Long Run Neutrality of Money in Mexico

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Fecha de recepción: 8 de septiembre de 2005; fecha de aceptación: 8 de diciembre de 2006.

Abstract: The Fisher-Seater (FS) methodology is used to investigate long run money neutrality with respect to real GDP and real output in ten selected industries in Mexico. Size distortions and low power of the FS test, issues first raised by Coe and Nason (2003, 2004), are addressed using the Coe-Nason bootstrapping procedure. The evidence indicates that long run money neutrality can be rejected for real GDP and for up to five of the ten industrial sectors studied. These findings indicate that the effects of monetary policy are likely to differ across sectors even in the long run.
Keywords: money neutrality, Fisher-Seater Test, bootstrapping.

Resumen: En este artículo se emplea la metodología de Fisher y Seater para investigar la neutralidad monetaria a largo plazo en el PIB real de diez industrias mexicanas. Las distorsiones por tamaño y el bajo poder de la prueba de Fisher y Seater, problemas planteados inicialmente por Coe y Nason (2003, 2004), se manejan mediante el procedimiento “bootstrap” de Coe-Nason. La evidencia indica que se puede rechazar la neutralidad monetaria a largo plazo en el PIB real y en hasta cinco de las diez industrias. Además, los resultados indican que los efectos de la política monetaria son probablemente diferentes entre los sectores, aun a largo plazo.
Palabras clave: neutralidad monetaria, Prueba de Fisher-Seater, “bootstrapping”.

JEL *Classification:* E31, E52

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Introduction

Intuitively, it would seem that permanently changing the quantity of money in an economy should have no long run effect on real variables; absolute prices should change, but nothing more.[1] In such an economy money is long run neutral (LRN). Macroeconomic models with optimizing agents are usually characterized by LRN, although many do allow for short run non-neutrality from a wide variety of sources. Exactly how money affects output and other real variables in the short run is an unresolved issue, but the absence of long run neutrality in a modern macro model would be surprising.[2] Despite its theoretical appeal in mainstream economics, the empirical evidence regarding long run neutrality (LRN) of money is not conclusive. Fisher and Seater (1993, henceforth FS) show that long-run propositions like monetary neutrality, superneutrality, or purchasing power parity may, under certain circumstances, be tested using ordinary least squares regressions (OLS).[3] We use the FS methodology with bootstrapped errors to examine long run neutrality of money with respect to real GDP and real output in ten industrial sectors of the Mexican economy.

Coe and Nason (2004, henceforth CN) have applied the OLS test of Fisher and Seater to data for Australia, Canada, the United Kingdom, and the United States. Using money and real output data for these four countries, they find that large size distortions characterize the FS test and that the power of the test is low. Indeed, in most of their OLS regressions, power declines as the horizon lengthens and is approximately equal to test size at the longest horizons (see Table 3 in CN). Shelley (2006) shows that despite errors in programming the bootstrap procedure, the CN conclusions regarding the size and power of OLS estimates remain valid. These problems with the FS test cast doubt on the long run neutrality results reported in such published papers as Fisher and Seater (1993), Boschen and Otrok (1994), Olekalns (1996), Haug and Lucas (1997), Wallace (1999), and Noriega (2004). Rejections of LRN in these papers may be due to size distortions. In contrast, our tests results are

[1] The menu costs of a price change in response to a one time, permanent change in money are surely negligible over the long run.

[2] We return to this issue in the conclusions.

[3] King and Watson (1997) present an alternative approach using vector autoregressions to test for LRN.

based on bootstrapped confidence intervals. Our hypothesis tests are of correct size; therefore rejections of LRN are strong evidence against this hypothesis.

There are two major objectives in this study. First, we wish to determine whether money is long run neutral with respect to real GDP and real output in ten different industries in Mexico. Second, we ask whether the long run effect of money on real output differs across sectors. For example, is money LRN with respect to some industries and not LRN for others? Or, are the effects of changes in money relatively consistent regardless of the industry? Briefly previewing the findings, for five industries and real GDP there is evidence that money is not long run neutral at the 90% confidence level or better in Mexico. Our rejections of LRN are strong evidence against this theory, as they are based on empirical confidence bands with correct size. Furthermore, the effects of a permanent change in money differ across the sectors we study.

This study makes three contributions to the long run monetary neutrality literature. First, this is the only application of the FS test to money neutrality (other than those of Coe and Nason) that addresses the size distortion problem. Second, only a few studies have examined long run neutrality in developing countries, which are often characterized by highly constrained financial markets. Wallace (1999) and Noriega (2004) apply the FS test to data for Mexico, Bai and Ratti (2000) use the FS test to study superneutrality in Argentina and Brazil, and Wallace, Shelley, and Cabrera (2004) examine superneutrality in Nicaragua. During the period under study, federal government intervention in Mexican financial markets included the imposition of capital controls, controls on interest rates, fixed exchange rates, and the nationalization of almost all banks. Thus, we ask whether money is long run neutral with respect to output in each of a wide variety of Mexican industrial sectors, regardless of financial constraints.

