THE ENGINE OF GROWTH OR ITS HANDMAIDEN?
A Time-Series Assessment of Export-Led Growth

by

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Abstract

This paper presents an analysis of time-series data for the countries in the Summers-Heston (1991) data set, in an attempt to ascertain the evidence for or against the export-led growth hypothesis. We find that standard methods of detecting export-led growth using Granger causality tests may give misleading results if imports are not included in the system being analysed. For this reason, our main statistical tool is the measure of conditional linear feedback developed by Geweke (1984), which allows us to examine the relationship between export growth and income growth while controlling for the growth of imports. These measures have two additional features which make them attractive for our work. First, they go beyond mere detection of evidence for export-led growth, to provide a measurement of its strength. Second, they enable us to determine the temporal pattern of the response of income to exports. In some cases export-led growth is a long run phenomenon, in the sense that export promotion strategies adopted today have their strongest effect after 8 to 16 years. In other cases the opposite is true; exports have their greatest influence in the short run (less than 4 years). We find modest support for the export-led growth hypothesis, if "support" is taken to mean a unidirectional causal ordering. Conditional on import growth, we find a causal ordering from export growth to income growth in 30 of the 126 countries analysed; 25 have the reverse ordering. Using a weaker notion of "support"--stronger conditional feedback from exports to income than vice versa, 65 of the 126 countries support the export-led growth hypothesis, although the difference in strength is small. Finally, we find that for the "Asian Tiger" countries of the Pacific Rim, the relationship between export growth and output growth becomes clearer when conditioned on human capital and investment growth as well as import growth.

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Introduction

One of the most enduring questions in economics involves how a nation could accelerate the pace of its economic development. One of the most enduring answers to this question is to promote exports--either because doing so directly influences development via encouraging production of goods for export, or because export promotion permits accumulation of foreign exchange which permits importation of high-quality goods and services, which can in turn be used to expand the nation's production possibilities. In either case, growth is said to be *export-led*; the latter case is the so-called "two-gap" hypothesis (McKinnon, 1964; Findlay, 1973).

The early work on export-led growth consists of static cross-country comparisons (Michaely, 1977; Balassa, 1978; Tyler, 1981; Kormendi and Meguire, 1985). These studies generally concluded that there is strong evidence in favor of export-led growth because export growth and income growth are highly correlated. However, Kravis pointed out in 1970 that the question is an essentially dynamic one: as he put it, are exports the handmaiden or the engine of growth? To make this determination one needs to look at time series to see whether or not exports are driving income. This approach has been taken in a number of papers (Jung and Marshall, 1985; Chow, 1987; Serletis, 1992; Kunst and Marin, 1989; Marin, 1992; Afxentiou and Serletis, 1991), designed to assess whether or not individual countries exhibit statistically significant evidence of export-led growth using Granger causality tests.

We adopt this dynamic approach, but make a number of important modifications. First, we use data from a single source designed to provide a consistent set of comparable cross-country statistics on output -- the purchasing power index data of Summers and Heston (1991). This data set avoids the standard difficulty that output valued at official exchange rates may not provide an accurate picture of a nation's stage of economic development. The intertemporal effect of this phenomenon is especially important when one is interested in the pattern of economic development. For example, as a country develops, its traded (i.e., exported) goods sector may grow relative to other sectors. Thus just as output has grown, the official-exchange-rate valuation of output will more accurately measure actual output precisely because exports constitute a larger fraction of output. This will make it appear to be the case that exports lead output regardless of the underlying source of output growth. Use of the purchasing power measure attenuates this confounding measurement error effect, since its valuation of output relies less heavily on a country's traded goods. This paper uses data from Mark 5.5 of the Penn-World Table (Summers and Heston, 1991), which covers the years 1950-1990.[1] Our measure of income growth is total *real* gross domestic product in *current* international dollars, which is computed by multiplying the CGDP series for each country by its population. Exports and imports are also expressed in current international dollars, and are derived from the Penn-World Table.[2]

Second, this paper strives to provide a consistent set of *measurements* of the importance of exports in leading economic growth. We employ several procedures which, while not new, have not previously been applied to this problem. These measures enable us to go beyond mere *detection* of evidence for export-led growth to the measurement of its strength.

The third modification is that we take account of imports explicitly. Other studies typically focus on the bivariate relationship between income and exports.[3] But as noted above, theory suggests that imports may play a central role in explaining export-led growth. Indeed, we find that omitting imports from the analysis may either mask or overstate the effect of exports on income.

Fourth, for a subset of countries, we also investigate whether other often-omitted variables influence the relationship between income and exports. In particular, we find that conditioning on measures of physical and human capital generally sharpens inferences regarding the relationship between export growth and output growth.

Finally, we are able to determine the temporal pattern of the response of income to exports. In some cases export-led growth is a long-run phenomenon, in the sense that export-

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[1]Although the Summers-Heston (1991) paper includes data only through 1988 (Mark 5), an updated version (Mark 5.5) includes data through 1990. This version is available via anonymous ftp from the NBER (nber.harvard.edu). Since this paper was written, a further update (Mark 5.6) has been released and is also available via ftp.

[2]The variable OPEN (exports + imports as % of CGDP) is given in the Penn-World Table, and the current net foreign balance (cnfb; as a percentage of CGDP) can be obtained by the formula 100-cc-ci-cg=cnfb, where cc, ci, and cg are the percentage shares of consumption, investment and government spending, respectively, in CGDP. Then exports/CGDP=(OPEN+cnfb)/200, and imports/CGDP=(OPEN-cnfb)/200

[3]Exceptions are Serletis (1992), who includes imports; Ghartey (1993), who includes the terms of trade and the capital stock; and Kunst and Marin (1989), who study the causal relationships between productivity, export growth, the terms of trade and OECD output.

promotion strategies adopted today have their strongest effect after 8 to 16 years. In other cases the opposite is true; exports have their greatest influence in the short run (less than 4 years). It may also be the case that a country may exhibit a strong export-led growth effect at particular frequencies (i.e., time horizon), even though there may be little evidence of the effect in the overall measure.

While we feel that these findings are interesting in themselves, they also provide a set of facts which may serve as a guide to theorists who are currently working to develop better theories of economic growth.

1. The State of the Evidence

A. Existing Evidence

Existing tests for the presence of export-led growth generally rely on the concept of Granger causality.[4] That is, it is customary to check whether exports help predict output once historical output has been taken into account. More specifically, let x_t denote exports and y_t denote output. Then estimate the following two equations by ordinary least squares:

$$(1) \qquad x_t = \sum_{j=1}^{p} a_j x_{t-j} + \sum_{j=1}^{p} b_j y_{t-j} + u_t$$

$$y_t = \sum_{j=1}^{p} c_j x_{t-j} + \sum_{j=1}^{p} d_j y_{t-j} + v_t$$

and test the null hypotheses

(2) H_1: $c_j = 0$, $j = 1, ..., p$, exports fail to Granger-cause (help predict) output;

H_2: $b_j = 0$, $j = 1, ..., p$, output fails to Granger-cause (help predict) exports.[5]

If neither hypothesis is rejected, then exports and output are causally independent, whereas if both are rejected, there is bi-directional causality between the two.[6]

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[4]The remainder of the paper focuses exclusively on the time-series approach to export-led growth, as opposed to the cross-sectional approach, or analyses of the determinants of growth along the lines of Barro (1991).

[5] As pointed out by several authors, the testing procedure described in (1) and (2) is valid only if x and y are (covariance) stationary time series.

Table 1 lists several recent time-series studies of export-led growth, together with their methods, data sources, and results. It is readily apparent that since the seminal paper of Jung and Marshall (1985), many refinements have been used in assessing the empirical evidence for export-led growth. These refinements include modifications of the standard Granger causality test, including tests for optimal lag length (Chow, 1987; Darrat, 1987; Kunst and Marin, 1989; Ahmad and Kwan, 1991; Bahmani-Oskooee et al, 1991; Serletis, 1992; Marin, 1992; Ghartey, 1993; Oxley, 1993), tests for nonstationarity and/or cointegration between the variables (Afxentiou and Serletis, 1991; Serletis; Oxley), and including other variables besides exports and growth (Kunst and Marin; Serletis; Marin; Ghartey). Rather than present an exhaustive comparison of the results of all of these papers, we summarize some of the major differences below.

[TABLE 1 HERE]

In their work on causality and export-led growth, Jung and Marshall (1985) analyze the relationship between the growth rate of real exports and the growth rate of real output, for 37 developing countries. Depending on the outcome of Granger causality tests, as described above, they then characterize the countries in their sample as exhibiting one of four causal patterns: Export Promotion (EP, what we call export-led growth), Internally Generated Exports (IGE), Export-Reducing Growth (ERG), or Growth-Reducing Exports (GRE). This characterization is made on the basis of the sign of the sum of the coefficients on lags of the causal variable in the equation for the dependent variable. Jung and Marshall find evidence for the export-led growth hypothesis in only 4 of the 37 countries: Indonesia, Egypt, Costa Rica, and Ecuador.

Chow (1987) performs a similar analysis on 8 of the "most successful export-oriented" newly industrialized countries (NICs), using the growth rate of manufacturing output as a measure of industrial development. With two exceptions, Chow finds bi-directional causality in

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[6]Many authors (including Granger, 1969) use the term "feedback" to describe the case of rejection of both null hypotheses in (2). Because we measure export-led growth using the "measures of linear feedback" introduced by Geweke (1982, 1984), we use the term "bi-directional causality" here to avoid confusion.

each country.[7] Direct comparisons with Jung and Marshall's results are hampered by the fact that Chow does not attempt to determine the sign of the relationship (i.e., whether export growth causes positive or negative output growth), as well as by the use of different variables. However, results for four of the six countries common to the two samples (Brazil, Korea, Mexico and Taiwan) differ across the studies. Jung and Marshall find no significant causality in Brazil or Mexico, and causality only from output to exports in Korea and Taiwan. The two papers draw similar inferences about the existence of causality in Israel, although Jung and Marshall argue that the effect is negative in each direction.

Unlike these two papers, Serletis (1992) also includes the growth of imports in his analysis. In Canadian data from 1870-1985, he finds that export growth causes GNP growth over the full sample and in the pre-WWII subsample. At the same time, he finds no evidence that import growth causes either export growth or income growth.

Marin (1992) presents a vector autoregressive (VAR) analysis of data for Germany, the United Kingdom, the United States and Japan. Using quarterly data for manufactured exports, the terms of trade, OECD output, and labor productivity, Marin performs preliminary tests for the cointegration of exports and productivity (i.e., tests of whether the two variables have a long-run equilibrium relationship). Although he finds no conclusive evidence of cointegration between these two variables, he does find evidence of a cointegrating relationship between exports, productivity and the terms of trade, except for the UK.

Marin's Granger causality tests support the export-led growth hypothesis for the four countries in his study, but he finds that the “quantitative impact of exports on productivity seems to be negligible,” (Marin, 1992, p. 685) on the basis of the sum of the autoregressive coefficients on lagged values of exports in the productivity equation.

Other large-scale studies reach divergent conclusions regarding export-led growth. Bahmani-Oskooee et al (1991) examine 20 less-developed countries (LDCs), all of which are also studied by Jung and Marshall. Although they find evidence of a causal relationship between exports and growth in half of these countries (including cases in which their two test procedures gave different results), they find evidence of a unidirectional positive relationship[8] only in

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[7]Note that Chow uses Sims's version of the Granger causality test; 3 *future values* (leads) of each variable are included in the regression equations (1), along with 3 lags.

[8]Based on the sign of the sum of the autoregressive coefficients, as in Jung and Marshall (1985) and Marin (1992).

Nigeria and Taiwan. Like Jung and Marshall, they find evidence for export-led growth in Indonesia. However, the two papers reach different conclusions for Korea, Taiwan and Thailand (export-led growth in Bahmani-Oskooee et al; export-reducing growth, causality from growth to exports, and internally-generated exports, respectively, in Jung and Marshall).

Afxentiou and Serletis (1991) find no export-led growth in any of the 16 industrial countries in their sample. Although they find unidirectional causality from output growth to export growth in Norway, Canada and Japan, there is a ten-year lag in the effect for the latter two countries. The only other causal relationship they find is bidirectional causality in the U.S.

The clear message from table 1 is that a great variety of techniques, data sets, and country groups have been employed in empirical assessments of the export-led growth hypothesis, with an equally wide variety of results. Our main motivation in undertaking the present study was a desire to reconcile these diverse results, or at least to discover why they could not be reconciled. Moreover, our use of the Summers-Heston (1991) data set and Geweke's (1984) measures of linear feedback also illustrates the value of *measuring* any export-led growth effects, as opposed to simply detecting them.

In interpreting the results below, it will prove useful to be precise about how we translate patterns of causality into statements about export-led growth. When used in this paper, "export-led growth" means that there exists a causal ordering (either direct or indirect) from export growth to income growth, with no "return loop" to export growth. For example, the bi-directional causality found by Chow does not meet our definition of export-led growth, since output growth Granger-causes export growth. Clearly, our definition is not unique. However, we feel that it is the best in terms of emphasizing the extent to which export growth *leads* income growth.[9]

Broadly speaking, the results of bivariate Granger causality tests we performed with the Heston/Summers data are consistent with those of other authors, who find little evidence of export-led growth.[10] Of the 126 countries for which results are available, only 16 display evidence of export-led growth (i.e., unidirectional causality from exports to income) at the 10%

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[9] Theoretical reasons for exports leading growth are summarized in, *inter alia*, Jung and Marshall (1985, p. 3), or Kunst and Marin (1989, p. 699).

significance level.[11] There is evidence of "growth-led exports" in 14 countries, while only 3 appear to have bi-directional causality between exports and income. Thus, the majority of the world's countries exhibit no clear causal ordering between exports and income. However, as we argue below, the results of bivariate Granger causality tests do not provide a comprehensive picture of the evidence regarding export-led growth.

In order to conserve space and simplify exposition, the body of this paper presents results only for a subset of countries in the Summers/Heston data set. This subset includes Hong Kong, Indonesia, Japan, (the Republic of) Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand: results for all countries in the sample are collected in an unpublished Appendix.[12] We focus on these countries in particular because they are often cited as instances of the success of export promotion strategies.

Table 2 presents the results of the bivariate Granger causality analysis for our subset of countries. Here, evidence in favour of the export-led growth hypothesis consists of export growth causing income growth, by which we mean that the null hypothesis of no causality from x to y is rejected at the 10% critical level, but not vice versa, by which we mean the null of no causality from y to x is *not* rejected at the 10% level. Columns 3 and 5 present marginal significance levels for the Granger-causality tests, while columns 7 and 8 contain the same information for the tests of no (unconditional) linear feedback in the sense of Geweke (1982). Further discussion of Geweke's linear feedback measures is given below. Causal inferences based on each of these tests are given in the final two columns of the table.

In columns 4 and 6 of table 2, we report the average response of each variable to a unit shock in the other, over a 16 year period.[13] This provides a means of assessing the sign of the

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[10] An appendix containing a complete set of our results for all 126 countries, as well as the details of the computation of the conditional linear feedback statistics reported below, is available via anonymous ftp from iks.biz.uiowa.edu. The file is called "RSW95.zip" and is in the \pub directory.

[11] The majority of the 24 missing countries have insufficient data for one or more variables to allow estimation. The major oil-exporting countries (eg, Saudi Arabia, Kuwait, the United Arab Emirates) have been excluded from Mark 5.5 of the data set.

[12] Tables 4 and 7 below include additional countries, in order to illustrate specific points. The Appendix is available upon request from the authors. See note 10.

[13] Doing this requires identifying economic shocks (to exports, to income) from statistical residuals. We follow Sims (1980) and use a Wold-causal chain scheme whereby the export shock is the residual in the export equation and the output shock is that part of the output residual which is orthogonal to (uncorrelated with) the export shock (i.e., exports are ordered "first"). We do not consider alternative identifying restrictions or causal orderings in this paper; for this reason, the results should be taken as suggestive.

relationship between export growth and output growth.[14] For example, a unit shock to export growth in Korea (i.e., a one-time doubling of exports) leads to an average increase in the rate of income growth of 0.22% per year for 16 years. Doubling income leads to a drop in export growth of 0.14% per year over the same period.[15] Of all the countries in our study which display evidence of export-led growth, none has a negative response of income to export shocks. Column 9 in the table presents the variable OPEN from the Summers-Heston (1991) data set, which is the share of trade in CGDP. The values reported are for the most recent year available (1990 unless indicated).

[TABLE 2 HERE]

B. The Role of Import Growth

With one exception, previous studies of export-led growth have not addressed the role of import growth in the export-income relationship. Serletis (1992) includes lagged values of import growth in his examination of Canadian data, and finds no Granger causality from import growth to either income growth or export growth. That is, letting m_t denote imports, he estimated equations of the form

$$(3)\qquad \begin{aligned} x_t &= \sum_{i=1}^{p} a_j x_{t-j} + \sum_{i=1}^{p} b_j y_{t-j} + \sum_{i=1}^{p} f_j m_{t-j} + u_t \\ y_t &= \sum_{i=1}^{p} c_j x_{t-j} + \sum_{i=1}^{p} d_j y_{t-j} + \sum_{i=1}^{p} g_j m_{t-j} + v_t \end{aligned}$$

and tested the null hypotheses

(4) H_1: $c_j = 0$, j = 1, ..., p (exports fail to Granger-cause output in the three variable universe)

H_2: $b_j = 0$, j = 1, ..., p (output fails to Granger-cause exports in the three variable universe),

[14] Using the sign of the sum of the autoregressive coefficients, as is done in Jung and Marshall (1985), Marin (1992) and Bahmani-Oskooee et al (1991), amounts to examining the impulse response at an infinite horizon.

