Long Run Money Neutrality: The Case of Guatemala

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Abstract

The Fisher and Seater (1993) methodology is used to test for the long run neutrality of money in Guatemala, 1950-2001. Real GDP, real *per capita* GDP, and the money measures, M1 and M2, are integrated of order one [I(1)]. Given these orders of integration, the Fisher-Seater neutrality test can be applied. The evidence suggests that M1 and M2 are neutral with respect to real GDP. Furthermore, the test indicates that M1, but not M2, is neutral with respect to real *per capita* GDP as well.

Resumen**

La metodología de Fisher y Seater (1993) es utilizada para analizar la neutralidad del dinero en el largo plazo en Guatemala, 1950-2001. El PIB Real, PIB Real *per capita*, y las medidas del dinero, M1 y M2, son variables integradas de orden uno [I(1)]. Dados estos ordenes de integracion, el test de neutralidad de Fisher y Seater puede ser aplicado. La evidencia sugiere que tanto M1 como M2 son neutrales respecto al PIB Real. De otra manera, el test tambien indica que solamente M1 es neutral con respecto al PIB Real *per capita*.

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1. Introduction

Most economists accept the proposition that money is neutral in the long run That is, a permanent and unexpected change in the quantity of money has no long run real effects Fisher and Seater (1993) have developed a simple empirical test of the long run neutrality (LRN) proposition under the assumption that money is exogenous The test depends on the orders of integration of the variables. Both money and the real variable must be integrated of, at least, order one to conduct the LRN test The intuition is straightforward. If money is I(0), then there have been only temporary changes in money and it makes no sense to test for neutrality in the absence of sustained changes in the money stock If, however, the real variable is I(0) and money is, say, I(1) then LRN cannot be rejected because there have been no permanent changes in the real variable The FS neutrality test and the superneutrality variant have been widely used in recent years although mostly with data for industrialized countries

The purpose of this study is to apply the FS test of long run money neutrality to real output in Guatemala The macroeconomic performance of Guatemala has by no means been exemplary, but by Latin American standards it has been better than most. Although the Guatemalan economy has not been beset by such problems as hyperinflation and exchange rate crises that one often associates with Latin America, the country has been anything but tranquil politically. An extended civil war and several military coups occurred during the study period, 1950-2002

Interestingly, given the theoretical appeal of the LRN proposition, use of the Fisher and Seater (FS) test for long run neutrality has yielded ambiguous results FS find that LRN does not hold for the US for 1869-1975 Boschen and Otrok (1994) show that the FS results for the US are sensitive to the inclusion of data from the Great Depression years Their findings indicate that money is LRN in the US for 1869-1929 and 1940-1992 sub-periods They speculate that the large number of US bank failures during the Great Depression accounts for the rejection in the sample that includes 1930-1939 Haug and Lucas (1997) note that Canada did not have a single bank failure in the 1930-1939 period yet their results indicate that money is not LRN in Canada for the 1914-1994 period LRN holds when a dummy variable for the Great Depression in included in the FS test leading Haug and Lucas to conclude that relation of money and output was unusual in Canada, as in the US, during the Great Depression period despite the absence of bank failures

Olekalns (1996) finds that LRN holds for Australia when using a narrow measure of money but not for a broader measure. Similarly, Coe and Nason (2002) find mixed support for LRN. Using a longer sample period than Haug and Lucas, they reject LRN for Canada. Coe and Nason fail to reject LRN for Australia and the US when using the monetary base but reject LRN when a broader money stock measure is employed. Finally, their evidence supports neutrality for the United Kingdom.

Wallace (1999) finds that both M1 and M2 are long run neutral for the 1932-1992 period in Mexico. In contrast Noriega (2001) concludes that M1 is not neutral in Mexico for the extended period 1932-2000. Shelley and Wallace (2003) also conclude that money, regardless of the measure, is not LRN in Mexico for 1932-2002 but that this result arises from inclusion of the 1982-1986 period of high money growth and inflation in the data. For 1932-1981, money is LRN in Mexico[1].

The mixed empirical evidence for LRN is surprising in light of the strong theoretical appeal of the proposition. In several of the studies in which LRN is rejected, periods of aberrant economic performance (severe recession or high inflation) are included. These anomalous periods appear to be driving the rejection of the proposition. The Boschen and Otrok results for the US, the Haug and Lucas findings for Canada, and the Shelley and Wallace study for Mexico can be interpreted in this fashion. As previously noted, Guatemala has been relatively stable economically but not politically. Can political instability, unaccompanied by severe macroeconomic problems, also cause a rejection of the long run neutrality proposition? In the case of Guatemala, the answer appears to be no.