Third, in our view it is important to verify results from testing macroeconomic hypotheses or propositions using aggregate data, with tests at more disaggregated levels. Garrett (2003) demonstrates that regression results with aggregate data can differ from those using the disaggregated components. Conceivably, one could reject LRN at the aggregate level, as we find in Mexico for 1932-2001, yet miss significant industry-specific effects. Application of the test to disaggregated data could help to identify the sources of non-neutrality and suggest how monetary policy might be transmitted to the real economy.

The following section contains a brief overview of the FS test and a discussion of the bootstrapping procedure. A description of the data series and an examination of their time series properties are provided in section two. The third section presents our interpretations of the FS test results for long run money neutrality in the ten industrial sectors and the aggregate economy. Conclusions are provided in the final section.

I. The Fisher-Seater Methodology and the Bootstrapping Experiment

We begin with a very concise description of the FS test derivation. The stationary and invertible, two variable, log-linear ARIMA model given by equations (1) and (2) is the starting point.

$$a(L)\Delta^{\langle m\rangle}m_t = b(L)\Delta^{\langle y\rangle}y_t + u_t \tag{1}$$

$$d(L)\Delta^{\langle y\rangle}y_t = c(L)\Delta^{\langle m\rangle}m_t + w_t \tag{2}$$

The terms m_t and y_t are log money and log real output respectively, while u_t and w_t are mean zero, i.i.d. error vectors. L is the lag operator and $a_0 = d_0 = 1$, so that $a(L) = 1-a_1-a_2-\ldots$, $b(L) = b_1+b_2+\ldots$, $c(L) = c_1+c_2+\ldots$, and $d(L) = 1-d_1-d_2-\ldots$. The order of integration of variable $q = m, y$ is given by $\langle q\rangle$.[4] The long run response of output to a permanent change in money is given by the long run derivative (LRD_{ym}), displayed in equation (3)

$$LRD_{y,m} = \lim_{k\to\infty} \frac{\partial y_{t+k}/\partial u_t}{\partial m_{t+k}/\partial u_t} \tag{3}$$

if $\lim_{k\to\infty} = \frac{\partial m_{t+k}}{\partial u_t} \neq 0$. If the limit of the denominator in equation (3) is zero, then there are no permanent changes in the monetary variable, hence $\langle m\rangle = 0$ and LRN cannot be tested. Provided that permanent changes in money have occurred, $\langle m\rangle \geq 1$ and equation (3) can be written

$$LRD_{y,m} = \frac{(1-L)^{\langle m\rangle-\langle y\rangle}\gamma(L)\big|_{L=1}}{\alpha(L)} \tag{3´}$$

[4] The money and output symbols, m and y respectively, replace the notation used by FS. Otherwise we follow their notation.

The expressions $\alpha(L)$ and $\gamma(L)$ are functions of the coefficients from equations (1) and (2).[5] Thus the value of $LRD_{y,m}$ depends on the difference in orders of integration of (log) money and (log) real output, *i.e.* $\langle m \rangle - \langle y \rangle$. Since the unit root tests described later in this paper indicate that money, real GDP, and real output in each of the sectors examined are integrated of order one, we consider only the case of $\langle m \rangle - \langle y \rangle = 0$, so that equation (3´) simplifies to

$$LRD_{y,m} = \frac{\gamma(1)}{\alpha(1)} = \frac{c(1)}{d(1)} \tag{4}$$

Under the assumption that money is exogenous in the long run, FS demonstrate that the long run derivative of real output with respect to money can be consistently estimated as b_k from the regression shown in equation (5).

$$y_t - y_{t-k-1} = a_k + b_k(m_t - m_{t-k-1}) + e_{kt} \tag{5}$$

Prior to the Coe and Nason critique, the standard approach has been to estimate equation (5) for a predetermined number of k using ordinary least squares with the Newey-West correction for autocorrelation.[6] However, Coe and Nason have shown that tests based on this procedure may suffer from a size distortion problem. Asymptotic confidence intervals, based on the Newey-West corrected standard errors, may be too narrow, incorrectly rejecting a valid null hypothesis of LRN more often than the nominal size of the test would predict. If size distortions are present, inference using asymptotic confidence intervals is invalid.

We use a series of bootstrapping experiments as described in Coe and Nason (2004) to investigate the empirical size of our FS tests. The experiments also provide information regarding the size-adjusted power of these tests.[7] These experiments are conducted using Shelley's correction of the Coe and Nason procedure. To determine the empirical size of the tests, 10,000 bootstrapped data sets are generated for each combination of real output (GDP and each industrial series) and money using a struc-

[5] $\alpha(L)=d(L)/[a(L)c(L)-b(L)c(L)]$ and $\gamma(L)=c(L)/[a(L)c(L)-b(L)c(L)]$.

[6] Different orders of integration of money and/or output can lead to different specifications and tests. For example $\langle m \rangle =2$ and $\langle y \rangle = 1$ allows testing for long run superneutrality of money.