[15] The impulse response analysis discussed here differs from many such applications, in that we do not (necessarily) think of the changes in growth rates as being induced by policy changes. Rather, it is our analogue to summing our estimated autoregressive coefficients (see the previous footnote).

as well as similar hypotheses regarding the f_j and g_j. Table 3 reports the results of Granger causality tests in this three-variable system, for the countries listed in table 2.[16]

[TABLE 3 HERE]

Table 4 demonstrates the importance of import growth in the causal ordering. Omitting imports can result in both “type I” and “type II” errors--spurious rejection of export-led growth as well as spurious detection of it. In columns 2 through 7 we present the marginal significance levels for the Granger causality F-tests in two systems: the 2-variable system of export growth and income growth, and a 3-variable system with import growth (m) included. Comparing the two rows for each of the six countries listed, we find that the omission of import growth can mask significant causality between exports and income, or may cause spurious causality.[17] For examples of the former, consider Ghana, South Africa, and Korea. In the two-variable system of exports and income, there is no significant causal ordering for either country. However, the second row for each of these countries shows that there does exist a significant two-stage causal chain, running from exports to imports to income, as well as a direct exports-to-income chain. There is also evidence of bi-directional causality between exports and imports in Korea.

In Japan, the “growth-led exports” phenomenon apparently operates both directly and indirectly through imports. Again, there is evidence of bi-directional causality between exports and imports.

The remaining countries in table 4 provide evidence of the possibility that causal inferences in the two-variable system may be due to omitted variable bias. In each of these countries, significant causality in the first row disappears in the second. The “growth-led exports” inference for Argentina does not change, but it is apparently an indirect causal chain, from income to imports to exports (a “reverse 2-gap model”). By contrast, the (bivariate) export-

[16] Note that this version of Granger causality tests exclusion restrictions on each equation separately, rather than in a full 3-variable VAR. The conditional linear feedback measures reported below are based on such a trivariate system. This difference, combined with sampling error, accounts for the disparity in results between our Granger causality and conditional linear feedback tests.

[17] For simplicity's sake, we will use the term "exports" instead of "growth rate of exports," and so on. When we wish to refer to the *level* of any variable we will say so explicitly.

led growth evidence for Peru is reversed completely in the trivariate system, revealing an indirect link similar to that in Argentina. In Colombia, exports appear to cause both income and imports, while in Sweden there is evidence of bi-directional causality between exports and imports, with imports being caused in turn by income.

[TABLE 4 HERE]

As we have seen, imports may play the role of a confounding variable in causal ordering (i.e., imports affect both income and exports). Failure to account for imports can therefore produce misleading results. In the remainder of this paper, all our results explicitly account for imports.

C. Perspective on the Evidence

There are two major problems with the use of Granger causality tests in searching for export-led growth. The first concerns the difference between statistical significance in the Granger causality F-tests and the strength of the relationship between exports and income. Marginal significance levels (or p-values) cannot be interpreted as indicators of the strength or weakness of any causal relationship. While p-values are certainly of interest, they are arguably of secondary importance to a consistent measurement of the causal relationship itself.

The second major problem is the limited time horizon of Granger causality tests. A finding that exports Granger-cause income means only that the variance in the *one-step-ahead* forecast error, made from predicting income linearly using its own past, is reduced when lags of exports are included. There is no *a priori* reason to think that any causal relationship between exports and imports must necessarily become apparent in a year.[18]

We present two ways of addressing these problems. The first is the decomposition of forecast error variance, and the second uses the measures of conditional linear feedback developed by Geweke (1984). Both methods provide measurements of the strength of feedback between exports and income which are comparable across countries. These measures also allow for a flexible time horizon. These techniques have been used for some time in the empirical

[18]This study, like most others, uses annual data.

macroeconomics literature, but to our knowledge have not previously been applied to the study of export-led growth.

2. New Measures of Export-Led Growth

A. Forecast Error Variance Decomposition

The forecast error variance decomposition (FEVD) is a way to answer the question, "How much of the variance in forecast errors of future income growth can be attributed to innovations in export growth?" This technique is standard in the VAR approach; for details, the reader is referred to Doan (1992), Sims (1980), etc.

Because the FEVD is based on the decomposition of the covariance matrix of the 3-variable vector autoregression (VAR), and because this decomposition is not unique, the fraction of the forecast error in income attributable to exports generally changes depending on the ordering of the variables. In order to set a criterion for export-led growth, we seek countries in which exports explain at least 25% of the variance of the 5-year-ahead forecast of income, when exports are placed second in the decomposition ordering. In other words, this ordering gives imports the "first shot" at explaining the variance of income forecasts. We chose a five year horizon based on evidence for a world business cycle of roughly that duration (Riezman and Whiteman, 1991). Countries which meet our criterion are thus the ones in which the role of export growth is particularly strong in explaining income growth.

Table 5 lists those countries which display evidence of export-led growth when measured by either Granger causality (in the 3-variable system) or FEVD. The table reports results for the Wold-causal chain orderings x-m-y and m-x-y.[19] The last column of the table reports the fraction of income forecast error variance explained by income innovations. This column gives an indication of the degree to which income growth is exogenous with respect to export growth and import growth. It is worth mentioning here that this group of countries is not presented as the only group exhibiting export-led growth. The fact that a particular country (Colombia, for example) appears to have export-led growth by one criterion and not another may be due solely

[19]See footnote 10 above.

to the difference in time horizon (short-term for Granger causality, medium-term for FEVD). We will return to this point below.

[TABLE 5 HERE]

B. Measures of Linear Feedback

(i) Unconditional Linear Feedback

The linear feedback measures developed by Geweke (1982, 1984) provide an alternative to both Granger causality tests and the FEVD. These statistics are designed not just to *detect* a feedback relationship (i.e., a causal ordering) but to provide a measure of its *strength*. While the Granger causality statistics simply reflect whether forecast error variance is reduced by adding another variable, it is useful to consider the extent of this reduction. Let $F_{x \to y}$ denote the measure of linear feedback from exports to income. The reduction in the variance of the (one-step-ahead) mean squared income forecast error, when exports are included in the regression, is given by -exp(-$F_{x \to y}$). Pierce (1982) notes that 1-exp(-$F_{x \to y}$) can be interpreted analogously to the coefficient of determination (R^2) in ordinary regression. As noted by Geweke (1982), $F_{x \to y}$ has all the features one expects in a measure--it is positive, monotone, and (in its R^2 form) lies between zero and unity. The absence of Granger causality from x to y is equivalent to $F_{x \to y} = 0$. Furthermore, these measures are invariant under filtering of the time series by (possibly different) invertible lag operators. Finally, when the data are measured in comparable units (e.g., the growth rates used here) this measure is comparable across countries.

We report the marginal significance levels for the test of (unconditional) linear feedback in Tables 2 and A1 (columns 7 and 8), along with the bivariate Granger causality results. These statistics are monotonic transformations of the F statistics computed in Granger causality tests for a system of (possibly vector-valued) time series **u** and **v**. When multiplied by the sample size, these measures have an asymptotic chi-square distribution, with degrees of freedom equal to the number of lags if **u** and **v** are univariate.[20] The two measures of causality are generally

[20]When **u** and **v** are multivariate, the degrees of freedom is equal to (number of lags)*(dimension of **u**)*(dimension of **v**). See Geweke (1982, 1984) for a more complete description of these measures.

consistent. Of the 33 countries which exhibit a significant Granger causal ordering, 31 have the same ordering as measured by Geweke's linear feedback measures. A causal ordering is somewhat more likely using Geweke's measures; 13 countries have evidence of “Geweke feedback” but no Granger causality. Only two countries exhibit significant Granger causality but no linear feedback.[21] In addition, for the countries which pass one test but not the other, the marginal significance levels are not “off” by very much.

(ii) Conditional Linear Feedback

When income is forecast using lags of itself and imports, adding lagged values of exports reduces forecast error variance by an amount given by the same formula as above, but using $F_{x \to y|m}$, the measure of *conditional* linear feedback from exports to income (Geweke, 1984). Both the conditional and unconditional measures can be decomposed by frequency in order to examine the nature of the causal relationship at various time horizons. This feature is discussed in the next section.

The great attraction of the measures of *conditional* linear feedback is that they allow us to focus on the causal relationship between exports and output, while at the same time controlling for imports. This helps us avoid the “omitted variables” situation described in section 1B. In contrast to the unconditional linear feedback measures however, there is no tractable asymptotic distribution theory available for the conditional measures. We therefore use Monte Carlo integration to compute Bayesian posterior distributions for these statistics (computational details are given in the Appendix, along with our non-informative prior distribution).

Table 6 presents the conditional linear feedback statistics for 9 countries in the Pacific Rim. (Results for all countries are presented in Table 9.) The conditional linear feedback measures in table 6 are expressed in their “R^2” version for ease of exposition. Thus, point estimates indicate that for Hong Kong, roughly 19% of the one-step ahead forecast error variance for income growth is explained by export growth, after the effects of import growth have been accounted for. Conversely, 25% of the forecast error variance for export growth is explained by income growth.

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[21]Actually, these two countries (Syria and Taiwan) show evidence of significant but *different* causal orderings under the two measures: export-led growth under Granger causality, but bi-directional causality under Geweke's measures.

There is evidence for export-led growth when the bulk of the $F_{x \to y|m}$ distribution lies to the right of the $F_{y \to x|m}$ distribution. Note that in Taiwan, the 90th percentile of the distribution of $F_{y \to x|m}$ lies below the 10th percentile of the $F_{x \to y|m}$ distribution. We believe this constitutes strong evidence of export-led growth, and use this condition as our preferred criterion for assessing the conditional linear feedback estimates.

This criterion for export-led growth is met in 19 of the countries in our sample.[22] Comparable evidence in favor of "growth-led exports" is present in 10 countries, including Japan and Korea in table 6.[23] It therefore seems that the export-led growth hypothesis is somewhat more likely than its converse.

[TABLE 6 HERE]

Expressing the feedback measures in terms of percentage of forecast error variance explained is also useful in cases where no clear causal ordering is present. For example, although a causal ordering is indicated in only three countries in table 6, point estimates of the predictive power of exports in explaining income growth exceed the converse in six of the nine.[24] Moreover, feedback from income growth to export growth is stronger for these nine countries than that for the sample overall: point estimates of the R^2 version of $F_{y \to x|m}$ are 40% for the countries in table 6, and 34% for all 126 countries. Comparable figures for $F_{x \to y|m}$ are 36% in both groups. It would therefore seem that although the conditional feedback measures provide weak support for export-led growth in these countries, the strength of the causal relationship differs little, on average, from the world as a whole.

An interesting pattern emerges when our results are compared with those of Jung and Marshall (1985), Bahmani-Oskooee et al (1991), and Afxentiou and Serletis (1992). First, we

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Apart from these two, the "Granger causal set" of countries is a proper subset of the "Geweke feedback set."

[22] An alternative criterion would be for $\hat{F}_{x \to y|m} > F^{(90)}_{y \to x|m}$ and $\hat{F}_{y \to x|m} < F^{(10)}_{x \to y|m}$ where $\hat{F}$ and $F^{(j)}$ denote the point estimate and the jth posterior percentile, respectively, of the indicated measure of feedback. This weaker criterion has more of the flavor of a standard one-sided hypothesis test. Measured in this way, 30 countries (24% of the sample) show evidence of export-led growth.

[23] Or 25 (20% of the sample), using the weaker criterion of footnote 18.

tend to find evidence of export-led growth more often than these authors. Using our weaker criterion, we find export-led growth in 9 of the 37 countries studied by Jung and Marshall (compared to their 4); in 5 of 20 studied by Bahmani-Oskooee et al (they find 3); and in 3 of 16 studied by Afxentiou and Serletis (who found 1). Second, although there are instances where our conclusions match those of these other authors, our results differ in general. For example, we confirm Jung and Marshall's findings in their four "export promotion" countries (Indonesia, Egypt, Costa Rica, Ecuador),[25] but of the 27 causal infrerences made by the others, we reach the same conclusion in only 8 (including Ecuador and Indonesia). It could be that this is due to the fact that none of these three papers includes import growth in their analysis, or to differences in data sets, length of sample period or technique.

Additional light can be shed on our results by considering the relationship between a country's openness and the support for the export-led growth hypothesis in that country. Table 7 lists the 10 countries with the "strongest" (conditional) causal inference in each direction (ie, from exports to income and vice versa). In measuring strength, we computed the difference between the R^2 for exports causing income and the R^2 for income causing exports. We interpret this difference as the relative strength of export-led growth, and report it as the variable RSX in table 7. We also report each country's degree of openness.

[TABLE 7 HERE]

Examination of table 7 shows that openness is neither necessary nor sufficient for a causal inference between exports and income. In the 20 countries in table 7, the correlation between openness and the relative strength of exports is just 0.0883.[26] This result suggests that the success or failure of trade policies in stimulating income growth depends on more than merely increasing the *volume* of trade.[27]

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[24] "Point estimates" are computed using the posterior mean values of VAR parameters. Also, note that Indonesia, the Philippines and Singapore narrowly miss satisfying our weaker criterion; the required difference in posterior deciles is less than 1% in each case.

[25] Ecuador is another "borderline" case, similar to the countries in footnote 22.

[26] For all 126 countries analyzed, this correlation is 0.0246, while for those for which we make a causal inference, it is 0.0654.

[27] Indeed, the fact that some of the world's most open economies are those of sub-Saharan Africa suggests that the trade-growth relationship is not a simple one.

C. The Temporal Nature of Export-Led Growth: Conditional Feedback by Frequency

A key motivation for the use of Geweke's measures of linear feedback is that these statistics may be additively decomposed by frequency. This enables us to examine not only the overall strength of a causal relationship, but also the temporal horizon over which it acts. We may therefore gain new insights into whether export-led growth is a long- or short-term phenomenon, if it is particularly strong at business cycle frequencies, etc. Details of the frequency decomposition are given in the Appendix.[28]

Figures 1 and 2 illustrate the usefulness of the frequency decompositions. The figures compare the conditional feedback between exports and income for Japan and Korea, respectively. According to table 6, both countries display strong evidence of growth-led exports. However, the temporal nature of the relationship is quite different, as the figures show. In Japan, feedback from exports to income is virtually nonexistent at all frequencies (figure 1a). Although the posterior medians of the various distributions are around 20% for cycles of 5.3 years or less, the corresponding point estimates never exceed 10%. Feedback from income to exports (figure 1b) is much stronger at all frequencies; point estimates increase from just under 60% in the very short run, to 90% in the long run.

In Korea, the pattern of feedback from exports to income is similar to that for Japan in the short run, with point estimates around 20% (figure 2a). However, feedback in this direction becomes much stronger in the long run, exceeding 80% in the very long run. The pattern of feedback from income to exports (figure 2b) is nearly the mirror image, with point estimates declining from 70% at cycles of 4.57 years to just over 10% at the longest cycles. Using the criteria introduced in the last section on a frequency-by-frequency basis, we find weak export-led growth (ie, $(x \rightarrow y)$, in the notation of table 6) for Korea for cycles longer than 10.67 years. In Japan, we find at least weak growth-led exports at all cycles longer than 2.29 years, with our stronger criterion met for cycles of 8 years or longer.

Although this decomposition of the conditional linear feedback measures by frequency provides a more detailed analysis of export-led growth within a particular country than was

[28]Note that this decomposition addresses a different issue than that of selecting the appropriate lag length in a standard Granger causality test. The latter is concerned with the appropriate specification of the autoregressive representation of the system; the former is derived from the moving average representation.

possible before, it leaves unanswered the question of *why* the export growth-income growth relationship differs across countries. The answer to this question requires a level of detailed analysis at the individual country level which is clearly beyond the scope of this paper. However, we believe this type of analysis can be used to direct future research into the appropriate *implementation* of export promotion policies in particular countries.

D. The Role of Investment and Human Capital

Given the results presented so far, a natural question arises: How do we know that our three-variable system is free of the "omitted variables" problem discussed in section 1B? In particular, what would happen if our analysis used human and/or physical capital accumulation as additional conditioning variables? Table 8 provides a partial answer. There we present values of the feedback between exports and income, conditional on human capital growth and investment growth as well as import growth, for the Pacific Rim countries in table 6 (except Taiwan, for which we do not have a sufficiently long series for human capital).[29] A comparison of these two tables shows that the strength of conditional feedback in each direction increases with the addition of variables to the conditioning set. The sole exception is in Korea, where $F_{y\rightarrow x|h,i,m}$ is lower than $F_{y\rightarrow x|m}$. Evidence for growth-led exports remains strong in Japan, but weakens considerably for Korea. Our weak criterion for causal inference is now met in Indonesia (export-led growth) and Thailand (growth-led exports). Malaysia, Singapore and Thailand now have stronger feedback from income growth to export growth than vice versa; this is the reverse of the results in table 6. Table 8 therefore suggests that our results may be subject to some degree of omitted variable bias.

[TABLE 8 HERE]

[29]The human capital measure is primary school enrolment as a percentage of primary school age children in each country (UNESCO), through 1990. Because this data is available only every 5 years from 1960-1985 for most countries, we use linear interpolation to estimate the data for the missing years. Investment is the total investment expenditure in CGDP (Summers and Heston, 1991).

3. Conclusions

This paper has addressed some of the limitations of existing methods of detecting evidence for the export-led growth hypothesis. In particular, we have shown that failure to account for the role of import growth can produce misleading results in the analysis of the relationship between export growth and income growth. We have presented two alternative methods of measuring the export-income relationship which allow us to control for the effect of imports. Use of these measures (the FEVD and conditional linear feedback) also permits us to investigate the nature of export-led growth at flexible time horizons, rather than focusing on a one year horizon.