2. Data

Real GDP figures for 1980-2002 and M1 and M2 money stock data for 1950-2002 are available from the Banco de Guatemala, the country's central bank. The bank also reports annual real growth rates for 1950-2002. The real growth rates are used to estimate real GDP data for the 1950-1979 period. These constructed figures are appended to the 1980-2002 series available from the bank. Since the real GDP data are, in part, constructed from the central bank's growth rate statistics, the FS test is also applied to an alternative

1 Shelley and Wallace show that Wallace's finding of LRN is caused by the use of data prior to 1932 in the generation of the differenced variables used in the FS test, even though the estimation sample is restricted to 1932-1992. Prior to 1932 gold circulated as money in Mexico thus money was unlikely to be exogenous, a necessary.

output measure, real per capita GDP for 1950-2000 from the Penn World Tables [Heston, Summers, and Bettina (2002)], as a robustness check

Economic growth (real GDP) averaged nearly 4 percent annually while inflation averaged slightly more than 7.5 percent each year of the study period Even at its worst, 60 6 percent in 1990, inflation never presented the serious problem it did in other Latin American countries In only two other years in the sample period did inflation exceed 20 percent. However Guatemala has been beset by political turmoil, military coups and civil war. Consequently its growth performance has been erratic. Figure 1 shows the growth rates of real GDP and M1 over the study period Table 1 presents these growth rates and those for the price level and real *per capita* GDP for three sub-periods

Figure 1: Real GDP and M1 Growth Rates, 1951-2002

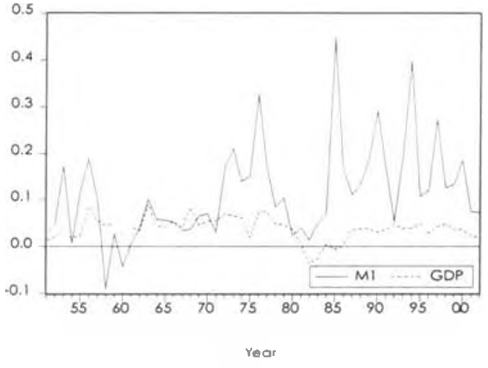


Table 1
Annual Percentage Growth Rates of Selected Variables

Variable	1951-1980	1981-1986	1987-2002
Real GDP	5.00	-.90	3.75
Real GDP per capita	2.14	-2.27	.74
M1	9.04	15.42	18.32
Price Level	3.80	12.90	12.83

As can be seen from the figure and table the growth rate of real output diminished sharply in the 1981-1986 period, averaging slightly less than a 1percent annual decrease

in real GDP. The effect of the poor economic performance during this period is even more starkly reflected in the average annual decline of -2.27 percent in real *per capita* GDP. M1 growth averaged 9 percent annually from 1951-1980. Given the 5 percent mean growth rate in real GDP and the nearly 4 percent mean growth rate in the price level, the 9 percent rate of M1 growth suggests a stable demand for money. The money stock as measured by M2 (not shown) grew much more rapidly on average during the 1951-1980 period than the price level. It is interesting to note that in none of the three sub-periods did the average annual increase in the price level exceed the mean rate of money growth. Thus, it appears that money demand was either stable (M1) or growing (M2) throughout the study period.

In the Fisher-Seater procedure, the orders of integration of the variables determine whether LRN can be tested and, if testable, the appropriate form of the test. All variables used in the study are logged. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are employed to determine the orders of variable integration. Unit root tests in levels include a constant and a trend. Unit root tests on the first differences of variables include a trend if a regression of the first difference on a constant and trend shows that the trend is significant[2]. Beginning with zero lags of the dependent variable, lags are added to the ADF equation until a Lagrange multiplier test indicates that serial correlation is eliminated. In all cases, the tests indicate that none of the variables is stationary in levels. But the hypothesis of a unit root in first differences can be rejected for all variables. Thus for the data used in this study, the ADF and PP test results clearly indicate that all output and money measures are I(1). However, the first differences of both (logged) money series contain significant trends, an issue addressed below.

Long run money exogeneity is an assumption of the Fisher-Seater approach. To examine this assumption, a Granger causality test is applied to the first differences of the logarithms of money and real output. The results (see Appendix 1) indicate that differenced real output does not Granger-cause either monetary variable. The test result suggests that money is likely to be exogenous. Although the absence of Granger causality is not a sufficient condition for exogeneity, a finding that output Granger-causes money would provide strong evidence against the assumption.