[7] Size-adjusted power refers to the ability of the test to reject a false null hypothesis of LRN using the bootstrapped, or size-adjusted, confidence intervals. Tables showing the test power results are available from the authors.

tural vector auto-regression (SVAR) of money growth (Δm_t) and output growth (Δy_t). The unrestricted, first-order SVAR is of the form:

$$\begin{bmatrix} u_{m,t} \\ u_{y,t} \end{bmatrix} = \begin{bmatrix} 1 & \beta_1 \\ \beta_2 & 1 \end{bmatrix} \begin{bmatrix} \Delta m_t \\ \Delta y_t \end{bmatrix} - \begin{bmatrix} \beta_3 \\ \beta_4 \end{bmatrix} - \begin{bmatrix} \beta_5 & \beta_6 \\ \beta_7 & \beta_8 \end{bmatrix} \begin{bmatrix} \Delta m_{t-1} \\ \Delta y_{t-1} \end{bmatrix} \tag{6}$$

The β_j are coefficients, $u_{m,t}$ is the money innovation, and $u_{y,t}$ is the innovation to real output.

The system is identified by assuming that the innovations to money growth and real output growth are generated independently of each other; thus the variance/covariance matrix of the money and output innovations is diagonal. Furthermore, money growth is assumed to be long-run exogenous with respect to real output. The assumption of long-run exogenous money (LREM) yields the following coefficient restriction on the system:

$$\beta_6 = \beta_1 \tag{7}$$

Long-run money neutrality imposes an additional restriction:

$$\beta_7 = \beta_2 \tag{8}$$

Initially, the system is estimated with all three restrictions imposed, and the residuals are saved in a T x 2 matrix, $\hat{U}$:

$$\hat{U} = \begin{bmatrix} \hat{u}_{m,T} & \hat{u}_{y,T} \\ \hat{u}_{m,T-1} & \hat{u}_{y,T-1} \\ \cdot & \cdot \\ \cdot & \cdot \\ \hat{u}_{m,1} & \hat{u}_{y,1} \end{bmatrix}. \tag{9}$$

The estimated SVAR coefficients are then combined with random draws from the residual matrix $\hat{U}$, to construct bootstrapped money growth and output growth series of length 3T, where T is the number of observations of money growth and output. T varies from 64 to 70, depending on the output series. To be consistent with the assumption of a diagonal variance/covariance matrix, the money growth and output growth residuals are drawn independently of each other. The bootstrapped money growth and real output growth series are given by:

$$\Delta m^{b}_{t_t} = \hat{\beta}_3 - \hat{\beta}_1 \Delta y^{b}_{t} + \hat{\beta}_5 \Delta m^{b}_{t-1} + \hat{\beta}_6 \Delta y^{b}_{t-1} + u^{b}_{m,t} \tag{10}$$

$$\Delta y^{b}_{t_t} = \hat{\beta}_4 - \hat{\beta}_2 \Delta m^{b}_{t} + \hat{\beta}_7 \Delta m^{b}_{t-1} + \hat{\beta}_8 \Delta y^{b}_{t-1} + u^{b}_{y,t} \tag{11}$$

Δm^b_t and Δy^b_t are bootstrapped money growth and bootstrapped output growth respectively, the $\hat{\beta}_j$ are the estimated coefficients of the SVAR, and $u^b_{m,t}$ and $u^b_{y,t}$ are the bootstrapped drawings of money growth and output growth innovations. These bootstrapped money growth and output growth series are then used to construct the bootstrapped log money and log output series. The first 2T observations are dropped to minimize the influence of starting values.

10,000 bootstrapped data sets are constructed for each combination of money and real output. Note that these data sets are created using estimates of the SVAR with restriction (8) imposed; therefore, LRN holds for these data series. We next run the FS test for each of the 10,000 bootstrapped data sets. The empirical size of the test is the percentage of times the valid null hypothesis of LRN is rejected. A size distortion problem occurs if LRN is rejected a greater percentage of times than the nominal size of the tests (5% or 10%).

The empirical confidence intervals are constructed as follows. For a given combination of money and real output, the absolute values of the t-statistics are saved and ordered by size, for each given b_k from all of the 10,000 FS regressions on the bootstrapped data, constructed with the neutrality restriction imposed. The empirical 95% critical t-statistic, denoted as t^e_{95}, is the t-statistic that is larger than 95% of the absolute values of the 10,000 saved t-statistics for that b_k. The 95% empirical confidence limits, denoted CL_U and CL_L, then are calculated as $b_k \pm t^e_{95}(s_{bk})$, where s_{bk} is the standard error of the estimated b_k. In some instances the 90% empirical confidence limits are shown instead. These are constructed using this same method, but replacing t^e_{95} with an empirical 90% critical value t^e_{90}.

II. Data

The choice of industries for the study is driven by data availability. Annual observations on real output levels for selected Mexican industries are available from 1932 through the mid 1990s. More recent information is unavailable. Real GDP for 1932-2001 and industrial production data are from the Instituto Nacional de Estadística, Geografía, e Informática (INEGI)(1994, 1999). An advantage of the industrial output data is that measurement is in physical units, allowing us to avoid index number problems which might arise from the conversion of nominal to real values in the usual manner. Money data are from INEGI and the Banco de México. All data are logged.