We believe our analysis points out several facts which need to be considered by theorists developing models of economic growth. First, export-led growth, when interpreted as a unidirectional causal ordering from exports to income, finds modest support in the Summers/Heston data set, seeming slightly more likely than the reverse ordering. Thirty of the countries in our study meet this definition of export-led growth, compared to 25 which have growth-led exports. The particular definition used (especially whether one interprets bi-directional causality as a form of export-led growth) may increase the prevalence of export-led growth still further. For example, the strength of conditional linear feedback from exports to income is stronger than feedback in the opposite direction in 65 of the 126 countries we study. Second, the role of the growth rate of imports cannot be ignored when examining the relationship between export growth and income growth. Third, the effects of export growth on income growth not only vary across countries, they are not uniform over time for the same country. In particular, even in a country such as Korea, which exhibits *overall* evidence of growth-led exports, there may be time horizons at which feedback from exports to income dominates that from income to exports. This suggests that it may prove fruitful to examine the temporal nature of export-led growth more closely, in addition to its geographical occurrence.

Regarding the question raised at the beginning of the paper, “how can a country accelerate the pace of its economic development,” our results provide little in the way of policy prescriptions, nor were they intended to. They do indicate that trade and growth interact in an important and subtle way which merits futher research.

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Table 1. Previous time-series studies of export-led growth

Author(s)[a]	**Method**		**Variables and Sources**	**Sample**	**Results**[b]
	Causality	Lag Length			
Jung & Marshall (1985)	Granger-causality (GC)	--	Real GDP, real exports *International Financial Statistics* (IFS)	37 LDCs	x→y in Indonesia, Egypt, Costa Rica and Ecuador
Chow (1987)	Sims's version of GC	--	Manufactured exports, manufacturing output; from *Yearbook of International Trade Statistics, Yearbook of National Account Statistics, Taiwan Statistical Data Book, Key Indicators of Developing Member Countries of Asian Development Bank*	Argentina, Brazil, Hong Kong, Israel, Korea, Mexico, Singapore, Taiwan	No causality in Argentina; x→y in Mexico; x↔y in all others
Darrat (1987)	White (1980)	No formal tests; up to 4 lags examined	Growth rates of real GDP and real exports, from IFS and *World Development Report*	Korea, Taiwan, Singapore, Hong Kong	x→y in Korea
Ram (1987)	Time series regression; aggregate production function specification, incorporating possible export externalities		Real GDP, exports, investment share, population growth, from World Bank's *World Tables* (WT)	88 Less developed countries	x→y in 38 or 37 countries (depending on specific model being estimated); positive but insignificant relationship in another 35 or 40
Kunst & Marin (1989)	GC	2 methods: a) AIC on diag. elements of AR coefficient matrix; off-diag. elements set at 4 b) diag. elements as in a; off-diag. set by backward elimination from maximum 8 lags	Exports, terms of trade and productivity, all in manufacturing, OECD GDP	Austria	OECD GDP→Productivity
Ahmad & Kwan (1991)	GC on pooled sample; AIC for lag length	Akaike Information Criterion (AIC)	Real GDP per capita, level and growth rate; real exports (total and mfd), share of mfd exports in total; from *Economic Indicators of African Development*	47 African countries	no x→y in any of several specifications; little causality overall

[a]See the cited works for specific details regarding methods, years of data sources, etc.
[b]x is the export variable, y is the income variable (both vary across studies); arrows denote directions of causality

Table 1. Continued

Author(s)[a]	Method: Causality	Method: Lag Length	Variables and Sources	Sample	Results[b]
Bahmani-Oskooee et al (1991)	Standard GC, also measured by FPE reduction	Final Prediction Error (FPE)	Real exports and GDP (1975 prices); from IFS, *Statistical Yearbook of the Republic of China*	20 LDCs	x→y in 10 (including those for which tests conflict); unidirectional positive relationship in Nigeria & Taiwan only
Afxentiou & Serletis (1991)	GC on growth rates after unit root (Phillips-Perron) and cointegration (Engle-Yoo) tests	Schwartz Criterion (SC)	Real exports (IFS) and GNP (Summers-Heston 1988)	All countries classified as industrial by IMF (16)	x↔y in U.S.; y→x in Norway, Canada, Japan (with 10-yr lag in Canada, Japan)
Kugler (1991)	Tests for presence of exports in cointegrating relationship, using Johansen/Juselius procedure ADF for stationarity	AIC	Real GDP (GNP for US), private consumption, investment and exports; from OECD	US, Germany, Japan, UK, France, Switzerland	Exports enter cointegrating vector only in Germany and France
Marin (1992)	GC	Bayesian Information Criterion (BIC)	As in Kunst & Marin (1989)	Germany, U.K., U.S., Japan	x→y for all four, but little impact as measured by sum of AR coefficients
Serletis (1992)	GC after Phillips-Perron tests for unit roots, Engle-Granger tests for cointegration	SC	Exports, imports, GNP; from Urquhart (1988)	Canada	x→y except for post-WWII period
Bahmani-Oskooee and Alse (1993)	Regression analysis of error-correction model, after ADF for stationarity, and ADF and CRDW for cointegration		Real exports and income; quarterly data constructed from annual IFS figures	Colombia, Greece, Korea, Malaysia, Pakistan, Philippines, Singapore, South Africa, Thailand	x↔y for all but Malaysia (x and y not cointegrated in Malaysia)
Dodaro (1993)	GC	Set at 2 lags	Real GDP, exports of goods and non-factor services; from WT	87 LDCs	x→y (positive effect) in 7; y→x (positive effect) in 13

[a]See the cited works for specific details regarding methods, years of data sources, etc.
[b]x is the export variable, y is the income variable (both vary across studies); arrows denote directions of causality

Table 1. Continued

Author(s)[a]	Method		Variables and Sources	Sample	Results[b]
	Causality	Lag Length			
Ghartey (1993)	FPE, Hsiao (1979)	FPE, BIC	Exports, GNP, capital stock, terms of trade; from *Survey of Current Business* (US); *Quarterly National Income Statisitcs*, *Monthly Statistics of Exports and Imports*, and *Financial Statistics, Taiwan District* (Taiwan); *Dep't. of National Accounts*, *Economic Research Institute*, and *Economic Planning Agency* (Japan)	U.S., Japan, Taiwan	x→y in Taiwan, y→x in U.S., terms of trade→x in Japan
Oxley (1993)	Modified Wald test (Schmidt, 1976) after ADF and Johansen tests for unit roots & cointegration	FPE	Real GDP, exports (1914 prices); from Nunes et al (1989)	Portugal	y→x
Ukpolo (1994)	Time series regression of output on disaggregated exports		Real GDP; exports of fuel, non-fuel primary products, and manufactures; sizes of public and private sectors, from World Bank	Congo Republic, Kenya, Morrocco, Nigeria, Senegal, Sierra Leone, Tanzania, Togo	x→y for non-fuel primary products

[a]See the cited works for specific details regarding methods, years of data sources, etc.
[b]x is the export variable, y is the income variable (both vary across studies); arrows denote directions of causality

Table 2. Measures of export-led growth, 2-variable system.

COUNTRY	DATA	$x \to y$[b] GC	impulse[c]	$y \to x$[b] GC	impulse[c]	$x \to y$[b] LF	$y \to x$[b] LF	OPEN[d]	Inference[e] (GC)	Inference[e] (LF)
HONG KONG	1960-90	0.4590	0.0015	0.2624	0.0002	0.3875	0.1962	268.22	0	0
INDONESIA	1960-90	0.7174	0.0051	0.8582	-0.0032	0.6675	0.8302	50.92		
JAPAN	1950-90	0.8530	0.0001	0.0135	0.0079	0.8240	0.0053	21.58	$y \to x$	$y \to x$
REP. OF KOREA	1953-89	0.3200	0.0022	0.1242	-0.0014	0.2470	0.0773	65.72 (89)	0	$y \to x$
MALAYSIA	1955-90	0.9881	0.0067	0.9896	-0.0003	0.9855	0.9873	156.06		
PHILIPPINES	1950-90	0.7707	0.0011	0.0165	0.0034	0.7283	0.0068	61.16	$y \to x$	$y \to x$
SINGAPORE	1960-90	0.6000	0.0055	0.5726	0.0010	0.5369	0.5072	373.83	0	0
TAIWAN	1951-90	0.0110	0.0033	0.1215	-0.0048	0.0041	0.0769	89.43	$x \to y$	$x \leftrightarrow y$
THAILAND	1950-90	0.2031	0.0022	0.1903	-0.0014	0.1436	0.1327	78.43		

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "$\to$" = unidirectional causality, "$\leftrightarrow$" = bi-directional causality.

Table 3. Granger causality tests, 3-variable system.

Country	Data	$x \to y$[a,b]	$y \to x$	$x \to m$	$y \to m$	$m \to x$	$m \to y$
HONG KONG	1960-90	0.1562	0.1557	0.3946	0.0652	0.3108	0.2722
INDONESIA	1960-90	0.1442	0.8001	0.8710	0.7633	0.9159	0.1774
JAPAN	1950-90	0.6564	0.0105	0.0574	0.0823	0.0093	0.7552
REP. OF KOREA	1953-89	0.0406	0.2763	0.0091	0.3866	0.0454	0.0846
MALAYSIA	1955-90	0.3609	0.5146	0.0889	0.3727	0.0588	0.0070
PHILIPPINES	1950-90	0.3136	0.0029	0.0565	0.0001	0.1117	0.1698
SINGAPORE	1960-90	0.9162	0.8546	0.3814	0.6479	0.2972	0.7786
TAIWAN	1951-90	0.0953	0.1527	0.3351	0.7924	0.8939	0.8371
THAILAND	1950-90	0.5530	0.1458	0.1137	0.1776	0.4905	0.6979

[a] x is the growth rate of exports; m is the growth rate of imports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality.

Table 4. Granger causal orderings, 2-variable vs 3-variable systems.

	$x \to y$	$y \to x$	$x \to m$	$y \to m$	$m \to x$	$m \to y$
GHANA	0.2309	0.8141				
	0.0068	0.8096	0.0521	0.3552	0.6667	0.0226
SOUTH AFRICA	0.2249	0.4357				
	0.0177	0.6549	0.0314	0.0258	0.1103	0.0017
ARGENTINA	0.6289	0.0144				
	0.5029	0.3726	0.3530	0.0261	0.0959	0.4956
COLOMBIA	0.0641	0.0340				
	0.0216	0.5229	0.0783	0.5796	0.4980	0.2218
PERU	0.0146	0.9991				
	0.1493	0.2891	0.4988	0.0785	0.0074	0.9612
SWEDEN	0.0079	0.6523				
	0.2723	0.7658	0.0003	0.0220	0.0344	0.4092
JAPAN	0.8530	0.0135				
	0.6564	0.0105	0.0574	0.0823	0.0093	0.7552
REP. OF KOREA	0.3200	0.1242				
	0.0406	0.2763	0.0091	0.3866	0.0454	0.0846

[a]Entries are marginal significance levels for null hypotheses of no Granger causality. Notation parallels that of Table 3.

Table 5. Five year forecast error variance decomposition

Country	x-m-y[a]	m-x-y[a]	% y[b]
HONG KONG	18.97	11.60	67.93
INDONESIA	22.88	44.60	44.53
JAPAN	2.85	2.82	94.37
REP. OF KOREA	17.43	24.38	63.35
MALAYSIA	67.18	19.48	21.29
PHILIPPINES	3.47	3.49	89.61
SINGAPORE	56.61	4.65	42.33
TAIWAN	58.18	17.58	39.16
THAILAND	22.23	13.04	59.08

[a]Entries are the percent of the five year forecast error in income which is attributable to innovations in exports, for the given ordering

[b]Percentage of income forecast error variance attributable to income innovations

Table 6. Linear feedback conditional on imports (R^2 measure).

		$1-\exp(-F_{x\to y\mid m})^a$				$1-\exp(-F_{y\to x\mid m})^a$				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt. est.	10th	50th	90th	pt. est.	
HONG KONG	1960-90	0.1475	0.2521	0.4047	0.1858	0.1892	0.2752	0.3803	0.2493	
INDONESIA	1960-90	0.1354	0.2832	0.4809	0.2075	0.0243	0.0850	0.2100	0.0274	
JAPAN	1950-90	0.0417	0.0929	0.2176	0.0319	0.6121	0.7284	0.8070	0.7468	$y\to x$
REP. OF KOREA	1953-89	0.2134	0.3296	0.4518	0.2737	0.5205	0.6209	0.6980	0.6439	$y\to x$
MALAYSIA	1955-90	0.4703	0.6033	0.7176	0.6081	0.3922	0.5324	0.6278	0.5308	
PHILIPPINES	1950-90	0.3630	0.4364	0.4961	0.4494	0.3266	0.3815	0.4474	0.3689	
SINGAPORE	1960-90	0.3802	0.5784	0.7207	0.5638	0.1837	0.3589	0.5122	0.3877	
TAIWAN	1951-90	0.5104	0.6487	0.7380	0.6546	0.2030	0.3535	0.4686	0.3838	$x\to y$
THAILAND	1950-90	0.2187	0.3367	0.4457	0.2948	0.1945	0.2852	0.4250	0.2440	

[a] $F_{x\to y\mid m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x\mid m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of $1-\exp(-F_{x\to y\mid m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] $x\to y$ means that the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$. $(x\to y)$ means that the point estimate of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$, and the point estimate of $1-\exp(-F_{y\to x\mid m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$. $y\to x$ and $(y\to x)$ are interpreted similarly.

Table 8. Linear feedback conditional on human capital, investment, and imports (R^2 measure).

		$1-\exp(-F_{x\to y\|h,i,m})$[a]				$1-\exp(-F_{y\to x\|h,i,m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt. est.	10th	50th	90th	pt. est.	
HONG KONG	1960-90	0.3250	0.4841	0.6496	0.3714	0.4491	0.5596	0.6529	0.5324	
INDONESIA	1960-90	0.5472	0.6566	0.7483	0.6946	0.2473	0.4038	0.5600	0.3095	(x→y)
JAPAN	1950-90	0.2080	0.3720	0.5558	0.2316	0.7629	0.8343	0.8815	0.8513	y→x
REP. OF KOREA	1953-89	0.3905	0.5206	0.6588	0.5162	0.5104	0.6070	0.6970	0.6257	
MALAYSIA	1955-90	0.6174	0.7185	0.8035	0.7128	0.6816	0.7892	0.8556	0.7960	
PHILIPPINES	1950-90	0.4848	0.6006	0.7007	0.6146	0.4552	0.5519	0.6477	0.5484	
SINGAPORE	1960-90	0.5758	0.7379	0.8460	0.7535	0.5465	0.6960	0.7917	0.7733	
TAIWAN[c]	1951-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
THAILAND	1950-90	0.4212	0.5443	0.6367	0.5287	0.5912	0.7007	0.7857	0.7160	(y→x)

[a] $F_{x\to y|h,i,m}$ is the measure of linear feedback from exports to income, conditional on human capital, investment and imports. $F_{y\to x|h,i,m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of $1-\exp(-F_{x\to y|h,i,m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y, (x→y), y→x and (y→x) are defined analogously to the same type of inference in table 6.

[c] Unavailable due to the lack of a sufficiently long data series for human capital.

Table 7. Relationship between conditional linear feedback (R^2 measure) and openness.

COUNTRY	$1\text{-exp}(-F_{x\rightarrow y\|m})$ [a]	$1\text{-exp}(-F_{y\rightarrow x\|m})$ [a]	RSX [b]	OPEN [c]	Inference [d]
EGYPT	0.7498	0.0507	0.6991	65.06	x→y
NEPAL	0.8267	0.2107	0.6159	35.15	x→y
URUGUAY	0.6698	0.1128	0.5570	46.54	x→y
GHANA	0.5052	0.0268	0.4784	48.75	x→y
RWANDA	0.6168	0.1517	0.4651	27.17	x→y
MALI	0.6333	0.1704	0.4629	51.33	x→y
MOROCCO	0.6355	0.2042	0.4313	56.13	x→y
ICELAND	0.6594	0.2368	0.4226	72.02	x→y
IRAN	0.4460	0.0269	0.4191	23.8	x→y
TUNISIA	0.5785	0.1761	0.4024	90.78	x→y
average	0.6321	0.1367	0.4954	51.67	--
SEYCHELLES	0.1845	0.5485	-0.3640	109.77	y→x
REP. OF KOREA	0.2737	0.6439	-0.3702	65.72	y→x
GUINEA-BISSEAU	0.1064	0.4873	-0.3809	78.99	y→x
MALAWI	0.0439	0.4284	-0.3845	58.02	y→x
CAMEROON	0.1046	0.5037	-0.3991	40.34	(y→x)
ZIMBABWE	0.0607	0.5213	-0.4607	64.88	y→x
YEMEN	0.0952	0.6081	-0.5128	41.9	y→x
ARGENTINA	0.1463	0.7765	-0.6302	20.79	y→x
BANGLADESH	0.1466	0.8564	-0.7097	26.42	y→x
JAPAN	0.0319	0.7468	-0.7148	21.58	y→x
average	0.1194	0.6121	-0.4927	52.84	--
ρ(RSX, OPEN) [e]				0.0883	

[a] Point estimates of $1\text{-exp}(-F_{x\rightarrow y|m})$ and $1\text{-exp}(-F_{y\rightarrow x|m})$, as defined in table 6. Countries listed are those with the ten largest and ten smallest values for RSX.
[b] Relative strength of exports, defined as the difference between columns 2 and 3.
[c] As in table 2.
[d] x→y, (x→y),y→x and (y→x) as defined in table 6.
[e] Coefficient of correlation between RSX and OPEN.

Table 9. Linear feedback between export growth and income growth, conditional on import growth.

