34

Boston University

Center for Latin American Development Studies

RELATIONSHIPS BETWEEN MACROECONOMIC TIME SERIES IN A FIXED-EXCHANGE-RATE-ECONOMY

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ABSTRACT*

This paper presents an empirical analysis that is useful for the task of characterizing the dynamic structure and causal orderings of the underlying macroeconometric model of a fixed-exchange-rate economy. In the course of the analysis key hypotheses embodied in the current theoretical and empirical literature on macroeconomic models for open economies are econometrically formulated and tested. Such hypotheses are related to issues like: the pattern of transmission of international disturbances into an open economy, the phenomenon of "imported" inflation, the degree of implementation of sterilization policies, and many others. Although the present paper does not focus on a particular Latin American economy, the analysis is certainly relevant for macro-economic modeling of Latin American countries. In fact, it is planned to apply the paper's methodology to the case of several of these countries.

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1. INTRODUCTION

This paper presents an empirical analysis that is useful for the task of characterizing the dynamic structure and causal orderings of the underlying macroeconometric model of a fixed-exchange-rate open economy (Italy 1956-1970).[1] In the course of the analysis key hypotheses embodied in the current theoretical and empirical literature on macroeconomic models for open economies are econometrically formulated and tested. Such hypotheses are related to issues like: the pattern of transmission of international disturbances into an open economy, the phenomenon of "imported" inflation, the existence of a policy-exploitable tradeoff between output and inflation, the degree of implementation of sterilization policies, and many others. The paper provides evidence bearing, directly or indirectly, on these frequently controversial issues.

Since the development of formal macroeconomic models for open economies, most of the theoretical and empirical work has been characterized by a common pattern of assumptions regarding the causal orderings of the underlying economic structure. On the one hand, measures of domestic price, output, and balance of payments are usually treated as endogenous variables. On the other hand, by explicitly or implicitly invoking "autonomous" policy decisions and a version of the "small open economy" hypothesis, domestic monetary and fiscal policy variables, as well as variables representing external impulses (e.g. foreign price and income) are regarded as exogenous, or causal variables (See [2, 4, 13, 19, 21]). Interestingly enough, applied work normally proceeds by holding this pattern of assumed causal orderings as a maintained hypothesis, not explicitly tested; the standard procedure being fitting a proposed model and evaluating its performance on the basis of the statistical fit and forecasting properties. (See [25] for a survey of applied work;and [10] for work on Italy).

This commonly assumed pattern of causal orderings among the relevant macroeconomic variables may have well established theoretical foundations, or may be justified in terms of analytical tractability. Yet in many cases other economically interesting orderings may be considered, on an a-priori basis, as equally plausible. For example, to the extent that domestic monetary and fiscal policies are partly determined in feedback to the path followed by other of the included variables (as e.g. in the case of countercyclical policies determined through a policy reaction function), an element of endogeneity of these policy variables is likely to emerge. Similarly, developments in the domestic economy may affect the path followed by the included foreign economic variables in a non-negligible manner, thus requiring modification of the "small open economy" hypothesis.[2] Moreover, recent work on "classical" macroeconomic models for closed and open economies (see Sargent [24],and also [15]) suggests an econometric formulation of a strict version of the "natural rate" hypothesis [9,23]. This version hypothesizes, at variance with conventional applied work,[3] that domestic output is econometrically exogenous with respect to the other variables included in the macroeconomic model. It seems possible to construct other cases that will lead to the main point emerging from these examples: the considerable difficulty involved in a-priori determining the causal ordering underlying a given macroeconomic system.

As emphasized by Sims [27, 28], paying attention to the empirical validity of an a-priori proposed pattern of causal orderings seems important from at least two points of view. First, the imposition of empirically invalid orderings may lead to estimators that are econometrically biased and inconsistent. Statistical tests of economic hypotheses based on such estimators will be also biased and unreliable. Furthermore, finding empirical support for the proposed causal ordering may, in many cases, lead to the discovery of recursiveness among different blocks of variables and thus reduce the complexity and costs of estimation. Second, by holding the proposed ordering as a maintained hypothesis there exists the possibility that many economically interesting empirical regularities remain undiscovered. If anything, these considerations seem to highlight the importance of attempting to see how emphatically the sample information rejects commonly specified orderings. As the latter impose restrictions on data, they can be subjected to econometric tests. The formulation and execution of these tests, as well as the economic interpretation of the empirical results are the main purposes of this paper.

In the following section, a methodology for investigating the empirical validity of different causal orderings among several macroeconomic variables is presented.[4] The section also includes a discussion of the concepts of causality and exogeneity, that are used in the subsequent parts of the paper. Section 3 presents an economic analysis of the hypotheses to be tested as well as a formal representation of the restrictions implied by these hypotheses on the data. Section 4 reports and interprets the empirical results; and it is followed by a brief summary and concluding remarks presented in section 5.

2. METHODOLOGY

The methodology employed in this paper focuses on estimation of general representations for the different variables as multivariate vector stochastic processes. In particular, I consider the quite general, unrestricted, autoregressive (reduced) form[5]

$$\underset{(m\times 1)}{X_t} = \underset{(m\times m)}{\pi(L)}\,.\underset{(m\times 1)}{X_{t-1}} + \underset{(m\times 1)}{u_t} \quad , \tag{1}$$

where X_t is a vector which includes the current values of m economic variables (or their rates of change in our case); $\pi(L)$ is a matrix which includes (mxm) polynomials in the lag operator that are one-sided on the past; X_{t-1} is analogous to X_t, but includes current values as of period t-1; and u_t is a vector of serially independent random variables, each with zero mean and finite variance. A representation like equation (1) is very general: all variables are treated as potentially endogenous, and as depending on the same set of variables. This representation is useful for studying the dynamic properties of a specified econometric model (e.g., the lag structure of the dependence of domestic inflation on foreign inflation) as well as for generating forecasts and policy projections.[6]

To make the framework operational, the specification of the relevant economic variables entering (1) is required.[7] To obtain guidance on this issue, and also on the form of the restrictions implied by the hypotheses of concern, I consider the main variables embodied in a simple prototype of fixed-exchange-rate models existent in the literature (e.g. [2, 4, 13, 19, 21, 25]). Such prototype considers domestic output, price, and balance of payments[8] as the potentially endogenous variables; domestic fiscal and monetary policy variables, and external price and quantity impulses are usually regarded as the exogenous variables in the model. Concretely, the subsequent analysis will be based on the results of fitting a seven-variable system such that

$$X_t = \begin{bmatrix} Y_t \\ P_t \\ R_t \\ P_t^w \\ Y_t^w \\ G_t \\ D_t \end{bmatrix}; \quad \pi(L) = \begin{bmatrix} a_1(L) & b_1(L) & c_1(L) & d_1(L) & e_1(L) & f_1(L) & g_1(L) \\ a_2(L) & b_2(L) & c_2(L) & d_2(L) & e_2(L) & f_2(L) & g_2(L) \\ a_3(L) & b_3(L) & c_3(L) & d_3(L) & e_3(L) & f_3(L) & g_3(L) \\ a_4(L) & b_4(L) & c_4(L) & d_4(L) & e_4(L) & f_4(L) & g_4(L) \\ a_5(L) & b_5(L) & c_5(L) & d_5(L) & e_5(L) & f_5(L) & g_5(L) \\ a_6(L) & b_6(L) & c_6(L) & d_6(L) & e_6(L) & f_6(L) & g_6(L) \\ a_7(L) & b_7(L) & c_7(L) & d_7(L) & e_7(L) & f_7(L) & g_7(L) \end{bmatrix}$$

and $u_t = (u_{1t}\ u_{2t}\ u_{3t}\ u_{4t}\ u_{5t}\ u_{6t}\ u_{7t})'$, where in general, $z_i(L)$ is an $(n + 1)$th order polynomial in the lag operator, specifically defined as: $z_i(L) = \sum_{j=0}^{n} a_{ij} L^j = z_{i0} + z_{i1} L + z_{i2} L^2 \ldots$; and i, $(i = 1,\ldots,7)$ indicates the equation in which such a polynomial appears; z, $(z = a, b, c, d, e, f, g)$ is an index of the variable multiplied by the polynomial: "a" corresponds to a polynomial multiplying lagged Y's; "b" to a polynomial multiplying lagged P's, and so on. For example, $a_2(L)$ is a polynomial that multiplies lagged Y's in the second equation, so that the first four terms in the latter are $P_t = a_{20} Y_{t-1} + a_{21} Y_{t-2} + a_{22} Y_{t-3} + a_{23} Y_{t-4}$. The variables are expressed in rates of change, calculated as logarithmic first differences, and the notation is as follows: Y is the rate of change of domestic output, P corresponds to the rate of change of domestic price, R to rate of change of domestic holdings of international reserves, P^w and Y^w are rates of change of foreign price and output, and G and D are rates of change of domestic government expenditures and of the domestic component of the money supply (or domestic credit).

After fitting the unconstrained system, and as in Sims [28], the economic hypotheses of concern will be formulated and tested. Proposed causal orderings and economic hypotheses will generally imply restrictions on (1), which can be represented by

$$X_t = \tilde{\pi}(L) . X_{t-1} + u_t \qquad (2)$$

where $\tilde{\pi}(L)$ denotes the matrix of autoregressive coefficients under the restrictions implied by the null hypothesis of interest. Indeed, in the following analysis variants of (2) are viewed as embodying different a priori restrictions; and one of the purposes of the analysis will be to check whether such restrictions are compatible with the sample information, as embodied in (1).