The orders of integration of the money and output series determine the appropriate form of the FS test. Unfortunately, it is well known that unit-root tests have low power and that findings can vary with the type of test used and the number of lags included in the test equation. With this in mind, the results of several procedures are examined in order to draw conclusions regarding variable integration.

We first apply the familiar Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests. For the ADF tests, four different methods are used to select the appropriate lag length for the test equation: Lagrange multiplier (LM), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and a general to simple (GS) approach. For the LM specification, lags are added to the ADF equation until an LM test indicates that serial correlation is eliminated at the 10% significance level. In the GS method, we begin with 6 lags and then iteratively drop each final lag if it is insignificant at the 10% level. A series of Phillips-Perron tests are run with lag lengths of four, two, one, and zero years.[8]

In addition, we employ a test proposed by Elliott, Rothenberg and Stock (1996) that is more powerful than the ADF and PP tests when the alternative is trend-stationarity. This test is similar to the usual augmented Dickey-Fuller test, except that the logged series are detrended or "quasi-differenced" in a way that is efficient under the alternative hypothesis. Because of its equivalence to generalized least squares, this method is referred to as DFGLS.

We also use the two tests proposed by Kwiatkowski *et al.* (1992), which are denoted KPSS (μ) and KPSS (τ). The KPSS (μ) test provides a test of stationarity versus an alternative of trend-stationarity. The KPSS (τ) test offers an alternative to the usual unit-root testing strategy, because the null hypothesis is trend stationarity and the alternative is a random walk with drift. The KPSS tests tend to be sensitive to lag length employed in

[8] For each of the series, the conclusions of the PP test are robust across all considered lag lengths.

the Newey-West serial correlation correction. However, our test statistics stabilized with the use of eight lags.[9]

The KPSS (μ) test rejects stationarity of all variables. Tests for trend stationarity versus an alternative of a random walk with drift are then appropriate for these series. All tests indicate that unit roots are present in M2 money, real GDP, and seven of the ten disaggregated real output series.[10] The seven disaggregated series are iron, steel, cement, petroleum, corn, sugar, and tobacco. For the remaining series, the evidence is mixed; however, in each case there is some evidence in favor of the presence of a unit root. For electricity and coffee, all tests fail to reject a unit root; however, the KPSS (τ) test fails to reject trend stationarity. In one unusual case, beer production, the DFGLS test fails to reject a unit root and the KPSS (τ) test rejects trend stationarity, but the PP and ADF tests reject a unit root.

Next, each series is tested for the presence of a second unit root, *i.e.* a unit root in the growth rate.[11] A second unit root is clearly rejected for real GDP and eight of the ten output series: petroleum, electricity, coffee, corn, sugar, tobacco, cement, and beer. All PP tests and at least one version of the ADF test reject second unit roots in the remaining two series, iron and steel. In most tests a second unit root is rejected for M2. We conclude that the weight of evidence indicates that money, as well as all the real output series, are random walks with drift, or I(1) series.

III. Long run neutrality tests

Test results indicate that the money series, real GDP, and real output in each of the ten industries are integrated of order one, so we can use the FS test as formulated in equation (5). The first task is to investigate whether size distortions characterize the FS tests when applied to the real output data for Mexico. Thus, equation (5) is estimated for k = 1…30, using bootstrapped data samples created for real GDP and each of the in-

[9] In their original paper, KPSS also found test statistics for annual data tended to stabilize with 8-lags. Unit-root tests for all series in levels are conducted with both a constant and a trend included in the test equations.

[10] For these series, the PP tests, all forms of the ADF test, and the DFGLS test all fail to reject a unit root, while the KPSS (τ) test rejects trend stationarity. Full test results are available from the authors on request.

[11] The DFGLS and KPSS (τ) tests are omitted from this round of tests, as they are inappropriate for discriminating between a simple random walk and a stationary series.

dustrial output series. The empirical size of the test exceeds its nominal size (5%) in every case.[12] For example, when the FS regression for k = 30 is estimated with data on beer production, the null of LRN, valid by construction for the bootstrapped data, is rejected more than 29% of the time. Indeed, the valid LRN null is rejected from 15.76% (sugar, k = 5) to 36.52 % (petroleum, k = 20) of the time. Thus, in all instances the size distortions are large.

The appendix contains graphs of the estimated values of b_k, obtained from full sample regressions of each output change on the change in log M2 for real GDP and each of the real industry production series. The graphs also show the empirical confidence intervals, constructed using the critical t-values obtained from the bootstrapped data (with the LRN restriction). The solid, horizontal line in each graph denotes zero. The empirical confidence intervals are adjusted for the size distortion, thus are substantially wider than the asymptotic bands.