		$1-\exp(-F_{x \to y \mid m})$[a]				$1-\exp(-F_{y \to x \mid m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt est	10th	50th	90th	pt est	
ALGERIA	1960-90	0.1076	0.2480	0.4129	0.2044	0.0658	0.1739	0.3089	0.1582	
ANGOLA	1960-89	0.0978	0.2163	0.3505	0.1934	0.2677	0.3896	0.4962	0.3921	(y→x)
BENIN	1959-89	0.1381	0.3338	0.4964	0.3353	0.2291	0.3077	0.4294	0.3061	
BOTSWANA	1960-89	0.0791	0.1411	0.2455	0.1187	0.1150	0.1976	0.3208	0.1871	
BURKINA FASO	1959-90	0.0693	0.1278	0.2447	0.0704	0.0586	0.1093	0.1887	0.0951	
BURUNDI	1960-90	0.1194	0.2681	0.4184	0.2944	0.1255	0.2860	0.4522	0.2956	
CAMEROON	1960-90	0.0743	0.1803	0.3229	0.1046	0.2959	0.4631	0.5912	0.5037	(y→x)
CAPE VERDE IS.	1960-89	0.2417	0.3407	0.4521	0.3321	0.1382	0.2585	0.4538	0.1595	
CENTRAL AFRICAN REP.	1960-90	0.0996	0.1438	0.2322	0.1141	0.2343	0.3444	0.4543	0.3437	y→x
CHAD	1960-90	0.3175	0.4037	0.5021	0.4247	0.3230	0.4375	0.5397	0.4554	
COMOROS	1960-86	0.1835	0.3227	0.4794	0.3192	0.1084	0.2079	0.3466	0.1886	
CONGO	1960-90	0.1534	0.2699	0.4216	0.2109	0.1188	0.2145	0.3734	0.2043	
DJIBOUTI	1970-87	0.6343	0.7554	0.8560	0.7699	0.4957	0.6928	0.7839	0.6652	
EGYPT	1950-90	0.6509	0.7433	0.8075	0.7498	0.0443	0.0952	0.1978	0.0507	x→y
ETHIOPIA	1960-86	0.1919	0.3949	0.5654	0.4126	0.4117	0.5020	0.6093	0.5004	
GABON	1960-90	0.4199	0.5622	0.6633	0.5746	0.0899	0.1795	0.2766	0.1851	x→y
GAMBIA	1960-90	0.0348	0.1179	0.2656	0.0597	0.2112	0.2993	0.4056	0.2682	(y→x)
GHANA	1955-89	0.3808	0.4858	0.5608	0.5052	0.0341	0.1004	0.2580	0.0268	x→y
GUINEA	1959-89	0.1133	0.2098	0.3614	0.2033	0.2228	0.2735	0.3709	0.2476	
GUINEA-BISSEAU	1960-90	0.0866	0.1352	0.2228	0.1064	0.2839	0.4677	0.6134	0.4873	y→x
IVORY COAST	1960-90	0.5048	0.6248	0.7159	0.6320	0.0983	0.2547	0.3982	0.2436	x→y
KENYA	1950-90	0.0717	0.1460	0.2840	0.1303	0.1553	0.2340	0.3826	0.1530	
LESOTHO	1960-90	0.6106	0.7616	0.8441	0.8212	0.5621	0.6699	0.7457	0.7065	
LIBERIA	1960-86	0.3262	0.4508	0.5715	0.4580	0.2408	0.3513	0.4589	0.2956	
MADAGASCAR	1960-90	0.2550	0.4033	0.5327	0.4286	0.1636	0.2815	0.4085	0.2564	
MALAWI	1954-90	0.0433	0.1061	0.2275	0.0439	0.3076	0.4209	0.5269	0.4284	y→x
MALI	1960-90	0.4787	0.6089	0.7194	0.6333	0.0869	0.1868	0.3277	0.1704	x→y
MAURITANIA	1960-90	0.3281	0.4873	0.6357	0.5071	0.0706	0.1959	0.3516	0.1466	(x→y)
MAURITIUS	1950-90	0.0613	0.1640	0.3058	0.0902	0.1923	0.3402	0.4765	0.3412	(y→x)

[a] $F_{x \to y \mid m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y \to x \mid m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1-\exp(-F_{x \to y \mid m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1-\exp(-F_{x \to y \mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y \to x \mid m})$. (x→y) means that the point estimate of $1-\exp(-F_{x \to y \mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y \to x \mid m})$, and the point estimate of $1-\exp(-F_{y \to x \mid m})$ lies below the 10th posterior decile of $1-\exp(-F_{x \to y \mid m})$. y→x and (y→x) are interpreted similarly.

Table 9. Continued

		$1-\exp(F_{x\to y\|m})$[a]				$1-\exp(-F_{y\to x\|m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt est	10th	50th	90th	pt est	
MOROCCO	1950-90	0.4717	0.6038	0.7053	0.6355	0.0880	0.2084	0.3711	0.2042	x→y
MOZAMBIQUE	1960-90	0.1489	0.2794	0.4277	0.2678	0.2874	0.3980	0.5111	0.3992	
NAMIBIA	1960-89	0.2309	0.3506	0.4484	0.3669	0.3562	0.4850	0.6157	0.4856	
NIGER	1960-89	0.2424	0.4024	0.5559	0.4241	0.3834	0.5328	0.6432	0.5696	
NIGERIA	1950-90	0.1264	0.2239	0.3704	0.1913	0.0187	0.0753	0.2047	0.0505	
REUNION	1960-88	0.2045	0.3324	0.4574	0.3409	0.0518	0.1399	0.2830	0.0893	(x→y)
RWANDA	1960-90	0.4413	0.6187	0.7505	0.6168	0.1057	0.1786	0.3033	0.1517	x→y
SENEGAL	1960-90	0.2749	0.4047	0.5203	0.4440	0.4011	0.5535	0.6917	0.5774	
SEYCHELLES	1960-89	0.1275	0.2240	0.3590	0.1845	0.4023	0.5162	0.6121	0.5485	y→x
SIERRA LEONE	1961-90	0.0697	0.1663	0.3090	0.1167	0.1903	0.3379	0.4398	0.3261	(y→x)
SOMALIA	1960-89	0.2129	0.3992	0.5901	0.3968	0.3556	0.4878	0.6024	0.4958	
SOUTH AFRICA	1950-90	0.5854	0.6788	0.7603	0.6842	0.3077	0.4857	0.6254	0.4937	(x→y)
SUDAN	1971-90	0.5188	0.6857	0.8268	0.7555	0.3811	0.5246	0.6399	0.5391	
SWAZILAND	1960-89	0.1354	0.2405	0.4010	0.2064	0.2669	0.4086	0.5383	0.4259	(y→x)
TANZANIA	1950-88	0.0613	0.1388	0.2596	0.0832	0.0857	0.2090	0.3757	0.1962	
TOGO	1960-90	0.2593	0.3949	0.5293	0.3715	0.0765	0.1823	0.3464	0.1518	(x→y)
TUNISIA	1960-90	0.4596	0.5687	0.6583	0.5785	0.1580	0.2306	0.3238	0.1761	x→y
UGANDA	1950-89	0.4567	0.5688	0.6731	0.5677	0.3036	0.4673	0.5951	0.4773	
ZAIRE	1950-89	0.3217	0.4257	0.5105	0.3989	0.2265	0.2969	0.4182	0.3011	
ZAMBIA	1955-90	0.1663	0.3271	0.4598	0.3414	0.0553	0.1045	0.1830	0.0578	(x→y)
ZIMBABWE	1954-90	0.0400	0.1021	0.2126	0.0607	0.3446	0.4807	0.5886	0.5213	y→x
BAHAMAS	1977-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARBADOS	1960-89	0.2433	0.3803	0.4988	0.3698	0.3621	0.4988	0.6225	0.5223	
BELIZE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CANADA	1950-90	0.1031	0.1929	0.3410	0.1046	0.0527	0.1365	0.2814	0.0726	
COSTA RICA	1950-90	0.2759	0.4376	0.5661	0.4458	0.1527	0.2353	0.3691	0.2153	(x→y)
DOMINICA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of $1-\exp(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.
[b] x→y means that the 10th posterior decile of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$. (x→y) means that the point estimate of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$, and the point estimate of $1-\exp(-F_{y\to x|m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y|m})$. y→x and (y→x) are interpreted similarly.

Table 9. Continued

COUNTRY	DATA	$1\text{-exp}(F_{x\to y\|m})$[a] 10th	50th	90th	pt est	$1\text{-exp}(-F_{y\to x\|m})$[a] 10th	50th	90th	pt est	Inference[b]
DOMINICAN REP.	1950-90	0.0330	0.0990	0.2399	0.0459	0.0290	0.1184	0.2603	0.0931	
EL SALVADOR	1950-90	0.1843	0.3774	0.5481	0.3609	0.4285	0.5530	0.6544	0.5611	(y→x)
GRENADA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
GUATEMALA	1950-90	0.1289	0.2624	0.4106	0.1804	0.0969	0.2045	0.3774	0.1558	
HAITI	1960-89	0.4229	0.5454	0.6426	0.5609	0.0835	0.2003	0.3674	0.2006	x→y
HONDURAS	1950-90	0.3157	0.4311	0.5275	0.4381	0.1782	0.3075	0.4245	0.2776	(x→y)
JAMAICA	1953-89	0.2812	0.4561	0.5896	0.4407	0.3221	0.4166	0.5447	0.4212	
MEXICO	1950-90	0.3828	0.5021	0.6143	0.5203	0.3157	0.4078	0.5124	0.3977	
NICARAGUA	1960-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
PANAMA	1950-90	0.1616	0.3319	0.4867	0.3222	0.1308	0.2457	0.3870	0.2390	
PUERTO RICO	1955-89	0.2970	0.5409	0.7117	0.5608	0.4970	0.5773	0.6631	0.5883	
ST.LUCIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
ST.VINCENT & GRE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRINIDAD & TOBAGO	1950-90	0.2274	0.3540	0.4844	0.3710	0.3006	0.4297	0.5440	0.4472	
U.S.A.	1950-90	0.0426	0.1473	0.3163	0.1061	0.1122	0.2642	0.4387	0.2572	
ARGENTINA	1950-90	0.0753	0.1725	0.3429	0.1463	0.6437	0.7339	0.7961	0.7765	y→x
BOLIVIA	1950-90	0.1344	0.2685	0.4350	0.2473	0.3213	0.4843	0.6162	0.4860	(y→x)
BRAZIL	1950-90	0.0685	0.1827	0.3431	0.1521	0.2178	0.4024	0.5388	0.4089	(y→x)
CHILE	1950-90	0.0729	0.1649	0.3039	0.1498	0.1816	0.3195	0.4588	0.3525	(y→x)
COLOMBIA	1950-90	0.4629	0.6008	0.7366	0.5877	0.4471	0.5659	0.6518	0.5808	
ECUADOR	1950-90	0.4484	0.5716	0.6857	0.5571	0.2791	0.4302	0.5572	0.4488	
GUYANA	1950-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PARAGUAY	1950-90	0.1160	0.1891	0.3058	0.1439	0.1670	0.2801	0.4101	0.2583	
PERU	1950-90	0.4100	0.5398	0.6426	0.5501	0.4110	0.5402	0.6617	0.5591	
SURINAME	1960-89	0.4076	0.5566	0.6678	0.6036	0.1969	0.3249	0.4926	0.3216	(x→y)
URUGUAY	1950-90	0.4647	0.6229	0.7371	0.6698	0.1012	0.1675	0.2936	0.1128	x→y
VENEZUELA	1950-90	0.0678	0.1878	0.3612	0.1433	0.1348	0.2853	0.4399	0.2614	
BAHRAIN	1985-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
BANGLADESH	1959-90	0.0702	0.1702	0.3176	0.1466	0.7999	0.8636	0.9143	0.8564	y→x

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1\text{-exp}(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1\text{-exp}(-F_{x\to y|m})$ lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x|m})$. (x→y) means that the point estimate of $1\text{-exp}(-F_{x\to y|m})$ lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x|m})$, and the point estimate of $1\text{-exp}(-F_{y\to x|m})$ lies below the 10th posterior decile of $1\text{-exp}(-F_{x\to y|m})$. y→x and (y→x) are interpreted similarly.

Table 9. Continued

COUNTRY	DATA	1-exp($-F_{x\to y\|m}$)[a] 10th	50th	90th	pt est	1-exp($-F_{y\to x\|m}$)[a] 10th	50th	90th	pt est	Inference[b]
BHUTAN	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHINA	1968-90	0.2694	0.4125	0.5536	0.4056	0.0334	0.0891	0.1763	0.0659	x→y
HONG KONG	1960-90	0.1475	0.2521	0.4047	0.1858	0.1892	0.2752	0.3803	0.2493	
INDIA	1950-90	0.2618	0.3749	0.4873	0.3537	0.1812	0.2952	0.4174	0.3135	
INDONESIA	1960-90	0.1354	0.2832	0.4809	0.2075	0.0243	0.0850	0.2100	0.0274	
IRAN	1955-89	0.2789	0.4429	0.5960	0.4460	0.0265	0.0835	0.2139	0.0269	x→y
IRAQ	1953-87	0.3038	0.4682	0.5959	0.4954	0.1365	0.2870	0.4414	0.2708	(x→y)
ISRAEL	1953-90	0.4039	0.5394	0.6693	0.5624	0.0649	0.1806	0.3464	0.1805	x→y
JAPAN	1950-90	0.0417	0.0929	0.2176	0.0319	0.6121	0.7284	0.8070	0.7468	y→x
JORDAN	1954-90	0.2271	0.4240	0.5763	0.4326	0.4162	0.5558	0.6693	0.5926	
REP. OF KOREA	1953-89	0.2134	0.3296	0.4518	0.2737	0.5205	0.6209	0.6980	0.6439	y→x
KUWAIT	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAOS	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MALAYSIA	1955-90	0.4703	0.6033	0.7176	0.6081	0.3922	0.5324	0.6278	0.5308	
MONGOLIA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MYANMAR	1950-89	0.3091	0.4030	0.5150	0.3824	0.1000	0.2262	0.4186	0.2272	
NEPAL	1951-86	0.7522	0.8168	0.8619	0.8267	0.1376	0.2434	0.4133	0.2107	x→y
OMAN	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAKISTAN	1950-90	0.1419	0.2614	0.3814	0.2381	0.2593	0.3934	0.5234	0.3966	(y→x)
PHILIPPINES	1950-90	0.3630	0.4364	0.4961	0.4494	0.3266	0.3815	0.4474	0.3689	
QATAR	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SAUDI ARABIA	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SINGAPORE	1960-90	0.3802	0.5784	0.7207	0.5638	0.1837	0.3589	0.5122	0.3877	
SRI LANKA	1950-89	0.3573	0.5201	0.6551	0.4761	0.2513	0.4328	0.6093	0.4235	
SYRIA	1960-90	0.4872	0.6182	0.7135	0.6486	0.1692	0.2880	0.3897	0.2672	x→y
TAIWAN	1951-90	0.5104	0.6487	0.7380	0.6546	0.2030	0.3535	0.4686	0.3838	x→y
THAILAND	1950-90	0.2187	0.3367	0.4457	0.2948	0.1945	0.2852	0.4250	0.2440	
UNITED ARAB EMIRATES	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of 1-exp($-F_{x\to y|m}$). This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of 1-exp($-F_{x\to y|m}$) lies above the 90th posterior decile of 1-exp($-F_{y\to x|m}$). (x→y) means that the point estimate of 1-exp($-F_{x\to y|m}$) lies above the 90th posterior decile of 1-exp($-F_{y\to x|m}$), and the point estimate of 1-exp($-F_{y\to x|m}$) lies below the 10th posterior decile of 1-exp($-F_{x\to y|m}$). y→x and (y→x) are interpreted similarly.

Table 9. Continued

COUNTRY	DATA	1-exp($-F_{x\to y\|m}$)[a] 10th	50th	90th	pt est	1-exp($-F_{y\to x\|m}$)[a] 10th	50th	90th	pt est	Inference[b]
YEMEN	1969-89	0.0426	0.1303	0.3005	0.0952	0.4047	0.5773	0.6827	0.6081	y→x
AUSTRIA	1950-90	0.2499	0.3868	0.5659	0.3143	0.2721	0.3442	0.4105	0.3490	
BELGIUM	1950-90	0.3543	0.5215	0.6470	0.5131	0.1526	0.2371	0.3686	0.2289	(x→y)
BULGARIA	1980-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYPRUS	1950-90	0.4553	0.5452	0.6235	0.5504	0.3237	0.4437	0.5650	0.4327	
CZECHOSLOVAKIA	1960-90	0.1164	0.2343	0.3975	0.1980	0.2796	0.3990	0.5318	0.4199	(y→x)
DENMARK	1950-90	0.2949	0.4708	0.6292	0.4911	0.2968	0.4723	0.6020	0.4894	
FINLAND	1950-90	0.3737	0.4506	0.5457	0.4357	0.3863	0.5268	0.6378	0.5408	
FRANCE	1950-90	0.1232	0.2602	0.4301	0.2368	0.2889	0.3768	0.4831	0.3589	
FED. REP. GERMANY	1950-90	0.0413	0.1052	0.2170	0.0512	0.0671	0.1468	0.2525	0.1340	
GREECE	1950-90	0.2552	0.4187	0.5750	0.4560	0.3727	0.4785	0.5758	0.4918	
HUNGARY	1970-90	0.4804	0.7365	0.8747	0.7958	0.7758	0.8459	0.9023	0.8463	
ICELAND	1950-90	0.5593	0.6551	0.7300	0.6594	0.1601	0.2418	0.3441	0.2368	x→y
IRELAND	1950-90	0.0304	0.0933	0.2132	0.0383	0.1102	0.2224	0.3817	0.1980	
ITALY	1950-90	0.2794	0.3446	0.4343	0.3451	0.0261	0.1192	0.2806	0.0575	(x→y)
LUXEMBOURG	1950-90	0.0458	0.1012	0.2490	0.0463	0.0865	0.1686	0.2877	0.1421	
MALTA	1954-89	0.7142	0.7724	0.8149	0.7720	0.2938	0.4452	0.5775	0.4587	x→y
NETHERLANDS	1950-90	0.2272	0.4475	0.6190	0.4218	0.1794	0.2504	0.3277	0.2447	
NORWAY	1950-90	0.2387	0.3720	0.5059	0.3156	0.3919	0.5142	0.6241	0.4843	
POLAND	1970-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PORTUGAL	1950-90	0.1646	0.3163	0.4727	0.3082	0.3795	0.5128	0.6195	0.5312	(y→x)
ROMANIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPAIN	1950-90	0.1211	0.2571	0.3994	0.2206	0.1763	0.2853	0.4243	0.2699	
SWEDEN	1950-90	0.4790	0.5776	0.6613	0.5687	0.5153	0.6613	0.7780	0.6983	
SWITZERLAND	1950-90	0.2759	0.4054	0.5356	0.4002	0.0562	0.1170	0.2090	0.0971	x→y
TURKEY	1950-90	0.0937	0.2327	0.4390	0.2749	0.0927	0.2388	0.4039	0.2222	
U.K.	1950-90	0.1149	0.2008	0.3295	0.1472	0.1918	0.3245	0.4774	0.3313	(y→x)

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of 1-exp($-F_{x\to y|m}$). This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of 1-exp($-F_{x\to y|m}$) lies above the 90th posterior decile of 1-exp($-F_{y\to x|m}$). (x→y) means that the point estimate of 1-exp($-F_{x\to y|m}$)lies above the 90th posterior decile of 1-exp($-F_{y\to x|m}$), and the point estimate of 1-exp($-F_{y\to x|m}$) lies below the 10th posterior decile of 1-exp($-F_{x\to y|m}$). y→x and (y→x) are interpreted similarly.