Since the tests and discussion presented in the following sections involve concepts of causality and exogeneity, it seems convenient to specify, at this point, their meaning. According to Granger [11], given two stationary time series x_t and y_t, we say that y_t (a single variable or block of variables) is causing x_t if we are better able to predict x_t using an information set that includes past x's and y's than if an information set including only past x's had been used. To test for the existence of causality from y to x Granger [11] suggests estimating by least squares the linear regression

$$\hat{x}_t = \hat{h}(L).x_{t-1} + \hat{k}(L).y_{t-1}, \tag{3}$$

where $\hat{h}(L)$ and $\hat{k}(L)$ are polynomials in the lag operator that contain the least-squares estimates. The null hypothesis that x is <u>not</u> caused (in the sense of Granger) by y amounts to the restriction that $\hat{k}(L)$ is identically equal to zero, an hypothesis that can be readily tested against the alternative hypothesis of existence of causality from y to x .

In an important contribution, Sims [26] has established the coincidence between Granger-causality and econometric exogeneity. The latter is important because it is a condition usually required in order for various estimators to have econometrically desirable properties. Concretely, Sims has shown that a given variable x is econometrically exogenous with respect to another variable (or block of variables) y (i.e., y_t can be expressed as a one sided distributed lag of x, with disturbance process orthogonal to the x process at all lags) if and only if y does not Granger-cause x. In the context of a simultaneous equation system, exogeneity of a given variable or block of variables implies that the system is recursive. Given the coincidence between exogeneity and Granger-causality, tests of the latter can be viewed as specification tests, whereby the a priori classification of variables into strictly exogenous and endogenous, or a proposed causal ordering, is subject to diagnostic checks.

In addition to viewing causality tests as specification tests, our interest on causality and exogeneity stems from the fact that the subsequent analysis envisions these tests as providing some information about the structure and behavior of the economy. Such information is of economic interest: it sheds light on the degree of compatibility of different hypotheses with the sample at hand. It is this view or aspect of causality tests that ought to be taken with caution: the tests are based on reduced forms; consequently, there exists the possibility (raised e.g. in [24] and [27]) that a given finding from the tests is consistent with many different structures or behavioral assumptions.[9] Although this possibility cannot be ruled out on an a-priori basis, Sims has argued that "...it seems clear that there will be a large class of applications where, if a Granger ordering fits the data, the most plausible structure consistent with the empirical result will be one in which the ordering is behavioral". [27, p. 42]. While it is hoped that the present analysis belongs to such large class of applications, this discussion suggests caution in behaviorally interpreting the tests' results as definitive or unambiguous.

The methodology described in this section is applied below to test the a priori classification of the seven macroeconomic variables considered into strictly endogenous and exogenous, and the empirical validity of different economically interesting hypotheses.

3. SPECIFIC HYPOTHESES TO BE ANALYZED

In the process of checking the compatibility of different causal orderings (to be represented by (2)) with the sample information (as represented by (1)) several hypotheses on the functioning of a fixed-exchange-rate economy will be tested. These hypotheses are formally specified and interpreted in this section.

Consider, first, the output equation of the system. As mentioned before, and as reported in [25], the usual procedure in applied work is to regard domestic output as one of the endogenous, or caused, variables in the system. On the other hand, recent econometric formulations of the "natural rate" hypothesis ([24]; see also [15]) have interpreted a strict version of the hypothesis as imposing the restriction that real (domestic) output is econometrically exogenous with respect to the other included variables; formally, it is hypothesized that the vector $(b_1(L)\ldots g_1(L))$ is identically equal to zero.[10] As this version of the "natural rate" hypothesis considerably differs from the hypotheses embodied in most of the existent empirical work, it would seem interesting to check its compatibility with the sample information. Of special interest, also, would be testing a "weaker" version of the hypothesis, postulating that domestic output is econometrically exogenous with respect to the included domestic monetary and fiscal policy variables; or, formally, the restriction that only $(f_1(L)\ g_1(L))$ is identically equal to zero. Moreover, the results may yield evidence bearing on the transmission of international disturbances through real output in the economy, as reflected in the coefficients entering $(d_1(L),\ e_1(L))$.

Similar analysis can be performed for the other proposed endogenous variables: domestic prices and balance of payments. In particular, is the path followed by domestic prices highly influenced by the path followed by foreign prices (as suggested by versions of the "small open economy" hypothesis [8, 13])?;or are domestic aggregate demand policies the principal causal factors of domestic prices? Are the main causal factors affecting the path of domestic holdings of international reserves of a domestic or of a foreign origin? Is there evidence of causality from domestic credit to domestic holdings of international reserves?; and to the extent that a positive answer is obtained, does this pattern of causality conform with that embodied in monetary models of the balance of payments(e.g. [8, 20, 32]) that postulate (in the absence of successful sterilization policies) balance of payments deficits following increases in domestic credit? By examining the causality relationships as reflected in the $\begin{pmatrix} a_2(L)\ldots g_2(L) \\ a_3(L)\ldots g_3(L) \end{pmatrix}$ coefficients, the analysis will seek empirical answers to these questions.

Finally, the usual procedure of treating domestic monetary and fiscal policy variables and the foreign economic variables as exogenous can be subjected to econometric tests. The maintained hypothesis that these variables are econometrically exogenous imposes zero restrictions such that each variable is specified as a function of only its own lagged values and an error term. In particular, the elements of the block

$$\begin{pmatrix} a_4(L) & b_4(L) & c_4(L) \\ \vdots & \vdots & \vdots \\ a_7(L) & b_7(L) & c_7(L) \end{pmatrix}$$

are assumed to be identically equal to zero, thus determining the classification of the model's variables into strictly endogenous and exogenous. Finding (significant) non-zero elements in this block will indicate the existence of feedback, and the inappropriateness of the specification chosen. Economically, the possibility that some of the elements in this block are non-zero does not seem implausible. For example, in determining government expenditures and domestic credit the domestic authorities may react to the past behavior of some of the proposed endogenous variables. This is probably the case of countercyclical fiscal and monetary policies, and of attempts of sterilization of international reserves' movements through changes in domestic credit. Moreover, embodied in this specification of the (proposed) exogenous variables is a version of the "small open economy" hypothesis, interpreted as postulating that domestic economic variables are not important causal factors determining the time series behavior followed by the included foreign variables. Also, the elements of the block $\begin{pmatrix} d_6(L) & e_6(L) \\ d_7(L) & e_7(L) \end{pmatrix}$ have been assumed as identically equal to zero. A possible interpretation of this restriction is that in determining domestic credit and government expenditures the domestic authorities do not significantly respond to the lagged values of the included foreign variables; a specification which is of relevance for the transmission mechanism of foreign economic shocks into the domestic economy.

This section has presented a formal statement and economic interpretation of the restrictions imposed by different causal orderings on the sample information. An analysis of the empirical validity of these restrictions is presented in the following section.

4. EMPIRICAL RESULTS

In this section I report the results of estimation of systems (1) and (2) in relation to the specification tests of interest. In particular, the analysis focuses on: (i) investigating the existence of some economically interesting regularities in the chosen sample of macroeconomic data, and (ii) checking whether the different considered hypotheses, discussed in the previous section, are compatible with the sample information.

Estimation was performed on the basis of quarterly data, seasonally unadjusted, for the Italian economy for the period 1956 (III) - 1970 (II). (Lagged variables correspond to the period 1955 (II) - 1970 (I)). During all this period fixed exchange rates were maintained, and the Italian economy functioned with relative stability. (On the relevant institutional and economic background for the period see [3, 12, 17]). The empirical counterparts for the different variables are: for Y, an index of industrial production; for P the Italian c.o.l. index; for G, Italian government expenditures; for D and R, the domestic credit and international reserves components of the money supply; and for P^W and Y^W, the U.S. c.o.l. index and index of industrial production. The source for Y, P, Y^W and P^W was O.E.C.D.'s publication Main Economic Indicators, various issues; the source for G, D, and R was International Financial Statistics (published by the I.M.F.), various issues. All the variables were expressed in rates of change, calculated as logarithmic first differences.

Systems (1) and (2) were estimated equation by equation by ordinary least squares, a method that, with serially uncorrelated residuals, yields consistent estimates of the parameters of the autoregressive representations considered. For each equation two sets of Granger-causality tests were performed: bivariate and multivariate. The former are useful in order to determine whether there are any individual variables that are causally prior to the dependent variable; the latter are useful in determining causality (or lack thereof) from a block of variables to the dependent variable. Bivariate tests are based on regressions including four and six lags of the variables; in general the tests' results were highly similar for these two lag-lengths. Multivariate regressions were performed on 4 lags of the included variables. (Specifying longer lags would yield a quite small number of degrees of freedom).

Tables 1-4 report a summary of F-statistics relevant for testing Granger causality. Table 1 corresponds only to bivariate tests, and the other tables only to multivariate tests. Each table is based on the results of estimating equations of the form $y_t = \sum_1^n \hat{\alpha}_i y_{t-i} + \sum_1^n \hat{\beta}_i x_{t-i} +$ (dummies and constant)[11], where y is the proposed caused, or endogenous, variable (indicated in each case at the top of the tables' columns); x is the proposed causal variable or block of variables (indicated at the start of the tables' rows); and, as mentioned before, n was set equal to four in tables 2-4 and to four and six, alternatively, in table 1. The reported F-statistics are pertinent for testing the null hypothesis of lack of causality from x to y, or that $\hat{\beta}_i = 0$ (i: 1,...,n).[12]

With respect to the results for output as a caused variable, the bivariate tests (reported in table 1, first column) indicate that in the four-lags specification none of the F- statistics, pertinent for testing the null hypothesis of output exogeneity, is significant at the usual .05 and .01 levels of significance. A similar result holds for the tests based on the six-lags specification; there is, however, one exception: the F-statistic for D (domestic credit) as causally prior to Y is significant at the 95 percent confidence level, though it is insignificant at the 99 percent confidence level. From the multivariate tests (table 2, first column) one observes a similar pattern of results: the different blocks of variables considered as causal candidates (i.e. the block of domestic policy variables, the block of foreign variables, and all the other six variables included) yield F-statistics that are insignificant. The finding that domestic output is, in most of the cases, econometrically exogenous can be interpreted as providing some support for non-rejection of a strict version of the "natural rate" hypothesis; in particular, with one exception, there appears to be no systematic relationship between domestic monetary and fiscal policy variables and the subsequent path of real output.[13] These results seem to cast doubt in incorporating simple output-inflation tradeoffs (or reverse Phillips curves) in macroeconomic models for the Italian economy (see e.g. [10]). Finally, it is interesting to note that there seems to be no evidence of transmission of external economic impulses (as measured by P^W and Y^W) through real output of the economy.