When the FS test is applied to the data, we find that LRN is rejected at the 5% level or better with respect to real output, in 2 of 10 industries (steel, sugar). For an additional 3 industries (tobacco, cement, iron) and real GDP, LRN is rejected at the 10% level. Given the wide empirical confidence intervals, we believe that the more generous significance level of 10% is convincing evidence for rejection of the null. Thus, the graphs show the 90% empirical confidence intervals in those instances when LRN is rejected at the 10% significance level, but when conclusions are more tentative, at the 5% level. In those cases where the LRN null is clearly rejected at a nominal size of 5%, the 95% empirical confidence bands are shown. The LRN rejections are displayed in the first 6 graphs in the appendix. As can be seen in the figures, for real GDP and these five series, most of the estimated b_k are negative and significant. Given the wide empirical confidence intervals, these rejections are forceful evidence against LRN, albeit at the less stringent 90% confidence intervals in some cases. Further, the negative coefficients indicate that increases in money lead to reductions in output in these sectors, contrary to standard (short run) results in Keynesian-type models. These findings may indicate that there have been significant, long run negative wealth effects of monetary policy in Mexico.

For the other five industries (beer, coffee, corn, electricity, petroleum), as can be seen in the last five figures in the appendix, LRN cannot be rejected, since zero is contained within the empirical confidence intervals.

[12] Empirical size tables for real GDP and each industry are available from the authors.

Two of these cases, corn and (perhaps) electricity production, illustrate the potential effects of the size distortion problem on statistical inference based on asymptotic standard errors and confidence limits. For these two series, the asymptotic confidence intervals for tests of these series do not contain zero for some large values of k.[13] Thus, one would reject LRN under the standard FS test; however, LRN cannot be rejected using the correctly sized empirical confidence intervals. Finally, although the FS test coefficients are not significant for these five industries, it is interesting to observe that for four of these industries almost all the estimated coefficients are negative.

IV. Summary and Conclusions

Results demonstrate that the standard FS test, as applied to data for Mexico, is characterized by severe size distortions and low power. The use of bootstrapped data to correct for the size distortions, considerably widens the confidence intervals around the estimated coefficients, showing the response of real output growth to money growth. Despite these wide empirical confidence bands, reflecting low size adjusted power, the null hypothesis of long run money neutrality can be rejected for real GDP over the period 1932-2001, and for real output in at most five of the ten disaggregated industries. These differing industry level findings lead us to conclude that the long run response of aggregate real output to permanent changes in money does conceal differential effects at the disaggregate level, as stressed by Garrett.

Economists have long grappled with the relationship between money and output, and many theories have been offered showing *short run* effects of money on real output. However, almost all of the models in which monetary non-neutralities occur in the short run are characterized by long run neutrality of money. Our empirical findings are of interest, as they indicate that money may not be neutral even in the long run. What might cause such long run non-neutralities? In our view, the consideration of wealth effects from monetary changes offers the most promising avenue for explaining the absence of LRN. Indeed, the results indicating that money is LRN for some industries but not for other, are suggestive of the distributional effects one might expect from changes in wealth.

[13] Graphs of the b_k coefficients and the asymptotic confidence intervals are available from the authors.

Two recent models in which money has persistent real effects for distributional reasons are Obstfeld and Rogoff (1995) and Williamson (2005). In the former, an unanticipated, permanent change in money leads to international capital flows and long run wealth effects.[14] In Williamson's limited participation model, an increase in money has real effects because money is introduced in a centralized market, in which not all agents participate each period, and exchange takes place separately in a search market. The effects of the monetary injection are highly persistent in Williamson's paper, although they do disappear in the limit.

The empirical results from the Fisher-Seater tests are not, of course, designed to test particular models of long run neutralities. But, we note that if a change in money affects international capital flows as in Obstfeld and Rogoff, then an expected result might be LRN in those industries in which foreign investment is unimportant. Unfortunately, data on foreign investment are not available by industry over the sample period to test directly this conjecture. However, it is interesting to note that two of the industries (electricity and petroleum) for which money is LRN, are public enterprises in which foreign investment has been either prohibited or severely limited by law over much of the study period.[15]

We conclude by raising three questions which are, in our opinion, worth pursuing in further research. First, why is money not long run neutral with respect to real GDP over the 1932-2001 period? Possible answers include the effects of the Great Depression of the 1930s in Mexico, the high inflation period of the 1980s, nationalization of the banks during the 1980s, the 1994-1995 recession, and distributional effects which do not disappear with aggregation. The low power of the FS tests precludes its application to restricted samples, so the first three explanations can not be assessed with these data, while different tests are needed to assess the distributional channel. Second, why does the long run effect of money appear to be different across industrial sectors? Stated differently, why would the effect of a permanent change in money affect long run real output in some sectors but not in others? Third, for the economy as a whole and those sectors in which money is not LRN, most of the coefficients on the change in money are significantly negative. Why would

[14] The long run effects persist beyond the duration of the nominal rigidities that provoke the capital flows.

[15] However, the size-adjusted power of the test is so low for petroleum output, that rejection of a false LRN hypothesis is unlikely.

a permanent increase in money cause real output to permanently decline? To us, some mechanism through which increases in money have negative impacts on wealth in Mexico seems the most likely answer to these questions.