2 The Newey-West correction for serial correlation is applied in these regressions.

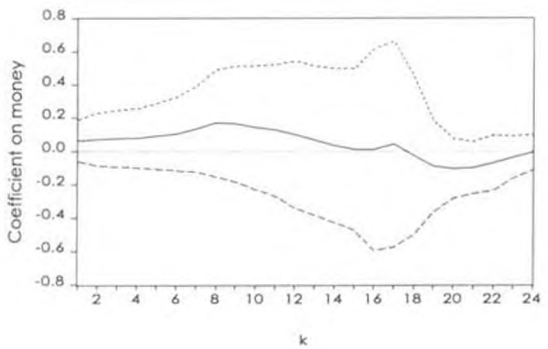
3. Fisher-Seater Test and Empirical Results

Fisher and Seater show that equation (1) can be used to test for LRN if both (logged) money, m, and the (logged) real variable, y, are I(1) and money is exogenous. In this case the estimator of the long run derivative of y with respect to a permanent change in m is the limit of the slope coefficient, b_k, as $k \to \infty$. A predetermined maximum of twenty or thirty periods is typically selected for k. $k = 24$ is used in this study. Equation (1) is estimated by OLS using the Newey-West (1994) correction for serial correlation. In addition to the differenced logged money and output terms, a trend (t) is included to remove the effects of the trend in logged differenced money. The degrees of freedom in the FS test are T/k where T is the number of observations.

$$(1) \qquad y_t - y_{t-k-1} = a_k + b_k(m_t - m_{t-k-1}) + d_k t + e_{kt}$$

Figures 2 and 3 show the b_k plots from estimation of equation (1) and the 95% confidence interval for real GDP and real per capita GDP, respectively, when M1 is the monetary variable. Except as noted, the results for M2 are very similar thus omitted[3]. In both graphs, zero is contained within the confidence interval for all values of k thus indicating that the hypothesis of long run neutrality of M1 with respect to either real aggregate or per capita GDP cannot be rejected[4]. The failure to reject long run neutrality of M1 appears robust, as the results for both total and per capita GDP are the same. Thus the construction of some of the values of the total GDP variable does not appear to affect the results.

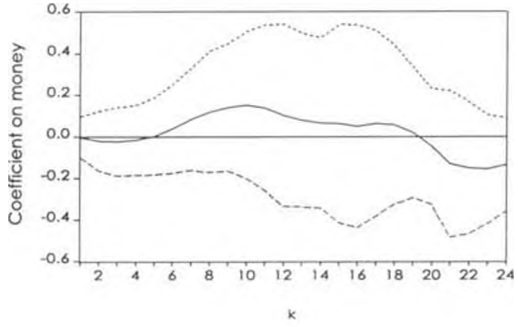
Figure 2: Real GDP on M1, 1950-2002



3 All coefficient estimates and standard errors are shown in Appendix 2.

4 The standard errors for the mid-range values of k tend to be large relative to other values of k. This difference accounts for the shape of the confidence interval.

Figure 3: Real *per capita* GDP on M1, 1950-2000



The results using M2 and total GDP in equation (1) are qualitatively the same as those for M1. However, when using M2 and *per capita* GDP as the real output measure, four of the bk coefficients (k = 8...11) are significantly positive. This result may indicate that the LRN cannot be rejected for M1 but does not hold for M2. Such an interpretation would be consistent with that of Olekalns who finds that the FS test results for Australia are sensitive to the money measure used. This explanation appears unlikely since the FS test results indicate that M2 is LRN with respect to total GDP. Alternatively, the results with M2 may be attributable to the manner in which the per capita GDP is measured since the two GDP measures are from different data sources.

4. Conclusions

Application of the Fisher-Seater test of long run money neutrality to data for Guatemala indicates that the LRN proposition cannot be rejected for either real GDP or real per capita GDP when M1 is the money measure. It is puzzling that long run neutrality cannot be rejected for total GDP but cannot be accepted for *per capita* GDP when M2 is used. There is no obvious reason for such a difference. However, the bulk of the evidence suggests that LRN does hold.

The failure to reject the LRN proposition is particularly interesting in the case of Guatemala because the country was subjected to significant political turmoil during the sample period. Previous work by Boschen and Otrok, Haug and Lucas, and Shelley and Wallace suggest that periods of aberrant economic performance can lead to a rejection of LRN. However, at least in the case of Guatemala, it does not appear that political instability affects LRN. Not even a long running civil war and military coups are sufficient to generate a violation of the classical LRN proposition.

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Appendix 1
Granger Causality Test Results

Table 1.1-Test Results of the Null Hypothesis that X_t-X_{t-1} Does Not Granger-cause Z_t-Z_{t-1}
Money and Real GDP Tests

X_t-X_{t-1}	Z_t-Z_{t-1}	Lags	F Statistic	Marginal Significance Level
Log M1	Log Real PIB	2	0.20813	0.81288
Log M1	Log Real PIB	4	0.16890	0.95296
Log M1	Log Real PIB	6	1.56722	0.18782
Log Real PIB	Log M1	2	1.02324	0.36764
Log Real PIB	Log M1	4	1.28945	0.29086
Log Real PIB	Log M1	6	0.95093	0.47288
Log M2	Log Real PIB	2	0.46078	0.63373
Log M2	Log Real PIB	4	0.60612	0.66058
Log M2	Log Real PIB	6	0.80490	0.57338
Log Real PIB	Log M2	2	0.32685	0.72289
Log Real PIB	Log M2	4	0.40222	0.80585
Log Real PIB	Log M2	6	0.33085	0.91582