When domestic price is considered as a potential caused variable, the results from the bivariate tests (table 1, second column) suggest the existence of a pattern of causal ordering whereby domestic price is Granger-caused by the foreign economic variables included: P^W and Y^W. In the four-lag regressions these variables Granger-cause P even at the significance level of .01. With six lags, P^W and Y^W cause P at the .05 level of significance; and only P^W is significant at the .01 level of significance. All the other variables do not cause P at these usual levels of significance. Similar results hold for the multivariate tests (table 2, second column): P^W and Y^W, as a block, significantly cause P; however, domestic monetary and fiscal policy variables are not significantly Granger-causing domestic price. These results conform with those reported by Spitaller [29], who finds (using quarterly data on Italy) that while foreign prices have significant effects on (a reduced form of) Italian prices, a measure of monetary policy does not.[14] An interesting implication of this evidence is that it is likely that Italian economic agents in forming their expectations about the rate of inflation in their open economy, will incorporate information concerning the expected path of the foreign impulses.

Tables 1 and 2 (third column) report the results concerning Italian holdings of international reserves as the dependent variable. The bivariate tests' results indicate that changes in domestic credit (D) Granger-cause changes in Italian holdings of international reserves. Moreover, we find (as reported in the appendix, available upon request) that the coefficients on all of the four (and six) lags of domestic credit in the reserves' equation are negative: increases in domestic credit are associated with posterior outflows of international reserves (or balance of payments' deficits). In addition, there is some evidence for domestic output as causing reserves, but only marginally at the .05 significance level and for the four-lag specification. When different blocks of variables are considered as potential candidates causally prior to R, the results are as follows: domestic policy variables (domestic credit and government expenditures) appear to be significantly causing international reserves; but the foreign variables (P^W and Y^W) as a block appear not to be causing R. The finding that domestic credit is causally prior to Italian international reserves, and that its coefficients in the reserves equation are negative at all lags, can be interpreted as providing support to the relationships postulated by the monetary approach to the balance of payments (see e.g. [8, 19, 20]). The results are also consistent with previous findings for Italy (e.g. [1, 14, 17, 31]; see also [22]) that indicate the existence of considerable difficulties involved in attempting to manage domestic credit so as to control the total money supply in the period of fixed-exchange-rates under study.

The results for testing exogeneity of domestic government expenditures (G) appear in tables 1 (fourth column) and 3 (first column). The tests' results indicate that the hypothesis that domestic government expenditures is exogenous is not rejected by the sample information, at the usual significance levels. A possible interpretation is that in determining government expenditures, the Italian authorities did not systematically react to past changes in the other domestic or foreign variables. In this sense, this finding supports the specification usually adopted in empirical work.

Tables 1 (fifth column) and 3 (second column) report the results for testing exogeneity of domestic credit (D). From the bivariate tests one learns that three variables appear to be significant as causing D: (i) domestic output, which Granger-causes D at the .05 level of significance both in the four and six lags equations; however, in both cases the relevant F-statistic is insignificant at the .01 level of significance;(ii) Y^W (U.S. output) causes D only for the four lags' specification, and only marginally at the .05 significance level; and (iii) government expenditures, which is not significantly causing D for the four lags' specification, but it does enter significantly as causal factor in the six lags' specification. The multivariate tests' results, on the other hand, indicate that none of the blocks of variables considered is significantly Granger-causing D. All in all, these results for domestic credit are mixed. There seems to be some evidence that some of the other variables included in the model help predict D; however such evidence appears to be somehow sensitive to the choice of lags and to the choice of the variable considered as potential causal factor. In any event, we find that the "truly endogenous" variables included in the model, P and R (we have found that Y is exogenous), do not significantly cause D. Finally, of particular interest is the finding that domestic credit did not react in any systematic way to movements in the Italian international reserves; such a finding is consistent with the absence of attempts of sterilization of movements in international reserves through the manipulation of domestic credit by the domestic monetary authorities; and in this sense the results conform with those reported in [1, 17, 31].

The test results based on regressions that included P^W as the dependent variable are reported in tables 1 (sixth column) and 4 (first column). From the bivariate tests it is apparent that the only variable that appears to be significantly causing P^W is domestic (Italian) government expenditures; the latter enters significantly as causal factor at the .05 significance level,[15] but not at the .01 level. All the other variables do not appear to be Granger-causing P^W. In the multivariate tests, none of the reported F-statistics is significant at the usual significance level. As a whole, and with only one exception, these results indicate some support for the "small economy" hypothesis and for the specification of P^W as exogenous.

Finally, the test results reported in tables 1 and 4 (last column) indicate that the null hypothesis of exogeneity of the foreign output (U.S. output) variable is not rejected by the sample information. This result holds for both the bivariate and the multivariate tests. Only in one case there is (weak) evidence of causality: P^W appears to be causing Y^W marginally at the .05 significance level, and only for the specification that includes four lags. Again, the finding that Italian economic variables do not Granger-cause foreign (U.S.) output, while the latter does appear to be significantly causing some of the Italian variables, can be interpreted as some support for the "small open economy" hypothesis.

5. CONCLUSIONS

This study has emphasized the importance of empirically testing the causal ordering assumptions embodied in conventional macroeconometric models of fixed-exchange-rate open economies. The paper proposed and applied a methodology designed for testing such assumptions. Particular emphasis was given to the restrictions implied on data by several often-invoked causal orderings and by different macroeconomic hypotheses. The empirical application consisted of an examination of the relationships between macroeconomic time-series using quarterly data for Italy (1956-70). The main findings concerning the economy's dynamic structure found in the econometric analysis of the sample information are:

1. Italian output appears to be econometrically exogenous with respect to the other domestic and foreign variables included in the model. In particular, with only one exception, the considered measures of domestic fiscal and monetary policies appear to have no systematic effects on the path followed by domestic output.

2. Foreign economic variables, measured by an index of U.S. price and output, significantly Granger-cause the Italian price; however, the latter appears to be exogenous with respect to domestic policy variables, like government expenditures and the domestic component of the money supply.

3. Domestic fiscal and monetary variables primarily Granger-cause movements in Italian holdings of international reserves. In particular, we found no indication of sterilization policies by the domestic authorities, and that lagged increases in domestic credit Granger-cause outflows of international reserves (or balance-of-payments deficits).

4. The evidence does not reject the null hypothesis that domestic credit, government expenditures, and U.S. price and output are econometrically exogenous with respect to Italian price, output and international reserves. Some evidence was found in favor of the hypothesis of existence of feedback within the block of these proposed exogenous variables (especially from domestic government expenditures to domestic credit and U.S. prices).

An important implication of these findings is that they place restrictions on the class of macroeconomic models that can be compatible with the sample information. For example, models characterized by systematic effects of domestic credit and government expenditures on domestic output (or stable Phillips curves), and (or) neglect of foreign prices and output as important determinants of the evolution of domestic prices, and (or) postulates of successful sterilization of international reserve movements by the monetary authorities, will be found in significant conflict with the data.

More positively, the results indicate some support for a strict version of the "natural rate" hypothesis, embodying the econometric restriction of output exogeneity. Moreover, the results seem to suggest a substantial degree of openness of the Italian economy: on the one hand disturbances to foreign price and output are transmitted to the economy primarily through domestic prices; on the other hand, neither the latter nor domestic output are significantly caused by the domestic policy variables considered, which appear to have their major effects on the Italian balance of payments. In other words, the findings for Italy (1956-70) indicate that while the economy's internal balance, or evolution of domestic output and prices, is not significantly influenced by the simple domestic monetary and fiscal variables considered, the latter appear as the main determinants of the economy's external balance.[16]

All in all, these empirical results suggest that the causal structure imposed on the data by macroeconomic models embodying a strict version of the "natural rate" hypothesis, the "small open economy" hypothesis, and the "nonsterilization" hypothesis, are not significantly in conflict with the sample information.

TABLE 1: F-STATISTICS FOR TESTING BIVARIATE CAUSAL ORDERINGS - [ITALY: 1956 (III) - 1970 (II)]

Caused Variable / Causal Variable	Y		P		R		G		D		P^W		Y^W	
	4 Lags	6 Lags	4 Lags	6 Lags	4 Lags	6 Lags	4 Lags	6 Lags	4 Lags	6 Lags	4 Lags	6 Lags	4 Lags	6 Lags
Y	X		1.34	1.32	2.61	1.71	1.17	.76	3.00	2.77	.99	.89	1.55	1.82
P	1.11	1.05	X		.41	.55	.78	.79	.24	1.40	2.35	1.84	.83	.75
R	2.32	1.63	1.47	1.06	X		.39	.62	1.45	1.22	.15	.23	.23	.67
G	.88	.93	1.15	1.13	1.35	1.53	X		2.26	3.58	3.14	2.53	1.16	1.00
D	2.30	2.82	2.37	1.42	3.74	2.57	1.10	1.20	X		.26	.56	.61	.36
P^W	.77	.72	4.28	3.12	1.20	.81	.84	1.26	.77	1.16	X		2.64	1.72
Y^W	1.08	1.34	5.89	3.03	1.26	1.06	.79	.55	2.67	2.27	1.89	1.71	X	

Notes: (i) For variables' definitions and explanations see the text.

