}$	5.80907	0.00335*	
$\dot{CU}$ does not Granger Cause $\dot{FD}$	13.3437	2.8E-06*	Bi-directional
$\dot{FD}$ does not Granger Cause $\dot{CU}$	2.74808	0.06567⁺	
$\dot{CU}$ does not Granger Cause $\dot{BEV}$	1.10324	0.33315	Unidirectional
$\dot{BEV}$ does not Granger Cause $\dot{CU}$	5.30276	0.00546*	
$\dot{CU}$ does not Granger Cause $\dot{TB}$	2.85675	0.05903⁺	Bi-directional
$\dot{TB}$ does not Granger Cause $\dot{CU}$	4.10544	0.01742*	
$\dot{CU}$ does not Granger Cause $\dot{TX}$	27.8131	8.4E-12*	Bi-directional
$\dot{TX}$ does not Granger Cause $\dot{CU}$	3.81895	0.02303*	
$\dot{CU}$ does not Granger Cause $\dot{WP}$	18.6418	2.4E-08*	Unidirectional √
$\dot{WP}$ does not Granger Cause $\dot{CU}$	2.12671	0.12104	
$\dot{CU}$ does not Granger Cause $\dot{RP}$	9.77794	7.7E-05*	Unidirectional √
$\dot{RP}$ does not Granger Cause $\dot{CU}$	0.15783	0.85406	
$\dot{CU}$ does not Granger Cause $\dot{CM}$	0.63704	0.52958	Unidirectional
$\dot{CM}$ does not Granger Cause $\dot{CU}$	3.92730	0.02072*	
$\dot{CU}$ does not Granger Cause $\dot{PC}$	2.94921	0.05391⁺	Unidirectional √
$\dot{PC}$ does not Granger Cause $\dot{CU}$	0.32824	0.72045	
$\dot{CU}$ does not Granger Cause $\dot{NM}$	33.3060	8.8E-14*	Unidirectional √
$\dot{NM}$ does not Granger Cause $\dot{CU}$	0.52318	0.59318	
$\dot{CU}$ does not Granger Cause $\dot{BM}$	7.72556	0.00054*	Unidirectional √
$\dot{BM}$ does not Granger Cause $\dot{CU}$	0.06805	0.93422	
$\dot{CU}$ does not Granger Cause $\dot{EP}$	5.07234	0.00682*	Unidirectional √
$\dot{EP}$ does not Granger Cause $\dot{CU}$	0.72191	0.48667	
$\dot{CU}$ does not Granger Cause $\dot{TPT}$	11.1647	2.1E-05*	Unidirectional √
$\dot{TPT}$ does not Granger Cause $\dot{CU}$	2.05339	0.13011	

Note: * There's granger causality relationship at the 5% level
⁺ There's granger causality relationship at the 10% level
√ Those components that has the same Granger Causality relationship with the growth of CU as the Total IIP
Those components that show insignificant Granger Causality relationship are not reported.

The above results in Table 4.6 shows that there is a more consistent trend of relationship between changes in *CU* and changes in output. From the 17 components of *IIP* 10 of the *IIP* components have a unidirectional relationship (from changes of *CU* to changes in output). These components are total *IIP*, Electricity *IIP*, Manufacturing *IIP*, Wood Product *IIP*, Rubber Product *IIP*, Product of Petroleum and Coal *IIP*, Non-Metallic Mineral Products *IIP*, Basic Metals *IIP*, Electronic and Electrical *IIP* and Transport Equipment *IIP*. Beverages *IIP* and Chemical and Chemical Products *IIP* have a unidirectional relationship from growth of output to changes in *CU*. There are four other components as indicated in the table, which have a bi-directional relationship.

The above three analyses on the relationship between *CU* and output shows that the three results do not show a theoretically predicted relationship between *CU* and output. In the first analysis of equation (4.5) it shows that there's a negative relationship between *CU* and output, then in the Granger Causality test it shows that most of the components have a unidirectional relationship from *CU* to output. This result indicates that *CU* affects output and it has a negative relationship, which does not support the theoretically predicted (positive) signs in the regression.