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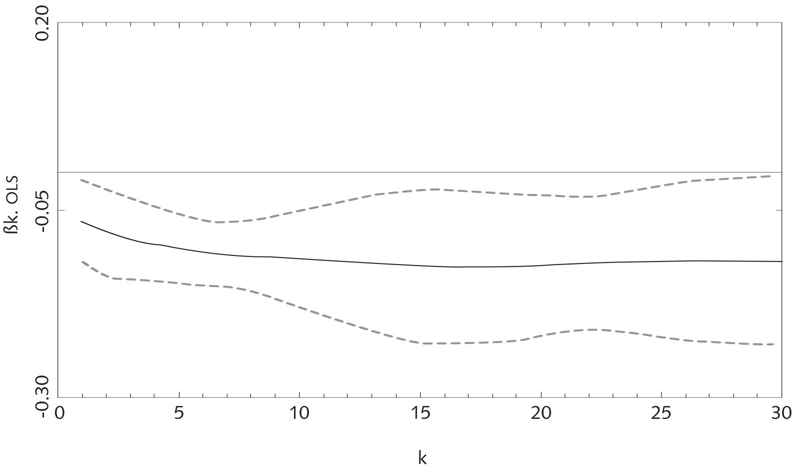
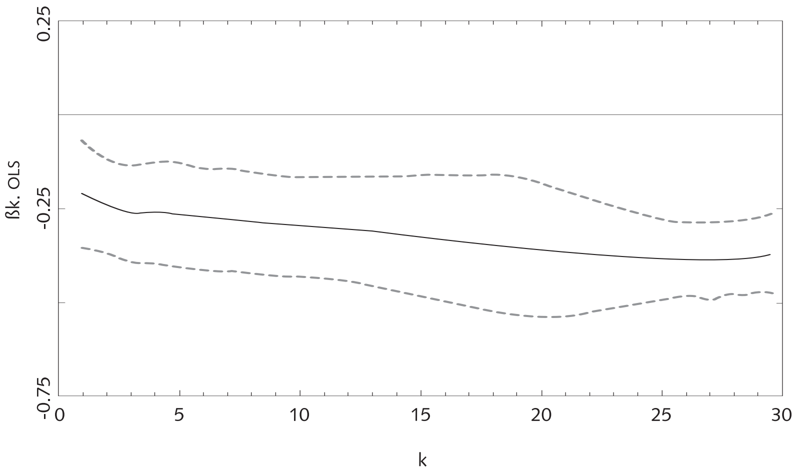
Appendix. FS Test Results. 1. Series That Reject LRN

Mexican real GDP and M2: 1932-2001
Empirical 90% Confidence Bands



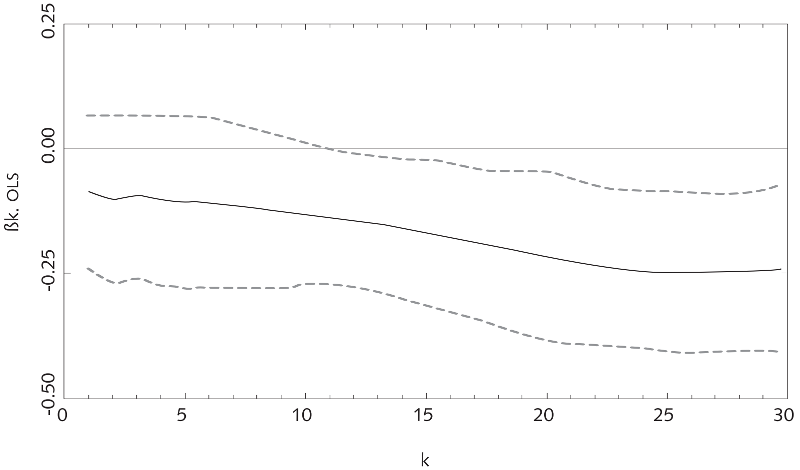
Source: Authors' own calculations.

Mexican steel production and M2: 1932-1995
Empirical 90% Confidence Bands



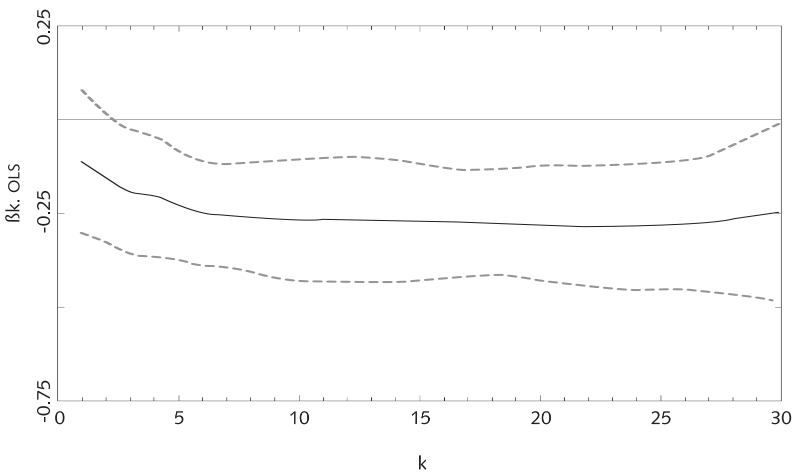
Source: Authors' own calculations.