(ii) F-critical values: $F(4,44) = 2.6$ (.05), and $= 3.8$ (.01).

$F(6,40) = 2.3$ (.05), and $= 3.3$ (.01).

TABLE 2: F-STATISTICS FOR TESTING MULTIVARIATE CAUSAL ORDERINGS FOR Y, P, AND R

[ITALY: 1956 (III) - 1970 (II)]

Causal block of Variables \ Caused Variable	Y	P	R
(1) G, D	1.39	1.49	2.86
(2) P^W, Y^W	.75	4.69	1.11
(3) All the other six variables	1.83	2.05	2.67

Notes: (i) See text for explanations and definitions.

(ii) F-critical values: for rows (1) and (2),

$F(8, 40) = 2.23$ (.05) and = 2.9 (.01).

For row (3), $F(24, 24) = 1.9$ (.05) and 2.7 (.01).

TABLE 3: F-STATISTICS FOR TESTING MULTIVARIATE CAUSAL ORDERINGS FOR G AND D.

[ITALY: 1956 (III) - 1970 (II)]

Causal Block of Variables \ Caused Variable	G	D
(1) P^W, Y^W	.95	1.50
(2) P, Y, R	.80	1.33
(3) D, Y^W, P^W	1.07	1.33
(4) All the other six variables	1.38	1.60

TABLE 4: F-STATISTICS FOR TESTING MULTIVARIATE CAUSAL ORDERINGS FOR P^W AND Y^W

[ITALY: 1956 (III) - 1970 (II)]

Causal Block of Variables \ Caused Variable	P^W	Y^W
(1) P, Y, R	1.11	1.12
(2) Y^W, G, D	1.83	1.03
(3) All the other six variables	1.85	1.68

Notes: (i) For definitions and explanations, see text.

(ii) F-critical values: For row (1) of Table 3: F(8,40) = 2.2 (.05) and 2.9 (.01). For last rows, F(24, 24) = 1.9 (.05) and 2.7(.01). For all other rows, F(12, 36) = 2.1 (.05) and 2.7(.01).

FOOTNOTES

1 The word causality is used in the sense of Granger [11], to be explained in the following discussion. On the different meanings of causality see some of the studies in [6], especially Sims [27].

2 For models that explicitly relax the "small economy" assumption, see e.g. [5, 18].

3 On the dominant role of aggregate demand expenditures in determining real output in current models, see [25].

4 Such methodology is primarily based on ideas of Granger [11] and Sims [27, 28].

5 Wold has proven that for any covariance-stationary stochastic process X_t there exists a linear decomposition such that the following moving average representation exists:

$$X_t = u_t + \Psi_1 u_{t-1} + \Psi_2 u_{t-2} + \ldots = \Psi(L)u_{t-1} + u_t.$$

Under very general conditions, the same variable can be expressed as an autoregressive process:

$$X_t = \pi_1 X_{t-1} + \pi_2 X_{t-2} + \ldots + u_t = \pi(L)X_{t-1} + u_t$$

and this is the form used throughout this paper. A "mixed" representation is in terms of Box-Jenkins class of models, whereby

$$\theta_p(L)X_t = \theta_q(L)u_t$$

an expression that contains p autoregressive terms and q moving-average terms.

6 In order for these forecasts and policy projections to be meaningful they should take into account that the coefficients in representation (1) will <u>not</u> be, in general, invariant with respect to the policy changes. See Lucas [16].

7 That is, we are imposing inclusion and exclusion restrictions; however the included variables are treated in a symmetric way, without imposing a-priori constraints on their relationships.

8 Here we refer to the "money account" of the balance of payments. An interesting extension may be to analyze also the causal orderings for the different accounts of the balance of payments.

9 For a detailed discussion on the properties and limitations of causality tests, see [6].

10 That this is a "stricter" version than what is required in order to obtain "classical" policy implications has been argued by Sargent [24].

11 Each regression included three seasonal dummies. Examination of the autocorrelation function of the residuals suggested, in the majority of the cases, the absence of significant spikes at seasonal lags, thus supporting the dummies' (deterministic) specification. (See e.g. [30]).

12 For brevity, the complete regression results are not presented in the text; they are included in an appendix available from the author upon request.

13 It seems worthwhile to emphasize that output exogeneity does not imply that output is irresponsive <u>in general</u> to economic variables; it may well be that <u>unanticipated</u> changes in policies (or say in prices) have significant output effects. For evidence on Italy, in this respect, see Leiderman [15], where it is found that unanticipated changes in domestic and foreign prices significantly affect Italian output. For evidence on the U.S., see e.g. Sargent [24].

14 Interestingly, these results are somewhat at variance with those reported by Fratianni [7], that finds (using <u>annual</u> data) that in addition to foreign prices a monetary policy variable significantly enters in the domestic price reduced form.

15 This result is somewhat surprising. It is possible that G is correlated with a third variable which is an economically more fundamental causal factor of P^W.

16 On the distinction between policies for internal and external balance see [18].

REFERENCES

1. Blejer, Mario I. "On Causality and the Monetary Approach to the Balance of Payments: The European Experience". European Economic Review (forthcoming, 1979).

2. Branson, William H. "Monetarist and Keynesian Models of the Transmission of Inflation". American Economic Review 65 (May 1975): 115-9.

3. Brunner, Karl, et al. "Fiscal and Monetary Policies in Moderate Inflation." Journal of Money, Credit, and Banking 5 (February 1973): 313-54.

4. Brunner, Karl, and Meltzer, Allan H., eds. The Problem of Inflation. Amsterdam: North-Holland, 1978.

5. Dornbusch, Rudiger, and Krugman, Paul. "Flexible Exchange Rates in the Short Run". Brookings Papers on Economic Activity, 1976, 537-84.

6. Federal Reserve Bank of Minneapolis. New Methods in Business Cycle Research: Proceedings of a Conference. October 1977.

7. Fratianni, Michele. "Inflation and Unanticipated Changes in Output in Italy". In Brunner and Meltzer [4], 141-80.

8. Frenkel, Jacob A., and Johnson, Harry G., eds. The Monetary Approach to the Balance of Payments. London: Allen and Unwin, Ltd., 1976.

9. Friedman, Milton. "The Role of Monetary Policy." American Economic Review 58 (March 1968): 1-17.

10. Gnes, P. and Rey, G.M. "A Short Term Planning Model of the Italian Economy." In Banca D'Italia, Econometric Research in European Central Banks, 1975, 207-282.

11. Granger, C.W.J. "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods." Econometrica 37 (July 1969): 424-38.

12. Hodgman, Donald. National Monetary Policies and International Monetary Cooperation. Boston: Little-Brown, 1974.

13. Kingston, Geoffrey M. and Turnovsky, Stephen J. "A Small Economy in an Inflationary World: Monetary and Fiscal Policies Under Fixed Exchange Rates." Economic Journal 88 (March 1978): 18-43.

14. Kouri, Pentti J., and Porter, Michael G. "International Capital Flows and Portfolio Equilibrium." Journal of Political Economy 82 (May/June 1974): 326-34.

15. Leiderman, Leonardo. "Expectations, Output-Inflation Tradeoffs, and the Balance of Payments in a Fixed-Exchange-Rate Economy." Ph.D. dissertation, University of Chicago, May 1978.

16. Lucas, Robert E., Jr. "Econometric Policy Evaluations: A Critique." In The Phillips Curve and Labor Markets. Edited by K. Brunner and A.M. Meltzer. Amsterdam: North-Holland, 1976.

17. Michaely, Michael. The Responsiveness of Demand Policies to the Balance of Payments: Postwar Patterns. New York: National Bureau of Economic Research, 1971.

18. Mundell, Robert A. "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability." IMF Staff Papers (March 1962): 70-79.

19. ________________. International Economics. New York: Macmillan, 1968.

20. Mussa, Michael. "Th Monetary Approach to the Balance of Payments." Journal of Money, Credit and Banking 6 (August 1974): 333-52.

21. Parkin, Michael J. "The Transition from Fixed Exchange Rates to Money Supply Targets." Journal of Money, Credit, and Banking 9 (February 1977): 228-42.

22. Phaup, E. Dwight, and Kusinitz Alan. "Monetary Control Under Fixed Exchange Rates". Journal of Money, Credit, and Banking 9 (November 1977): 552-61.

23. Phelps, Edmund 8. "Phillips Curves, Expectations of Inflation, and Optimal Unemployment Over Time". Economica 34 (August 1967): 254-81.

24. Sargent, Thomas J. "A Classical Macroeconometric Model for the United States." Journal of Political Economy 84 (April 1976): 207-37.

25. Shapiro, Harold T., and Halabuk, Lazlo. "Macro-Econometric Model Building in Socialist and Non-Socialist Countries: A Comparative Study". International Economic Review 17 (October 1976): 529-65.

26. Sims, Christopher A. "Money, Income and Causality." American Economic Review 62 (September 1972): 540-52.

27. ________________. "Exogeneity and Causal Ordering in Macroeconomic Models." In Federal Reserve Bank of Minneapolis. [6], 23-44.

28. ________________. "Macro-economics and Reality." Working Paper, University of Minnesota, December 1977.