Table 9. Continued

COUNTRY	DATA	$1-\exp(-F_{x\to y\|m})^{a}$ 10th	50th	90th	pt est	$1-\exp(-F_{y\to x\|m})^{a}$ 10th	50th	90th	pt est	Inference[b]
U.S.S.R.	1970-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
YUGOSLAVIA	1960-90	0.2419	0.4078	0.5667	0.4421	0.1468	0.2868	0.4469	0.3006	
AUSTRALIA	1950-90	0.0832	0.1430	0.2773	0.0975	0.1440	0.2302	0.3286	0.2195	
FIJI	1960-90	0.1804	0.3397	0.4909	0.3256	0.1387	0.2846	0.4067	0.2928	
NEW ZEALAND	1950-90	0.0780	0.2277	0.3997	0.2062	0.0854	0.2216	0.3893	0.1998	
PAPUA NEW GUINEA	1960-90	0.2390	0.4080	0.5520	0.4170	0.4973	0.6348	0.7341	0.6604	$(y\to x)$
SOLOMON IS.	1980-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
TONGA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANUATU	1983-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
WESTERN SAMOA	1979-90	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of $1-\exp(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] $x\to y$ means that the 10th posterior decile of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$. $(x\to y)$ means that the point estimate of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$, and the point estimate of $1-\exp(-F_{y\to x|m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y|m})$. $y\to x$ and $(y\to x)$ are interpreted similarly.

Table A1. Measures of export-led growth, 2-variable system.

COUNTRY	DATA	$x \to y$[b] GC	impulse[c]	$y \to x$[b] GC	impulse[c]	$x \to y$[b] LF	$y \to x$[b] LF	OPEN[d]	Inference[e] (GC)	Inference[e] (LF)
ALGERIA	1960-90	0.1043	0.0082	0.9861	0.0006	0.0638	0.9831	45.72		$x \to y$
ANGOLA	1960-89	0.7485	0.0040	0.5487	0.0012	0.7008	0.4787	54.35 (89)		
BENIN	1959-89	0.3361	0.0013	0.2431	-0.0014	0.2623	0.1763	50.87 (89)		
BOTSWANA	1960-89	0.4806	0.0053	0.1600	0.0026	0.4069	0.1055	114.13 (89)		
BURKINA FASO	1959-90	0.2403	0.0027	0.5711	0.0013	0.1762	0.5056	37.72		
BURUNDI	1960-90	0.8345	0.0044	0.1597	0.0040	0.8023	0.1071	33.7		
CAMEROON	1960-90	0.9723	0.0052	0.4209	0.0053	0.9664	0.3488	40.34		
CAPE VERDE IS.	1960-89	0.1678	0.0148	0.7371	0.0079	0.1118	0.6877	67.19 (89)		
CENTRAL AFR. REP.	1960-90	0.5846	0.0027	0.2270	0.0007	0.5202	0.1645	47.36		
CHAD	1960-90	0.2580	0.0022	0.1147	0.0012	0.1922	0.0716	76.61		$y \to x$
COMOROS	1960-86	0.6431	0.0012	0.5272	0.0017	0.5759	0.4492	54.04 (87)		
CONGO	1960-90	0.3341	0.0094	0.3309	0.0060	0.2632	0.2602	89.76		
DJIBOUTI	1970-87	0.3916	0.0042	0.0730	-0.0149	0.2451	0.0197	114.98 (87)	$y \to x$	$y \to x$
EGYPT	1950-90	0.0116	0.0042	0.6652	-0.0019	0.0044	0.6088	65.06	$x \to y$	$x \to y$
ETHIOPIA	1960-86	0.5838	0.0013	0.0411	0.0003	0.5067	0.0177	35.61 (86)	$y \to x$	$y \to x$
GABON	1960-90	0.1070	0.0134	0.4714	-0.0001	0.0658	0.4003	84.93		$x \to y$
GAMBIA	1960-90	0.7787	0.0035	0.0981	0.0042	0.7375	0.0592	147.41	$y \to x$	$y \to x$
GHANA	1955-89	0.2309	0.0006	0.8141	-0.0021	0.1655	0.7769	48.75 (89)		
GUINEA	1959-89	0.5693	0.0045	0.1912	-0.0099	0.5009	0.1313	70.17 (89)		
GUINEA-BISSEAU	1960-90	0.9598	0.0023	0.5588	-0.0014	0.9513	0.4924	78.99		
IVORY COAST	1960-90	0.1802	0.0077	0.9755	0.0002	0.1242	0.9702	68.88		
KENYA	1950-90	0.8396	0.0026	0.1834	-0.0004	0.8083	0.1269	55.93		
LESOTHO	1960-90	0.2682	0.0066	0.7942	0.0020	0.2015	0.7554	141.09		

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991). NA = not available.
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "$\to$" = unidirectional causality, "$\leftrightarrow$" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	x→y[b] GC	impulse[c]	y→x[b] GC	impulse[c]	x→y[b] LF	y→x[b] LF	OPEN[d]		Inference[e] (GC)	Inference[e] (LF)
LIBERIA	1960-86	0.6817	0.0030	0.6390	-0.0026	0.6163	0.5680	76.77	(86)		
MADAGASCAR	1960-90	0.3816	0.0015	0.2287	-0.0024	0.3095	0.1660	39.29			
MALAWI	1954-90	0.9182	0.0020	0.5020	0.0014	0.9014	0.4321	58.02			
MALI	1960-90	0.1626	0.0043	0.3165	0.0052	0.1096	0.2465	51.33			
MAURITANIA	1960-90	0.2018	0.0029	0.8131	-0.0013	0.1425	0.7773	105.79			
MAURITIUS	1950-90	0.6412	0.0079	0.2585	-0.0016	0.5821	0.1926	143.47			
MOROCCO	1950-90	0.2035	0.0032	0.9790	0.0005	0.1440	0.9745	56.13			
MOZAMBIQUE	1960-90	0.5379	0.0019	0.0379	-0.0146	0.4700	0.0186	80.79		y→x	y→x
NAMIBIA	1960-89	0.2088	-0.0044	0.0207	0.0118	0.1463	0.0086	110.9	(89)	y→x	y→x
NIGER	1960-89	0.6803	0.0045	0.4138	0.0015	0.6233	0.3386	42.56	(89)		
NIGERIA	1950-90	0.6491	0.0082	0.9869	-0.0009	0.5909	0.9840	64.11			
REUNION	1960-88	0.5484	0.0022	0.8979	-0.0013	0.4753	0.8751	48.32	(88)		
RWANDA	1960-90	0.0201	0.0063	0.4782	-0.0016	0.0086	0.4073	27.17		x→y	x→y
SENEGAL	1960-90	0.3698	0.0034	0.2353	-0.0004	0.2979	0.1718	55.58			
SEYCHELLES	1960-89	0.4971	0.0048	0.5942	0.0007	0.4241	0.5279	109.77	(89)		
SIERRA LEONE	1961-90	0.7603	0.0033	0.6812	-0.0024	0.7144	0.6243	41.13			
SOMALIA	1960-89	0.3861	0.0032	0.0559	0.0088	0.3110	0.0290	52.58	(89)	y→x	y→x
SOUTH AFRICA	1950-90	0.2249	0.0035	0.4357	-0.0015	0.1626	0.3637	47.01			
SUDAN	1971-90	0.4545	0.0002	0.7797	-0.0011	0.3272	0.7029	22.83			
SWAZILAND	1960-89	0.5742	0.0024	0.7394	0.0005	0.5062	0.6904	165.84	(89)		
TANZANIA	1950-88	0.7647	0.0010	0.6920	0.0008	0.7174	0.6339	55.67	(88)		
TOGO	1960-90	0.2508	0.0043	0.2798	0.0035	0.1857	0.2122	93.93			

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "→" = unidirectional causality, "↔" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	x→y[b] GC	impulse[c]	y→x[b] GC	impulse[c]	x→y[b] LF	y→x[b] LF	OPEN[d]		Inference[e] (GC)	Inference[e] (LF)
TUNISIA	1960-90	0.0136	0.0081	0.2644	0.0026	0.0053	0.1980	90.78		x→y	x→y
UGANDA	1950-89	0.0624	-0.0064	0.9739	0.0002	0.0332	0.9680	1	(89)	x→y	x→y
ZAIRE	1950-89	0.0016	0.0038	0.5210	-0.0042	0.0004	0.4492	56.52	(89)	x→y	x→y
ZAMBIA	1955-90	0.9921	0.0033	0.9325	-0.0005	0.9904	0.9185	62.09			
ZIMBABWE	1954-90	0.7808	0.0025	0.7585	0.0012	0.7399	0.7143	64.88			
BAHAMAS	1977-87	NA	NA	NA	NA	NA	NA	117.13	(87)	NA	NA
BARBADOS	1960-89	0.6060	0.0043	0.1523	0.0000	0.5408	0.0993	102.45	(89)		y→x
BELIZE	1985-85	NA	NA	NA	NA	NA	NA	121.02	(85)	NA	NA
CANADA	1950-90	0.4249	0.0033	0.9882	0.0001	0.3527	0.9856	50.48			
COSTA RICA	1950-90	0.1034	-0.0015	0.1918	0.0036	0.0632	0.1340	75.28			x→y
DOMINICA	1985-85	NA	NA	NA	NA	NA	NA	106.75	(85)	NA	NA
DOMINICAN REP.	1950-90	0.9013	0.0017	0.9981	-0.0003	0.8812	0.9976	60.36			
EL SALVADOR	1950-90	0.6528	0.0061	0.3975	0.0061	0.5950	0.3253	42.97			
GRENADA	1984-90	NA	NA	NA	NA	NA	NA	114.33		NA	NA
GUATEMALA	1950-90	0.6025	0.0051	0.4411	-0.0049	0.5397	0.3692	45.6			
HAITI	1960-89	0.0550	0.0066	0.8546	-0.0025	0.0285	0.8246	32.32	(89)	x→y	x→y
HONDURAS	1950-90	0.1713	0.0038	0.4645	-0.0028	0.1168	0.3932	87.11			
JAMAICA	1953-89	0.0890	-0.0009	0.0134	-0.0021	0.0514	0.0050	116.07	(89)	x↔y	x↔y
MEXICO	1950-90	0.1650	0.0038	0.0408	0.0060	0.1115	0.0203	32.88		y→x	y→x
NICARAGUA	1960-87	0.8393	0.0032	0.1907	0.0017	0.8033	0.1260	25.53	(87)		
PANAMA	1950-90	0.3372	0.0040	0.6381	0.0010	0.2662	0.5787	73.66			
PUERTO RICO	1955-89	0.0587	0.0011	0.0072	0.0010	0.0308	0.0024	147.27	(89)	x↔y	x↔y
ST.LUCIA	1985-85	NA	NA	NA	NA	NA	NA	165.77	(85)	NA	NA
ST.VINCENT&GRE	1985-85	NA	NA	NA	NA	NA	NA	153.17	(85)	NA	NA
TRINIDAD&TOBAGO	1950-90	0.8119	0.0081	0.9213	-0.0011	0.7759	0.9051	76.14			

[a]x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b]Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c]Average impulse response over 16 year period.
[d]Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e]Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "→" = unidirectional causality, "↔" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	$x \to y$[b] GC	impulse[c]	$y \to x$[b] GC	impulse[c]	$x \to y$[b] LF	$y \to x$[b] LF	OPEN[d]	Inference[e] (GC)	Inference[e] (LF)
U.S.A.	1950-90	0.9904	0.0008	0.6921	0.0019	0.9884	0.6389	21.08		
ARGENTINA	1950-90	0.6289	-0.0009	0.0144	0.0071	0.5686	0.0057	20.79	$y \to x$	$y \to x$
BOLIVIA	1950-90	0.6761	0.0038	0.6884	-0.0028	0.6209	0.6347	45.8		
BRAZIL	1950-90	0.9183	0.0024	0.1686	0.0105	0.9015	0.1145	12.73		
CHILE	1950-90	0.9447	0.0007	0.2898	-0.0011	0.9332	0.2214	70.31		
COLOMBIA	1950-90	0.0641	0.0052	0.0340	-0.0028	0.0353	0.0163	33.65	$x \leftrightarrow y$	$x \leftrightarrow y$
ECUADOR	1950-90	0.6792	0.0084	0.9606	-0.0010	0.6244	0.9522	58.86		
GUYANA	1950-90	NA	NA	NA	NA	NA	NA	65.54	NA	NA
PARAGUAY	1950-90	0.6096	0.0033	0.2660	-0.0018	0.5474	0.1995	67.32		
PERU	1950-90	0.0146	0.0040	0.9991	-0.0001	0.0058	0.9990	21.54	$x \to y$	$x \to y$
SURINAME	1960-89	0.1387	0.0080	0.2027	0.0046	0.0885	0.1410	70.91 (89)		$x \to y$
URUGUAY	1950-90	0.1364	0.0003	0.4538	0.0000	0.0885	0.3822	46.54		$x \to y$
VENEZUELA	1950-90	0.3145	0.0084	0.7535	0.0077	0.2446	0.7086	58.71		
BAHRAIN	1985-88	NA	NA	NA	NA	NA	NA	169.02 (88)	NA	NA
BANGLADESH	1959-90	0.9206	0.0034	0.0056	0.0112	0.9042	0.0018	26.42	$y \to x$	$y \to x$
BHUTAN	1985-85	NA	NA	NA	NA	NA	NA	62.53 (85)	NA	NA
CHINA	1968-90	0.3135	0.0005	0.9853	-0.0001	0.2130	0.9804	32.78		
HONG KONG	1960-90	0.4590	0.0015	0.2624	0.0002	0.3875	0.1962	268.22		
INDIA	1950-90	0.1153	0.0032	0.8470	-0.0010	0.0721	0.8170	18.74		$x \to y$
INDONESIA	1960-90	0.7174	0.0051	0.8582	-0.0032	0.6675	0.8302	50.92		
IRAN	1955-89	0.3913	0.0057	0.9415	-0.0032	0.3162	0.9287	23.8 (89)		
IRAQ	1953-87	0.7693	0.0121	0.8849	-0.0029	0.7205	0.8583	50.85 (87)		
ISRAEL	1953-90	0.6448	0.0023	0.9218	-0.0005	0.5862	0.9057	69.85		
JAPAN	1950-90	0.8530	0.0001	0.0135	0.0079	0.8240	0.0053	21.58	$y \to x$	$y \to x$
JORDAN	1954-90	0.5427	0.0069	0.8442	-0.0012	0.4752	0.8137	158.06		