Mexican sugar production and M2: 1932-1997
Empirical 95% Confidence Bands

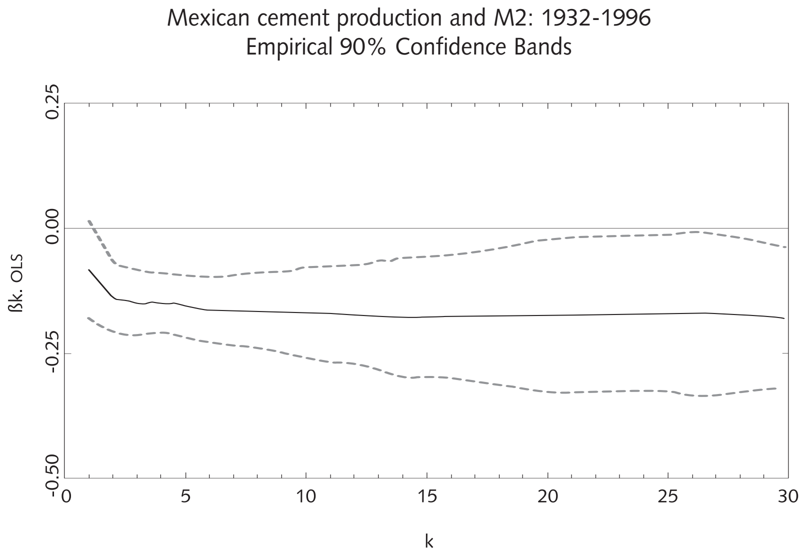


Source: Authors' own calculations.

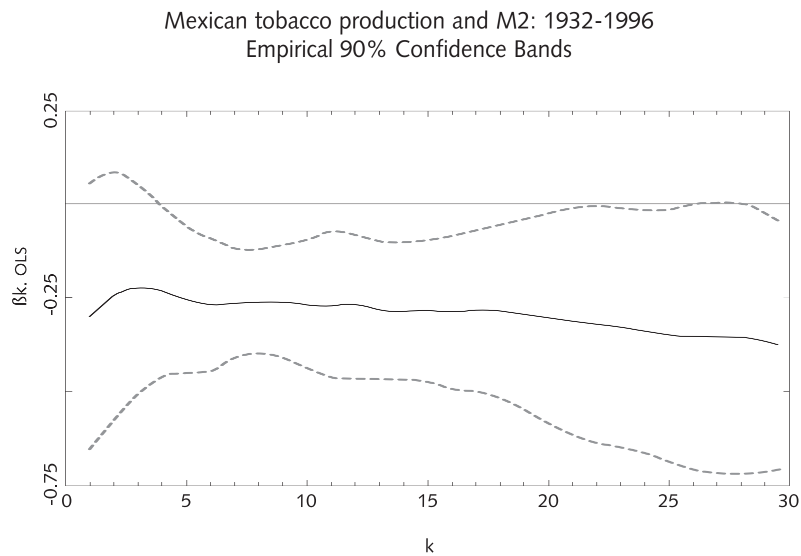
Mexican iron production and M2: 1932-1995
Empirical 90% Confidence Bands



Source: Authors' own calculations.

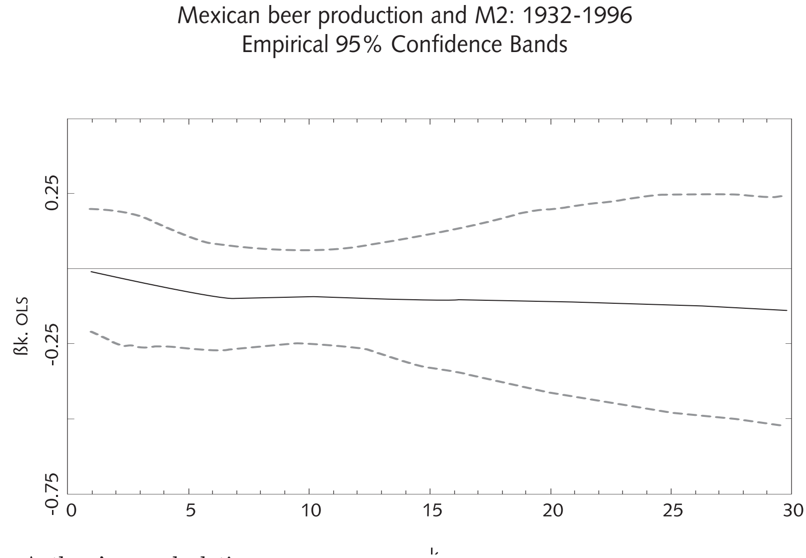


Source: Authors' own calculations.