29. Spitaller, Erich "An Analysis of Inflation in the Seven Main Industrial Countries, 1958-76". Research paper, International Monetary Fund, December 1977.

30. Thomas, J.J., and Wallis, Kenneth F. "Seasonal Variation in Regression Analysis." Journal of the Royal Statistical Society, Series A, 134 (1971): 57-72.

31. Tullio, Giuseppe. "Monetary Equilibrium and Balance of Payments Adjustments: Empirical Tests for the U.S. and the Italian Balance of Payments." Ph.D thesis core, University of Chicago, 1976.

32. Whitman, Marina v. N. "Global Monetarism and the Monetary Approach to the Balance of Payments." Brookings Papers on Economic Activity (1975): 491-555.

L. LEIDERMAN

APPENDIX TO "RELATIONSHIPS BETWEEN MACROECONOMIC TIME-SERIES IN A FIXED-EXCHANGE-RATE ECONOMY"

Notes on Tables A1 - A14

These tables report the results of estimating bivariate regressions of the form:

$$Z_t = \sum_{s=1}^{n} \alpha(s) Z_{t-s} + \sum_{s=1}^{n} \beta(s) x_{t-s} + \sum_{i=0}^{3} \delta_i S_i$$

where Z and x are the first difference of the relevant variables, that have been defined in the text. In each case Z represents the potentially "caused" variable, and x the potential causal variable. S denotes seasonal dummies and a constant. D.W. is the Durbin-Watson statistic; S.E. is the standard error of estimate. Figures in parentheses are standard errors of coefficients. (Multivariate regressions' results are not presented here, for brevity, but are available upon request).

TABLE A1

REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC OUTPUT (4 LAGS)

Variable for x \ Coefficients	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	−.344 (.142)	−.226 (.149)	−.066 (.157)	.21 (.154)					−.048 (.024)	.108 (.039)	.079 (.025)	.110 (.037)
			R^2 = .8226 D.W. = 2.01 S.E. = .0372									
p	−.413 (.157)	−.226 (.169)	−.119 (.185)	.196 (.166)	−.379 (.842)	−1.248 (.942)	−.267 (.954)	.177 (.885)	−.02 (.024)	.094 (.041)	.069 (.028)	.069 (.026)
			R^2 = .8389 D.W. = 2.03 S.E.=.0370									
p^W	−.402 (.150)	−.296 (.164)	−.135 (.173)	.161 (.169)	.169 (1.914)	−1.61 (2.064)	.741 (2.003)	.756 (1.938)	−.029 (.030)	1.06 (.043)	.08 (.030)	.112 (.062)
			R^2 = .8342 D.W. = 2.00 S.E. = .0375									
y^W	−.371 (.147)	−.285 (.154)	−.193 (.172)	.232 (.177)	.133 (.266)	.346 (.247)	.065 (.241)	.241 (.234)	−.039 (.026)	.091 (.042)	.065 (.029)	.086 (.042)
			R^2 = .8385 D.W. = 2.01 S.E. = .037									
D	−.273 (.141)	−.380 (.155)	−.083 (.166)	.251 (.164)	.095 (.244)	−.411 (.255)	.352 (2.55)	−.414 (.259)	.094 (.409)	.006 (.075)	.080 (.049)	.022 (.065)
			R^2 = .8533 D.W. = −2.10 S.E. = .0353									
G	−.319 (.153)	−.186 (.159)	−.073 (.166)	.151 (.170)	−.081 (.060)	−.099 (.070)	−.065 (.079)	.026 (.059)	−.072 (.035)	.129 (.055)	.138 (.052)	.149 (.045)
			R^2 = .8358 D.W. = 2.01 S.E. = .0374									
R	−.497 (.146)	−.371 (.172)	−.277 (.194)	.084 (.183)	.062 (.106)	−.026 (.128)	−.084 (.125)	.137 (.110)	−.041 (.023)	.089 (.040)	.080 (.068)	.108 (.033)
					R^2 = .854 D.W. = 2.09 S.E. =.035							

TABLE A2

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC PRICE
(4 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	.526	−.034	.292	−.288					.002	.003	.005	−.001
	(.135)	(.184)	(.148)	(.135)					(.002)	(.002)	(.003)	(.002)
	R^2 = .386 D.W. = 1.90 S.E. = .006											
Y	.587	−.059	.288	−.257	.034	−.003	−.014	−.039	.005	−.002	−.001	−.008
	(.137)	(.149)	(.151)	(.140)	(.024)	(.025)	(.027)	(.027)	(.004)	(.006)	(.004)	(.006)
	R^2 = .452 D.W. = 1.92 S.E. = .006											
P^w	.711	−.168	.225	−.187	.887	−1.14	.438	−.304	.002	.004	.006	−.001
	(.133)	(.156)	(.151)	(.129)	(.276)	(.319)	(.328)	(.287)	(.003)	(.002)	(.003)	(.002)
	R^2 = .558 D.W. = 1.96 S.E. = .005											
Y^w	.414	.077	.332	−.218	−.084	.071	.063	.053	.002	−.002	.007	−.003
	(.134)	(.141)	(.136)	(.122)	(.032)	(.035)	(.037)	(.036)	(.002)	(1003)	(.002)	(.003)
	R^2 = .60 D.W. = 2.06 S.E. = .05											
G	.554	−.010	.267	−.275	.009	−.009	−.005	−.006	.301	−.001	.003	.002
	(.149)	(.161)	(.156)	(.139)	(.009)	(.012)	(.014)	(.009)	(.003)	(.005)	(.006)	(.004)
	R^2 = .444 D.W. = 1.93 S.E. = .006											
D	.407	−.136	.237	−.332	.029	.029	.021	.068	.000	.004	.002	.002
	(.137)	(.145)	(.143)	(.130)	(.037)	(.040)	(.040)	(.040)	(.005)	(.008)	(.006)	(.008)
	R^2 = .434 D.W. = 1.92 S.E. = .006											
R	.420	−.078	−.249	−.308	−.014	−.014	−.004	−.001	.004	.003	.007	.001
	(.141)	(.150)	(.149)	(.134)	(.015)	(.019)	(.019)	(.017)	(.003)	(.004)	(.004)	(.003)
	R^2 = .458 D.W. = 1.90 S.E. = .006											

TABLE A3

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC HOLDINGS OF INTERNATIONAL RESERVES
(4 lags)

Variable for x	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	.690 (.146)	.226 (.179)	-.220 (.178)	-.305 (.149)					.075 (.021)	.008 (.035)	-.142 (.034)	-.123 (.029)
	R^2 = .666 D.W. = 1.97 S.E. = .056											
Y	.691 (.157)	.269 (.189)	-.236 (.185)	.074 (.163)	-.690 (.216)	-.338 (.254)	-.213 (.297)	-.110 (.270)	.124 (.034)	-.084 (.060)	-.144 (.041)	-.144 (.055)
	R^2 = .730 D.W. = 1.95 S.E. = .052											
P^w	.639 (.149)	.283 (.180)	-.212 (.178)	-.054 (.149)	-2.28 (2.70)	-2.85 (2.95)	.716 (2.87)	4.70 (2.70)	.065 (.027)	.003 (.037)	-.118 (.039)	-.127 (.031)
	R^2 = .699 D.W. = 1.92 S.E. = .055											
P	.673 (.152)	.217 (.186)	-.255 (.186)	-.069 (.161)	-.977 (1.36)	-.627 (1.45)	.450 (1.66)	-.866 (1.30)	.094 (.029)	.006 (.037)	-.140 (.037)	-.121 (.032)
	R^2 = .678 D.W. = 1.98 S.E. = .057											
Y^w	.730 (.152)	.206 (.185)	-.252 (.180)	.010 (.150)	-.472 (.335)	.524 (.366)	-.661 (.367)	.019 (.347)	.102 (.025)	-.038 (.045)	-.145 (.035)	-.164 (.037)
	R^2 = .700 D.W. = 1.97 S.E. = .055											
G	.728 (.151)	.190 (.184)	-.200 (.178)	-.057 (.150)	-.024 (.086)	.091 (.099)	.164 (.115)	-.016 (.089)	.063 (.034)	.067 (.053)	-.137 (.064)	-.160 (.040)
	R^2 = .702 D.W. = 2.02 S.E. = .055											
D	.326 (.176)	-.002 (.179)	-.311 (.183)	-.084 (.149)	-.386 (.394)	-1.007 (.413)	-.934 (.448)	-.533 (.445)	.208 (.057)	-.027 (.081)	-.173 (.068)	-.159 (.080)
	R^2 = .751 D.W. = 2.02 S.E. = .050											

TABLE A4

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF FOREIGN (U.S.) PRICES
(4 lags)