Table 1.2-Test Results of the Null Hypothesis that X_t-X_{t-1} Does Not Granger-cause Z_t-Z_{t-1}
Money and Real GDP *per capita* Tests

X_t-X_{t-1}	Z_t-Z_{t-1}	Lags	F Statistic	Marginal Significance Level
Log M1	Log Real PIB per capita	2	0.00082	0.99918
Log M1	Log Real PIB per capita	4	0.34044	0.84890
Log M1	Log Real PIB per capita	6	0.58335	0.74078
Log Real PIB per capita	Log M1	2	2.55576	0.08938
Log Real PIB per capita	Log M1	4	1.60476	0.19362
Log Real PIB per capita	Log M1	6	1.20661	0.32921
Log M2	Log Real PIB per capita	2	0.09973	0.90529
Log M2	Log Real PIB per capita	4	0.18922	0.94253
Log M2	Log Real PIB per capita	6	0.92347	0.49173
Log Real PIB per capita	Log M2	2	0.88792	0.41892
Log Real PIB per capita	Log M2	4	0.51961	0.72181
Log Real PIB per capita	Log M2	6	0.37939	0.88650

Appendix 2
Coefficients and Standard Errors

Table 2.1-b_k Coefficients and Standard Errors
Dependent Variable:Differenced Log Real GDP

k	Coefficient $\log M1_t - \log M1_{t-k-1}$	Standard Error	Coefficient $\log M2_t - \log M2_{t-k-1}$	Standard Error
1	0.063035	0.06218	0.11827	0.059536
2	0.070452	0.07748	0.13656	0.074095
3	0.075257	0.08058	0.1591	0.077214
4	0.077566	0.08191	0.17168	0.08426
5	0.089082	0.08982	0.18771	0.098736
6	0.103981	0.09731	0.20079	0.109646
7	0.132775	0.11149	0.22967	0.126986
8	0.168619	0.13582	0.26802	0.146307
9	0.163434	0.14232	0.27723	0.155083
10	0.141797	0.1445	0.2844	0.156101
11	0.126416	0.15373	0.3084	0.156837
12	0.099425	0.15904	0.26728	0.170195
13	0.065565	0.16113	0.23244	0.184983
14	0.033784	0.16683	0.21148	0.203863
15	0.012119	0.17403	0.2082	0.211899
16	0.010439	0.19031	0.20433	0.207886
17	0.043402	0.19441	0.20087	0.203267
18	-0.02356	0.15055	0.15535	0.201954
19	-0.09074	0.08653	0.09223	0.17115
20	-0.10474	0.05601	0.0434	0.126708
21	-0.10026	0.04875	-0.01356	0.085501
22	-0.07212	0.03861	-0.04918	0.061008
23	-0.03756	0.0293	-0.04277	0.046252
24	-0.00783	0.02468	-0.0216	0.031185

Table 2.2-b_k Coefficients and Standard Errors
Dependent Variable:Differenced Log Real GDP *per capita*

k	Coefficient $\log M1_t - \log M1_{t-k-1}$	Standard Error	Coefficient $\log M2_t - \log M2_{t-k-1}$	Standard Error
1	-0.002297	0.048974	0.018716	0.05244
2	-0.021093	0.070308	0.019315	0.06955
3	-0.024508	0.078497	0.043484	0.07639
4	-0.01749	0.07845	0.06822	0.07953
5	0.001598	0.0833	0.103413	0.08629
6	0.0379	0.093041	0.153535	0.08904
7	0.083463	0.104528	0.215094	0.09759
8	0.119588	0.119742	0.291455	0.10091
9	0.141571	0.125786	0.359468	0.09026
10	0.152422	0.137837	0.35844	0.1047
11	0.139005	0.155015	0.346313	0.12858
12	0.101789	0.157901	0.327859	0.14695
13	0.078648	0.150699	0.335953	0.15373
14	0.065308	0.147973	0.368414	0.15541
15	0.062872	0.149968	0.391573	0.14209
16	0.048884	0.153658	0.374879	0.13866
17	0.062908	0.140063	0.357901	0.14397
18	0.056209	0.120413	0.340073	0.16137
19	0.020264	0.099119	0.279856	0.16951
20	-0.047757	0.087926	0.175481	0.14236
21	-0.131262	0.082124	0.04911	0.09749
22	-0.150995	0.074022	-0.03252	0.08275
23	-0.157232	0.061023	-0.07494	0.08091
24	-0.135922	0.052097	-0.08983	0.07487