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "$\to$" = unidirectional causality, "$\leftrightarrow$" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	$x \rightarrow y$[b] GC	impulse[c]	$y \rightarrow x$[b] GC	impulse[c]	$x \rightarrow y$[b] LF	$y \rightarrow x$[b] LF	OPEN[d]		Inference[e] (GC)	Inference[e] (LF)
REP. OF KOREA	1953-89	0.3200	0.0022	0.1242	-0.0014	0.2470	0.0773	65.72	(89)		$y \rightarrow x$
KUWAIT	1985-89	NA	NA	NA	NA	NA	NA	100.26	(89)	NA	NA
LAOS	1984-90	NA	NA	NA	NA	NA	NA	33.97		NA	NA
MALAYSIA	1955-90	0.9881	0.0067	0.9896	-0.0003	0.9855	0.9873	156.06			
MONGOLIA	1984-90	NA	NA	NA	NA	NA	NA	72.83		NA	NA
MYANMAR	1950-89	0.0079	0.0056	0.2499	-0.0059	0.0026	0.1823	8.15	(89)	$x \rightarrow y$	$x \rightarrow y$
NEPAL	1951-86	0.0000	0.0086	0.5362	-0.0027	0.0000	0.4551	35.15	(86)	$x \rightarrow y$	$x \rightarrow y$
OMAN	1985-89	NA	NA	NA	NA	NA	NA	74.02	(89)	NA	NA
PAKISTAN	1950-90	0.4709	0.0017	0.2462	-0.0041	0.3998	0.1815	39.49			
PHILIPPINES	1950-90	0.7707	0.0011	0.0165	0.0034	0.7283	0.0068	61.16		$y \rightarrow x$	$y \rightarrow x$
QATAR	1985-89	NA	NA	NA	NA	NA	NA	77.4	(89)	NA	NA
SAUDI ARABIA	1985-89	NA	NA	NA	NA	NA	NA	76.58	(89)	NA	NA
SINGAPORE	1960-90	0.6000	0.0055	0.5726	0.0010	0.5369	0.5072	373.83			
SRI LANKA	1950-89	0.1320	0.0069	0.4833	-0.0026	0.0833	0.4097	63.04	(89)		$x \rightarrow y$
SYRIA	1960-90	0.0812	0.0064	0.1020	-0.0070	0.0471	0.0621	54.77		$x \rightarrow y$	$x \leftrightarrow y$
TAIWAN	1951-90	0.0110	0.0033	0.1215	-0.0048	0.0041	0.0769	89.43		$x \rightarrow y$	$x \leftrightarrow y$
THAILAND	1950-90	0.2031	0.0022	0.1903	-0.0014	0.1436	0.1327	78.43			
UNITED ARAB E.	1985-89	NA	NA	NA	NA	NA	NA	94.48	(89)	NA	NA
YEMEN	1969-89	0.9620	0.0024	0.9688	-0.0005	0.9478	0.9570	41.9	(89)		
AUSTRIA	1950-90	0.2852	0.0027	0.0883	0.0037	0.2171	0.0521	80.99		$y \rightarrow x$	$y \rightarrow x$
BELGIUM	1950-90	0.0485	0.0005	0.1633	0.0037	0.0251	0.1101	145.4		$x \rightarrow y$	$x \rightarrow y$
BULGARIA	1980-90	NA	NA	NA	NA	NA	NA	81.33		NA	NA
CYPRUS	1950-90	0.8840	0.0043	0.3439	-0.0014	0.8606	0.2727	106.61			
CZECHOSLOVAKIA	1960-90	0.8644	0.0039	0.3647	0.0012	0.8375	0.2929	68.41			
DENMARK	1950-90	0.2355	0.0011	0.6783	0.0010	0.1719	0.6235	64.43			

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "$\rightarrow$" = unidirectional causality, "$\leftrightarrow$" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	x→y[b] GC	impulse[c]	y→x[b] GC	impulse[c]	x→y[b] LF	y→x[b] LF	OPEN[d]		Inference[e] (GC)	Inference[e] (LF)
FINLAND	1950-90	0.0236	0.0029	0.1610	-0.0031	0.0104	0.1082	46.78		x→y	x→y
FRANCE	1950-90	0.9158	0.0016	0.0443	0.0039	0.8984	0.0225	45.29		y→x	y→x
GERMANY, WEST	1950-90	0.5025	0.0016	0.4660	0.0012	0.4327	0.3947	58.43			
GREECE	1950-90	0.5998	0.0019	0.0497	0.0059	0.5367	0.0259	54.01		y→x	y→x
HUNGARY	1970-90	0.1174	0.0092	0.9132	-0.0020	0.0515	0.8819	62			x→y
ICELAND	1950-90	0.0014	0.0049	0.4105	-0.0014	0.0003	0.3382	72.02		x→y	x→y
IRELAND	1950-90	0.9683	0.0021	0.5780	0.0014	0.9616	0.5131	115.99			
ITALY	1950-90	0.1660	0.0030	0.8709	0.0002	0.1123	0.8451	41.98			
LUXEMBOURG	1950-90	0.7979	0.0037	0.6198	0.0014	0.7597	0.5586	197.32			
MALTA	1954-89	0.0003	0.0051	0.3560	-0.0019	0.0000	0.2815	173.15	(89)	x→y	x→y
NETHERLANDS	1950-90	0.2651	0.0010	0.2219	0.0040	0.1987	0.1599	108.21			
NORWAY	1950-90	0.9658	0.0048	0.9724	0.0005	0.9585	0.9665	80.73			
POLAND	1970-90	NA	NA	NA	NA	NA	NA	43.52		NA	NA
PORTUGAL	1950-90	0.4716	0.0000	0.8357	0.0010	0.4005	0.8037	80.93			
ROMANIA	1985-85	NA	NA	NA	NA	NA	NA	48.83	(85)	NA	NA
SPAIN	1950-90	0.6685	-0.0001	0.6111	0.0016	0.6124	0.5491	37.56			
SWEDEN	1950-90	0.0079	0.0013	0.6523	0.0001	0.0028	0.5944	60.18		x→y	x→y
SWITZERLAND	1950-90	0.4919	0.0019	0.6140	0.0001	0.4215	0.5522	73.21			
TURKEY	1950-90	0.9566	0.0002	0.7916	-0.0030	0.9474	0.7524	41.99			
U.K.	1950-90	0.4596	0.0008	0.1373	0.0028	0.3882	0.0892	51.51			y→x
U.S.S.R.	1970-89	NA	NA	NA	NA	NA	NA	15.25	(89)	NA	NA
YUGOSLAVIA	1960-90	0.5069	0.0000	0.2304	0.0038	0.4373	0.1675	48.94			
AUSTRALIA	1950-90	0.4823	0.0014	0.1023	0.0000	0.4116	0.0623	34.52			y→x
FIJI	1960-90	0.1787	0.0038	0.5321	0.0004	0.1229	0.4639	126.52			
NEW ZEALAND	1950-90	0.8995	0.0025	0.6527	0.0007	0.8790	0.5949	58.48			

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "→" = unidirectional causality, "↔" = bi-directional causality.

Table A1. Continued.

COUNTRY	DATA	$x \to y$[b] GC	impulse[c]	$y \to x$[b] GC	impulse[c]	$x \to y$[b] LF	$y \to x$[b] LF	OPEN[d]		Inference[e] (GC)	Inference[e] (LF)
PAPUA N.GUINEA	1960-90	0.4128	0.0042	0.8754	-0.0014	0.3405	0.8505	89.35			
SOLOMON IS.	1980-88	NA	NA	NA	NA	NA	NA	165.43	(88)	NA	NA
TONGA	1985-85	NA	NA	NA	NA	NA	NA	102.25	(85)	NA	NA
VANUATU	1983-89	NA	NA	NA	NA	NA	NA	101.4	(89)	NA	NA
WESTERN SAMOA	1979-90	NA	NA	NA	NA	NA	NA	102.44		NA	NA

[a] x is the growth rate of exports; y is the growth rate of income (total GDP in current international dollars; see Summers and Heston, 1991).
[b] Marginal significance level for the null hypothesis of no unidirectional causality (Granger causality F-tests in columns 3 and 5, unconditional linear feedback in columns 7 and 8).
[c] Average impulse response over 16 year period.
[d] Exports plus imports as a percentage of CGDP (Summers and Heston, 1991), data for 1990 unless otherwise indicated.
[e] Inference regarding causal ordering, at 10% level. GC = Granger causality, LF = linear feedback; "$\to$" = unidirectional causality, "$\leftrightarrow$" = bi-directional causality.

Table A2. Measures of export-led growth, 3-variable system.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	x→y	y→x	x→m	y→m	m→x	m→y	x-m-y	m-x-y	%y
ALGERIA	1960-90	0.2457	0.9702	0.2366	0.7208	0.5271	0.6447	50.54	21.96	42.21
ANGOLA	1960-89	0.4551	0.6443	0.4067	0.9945	0.2803	0.4618	52.01	29.73	29.65
BENIN	1959-89	0.7218	0.2228	0.9769	0.3318	0.5899	0.7764	28.37	1.97	67.20
BOTSWANA	1960-89	0.3974	0.2216	0.5896	0.2602	0.9162	0.6702	37.57	12.72	40.59
BURKINA FASO	1959-90	0.2586	0.7015	0.0792	0.2210	0.9219	0.7831	28.17	9.23	61.51
BURUNDI	1960-90	0.9905	0.2822	0.6281	0.5376	0.6755	0.4199	36.11	1.38	39.90
CAMEROON	1960-90	0.7059	0.5755	0.2970	0.8932	0.1586	0.6107	56.64	10.71	36.45
CAPE VERDE IS.	1960-89	0.5378	0.7140	0.0133	0.1203	0.5199	0.8799	49.64	23.76	48.90
CENTRAL AFRICAN REP.	1960-90	0.2288	0.2622	0.3568	0.2454	0.4940	0.3635	37.35	19.77	56.14
CHAD	1960-90	0.0344	0.5677	0.5483	0.2199	0.7905	0.0326	21.79	18.50	53.20
COMOROS	1960-86	0.7706	0.6595	0.6089	0.8601	0.8720	0.6120	39.59	8.62	29.43
CONGO	1960-90	0.4215	0.3711	0.6486	0.4618	0.7849	0.7024	59.29	5.89	34.41
DJIBOUTI	1970-87	0.6717	0.0640	0.5039	0.1829	0.3653	0.0932	37.50	47.52	23.30
EGYPT	1950-90	0.8122	0.6995	0.9612	0.6087	0.9542	0.3772	55.09	8.38	41.59
ETHIOPIA	1960-86	0.6548	0.0245	0.0721	0.1834	0.2682	0.2296	14.44	5.83	79.41
GABON	1960-90	0.0796	0.6204	0.7576	0.3205	0.5044	0.0579	45.98	46.44	34.95
GAMBIA	1960-90	0.8129	0.1962	0.6440	0.0731	0.4748	0.7684	26.91	3.69	43.51
GHANA	1955-89	0.0068	0.8096	0.0521	0.3552	0.6667	0.0226	13.08	36.74	59.00
GUINEA	1959-89	0.3567	0.1183	0.5416	0.5847	0.4581	0.3070	54.80	53.99	38.90
GUINEA-BISSEAU	1960-90	0.5270	0.4021	0.7265	0.9341	0.0620	0.5104	14.23	7.30	81.20
IVORY COAST	1960-90	0.6489	0.9016	0.7661	0.7665	0.6299	0.4794	64.60	1.91	22.76
KENYA	1950-90	0.7252	0.1609	0.5831	0.2528	0.7240	0.4162	48.53	11.78	43.73
LESOTHO	1960-90	0.0289	0.5270	0.1497	0.9430	0.0139	0.0004	24.43	25.86	31.38

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	x→y	y→x	x→m	y→m	m→x	m→y	x-m-y	m-x-y	%y
LIBERIA	1960-86	0.4629	0.3742	0.6311	0.6832	0.0420	0.0982	56.93	8.12	32.38
MADAGASCAR	1960-90	0.8922	0.3298	0.8413	0.3115	0.9565	0.5304	13.40	3.90	66.12
MALAWI	1954-90	0.7204	0.7913	0.5047	0.7350	0.2562	0.6464	27.41	2.87	54.48
MALI	1960-90	0.9115	0.3692	0.9279	0.4062	0.6228	0.1258	22.01	18.06	57.70
MAURITANIA	1960-90	0.8382	0.9290	0.3179	0.3737	0.4803	0.6741	34.79	24.55	55.85
MAURITIUS	1950-90	0.8206	0.5540	0.5665	0.5524	0.6193	0.9674	75.33	1.91	21.74
MOROCCO	1950-90	0.7076	0.5370	0.7666	0.9262	0.3284	0.1592	33.44	3.60	54.20
MOZAMBIQUE	1960-90	0.7371	0.1310	0.9379	0.0976	0.8719	0.7464	10.86	25.70	56.95
NAMIBIA	1960-89	0.0302	0.0158	0.2860	0.0760	0.2926	0.1023	25.73	20.67	47.71
NIGER	1960-89	0.9471	0.3365	0.8942	0.6528	0.1324	0.2853	34.50	3.03	57.99
NIGERIA	1950-90	0.6622	0.9737	0.0846	0.3811	0.8729	0.9380	58.30	29.18	40.00
REUNION	1960-88	0.2913	0.7347	0.5202	0.9027	0.7247	0.2558	5.22	12.93	63.77
RWANDA	1960-90	0.0849	0.3883	0.2683	0.1929	0.6851	0.1900	51.21	19.65	34.04
SENEGAL	1960-90	0.5039	0.5696	0.0835	0.9008	0.0787	0.2057	23.82	16.82	59.46
SEYCHELLES	1960-89	0.4806	0.5587	0.4286	0.6166	0.0677	0.4421	27.57	5.49	54.43
SIERRA LEONE	1961-90	0.4611	0.7150	0.9233	0.5942	0.3766	0.3430	44.10	8.61	41.24
SOMALIA	1960-89	0.0216	0.0043	0.0054	0.0015	0.0084	0.0436	18.96	34.55	60.15
SOUTH AFRICA	1950-90	0.0177	0.6549	0.0314	0.0258	0.1103	0.0017	39.14	51.14	32.48
SUDAN	1971-90	0.0196	0.5325	0.2522	0.3872	0.1320	0.0236	20.74	50.26	21.59
SWAZILAND	1960-89	0.0915	0.8563	0.1354	0.9941	0.2331	0.1134	29.45	17.98	56.46
TANZANIA	1950-88	0.5612	0.6991	0.7722	0.6769	0.7944	0.6844	16.98	8.46	56.02
TOGO	1960-90	0.6358	0.3395	0.9054	0.4501	0.9572	0.7564	79.44	22.19	18.45
TUNISIA	1960-90	0.2287	0.2517	0.3679	0.2537	0.8145	0.9180	58.11	21.12	38.75
UGANDA	1950-89	0.0937	0.7972	0.0568	0.8838	0.1607	0.1539	31.01	37.13	32.80

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	x→y	y→x	x→m	y→m	m→x	m→y	x-m-y	m-x-y	%y
ZAIRE	1950-89	0.0018	0.1730	0.0294	0.0203	0.2260	0.5572	31.28	30.05	61.55
ZAMBIA	1955-90	0.8622	0.8992	0.9745	0.2785	0.8213	0.4741	51.43	50.42	38.19
ZIMBABWE	1954-90	0.3091	0.0960	0.2612	0.2359	0.0207	0.3478	28.11	6.90	48.04
BAHAMAS	1977-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARBADOS	1960-89	0.3411	0.0832	0.4013	0.2162	0.0615	0.1714	25.78	10.81	56.12
BELIZE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CANADA	1950-90	0.5013	0.9917	0.1922	0.9111	0.9983	0.8368	75.58	11.55	14.48
COSTA RICA	1950-90	0.2295	0.3905	0.9134	0.2141	0.8867	0.8099	14.14	13.91	82.21
DOMINICA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
DOMINICAN REP.	1950-90	0.7013	0.8906	0.9458	0.9701	0.5037	0.6595	7.88	13.97	65.97
EL SALVADOR	1950-90	0.6177	0.5785	0.2976	0.2909	0.0269	0.1682	39.69	7.43	39.57
GRENADA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
GUATEMALA	1950-90	0.4809	0.5110	0.0149	0.5205	0.9554	0.7310	67.37	7.32	28.22
HAITI	1960-89	0.7950	0.6444	0.9460	0.8337	0.4793	0.9380	56.63	3.45	34.00
HONDURAS	1950-90	0.9526	0.5045	0.0765	0.6047	0.4887	0.3825	32.07	5.12	63.27
JAMAICA	1953-89	0.0881	0.0476	0.4130	0.2675	0.6621	0.3466	10.57	17.22	75.03
MEXICO	1950-90	0.4900	0.1258	0.8721	0.7378	0.5155	0.1016	28.00	5.44	35.93
NICARAGUA	1960-87	0.9167	0.0211	0.0519	0.1220	0.0495	0.9829	41.12	1.05	33.10
PANAMA	1950-90	0.7807	0.9490	0.8188	0.5104	0.4683	0.8573	54.59	2.23	28.57
PUERTO RICO	1955-89	0.0534	0.0071	0.8476	0.1585	0.3186	0.6276	15.37	15.80	77.06
ST.LUCIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
ST.VINCENT&GRE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRINIDAD&TOBAG	1950-90	0.2632	0.9045	0.1771	0.4231	0.1335	0.1130	59.92	31.42	26.20
U.S.A.	1950-90	0.7675	0.9957	0.2943	0.4562	0.3341	0.6241	12.70	2.24	51.15

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	$x \rightarrow y$	$y \rightarrow x$	$x \rightarrow m$	$y \rightarrow m$	$m \rightarrow x$	$m \rightarrow y$	x-m-y	m-x-y	%y
ARGENTINA	1950-90	0.5029	0.3726	0.3530	0.0261	0.0959	0.4956	20.28	21.39	73.24
BOLIVIA	1950-90	0.8584	0.8757	0.9159	0.5698	0.3007	0.7909	37.08	37.67	51.73
BRAZIL	1950-90	0.9327	0.6029	0.7266	0.2789	0.7480	0.8819	2.78	19.43	60.30
CHILE	1950-90	0.8176	0.0591	0.0122	0.4537	0.0766	0.7015	3.91	6.05	73.19
COLOMBIA	1950-90	0.0216	0.5229	0.0783	0.5796	0.4980	0.2218	64.83	42.95	14.47
ECUADOR	1950-90	0.0164	0.9212	0.1325	0.9031	0.1643	0.0117	61.32	36.89	18.80
GUYANA	1950-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PARAGUAY	1950-90	0.4680	0.4208	0.9308	0.8667	0.9763	0.6364	37.98	7.56	34.51
PERU	1950-90	0.1493	0.2891	0.4988	0.0785	0.0074	0.9612	26.02	23.06	45.12
SURINAME	1960-89	0.3020	0.2619	0.3258	0.6215	0.6034	0.0892	46.30	17.23	38.56
URUGUAY	1950-90	0.3821	0.3595	0.4822	0.9406	0.6902	0.1544	7.92	40.81	34.89
VENEZUELA	1950-90	0.2827	0.5873	0.9692	0.4144	0.3815	0.5817	54.51	38.23	40.89
BAHRAIN	1985-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
BANGLADESH	1959-90	0.8389	0.3704	0.0157	0.1446	0.0001	0.7701	64.88	0.53	24.43
BHUTAN	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHINA	1968-90	0.9299	0.9708	0.1930	0.6096	0.6988	0.6413	19.56	3.64	77.90
HONG KONG	1960-90	0.1562	0.1557	0.3946	0.0652	0.3108	0.2722	18.97	11.60	67.93
INDIA	1950-90	0.3869	0.6772	0.2435	0.5973	0.2964	0.8207	31.61	4.09	66.46
INDONESIA	1960-90	0.1442	0.8001	0.8710	0.7633	0.9159	0.1774	22.88	44.60	44.53
IRAN	1955-89	0.1810	0.7385	0.5089	0.8677	0.6775	0.0849	37.19	11.80	44.52
IRAQ	1953-87	0.3232	0.7622	0.1169	0.2327	0.4648	0.1096	69.64	40.20	15.50
ISRAEL	1953-90	0.3120	0.8634	0.5659	0.6176	0.6344	0.0278	31.18	6.71	40.64