Variable for x	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	.460	.264	.149	.011					.002	−.002	−.002	.000
	(.142)	(.156)	(.152)	(.141)					(.001)	(.001)	(.001)	(.001)
	R^2 = .634 D.W. = 2.01 S.E. = .003											
Y	.515	.224	.166	−.009	.007	−.015	.010	−.007	−.000	−.002	.003	.005
	(.148)	(.162)	(.157)	(.151)	(.012)	(.013)	(.014)	(.013)	(.002)	(.003)	(.002)	(.003)
	R^2 = .665 D.W. = 2.03 S.E. = .003											
P	.536	.291	−.112	.197	−.135	.186	−.199	.096	.001	−.001	−.001	.002
	(.144)	(.167)	(.172)	(.150)	(.070)	(.081)	(.079)	(.068)	(.001)	(.001)	(.001)	(.001)
	R^2 = .699 D.W. = 1.89 S.E. = .003											
Y^w	.390	.361	.199	.021	.009	.030	.023	.007	.001	−.002	−.002	.000
	(.152)	(.168)	(.161)	(.156)	(.019)	(.020)	(.020)	(.019)	(.001)	(.002)	(.001)	(.001)
	R^2 = .688 D.W. = 2.08 S.E. = .003											
G	.395	.386	.181	−.017	−.011	−.018	−.012	−.003	−.000	−.002	.002	.004
	(.150)	(.160)	(.156)	(.139)	(.004)	(.005)	(.006)	(.005)	(.002)	(.002)	(.003)	(.002)
	R^2 = .715 D.W. = 1.94 S.E. = .003											
D	.484	.242	.128	.028	.001	−.001	.019	−.003	.003	−.005	−.002	−.001
	(.152)	(.165)	(.162)	(.150)	(.020)	(.021)	(.021)	(.021)	(.003)	(.004)	(.003)	(.004)
	R^2 = .643 D.W. = 2.01 S.E. = .003											
R	.473	.261	.151	.004	.003	−.005	.005	−.004	.002	−.002	−.002	.001
	(.149)	(.163)	(.159)	(.149)	(.008)	(.009)	(.009)	(.008)	(.002)	(.002)	(.002)	(.002)
	R^2 = .639 D.W. = 1.99 S.E. = .003											

TABLE A5

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF FOREIGN (U.S.) OUTPUT
(4 lags)

Variable for x	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	.405	−.338	.182	−.335					−.022	.065	.008	.057
	(.135)	(.146)	(.145)	(.136)					(.008)	(.013)	(.008)	(.013)
	R^2 = .411 D.W. = 1.77 S.E. = .023											
Y	.449	−.310	.124	−.312	.071	.134	−.122	−.014	−.015	.058	.014	.024
	(.148)	(.157)	(.145)	(.140)	(.087)	(.092)	(.102)	(.106)	(.015)	(.025)	(.017)	(.125)
	R^2 = .483 D.W. = 1.77 S.E. = .022											
P^w	.413	−.357	.034	−.389	2.00	−.797	−2.83	−.060	−.012	.060	.015	.063
	(.141)	(.149)	(.147)	(.143)	(1.13)	(1.25)	(1.20)	(1.16)	(.010)	(.013)	(.009)	(.013)
	R^2 = .525 D.W. = 1.81 S.E. = .021											
P	.441	−.343	.213	−.280	.013	.023	.946	−.505	−.028	.064	.012	.060
	(.145)	(.157)	(.165)	(.159)	(.598)	(.630)	(.607)	(.546)	(.010)	(.015)	(.009)	(.015)
	R^2 = .452 D.W. = 1.80 S.E. = .023											
G	.472	−.381	.258	−.438	.066	.034	.057	−.017	−.022	.074	−.126	.055
	(.140)	(.154)	(.155)	(.147)	(.036)	(.042)	(.048)	(.036)	(.014)	(.022)	(.023)	(.018)
	R^2 = .467 D.W. = 1.82 S.E. = .022											
D	.427	−.315	.128	−.253	−.213	.160	.028	.036	−.046	.097	.029	.100
	(.147)	(.166)	(.168)	(.156)	(.163)	(.169)	(.173)	(.162)	(.020)	(.036)	(.028)	(.032)
	R^2 = .441 D.W. = 1.84 S.E. = .023											
R	.385	−.327	.173	−.326	.024	.025	−.018	.011	−.019	.060	.003	.052
	(.142)	(.155)	(.155)	(.147)	(.064)	(.078)	(.076)	(.064)	(.011)	(.019)	(.015)	(.016
	R^2 = .423 D.W. = 1.76 S.E. = .023											

TABLE A6

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC GOVERNMENT EXPENDITURES
(4 lags)

Variable for x	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	-.772	-.760	-.362	-.136					.068	.157	-.022	-.082
	(.142)	(.167)	(.192)	(.143)					(.050)	(.071)	(.090)	(.061)
	R^2 = .806 D.W. = 2.00 S.E. = .092											
Y	-.799	-.763	-.413	-.197	-.344	-.726	-.649	-.308	.151	.122	-.110	-.127
	(.148)	(.171)	(.195)	(.148)	(.375)	(.391)	(.402)	(.418)	(.090)	(.135)	(.128)	(.111)
	R^2 = .825 D.W. = 2.01 S.E. = .092											
P^W	-.782	-.782	-.395	-.080	1.93	.428	5.93	-7.84	.067	.139	-.028	-.073
	(.145)	(.180)	(.216)	(.164)	(5.14)	(5.48)	(5.35)	(4.78)	(.062)	(.077)	(.103)	(.065)
	R^2 = .820 D.W. = 2.03 S.E. = .093											
P	-.825	-.879	-.454	-.143	2.23	2.11	-2.08	.568	.038	.163	.008	-.056
	(.152)	(.188)	(.213)	(.155)	(2.23)	(2.52)	(2.44)	(2.17)	(.054)	(.074)	(.094)	(.065)
	R^2 = .819 D.W. = 2.05 S.E. = .093											
Y^W	-.821	-.767	-.337	-.096	-.388	.059	.503	.537	.050	.161	.041	-.081
	(.149)	(.174)	(.202)	(.149)	(.582)	(.642)	(.648)	(.613)	(.057)	(.091)	(.095)	(.076)
	R^2 = .819 D.W. = 2.01 S.E. = .093											
D	-.725	-.744	-.333	-.079	.006	-.903	1.132	.013	.139	-.081	-.019	-.172
	(.147)	(.168)	(.194)	(.152)	(.629)	(.671)	(.639)	(.648)	(.087)	(.152)	(.123)	(.127)
	R^2 = .824 D.W. = 2.04 S.E. = .092											
R	-.780	-.771	-.343	-.114	-.093	.242	-.079	-.216	.068	.190	-.012	-.106
	(.149)	(.173)	(.199)	(.153)	(.261)	(.318)	(.308)	(.259)	(.059)	(.091)	(.110)	(.070)
	R^2 = .813 D.W. = 2.04 S.E. = .095											

TABLE A7

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC CREDIT
(4 lags)

Variable for x	α(1)	α(2)	α(3)	α(4)	β(1)	β(2)	β(3)	β(4)	δ0	δ1	δ2	δ3
None	.203	.435	.232	−.139					−.004	.008	.120	−.071
	(.143)	(.152)	(.151)	(.148)					(.018)	(.031)	(.024)	(.029)
	R^2 = .871 D.W. = 1.93 S.E. = .022											
Y	.169	.538	.328	−.264	.224	.103	−.062	−.136	−.033	.063	.154	−.060
	(.144)	(.150)	(.150)	(.151)	(.083)	(.091)	(.096)	(.096)	(.024)	(.039)	(.029)	(.037)
	R^2 = .899 D.W. = 1.84 S.E. = .021											
P^W	.224	.402	.223	−.128	.280	1.49	1.57	.248	−.003	−.002	.115	−.074
	(.150)	(.156)	(.156)	(.152)	(1.13)	(1.22)	(1.20)	(1.12)	(.019)	(.032)	(.025)	(.030)
	R^2 = .879 D.W. = 2.00 S.E. = .023											
P	.201	.417	.197	−.153	.367	−.252	.141	.237	−.003	.006	.005	−.075
	(.149)	(.160)	(.163)	(.162)	(.555)	(.589)	(.578)	(.527)	(.019)	(.032)	(.026)	(.031)
	R^2 = .874 D.W. = 1.89 S.E. = .023											
Y^W	.340	.433	.021	−.024	.237	−.363	.451	−.147	−.016	.047	.092	−.048
	(.149)	(.155)	(.159)	(.148)	(.134)	(.152)	(.153)	(.143)	(.019)	(.033)	(.025)	(.029)
	R^2 = .896 D.W. = 1.89 S.E. = .021											
G	.281	.362	.198	−.108	.012	.010	−.087	−.005	.026	−.044	.076	−.091
	(.145)	(.155)	(.148)	(.150)	(.034)	(.039)	(.045)	(.035)	(.020)	(.035)	(.029)	(.029)
	R^2 = .893 D.W. = 1.81 S.E. = .021											
R	.190	.547	.405	.050	−.001	.145	−.046	.067	−.025	.007	.118	−.060
	(.172)	(.181)	(.196)	(.194)	(.077)	(.078)	(.080)	(.065)	(.025)	(.036)	(.030)	(.035
	R^2 = .886 D.W. = 1.96 S.E. = .022											