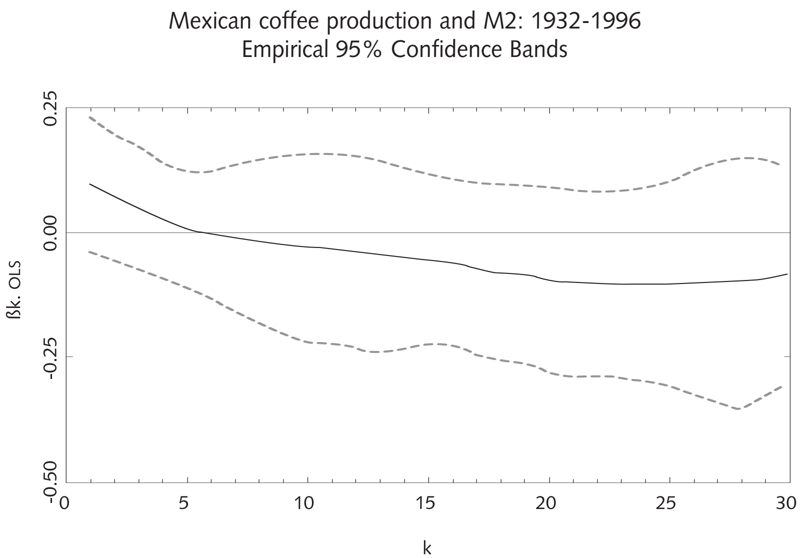


Source: Authors' own calculations.

Appendix. FS Test Results. 2. Series That Fail to Reject LRN

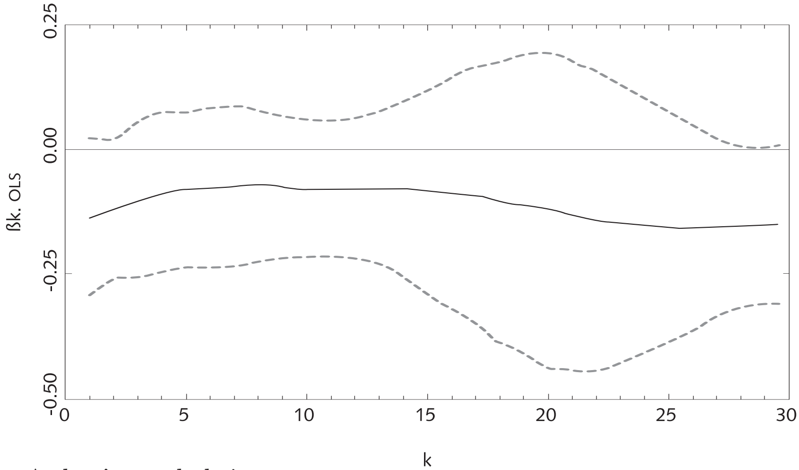


Source: Authors' own calculations.



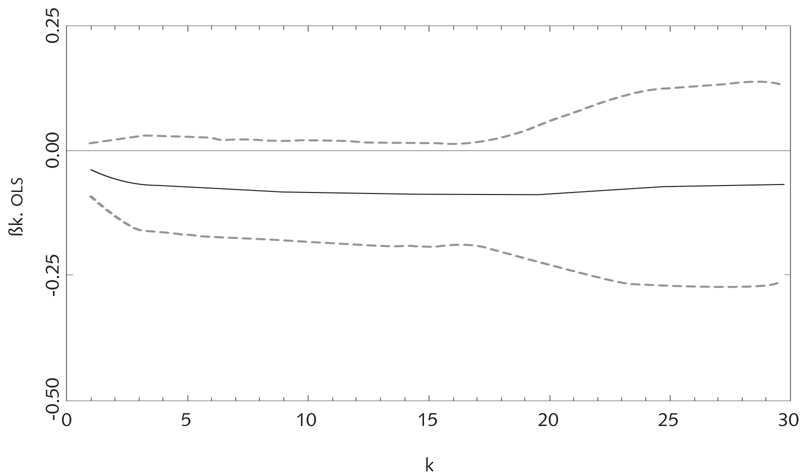
Source: Authors' own calculations.

Mexican corn production and M2: 1932-1996
Empirical 95% Confidence Bands

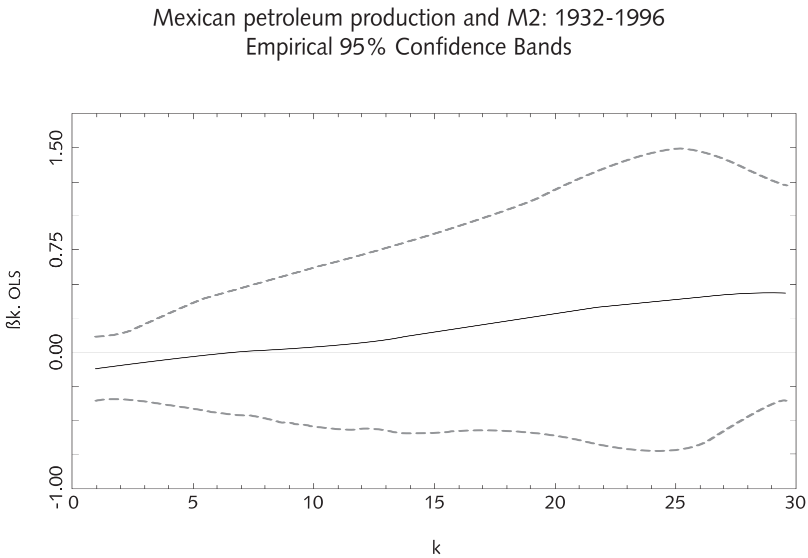


Source: Authors' own calculations.

Mexican electricity production and M2: 1932-1994
Empirical 95% Confidence Bands



Source: Authors' own calculations.



Source: Authors' own calculations.