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	x→y	y→x	x→m	y→m	m→x	m→y	x-m-y	m-x-y	%y
JAPAN	1950-90	0.6564	0.0105	0.0574	0.0823	0.0093	0.7552	2.85	2.82	94.37
JORDAN	1954-90	0.0612	0.4366	0.2524	0.4830	0.1073	0.0583	32.33	9.81	51.69
REP. OF KOREA	1953-89	0.0406	0.2763	0.0091	0.3866	0.0454	0.0846	17.43	24.38	63.35
KUWAIT	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAOS	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MALAYSIA	1955-90	0.3609	0.5146	0.0889	0.3727	0.0588	0.0070	67.18	19.48	21.29
MONGOLIA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MYANMAR	1950-89	0.0193	0.3483	0.0091	0.0274	0.7115	0.7422	49.96	19.47	46.44
NEPAL	1951-86	0.0007	0.4166	0.0944	0.4776	0.3498	0.2705	53.63	27.48	35.96
OMAN	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAKISTAN	1950-90	0.8312	0.4394	0.5610	0.6431	0.7449	0.4771	27.65	3.14	60.25
PHILIPPINES	1950-90	0.3136	0.0029	0.0565	0.0001	0.1117	0.1698	3.47	3.49	89.61
QATAR	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SAUDI ARABIA	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SINGAPORE	1960-90	0.9162	0.8546	0.3814	0.6479	0.2972	0.7786	56.61	4.65	42.33
SRI LANKA	1950-89	0.1045	0.4755	0.0238	0.3466	0.1325	0.2068	54.32	23.66	28.78
SYRIA	1960-90	0.2977	0.1419	0.8124	0.3046	0.8056	0.1039	36.14	8.93	53.63
TAIWAN	1951-90	0.0953	0.1527	0.3351	0.7924	0.8939	0.8371	58.18	17.58	39.16
THAILAND	1950-90	0.5530	0.1458	0.1137	0.1776	0.4905	0.6979	22.23	13.04	59.08
UNITED ARAB E.	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
YEMEN	1969-89	0.9211	0.5874	0.2947	0.8440	0.3546	0.9488	29.40	1.84	69.87
AUSTRIA	1950-90	0.0526	0.0503	0.3321	0.0685	0.1951	0.1221	31.71	11.46	56.38
BELGIUM	1950-90	0.8793	0.1341	0.4733	0.0564	0.6049	0.9229	36.30	3.01	62.31
BULGARIA	1980-90	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	x→y	y→x	x→m	y→m	m→x	m→y	x-m-y	m-x-y	%y
CYPRUS	1950-90	0.4138	0.2712	0.8022	0.7094	0.3094	0.0486	54.33	22.13	22.59
CZECHOSLOVAKIA	1960-90	0.2116	0.0513	0.1090	0.0258	0.0764	0.1845	27.16	21.60	37.16
DENMARK	1950-90	0.6984	0.0658	0.0237	0.1833	0.0187	0.5179	15.20	6.62	55.21
FINLAND	1950-90	0.0207	0.7028	0.0464	0.1527	0.2578	0.6099	38.30	36.96	20.69
FRANCE	1950-90	0.4842	0.0207	0.4978	0.0126	0.2932	0.4081	22.56	6.21	73.90
GERMANY, WEST	1950-90	0.4045	0.5875	0.2868	0.1656	0.9728	0.7419	20.54	6.72	72.99
GREECE	1950-90	0.8227	0.1298	0.7785	0.4253	0.3299	0.1881	23.81	6.24	66.52
HUNGARY	1970-90	0.0497	0.9357	0.0004	0.7803	0.0007	0.1156	38.15	49.77	28.62
ICELAND	1950-90	0.0020	0.3683	0.0195	0.7943	0.2995	0.2532	49.02	48.30	40.51
IRELAND	1950-90	0.6751	0.4516	0.9774	0.0691	0.5373	0.6105	40.11	23.00	55.61
ITALY	1950-90	0.0448	0.9826	0.3672	0.7853	0.9756	0.1375	43.63	26.20	29.71
LUXEMBOURG	1950-90	0.7010	0.4781	0.7169	0.2977	0.5794	0.7108	79.12	8.16	17.61
MALTA	1954-89	0.1059	0.3252	0.0447	0.7350	0.2034	0.9900	56.55	29.15	30.87
NETHERLANDS	1950-90	0.9439	0.1791	0.6061	0.0682	0.5419	0.9105	23.15	1.93	76.08
NORWAY	1950-90	0.8303	0.3674	0.8870	0.2675	0.0674	0.2573	66.95	67.04	22.44
POLAND	1970-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PORTUGAL	1950-90	0.9394	0.0448	0.0555	0.0302	0.0119	0.6165	7.44	12.25	56.98
ROMANIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPAIN	1950-90	0.8853	0.1697	0.7809	0.2258	0.1778	0.2375	5.67	0.70	82.42
SWEDEN	1950-90	0.2723	0.7658	0.0003	0.0220	0.0344	0.4092	58.10	36.08	29.73
SWITZERLAND	1950-90	0.6241	0.4683	0.5535	0.7415	0.5644	0.2360	57.75	2.53	21.02

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A2. Continued.

		Granger Causality[a]						5 year FEVD[b]		
COUNTRY	DATA	$x \rightarrow y$	$y \rightarrow x$	$x \rightarrow m$	$y \rightarrow m$	$m \rightarrow x$	$m \rightarrow y$	x-m-y	m-x-y	%y
TURKEY	1950-90	0.4346	0.9927	0.5721	0.9851	0.5343	0.3155	1.08	40.05	40.97
U.K.	1950-90	0.0641	0.2681	0.2183	0.1569	0.5182	0.1296	14.55	23.94	72.81
U.S.S.R.	1970-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
YUGOSLAVIA	1960-90	0.7135	0.1200	0.8748	0.1673	0.3202	0.3450	5.04	18.89	62.03
AUSTRALIA	1950-90	0.4776	0.2597	0.0403	0.2693	0.8267	0.8689	26.77	21.10	64.13
FIJI	1960-90	0.3398	0.5286	0.4359	0.5614	0.7933	0.6367	41.55	4.37	55.76
NEW ZEALAND	1950-90	0.7559	0.9018	0.9206	0.2655	0.5873	0.4967	45.97	19.41	46.65
PAPUA N.GUINEA	1960-90	0.2363	0.6924	0.7899	0.4049	0.0043	0.2203	63.39	33.74	28.43
SOLOMON IS.	1980-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
TONGA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANUATU	1983-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
WESTERN SAMOA	1979-90	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a]Marginal significance levels for the null hypothesis of no causality in the indicated direction. x, y and m are the growth rates of exports, income and imports, respectively.
[b]Percent of five-year ahead income forecast error variance attributable to innovations in exports. Orderings are: exports, imports, income (x-m-y); imports, exports, income (m-x-y). %y is the percent of forecast error variance attributable to income innovations. NA = not available.

Table A3. Linear feedback between export growth and income growth, conditional on import growth.

COUNTRY	DATA	$1-\exp(-F_{x\to y\mid m})$[a] 10th	50th	90th	pt est	$1-\exp(-F_{y\to x\mid m})$[a] 10th	50th	90th	pt est	Inference[b]
ALGERIA	1960-90	0.1076	0.2480	0.4129	0.2044	0.0658	0.1739	0.3089	0.1582	
ANGOLA	1960-89	0.0978	0.2163	0.3505	0.1934	0.2677	0.3896	0.4962	0.3921	(y→x)
BENIN	1959-89	0.1381	0.3338	0.4964	0.3353	0.2291	0.3077	0.4294	0.3061	
BOTSWANA	1960-89	0.0791	0.1411	0.2455	0.1187	0.1150	0.1976	0.3208	0.1871	
BURKINA FASO	1959-90	0.0693	0.1278	0.2447	0.0704	0.0586	0.1093	0.1887	0.0951	
BURUNDI	1960-90	0.1194	0.2681	0.4184	0.2944	0.1255	0.2860	0.4522	0.2956	
CAMEROON	1960-90	0.0743	0.1803	0.3229	0.1046	0.2959	0.4631	0.5912	0.5037	(y→x)
CAPE VERDE IS.	1960-89	0.2417	0.3407	0.4521	0.3321	0.1382	0.2585	0.4538	0.1595	
CENTRAL AFRICAN REP.	1960-90	0.0996	0.1438	0.2322	0.1141	0.2343	0.3444	0.4543	0.3437	y→x
CHAD	1960-90	0.3175	0.4037	0.5021	0.4247	0.3230	0.4375	0.5397	0.4554	
COMOROS	1960-86	0.1835	0.3227	0.4794	0.3192	0.1084	0.2079	0.3466	0.1886	
CONGO	1960-90	0.1534	0.2699	0.4216	0.2109	0.1188	0.2145	0.3734	0.2043	
DJIBOUTI	1970-87	0.6343	0.7554	0.8560	0.7699	0.4957	0.6928	0.7839	0.6652	
EGYPT	1950-90	0.6509	0.7433	0.8075	0.7498	0.0443	0.0952	0.1978	0.0507	x→y
ETHIOPIA	1960-86	0.1919	0.3949	0.5654	0.4126	0.4117	0.5020	0.6093	0.5004	
GABON	1960-90	0.4199	0.5622	0.6633	0.5746	0.0899	0.1795	0.2766	0.1851	x→y
GAMBIA	1960-90	0.0348	0.1179	0.2656	0.0597	0.2112	0.2993	0.4056	0.2682	(y→x)
GHANA	1955-89	0.3808	0.4858	0.5608	0.5052	0.0341	0.1004	0.2580	0.0268	x→y
GUINEA	1959-89	0.1133	0.2098	0.3614	0.2033	0.2228	0.2735	0.3709	0.2476	
GUINEA-BISSEAU	1960-90	0.0866	0.1352	0.2228	0.1064	0.2839	0.4677	0.6134	0.4873	y→x
IVORY COAST	1960-90	0.5048	0.6248	0.7159	0.6320	0.0983	0.2547	0.3982	0.2436	x→y
KENYA	1950-90	0.0717	0.1460	0.2840	0.1303	0.1553	0.2340	0.3826	0.1530	
LESOTHO	1960-90	0.6106	0.7616	0.8441	0.8212	0.5621	0.6699	0.7457	0.7065	
LIBERIA	1960-86	0.3262	0.4508	0.5715	0.4580	0.2408	0.3513	0.4589	0.2956	
MADAGASCAR	1960-90	0.2550	0.4033	0.5327	0.4286	0.1636	0.2815	0.4085	0.2564	
MALAWI	1954-90	0.0433	0.1061	0.2275	0.0439	0.3076	0.4209	0.5269	0.4284	y→x
MALI	1960-90	0.4787	0.6089	0.7194	0.6333	0.0869	0.1868	0.3277	0.1704	x→y
MAURITANIA	1960-90	0.3281	0.4873	0.6357	0.5071	0.0706	0.1959	0.3516	0.1466	(x→y)
MAURITIUS	1950-90	0.0613	0.1640	0.3058	0.0902	0.1923	0.3402	0.4765	0.3412	(y→x)

[a] $F_{x\to y\mid m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x\mid m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1-\exp(-F_{x\to y\mid m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$. (x→y) means that the point estimate of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$, and the point estimate of $1-\exp(-F_{y\to x\mid m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$. y→x and (y→x) are interpreted similarly.

Table A3. Continued

COUNTRY	DATA	$1\text{-exp}(F_{x\to y\mid m})^a$ 10th	50th	90th	pt est	$1\text{-exp}(-F_{y\to x\mid m})^a$ 10th	50th	90th	pt est	Inference[b]
MOROCCO	1950-90	0.4717	0.6038	0.7053	0.6355	0.0880	0.2084	0.3711	0.2042	x→y
MOZAMBIQUE	1960-90	0.1489	0.2794	0.4277	0.2678	0.2874	0.3980	0.5111	0.3992	
NAMIBIA	1960-89	0.2309	0.3506	0.4484	0.3669	0.3562	0.4850	0.6157	0.4856	
NIGER	1960-89	0.2424	0.4024	0.5559	0.4241	0.3834	0.5328	0.6432	0.5696	
NIGERIA	1950-90	0.1264	0.2239	0.3704	0.1913	0.0187	0.0753	0.2047	0.0505	
REUNION	1960-88	0.2045	0.3324	0.4574	0.3409	0.0518	0.1399	0.2830	0.0893	(x→y)
RWANDA	1960-90	0.4413	0.6187	0.7505	0.6168	0.1057	0.1786	0.3033	0.1517	x→y
SENEGAL	1960-90	0.2749	0.4047	0.5203	0.4440	0.4011	0.5535	0.6917	0.5774	
SEYCHELLES	1960-89	0.1275	0.2240	0.3590	0.1845	0.4023	0.5162	0.6121	0.5485	y→x
SIERRA LEONE	1961-90	0.0697	0.1663	0.3090	0.1167	0.1903	0.3379	0.4398	0.3261	(y→x)
SOMALIA	1960-89	0.2129	0.3992	0.5901	0.3968	0.3556	0.4878	0.6024	0.4958	
SOUTH AFRICA	1950-90	0.5854	0.6788	0.7603	0.6842	0.3077	0.4857	0.6254	0.4937	(x→y)
SUDAN	1971-90	0.5188	0.6857	0.8268	0.7555	0.3811	0.5246	0.6399	0.5391	
SWAZILAND	1960-89	0.1354	0.2405	0.4010	0.2064	0.2669	0.4086	0.5383	0.4259	(y→x)
TANZANIA	1950-88	0.0613	0.1388	0.2596	0.0832	0.0857	0.2090	0.3757	0.1962	
TOGO	1960-90	0.2593	0.3949	0.5293	0.3715	0.0765	0.1823	0.3464	0.1518	(x→y)
TUNISIA	1960-90	0.4596	0.5687	0.6583	0.5785	0.1580	0.2306	0.3238	0.1761	x→y
UGANDA	1950-89	0.4567	0.5688	0.6731	0.5677	0.3036	0.4673	0.5951	0.4773	
ZAIRE	1950-89	0.3217	0.4257	0.5105	0.3989	0.2265	0.2969	0.4182	0.3011	
ZAMBIA	1955-90	0.1663	0.3271	0.4598	0.3414	0.0553	0.1045	0.1830	0.0578	(x→y)
ZIMBABWE	1954-90	0.0400	0.1021	0.2126	0.0607	0.3446	0.4807	0.5886	0.5213	y→x
BAHAMAS	1977-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARBADOS	1960-89	0.2433	0.3803	0.4988	0.3698	0.3621	0.4988	0.6225	0.5223	
BELIZE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CANADA	1950-90	0.1031	0.1929	0.3410	0.1046	0.0527	0.1365	0.2814	0.0726	
COSTA RICA	1950-90	0.2759	0.4376	0.5661	0.4458	0.1527	0.2353	0.3691	0.2153	(x→y)
DOMINICA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y\mid m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x\mid m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1^{st}, 5^{th}, and 9^{th} deciles of the posterior distributions of $1\text{-exp}(-F_{x\to y\mid m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1\text{-exp}(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x\mid m})$. (x→y) means that the point estimate of $1\text{-exp}(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x\mid m})$, and the point estimate of $1\text{-exp}(-F_{y\to x\mid m})$ lies below the 10th posterior decile of $1\text{-exp}(-F_{x\to y\mid m})$. y→x and (y→x) are interpreted similarly.