TABLE A8

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC OUTPUT
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	−.346	−.201	−.072	.229	.008	−.155							−.047	.113	.067	.121
	(.146)	(.153)	(.160)	(.171)	(.200)	(.176)							(.025)	(.041)	(.030)	(.039)
	R^2 = .8259 D.W. = 2.06 S.E. = .0376															
P	−.394	−.275	−.101	.166	−.016	−.148	.0274	−1.70	.013	−.101	1.104	1.407	−.019	.103	.050	.116
	(.154)	(.165)	(.177)	(.187)	(.200)	(.190)	(.913)	(1.090)	(1.300)	(1.300)	(1.004)	(.944)	(.030)	(.043)	(.032)	(.041)
	R^2 = .8495 D.W. = 1.96 S.E. = .0375															
P^W	−.402	−.244	−.086	.241	.074	−.185	.752	−2.143	−.763	−1.90	1.472	1.046	−.035	.109	.058	.131
	(.156)	(.171)	(.187)	(.190)	(.195)	(.189)	(1.979)	(2.187)	(2.119)	(2.159)	(2.133)	(2.012)	(.032)	(.047)	(.036)	(.046)
	R^2 = .843 D.W. = 2.06 S.E. = .0383															
Y^W	−.356	−.198	−.176	.399	.178	−.272	.309	.147	−.251	.500	−.314	−.161	−.020	.075	.023	.076
	(.152)	(.158)	(.178)	(.196)	(.214)	(.201)	(.262)	(.288)	(.292)	(.287)	(.278)	(.252)	(.029)	(.047)	(.037)	(.044)
	R^2 = .855 D.W. = 2.05 S.E. = .0368															
D	−.401	−.321	−.135	.122	−.172	−.255	.095	−.485	.628	.021	−.358	−.571	−.057	.090	.031	.066
	(.149)	(.157)	(.163)	(.177)	(.189)	(.183)	(.250)	(.274)	(.292)	(.300)	(.259)	(.264)	(.056)	(.085)	(.079)	(.080)
	R^2 = .878 D.W. = 2.02 S.E. = .0338															
G	−.326	−.126	−.03	.148	−.141	−.171	−.038	−.086	−.049	.070	.046	−.041	−.081	.111	.157	.193
	(.161)	(.164)	(.176)	(.192)	(.199)	(.190)	(.054)	(.076)	(.091)	(.084)	(.084)	(.061)	(.040)	(.063)	(.071)	(.052)
	R^2 = .847 D.W. = 2.08 S.E. = .0378															
R	−.555	−.444	−.338	.061	.026	−.049	.049	.017	.077	.051	.091	.054	−.031	.093	.054	.095
	(.157)	(.190)	(.210)	(.217)	(.227)	(.204)	(.110)	(.138)	(.137)	(.132)	(.126)	(.117)	(.027)	(.045)	(.038)	(.041)
	R^2 = .860 D.W. = 2.02 S.E. = .036															

TABLE A9

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC PRICE
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	.543	-.027	.256	-.379	.117	.174							.000	.004	.006	-.001
	(.141)	(.160)	(.150)	(.151)	(.160)	(.141)							(.002)	(.003)	(.003)	(.003)
	R^2 = .435 D.W. = 2.06 S.E. = .006															
Y	.572	-.056	.264	-.351	.118	.247	.030	-.005	-.004	.054	.027	.036	.002	-.001	.001	.001
	(.147)	(.167)	(.161)	(.158)	(.163)	(.146)	(.024)	(.025)	(.027)	(.029)	(.031)	(.005)	(.007)	(.005)	(.005)	(.006)
	R^2 = .528 D.W. = 2.09 S.E. = .006															
P'^W	.722	-.175	-.268	-.309	.007	.234	.847	-1.129	.548	-.517	.411	-.196	-.001	.005	.008	.001
	(.139)	(.171)	(.173)	(.184)	(.175)	(.136)	(.283)	(.332)	(.330)	(.330)	(.345)	(.302)	(.003)	(.003)	(.003)	(.003)
	R^2 = .615 D.W. = 1.99 S.E. = .005															
Y^W	.418	.122	.312	-.227	.055	.124	-.090	.072	.053	.051	-.011	-.016	.001	-.001	.007	-.002
	(.146)	(.160)	(.149)	(.157)	(.161)	(.133)	(.035)	(.040)	(.042)	(.041)	(.042)	(.039)	(.003)	(.004)	(.003)	(.004)
	R^2 = .612 D.W. = 2.15 S.E. = .005															
C	.580	.045	.191	-.342	.003	.248	.005	-.015	-.006	-.003	.009	.013	.002	-.001	.001	.001
	(.154)	(.178)	(.160)	(.161)	(.169)	(.145)	(.009)	(.013)	(.015)	(.014)	(.013)	(.009)	(.004)	(.005)	(.007)	(.005)
	R^2 = .518 D.W. = 2.02 S.E. = .006															
D	.402	-.115	.209	-.397	.010	.192	.048	.024	.002	.050	.003	.029	-.002	.009	.004	.001
	(.154)	(.166)	(.152)	(.152)	(.166)	(.153)	(.041)	(.042)	(.044)	(.043)	(.042)	(.043)	(.007)	(.012)	(.009)	(.011)
	R^2 = .534 D.W. = 2.12 S.E. = .006															
R	.402	-.079	.221	-.415	.104	.138	-.012	-.019	.001	.014	-.022	.003	.002	.004	.011	.002
	(.154)	(.163)	(.154)	(.155)	(.172)	(.144)	(.016)	(.020)	(.020)	(.019)	(.020)	(.018)	(.003)	(.004)	(.005)	(.004)

TABLE A10

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC HOLDINGS OF INTERNATIONAL RESERVES
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	.685	.197	-.196	.056	-.111	-.032							.068	.009	-.121	-.108
	(.150)	(.187)	(.190)	(.183)	(.185)	(.157)							(.024)	(.038)	(.045)	(.035)
	R^2 = .671 D.W. = 1.96 S.E. = .056															
Y	.700	.235	-.257	.054	-.004	.105	-.676	-.371	-.272	-.280	-.362	-.146	.137	-.095	-.135	-.142
	(.164)	(.205)	(.204)	(.196)	(.188)	(.175)	(.235)	(.284)	(.313)	(.323)	(.339)	(.304)	(.041)	(.067)	(.056)	(.062)
	R^2 = .738 D.W. = 1.95 S.E. = .054															
P^W	.639	.259	-.197	.047	-.120	-.041	-2.452	-2.72	1.024	5.190	-.530	-.415	.060	.034	-.096	-.113
	(.163)	(.200)	(.196)	(.191)	(.195)	(.165)	(2.906)	(3.260)	(3.064)	(3.062)	(3.145)	(3.007)	(.031)	(.042)	(.051)	(.039)
	R^2 = .707 D.W. = 1.92 S.E. = .057															
P	.642	.201	-.255	.059	-.111	-.098	-1.300	-.297	-.040	-1.194	-.611	1.260	.083	.011	-.105	-.093
	(.162)	(.198)	(.201)	(.192)	(.198)	(.178)	(1.525)	(1.617)	(1.527)	(1.538)	(1.698)	(1.428)	(.034)	(.041)	(.049)	(.040)
	R^2 = .697 D.W. = 2.01 S.E. = .058															
Y^W	.729	.140	-.191	.088	-.056	-.093	-.642	.642	-.870	.275	-.454	.117	.113	-.075	-.121	-.170
	(.159)	(.202)	(.203)	(.191)	(.190)	(.162)	(.371)	(.409)	(.408)	(.423)	(.414)	(.381)	(.031)	(.057)	(.046)	(.049)
	R^2 = .717 D.W. = 1.96 S.E. = .056															
G	.729	.157	-.076	-.011	-.101	.055	-.018	.084	.129	-.080	-.131	-.170	.024	.129	-.042	-.123
	(.15)	(.190)	(.195)	(.187)	(.188)	(.164)	(.088)	(.107)	(.135)	(.121)	(.113)	(.087)	(.042)	(.064)	(.082)	(.057)
	R^2 = .733 D.W. = 1.95 S.E. = .055															
D	.286	-.050	-.317	-.378	-.159	-.100	-.356	-.996	-.842	-.629	-.501	-.225	.211	-.032	-.121	-.097
	(.190)	(.194)	(.196)	(.196)	(.203)	(.156)	(.419)	(.444)	(.475)	(.489)	(.495)	(.477)	(.080)	(.121)	(.095)	(.111)
	R^2 = .763 D.W. = 1.99 S.E. = .051															

TABLE A11

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF FOREIGN (U.S.) PRICES
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	.454	.251	.121	-.047	.108	.038							.002	-.002	-.002	.001
	(.146)	(.160)	(.157)	(.157)	(.156)	(.148)							(.001)	(.001)	(.002)	(.001)
	R^2 = .641 D.W. = 2.00 S.E. = .003															
Y	.523	.172	.160	-.096	.197	.004	.008	-.008	.015	-.003	-.000	-.015	-.001	.002	-.004	.007
	(.154)	(.172)	(.168)	(.169)	(.167)	(.156)	(.012)	(.013)	(.015)	(.015)	(.016)	(.015)	(.003)	(.004)	(.003)	(.004)
	R^2 = .683 D.W. = 2.12 S.E. = .003															
P	.581	.227	-.089	.216	-.183	.214	-.176	.253	-.261	.196	-.136	.093	.001	-.001	-.001	.002
	(.153)	(.180)	(.179)	(.179)	(.187)	(.163)	(.075)	(.093)	(.094)	(.100)	(.095)	(.074)	(.002)	(.001)	(.002)	(.001)
	R^2 = .719 D.W. = 1.94 S.E. = .003															
Y^W	.352	.370	.107	-.091	.195	.150	.008	.045	.023	.009	.003	.028	.000	-.003	-.002	-.001
	(.156)	(.174)	(.169)	(.175)	(.172)	(.164)	(.021)	(.023)	(.022)	(.021)	(.022)	(.021)	(.002)	(.003)	(.002)	(.002)
	R^2 = .714 D.W. = 2.11 S.E. = .003															
G	.411	.449	.203	-.144	-.032	.081	-.010	-.015	-.006	.006	.009	-.000	-.001	-.003	.003	.007
	(.154)	(.169)	(.168)	(.169)	(.166)	(.145)	(.005)	(.006)	(.007)	(.007)	(.007)	(.005)	(.002)	(.003)	(.004)	(.002)
	R^2 = .739 D.W. = 2.00 S.E. = .003															
D	.483	.248	.076	-.016	.072	.077	-.003	-.002	.002	.002	-.014	-.022	-.003	.002	.004	.006
	(.155)	(.069)	(.167)	(.171)	(.168)	(.160)	(.021)	(.023)	(.024)	(.023)	(.021)	(.021)	(.004)	(.006)	(.005)	(.006)
	R^2 = .669 D.W. = 2.00 S.E. = .003															
R	.496	.221	.115	-.053	.105	.033	.001	-.003	.004	-.008	.009	-.003	.002	-.002	-.003	.001
	(.160)	(.176)	(.168)	(.168)	(.173)	(.165)	(.009)	(.011)	(.011)	(.011)	(.011)	(.009)	(.002)	(.002)	(.003)	(.002)
	R^2 = .653 D.W. = 2.02 S.E. = .003															
	.465	.207	.93	.184	-.095	.081	.011	.061	-.151	-.245	.220	-.047	.002	-.001	-.002	.001
	(.231)	(.243)	(.245)	(.242)	(.239)	(.232)	(.232)	(.230)	(.230)	(.227)	(.227)	(.230)	(.002)	(.002)	(.002)	(.002)

TABLE A12

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF FOREIGN (U.S.) OUTPUT
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	.433	-.351	.211	-.368	.088	.006							-.025	.070	.008	.061
	(.146)	(.161)	(.158)	(.159)	(.160)	(.147)							(.010)	(.018)	(.009)	(.017)
	R^2 = .415 D.W. = 1.82 S.E. = .023															
•	.459	-.370	.080	-.233	.032	.047	.096	.152	-.150	.031	-.129	-.235	-.007	.054	-.000	.035
	(.155)	(.172)	(.174)	(.170)	(.165)	(.150)	(.090)	(.094)	(.105)	(.116)	(.127)	(.120)	(.017)	(.028)	(.022)	(.026)
	R^2 = .541 D.W. = 1.79 S.E. = .022															
F W	.454	-.404	.059	-.402	.063	-.021	2.134	-.953	-2.616	-.637	-.637	-.365	-.015	.067	.016	.067
	(.160)	(.177)	(.169)	(.164)	(.168)	(.161)	(1.203)	(1.338)	(1.302)	(1.348)	(1.326)	(1.259)	(.013)	(.020)	(.011)	(.018)
	R^2 = .535 D.W. = 1.85 S.E. = .022															
P	.437	-.359	.156	-.297	-.036	.033	.119	-.012	.793	-.783	.317	.530	-.031	.066	.016	.056
	(.155)	(.179)	(.188)	(.180)	(.185)	(.173)	(.651)	(.713)	(.664)	(.700)	(.715)	(.593)	(.012)	(.020)	(.012)	(.020)
	R^2 = .475 D.W. = 1.87 S.E. = .023															
G	.542	-.462	.341	-.554	.210	-.071	.066	.032	.076	.005	.049	.011	-.033	.084	-.017	.079
	(.159)	(.183)	(.180)	(.186)	(.187)	(.169)	(.037)	(.045)	(.057)	(.051)	(.048)	(.036)	(.018)	(.030)	(.027)	(.030)
	R^2 = .492 D.W. = 2.03 S.E. = .023															
D	.433	-.304	.128	-.223	-.022	.065	-.211	.152	-.003	.056	.057	-.052	-.037	.084	.018	.085
	(.158)	(.183)	(.197)	(.211)	(.200)	(.170)	(.173)	(.196)	(.206)	(.196)	(.177)	(.176)	(.031)	(.052)	(.039)	(.050)
	R^2 = .445 D.W. = 1.83 S.E. = .024															
R	.394	-.332	.188	-.357	.132	.006	.015	.028	-.034	.084	-.027	-.079	-.023	.059	.009	.067
	(.155)	(.170)	(.170)	(.176)	(.173)	(.159)	(.067)	(.084)	(.085)	(.080)	(.079)	(.068)	(.013)	(.024)	(.019)	(.021)
	R^2 = .469 D.W. = 1.82 S.E. = .023															

TABLE A13

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC GOVERNMENT EXPENDITURES
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	-.753	-.754	-.394	-.187	-.116	-.181							.040	.192	.046	-.043
	(.144)	(.175)	(.215)	(.200)	(.189)	(.141)							(.056)	(.079)	(.105)	(.074)
	R^2 = .813 D.W. = [illegible]															
Y	-.794	-.762	-.452	-.298	-.177	-.160	-.303	-.685	-.688	-.294	.298	.088	.118	.207	-.060	-.122
	(.161)	(.190)	(.226)	(.212)	(.209)	(.152)	(.402)	(.411)	(.427)	(.479)	(.496)	(.475)	(.099)	(.159)	(.078)	(.131)
	R^2 = .843 D.W. = 1.96 S.E. = .094															
P^W	-.730	-.665	-.273	.060	-.007	-.267	3.720	.727	4.727	-12.653	-2.747	8.152	.002	.168	.075	.010
	(.150)	(.186)	(.239)	(.233)	(.223)	(.164)	(5.177)	(5.665)	(5.624)	(5.673)	(5.559)	(4.854)	(.071)	(.089)	(.122)	(.082)
	R^2 = .833 D.W. = 2.02 S.E. = .094															
P	-.835	-.893	-.516	-.231	-.169	-.224	2.856	1.288	-1.541	.777	3.176	-.183	-.006	.218	.096	-.031
	(.158)	(.203)	(.245)	(.219)	(.206)	(.152)	(2.487)	(2.866)	(2.578)	(2.596)	(2.730)	(2.338)	(.063)	(.083)	(.110)	(.078)
	R^2 = .833 D.W. = 2.02 S.E. = .094															
Y^W	-.797	-.747	-.365	-.143	-.145	-.191	-.405	.125	.425	.706	-.296	-.027	.030	.186	.090	-.061
	(.155)	(.189)	(.236)	(.214)	(.202)	(.149)	(.663)	(.765)	(.752)	(.776)	(.779)	(.704)	(.076)	(.125)	(.113)	(.124)
	R^2 = .827 D.W. = 2.00 S.E. = .096															
D	-.743	-.815	-.505	-.176	-.257	-.250	.677	-1.203	.548	-.262	.190	.849	.096	.036	.084	-.201
	(.148)	(.178)	(.225)	(.198)	(.204)	(.167)	(.739)	(.719)	(.743)	(.723)	(.678)	(.663)	(.120)	(.190)	(.150)	(.185)
	R^2 = .842 D.W. = 1.91 S.E. = .092															
R	-.808	-.842	-.481	-.203	-.139	-.202	-.147	.208	.016	-.093	-.020	-.305	.033	.208	.103	-.003
	(.153)	(.186)	(.235)	(.211)	(.198)	(.152)	(.265)	(.332)	(.340)	(.326)	(.327)	(.286)	(.073)	(.112)	(.143)	(.099)
	R^2 = .829 D.W. = 1.96 S.E. = .095															

TABLE A14

BIVARIATE REGRESSIONS FOR TESTING EXOGENEITY OF DOMESTIC CREDIT
(6 lags)

Variable for x \ coefficients	α(1)	α(2)	α(3)	α(4)	α(5)	α(6)	β(1)	β(2)	β(3)	β(4)	β(5)	β(6)	δ0	δ1	δ2	δ3
None	.203	.407	.256	-.077	.026	-.134							.012	-.020	.013	-.086
	(.146)	(.159)	(.170)	(.169)	(.153)	(.155)							(.028)	(.045)	(.034)	(.044)
	R^2 = .873 D.W. = 1.96 S.E. = .023															
Y	.164	.597	.214	-.390	.069	.076	.213	.077	-.060	-.091	.203	.208	-.047	.095	.166	-.078
	(.153)	(.165)	(.177)	(.180)	(.157)	(.160)	(.090)	(.095)	(.097)	(.107)	(.114)	(.111)	(.034)	(.052)	(.047)	(.049)
	R^2 = .910 D.W. = 1.86 S.E. = .021															
P^W	.260	.422	.163	-.050	-.003	-.118	.282	1.215	-1.624	-.354	2.360	-1.507	.004	-.011	.103	-.074
	(.155)	(.165)	(.177)	(.171)	(.153)	(.155)	(1.131)	(1.235)	(1.219)	(1.250)	(1.227)	(1.170)	(.029)	(.045)	(.035)	(.045)
	R^2 = .892 D.W. = 2.04 S.E. = .002															
P	.166	.451	.245	-.071	.027	-.103	.053	-.090	.116	.897	-.956	-.598	.010	-.012	.103	-.071
	(.156)	(.160)	(.170)	(.167)	(.162)	(.166)	(.594)	(.637)	(.586)	(.587)	(.638)	(.588)	(.208)	(.045)	(.034)	(.044)
	R^2 = .895 D.W. = 2.02 S.E. = .022															
Y^W	.343	.390	-.002	.116	.075	-.263	.259	-.333	.488	-.092	-.049	.171	.015	-.005	.054	-.083
	(.152)	(.172)	(.181)	(.172)	(.155)	(.154)	(.139)	(.160)	(.173)	(.185)	(.175)	(.149)	(.028)	(.045)	(.035)	(.043)
	R^2 = .905 D.W. = 1.97 S.E. = .021															
C	.293	.446	.140	-.079	-.034	-.094	.027	.049	-.022	.080	.108	.002	.014	-.050	.077	-.062
	(.158)	(.154)	(.160)	(.155)	(.145)	(.142)	(.032)	(.038)	(.048)	(.042)	(.043)	(.036)	(.026)	(.041)	(.032)	(.040)
	R^2 = .917 D.W. = 1.92 S.E. = .020															
R	.254	.466	.422	.097	.203	-.020	.036	.121	-.016	.107	-.065	.070	-.011	-.025	.099	-.106
	(.182)	(.193)	(.206)	(.213)	(.215)	(.208)	(.083)	(.084)	(.085)	(.085)	(.088)	(.072)	(.035)	(.053)	(.041)	(.048)
	R^2 = .893 D.W. = 1.95 S.E. = .022															

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