Table A3. Continued

COUNTRY	DATA	$1-\exp(F_{x\to y\|m})$[a] 10th	50th	90th	pt est	$1-\exp(-F_{y\to x\|m})$[a] 10th	50th	90th	pt est	Inference[b]
DOMINICAN REP.	1950-90	0.0330	0.0990	0.2399	0.0459	0.0290	0.1184	0.2603	0.0931	
EL SALVADOR	1950-90	0.1843	0.3774	0.5481	0.3609	0.4285	0.5530	0.6544	0.5611	(y→x)
GRENADA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
GUATEMALA	1950-90	0.1289	0.2624	0.4106	0.1804	0.0969	0.2045	0.3774	0.1558	
HAITI	1960-89	0.4229	0.5454	0.6426	0.5609	0.0835	0.2003	0.3674	0.2006	x→y
HONDURAS	1950-90	0.3157	0.4311	0.5275	0.4381	0.1782	0.3075	0.4245	0.2776	(x→y)
JAMAICA	1953-89	0.2812	0.4561	0.5896	0.4407	0.3221	0.4166	0.5447	0.4212	
MEXICO	1950-90	0.3828	0.5021	0.6143	0.5203	0.3157	0.4078	0.5124	0.3977	
NICARAGUA	1960-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
PANAMA	1950-90	0.1616	0.3319	0.4867	0.3222	0.1308	0.2457	0.3870	0.2390	
PUERTO RICO	1955-89	0.2970	0.5409	0.7117	0.5608	0.4970	0.5773	0.6631	0.5883	
ST.LUCIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
ST.VINCENT & GRE	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRINIDAD & TOBAGO	1950-90	0.2274	0.3540	0.4844	0.3710	0.3006	0.4297	0.5440	0.4472	
U.S.A.	1950-90	0.0426	0.1473	0.3163	0.1061	0.1122	0.2642	0.4387	0.2572	
ARGENTINA	1950-90	0.0753	0.1725	0.3429	0.1463	0.6437	0.7339	0.7961	0.7765	y→x
BOLIVIA	1950-90	0.1344	0.2685	0.4350	0.2473	0.3213	0.4843	0.6162	0.4860	(y→x)
BRAZIL	1950-90	0.0685	0.1827	0.3431	0.1521	0.2178	0.4024	0.5388	0.4089	(y→x)
CHILE	1950-90	0.0729	0.1649	0.3039	0.1498	0.1816	0.3195	0.4588	0.3525	(y→x)
COLOMBIA	1950-90	0.4629	0.6008	0.7366	0.5877	0.4471	0.5659	0.6518	0.5808	
ECUADOR	1950-90	0.4484	0.5716	0.6857	0.5571	0.2791	0.4302	0.5572	0.4488	
GUYANA	1950-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PARAGUAY	1950-90	0.1160	0.1891	0.3058	0.1439	0.1670	0.2801	0.4101	0.2583	
PERU	1950-90	0.4100	0.5398	0.6426	0.5501	0.4110	0.5402	0.6617	0.5591	
SURINAME	1960-89	0.4076	0.5566	0.6678	0.6036	0.1969	0.3249	0.4926	0.3216	(x→y)
URUGUAY	1950-90	0.4647	0.6229	0.7371	0.6698	0.1012	0.1675	0.2936	0.1128	x→y
VENEZUELA	1950-90	0.0678	0.1878	0.3612	0.1433	0.1348	0.2853	0.4399	0.2614	
BAHRAIN	1985-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
BANGLADESH	1959-90	0.0702	0.1702	0.3176	0.1466	0.7999	0.8636	0.9143	0.8564	y→x

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1-\exp(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$. (x→y) means that the point estimate of $1-\exp(-F_{x\to y|m})$lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$, and the point estimate of $1-\exp(-F_{y\to x|m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y|m})$. y→x and (y→x) are interpreted similarly.

Table A3. Continued

		$1-\exp(-F_{x\to y\mid m})$[a]				$1-\exp(-F_{y\to x\mid m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt est	10th	50th	90th	pt est	
BHUTAN	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHINA	1968-90	0.2694	0.4125	0.5536	0.4056	0.0334	0.0891	0.1763	0.0659	x→y
HONG KONG	1960-90	0.1475	0.2521	0.4047	0.1858	0.1892	0.2752	0.3803	0.2493	
INDIA	1950-90	0.2618	0.3749	0.4873	0.3537	0.1812	0.2952	0.4174	0.3135	
INDONESIA	1960-90	0.1354	0.2832	0.4809	0.2075	0.0243	0.0850	0.2100	0.0274	
IRAN	1955-89	0.2789	0.4429	0.5960	0.4460	0.0265	0.0835	0.2139	0.0269	x→y
IRAQ	1953-87	0.3038	0.4682	0.5959	0.4954	0.1365	0.2870	0.4414	0.2708	(x→y)
ISRAEL	1953-90	0.4039	0.5394	0.6693	0.5624	0.0649	0.1806	0.3464	0.1805	x→y
JAPAN	1950-90	0.0417	0.0929	0.2176	0.0319	0.6121	0.7284	0.8070	0.7468	y→x
JORDAN	1954-90	0.2271	0.4240	0.5763	0.4326	0.4162	0.5558	0.6693	0.5926	
REP. OF KOREA	1953-89	0.2134	0.3296	0.4518	0.2737	0.5205	0.6209	0.6980	0.6439	y→x
KUWAIT	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAOS	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MALAYSIA	1955-90	0.4703	0.6033	0.7176	0.6081	0.3922	0.5324	0.6278	0.5308	
MONGOLIA	1984-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
MYANMAR	1950-89	0.3091	0.4030	0.5150	0.3824	0.1000	0.2262	0.4186	0.2272	
NEPAL	1951-86	0.7522	0.8168	0.8619	0.8267	0.1376	0.2434	0.4133	0.2107	x→y
OMAN	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAKISTAN	1950-90	0.1419	0.2614	0.3814	0.2381	0.2593	0.3934	0.5234	0.3966	(y→x)
PHILIPPINES	1950-90	0.3630	0.4364	0.4961	0.4494	0.3266	0.3815	0.4474	0.3689	
QATAR	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SAUDI ARABIA	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
SINGAPORE	1960-90	0.3802	0.5784	0.7207	0.5638	0.1837	0.3589	0.5122	0.3877	
SRI LANKA	1950-89	0.3573	0.5201	0.6551	0.4761	0.2513	0.4328	0.6093	0.4235	
SYRIA	1960-90	0.4872	0.6182	0.7135	0.6486	0.1692	0.2880	0.3897	0.2672	x→y
TAIWAN	1951-90	0.5104	0.6487	0.7380	0.6546	0.2030	0.3535	0.4686	0.3838	x→y
THAILAND	1950-90	0.2187	0.3367	0.4457	0.2948	0.1945	0.2852	0.4250	0.2440	
UNITED ARAB EMIRATES	1985-89	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y\mid m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x\mid m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1-\exp(-F_{x\to y\mid m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] x→y means that the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$. (x→y) means that the point estimate of $1-\exp(-F_{x\to y\mid m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x\mid m})$, and the point estimate of $1-\exp(-F_{y\to x\mid m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y\mid m})$. y→x and (y→x) are interpreted similarly.

Table A3. Continued

		$1\text{-exp}(-F_{x\to y\|m})$[a]				$1\text{-exp}(-F_{y\to x\|m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt est	10th	50th	90th	pt est	
YEMEN	1969-89	0.0426	0.1303	0.3005	0.0952	0.4047	0.5773	0.6827	0.6081	y→x
AUSTRIA	1950-90	0.2499	0.3868	0.5659	0.3143	0.2721	0.3442	0.4105	0.3490	
BELGIUM	1950-90	0.3543	0.5215	0.6470	0.5131	0.1526	0.2371	0.3686	0.2289	(x→y)
BULGARIA	1980-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYPRUS	1950-90	0.4553	0.5452	0.6235	0.5504	0.3237	0.4437	0.5650	0.4327	
CZECHOSLOVAKIA	1960-90	0.1164	0.2343	0.3975	0.1980	0.2796	0.3990	0.5318	0.4199	(y→x)
DENMARK	1950-90	0.2949	0.4708	0.6292	0.4911	0.2968	0.4723	0.6020	0.4894	
FINLAND	1950-90	0.3737	0.4506	0.5457	0.4357	0.3863	0.5268	0.6378	0.5408	
FRANCE	1950-90	0.1232	0.2602	0.4301	0.2368	0.2889	0.3768	0.4831	0.3589	
FED. REP. GERMANY	1950-90	0.0413	0.1052	0.2170	0.0512	0.0671	0.1468	0.2525	0.1340	
GREECE	1950-90	0.2552	0.4187	0.5750	0.4560	0.3727	0.4785	0.5758	0.4918	
HUNGARY	1970-90	0.4804	0.7365	0.8747	0.7958	0.7758	0.8459	0.9023	0.8463	
ICELAND	1950-90	0.5593	0.6551	0.7300	0.6594	0.1601	0.2418	0.3441	0.2368	x→y
IRELAND	1950-90	0.0304	0.0933	0.2132	0.0383	0.1102	0.2224	0.3817	0.1980	
ITALY	1950-90	0.2794	0.3446	0.4343	0.3451	0.0261	0.1192	0.2806	0.0575	(x→y)
LUXEMBOURG	1950-90	0.0458	0.1012	0.2490	0.0463	0.0865	0.1686	0.2877	0.1421	
MALTA	1954-89	0.7142	0.7724	0.8149	0.7720	0.2938	0.4452	0.5775	0.4587	x→y
NETHERLANDS	1950-90	0.2272	0.4475	0.6190	0.4218	0.1794	0.2504	0.3277	0.2447	
NORWAY	1950-90	0.2387	0.3720	0.5059	0.3156	0.3919	0.5142	0.6241	0.4843	
POLAND	1970-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
PORTUGAL	1950-90	0.1646	0.3163	0.4727	0.3082	0.3795	0.5128	0.6195	0.5312	(y→x)
ROMANIA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPAIN	1950-90	0.1211	0.2571	0.3994	0.2206	0.1763	0.2853	0.4243	0.2699	
SWEDEN	1950-90	0.4790	0.5776	0.6613	0.5687	0.5153	0.6613	0.7780	0.6983	
SWITZERLAND	1950-90	0.2759	0.4054	0.5356	0.4002	0.0562	0.1170	0.2090	0.0971	x→y
TURKEY	1950-90	0.0937	0.2327	0.4390	0.2749	0.0927	0.2388	0.4039	0.2222	
U.K.	1950-90	0.1149	0.2008	0.3295	0.1472	0.1918	0.3245	0.4774	0.3313	(y→x)

[a]$F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1\text{-exp}(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.
[b]x→y means that the 10th posterior decile of $1\text{-exp}(-F_{x\to y|m})$ lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x|m})$. (x→y) means that the point estimate of $1\text{-exp}(-F_{x\to y|m})$lies above the 90th posterior decile of $1\text{-exp}(-F_{y\to x|m})$, and the point estimate of $1\text{-exp}(-F_{y\to x|m})$ lies below the 10th posterior decile of $1\text{-exp}(-F_{x\to y|m})$. y→x and (y→x) are interpreted similarly.

Table A3. Continued

		$1-\exp(-F_{x\to y\|m})$[a]				$1-\exp(-F_{y\to x\|m})$[a]				Inference[b]
COUNTRY	DATA	10th	50th	90th	pt est	10th	50th	90th	pt est	
U.S.S.R.	1970-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
YUGOSLAVIA	1960-90	0.2419	0.4078	0.5667	0.4421	0.1468	0.2868	0.4469	0.3006	
AUSTRALIA	1950-90	0.0832	0.1430	0.2773	0.0975	0.1440	0.2302	0.3286	0.2195	
FIJI	1960-90	0.1804	0.3397	0.4909	0.3256	0.1387	0.2846	0.4067	0.2928	
NEW ZEALAND	1950-90	0.0780	0.2277	0.3997	0.2062	0.0854	0.2216	0.3893	0.1998	
PAPUA NEW GUINEA	1960-90	0.2390	0.4080	0.5520	0.4170	0.4973	0.6348	0.7341	0.6604	$(y\to x)$
SOLOMON IS.	1980-88	NA	NA	NA	NA	NA	NA	NA	NA	NA
TONGA	1985-85	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANUATU	1983-89	NA	NA	NA	NA	NA	NA	NA	NA	NA
WESTERN SAMOA	1979-90	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] $F_{x\to y|m}$ is the measure of linear feedback from exports to income, conditional on imports. $F_{y\to x|m}$ is interpreted similarly. Table entries are the point estimate (pt. est.) and the 1st, 5th, and 9th deciles of the posterior distributions of $1-\exp(-F_{x\to y|m})$. This latter quantity is analogous to the coefficient of determination (R^2) or fraction of variation explained.

[b] $x\to y$ means that the 10th posterior decile of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$. $(x\to y)$ means that the point estimate of $1-\exp(-F_{x\to y|m})$ lies above the 90th posterior decile of $1-\exp(-F_{y\to x|m})$, and the point estimate of $1-\exp(-F_{y\to x|m})$ lies below the 10th posterior decile of $1-\exp(-F_{x\to y|m})$. $y\to x$ and $(y\to x)$ are interpreted similarly.

Table A4. Relationship between conditional linear feedback (R^2 measure) and openness.

COUNTRY	$1\text{-}\exp(-F_{x\to y\mid m})$[a]	$1\text{-}\exp(-F_{y\to x\mid m})$[a,b]	RSX[b]	OPEN[c]	Inference[d]
EGYPT	0.7498	0.0507	0.6991	65.06	$x\to y$
NEPAL	0.8267	0.2107	0.6159	35.15	$x\to y$
URUGUAY	0.6698	0.1128	0.5570	46.54	$x\to y$
GHANA	0.5052	0.0268	0.4784	48.75	$x\to y$
RWANDA	0.6168	0.1517	0.4651	27.17	$x\to y$
MALI	0.6333	0.1704	0.4629	51.33	$x\to y$
MOROCCO	0.6355	0.2042	0.4313	56.13	$x\to y$
ICELAND	0.6594	0.2368	0.4226	72.02	$x\to y$
IRAN	0.4460	0.0269	0.4191	23.8	$x\to y$
TUNISIA	0.5785	0.1761	0.4024	90.78	$x\to y$
GABON	0.5746	0.1851	0.3895	84.93	$x\to y$
IVORY COAST	0.6320	0.2436	0.3884	68.88	$x\to y$
ISRAEL	0.5624	0.1805	0.3820	69.85	$x\to y$
SYRIA	0.6486	0.2672	0.3815	54.77	$x\to y$
MAURITANIA	0.5071	0.1466	0.3606	105.79	$(x\to y)$
HAITI	0.5609	0.2006	0.3603	32.32	$x\to y$
CHINA	0.4056	0.0659	0.3397	32.78	$x\to y$
MALTA	0.7720	0.4587	0.3132	173.15	$x\to y$
SWITZERLAND	0.4002	0.0971	0.3030	73.21	$x\to y$
ITALY	0.3451	0.0575	0.2876	41.98	$(x\to y)$
BELGIUM	0.5131	0.2289	0.2842	145.4	$(x\to y)$
ZAMBIA	0.3414	0.0578	0.2836	62.09	$(x\to y)$
SURINAME	0.6036	0.3216	0.2820	70.91	$(x\to y)$
TAIWAN	0.6546	0.3838	0.2709	89.43	$x\to y$
REUNION	0.3409	0.0893	0.2516	48.32	$(x\to y)$
COSTA RICA	0.4458	0.2153	0.2305	75.28	$(x\to y)$
IRAQ	0.4954	0.2708	0.2246	50.85	$(x\to y)$
TOGO	0.3715	0.1518	0.2197	93.93	$(x\to y)$
SOUTH AFRICA	0.6842	0.4937	0.1905	47.01	$(x\to y)$
HONDURAS	0.4381	0.2776	0.1605	87.11	$(x\to y)$
average	0.5539	0.1920	0.3619	67.49	

[a]Point estimates of $1\text{-}\exp(-F_{x\to y\mid m})$ and $1\text{-}\exp(-F_{y\to x\mid m})$, as defined in table A3. Countries are those in table A3 for which a causal inference is made.

[b]Relative strength of exports, defined as the difference between columns 2 and 3.

[c]As in table A1.

[d]$x\to y$, $(x\to y)$, $y\to x$ and $(y\to x)$ as defined in table A3.

Table A4. Continued

COUNTRY	1-exp($-F_{x\to y\|m}$)[a]	1-exp($-F_{y\to x\|m}$)[a]	RSX[b]	OPEN[c]	Inference[d]
PAKISTAN	0.2381	0.3966	-0.1585	39.49	(y→x)
U.K.	0.1472	0.3313	-0.1841	51.51	(y→x)
ANGOLA	0.1934	0.3921	-0.1987	54.35	(y→x)
EL SALVADOR	0.3609	0.5611	-0.2002	42.97	(y→x)
CHILE	0.1498	0.3525	-0.2027	70.31	(y→x)
GAMBIA	0.0597	0.2682	-0.2086	147.41	(y→x)
SIERRA LEONE	0.1167	0.3261	-0.2094	41.13	(y→x)
SWAZILAND	0.2064	0.4259	-0.2195	165.84	(y→x)
CZECHOSLOVAKIA	0.1980	0.4199	-0.2219	68.41	(y→x)
PORTUGAL	0.3082	0.5312	-0.2230	80.93	(y→x)
CENTRAL AFRICAN REP.	0.1141	0.3437	-0.2296	47.36	y→x
BOLIVIA	0.2473	0.4860	-0.2388	45.8	(y→x)
PAPUA N.GUINEA	0.4170	0.6604	-0.2434	89.35	(y→x)
MAURITIUS	0.0902	0.3412	-0.2510	143.47	(y→x)
BRAZIL	0.1521	0.4089	-0.2568	12.73	(y→x)
SEYCHELLES	0.1845	0.5485	-0.3640	109.77	y→x
REP. OF KOREA	0.2737	0.6439	-0.3702	65.72	y→x
GUINEA-BISSEAU	0.1064	0.4873	-0.3809	78.99	y→x
MALAWI	0.0439	0.4284	-0.3845	58.02	y→x
CAMEROON	0.1046	0.5037	-0.3991	40.34	(y→x)
ZIMBABWE	0.0607	0.5213	-0.4607	64.88	y→x
YEMEN	0.0952	0.6081	-0.5128	41.9	y→x
ARGENTINA	0.1463	0.7765	-0.6302	20.79	y→x
BANGLADESH	0.1466	0.8564	-0.7097	26.42	y→x
JAPAN	0.0319	0.7468	-0.7148	21.58	y→x
average	0.1677	0.4946	-0.3269	65.18	
ρ(RSX, OPEN)[e]				0.0654	

[a]Point estimates of 1-exp($-F_{x\to y|m}$) and 1-exp($-F_{y\to x|m}$), as defined in table A3. Countries are those in table A3 for which a causal inference is made.
[b]Relative strength of exports, defined as the difference between columns 2 and 3.
[c]As in table A1.
[d]x→y, (x→y),y→x and (y→x) as defined in table A3.
[e]Coefficient of correlation between RSX and OPEN.