The Causes of British Business Cycles, 1833-1913

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I. *Introduction*

Few topics loom so large in the history of Victorian Britain as the business cycle, or the trade cycle, as it is also known. Broadly speaking, one might distinguish two schools of thought on the causes of Victorian business cycles, and several distinct viewpoints within each school.[1] There is a school of thought that associates macroeconomic fluctuations in XIXth century Britain with long swings in the levels of domestic and foreign investment. Superimposed upon the Kondratieff long wave, the interaction of these two 16-to-22 year investment cycles generated recurrent business fluctuations with a periodicity of eight to 11 years.[2] A more influential recent view has held that Victorian business fluctuations resulted from the influence of autonomous

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[1] This taxonomy follows D.H. Aldcroft and H.W. Richardson, *The British Economy 1870-1939* (New York, 1970), chapter 2, and A.G. Ford, "The Trade Cycle in Britain, 1860-1914," in R. Floud and D. McCloskey (eds.), *The Economic History of Britain Since 1700*, Volume 2 (Cambridge, 1981), pp. 27-49.

[2] See for example R.C.O. Matthews, *The Trade Cycle* (Cambridge, 1959).

factors that fluctuated systematically with approximately the same periodicity as the trade cycle. Here, one might distinguish real and monetary theories. Among those who accord the dominant influence to real variables, it is possible further to differentiate historians who emphasize internal variables, such as private demands for housing, from those who are principally concerned with external variables, such as the state of export demand. Increasingly in recent years, contributions to the literature on the causes of British business cycles in the XIXth century have fallen into either the real or monetary categories.[3]

The proponents of these various explanations for the trade cycle face a common challenge. To build a convincing case, they must do more than merely demonstrate that fluctuations in certain real or monetary variables coincided with fluctuations in British national income. Such coincidences could have resulted from the impact of other factors on both national income and the supposed explanatory variable, or from the influence of changes in national income over conditions in specific financial and commodity markets. Truly convincing arguments must not consider exports, construction or monetary conditions in isolation from other potential determinants of the trade cycle, and must be based on evidence that movements in such variables were in some sense responsible for, and not simply a consequence of, fluctuations in national income.

The problems of distinguishing cause from effect and of minimizing the likelihood that the correlation among variables results spuriously from the influence of omitted factors have been recognized on occasion. What has not always been recognized is the extent to which these problems pervade the literature on the trade cycle in XIXth century Britain. The purpose of this note is to emphasize the pervasiveness of these problems. The argument proceeds in two steps: first, the literature on the trade cycle is summarily reviewed from this perspective; then, some recently developed time series techniques are used to marshal new evidence bearing on these issues.

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[3] The case for real variables has been made recently by Lewis, Rostow and Kennedy. See W.A. Lewis, *Growth and Fluctuations 1870-1913* (London, 1978); W.W. Rostow and M. Kennedy, "A Simple Model of the Kondratieff Cycle," *Research in Economic History* 4 (1979), pp. 1-36. The case for money has been set out recently in M.D. Bordo and A.J. Schwartz, "Money and Prices in the Nineteenth Century: An Old Debate Rejoined," *Journal of Economic History* 60 (1981), pp. 61-67; M.D. Bordo and A.J. Schwartz, "Money and Prices in the Nineteenth Century: Was Thomas Tooke Right?" *Explorations in Economic History* 18 (1981), pp. 97-127. The importance of internal and external factors is discussed by D.J. Coppock, "The Causes of Business Fluctuations," in D.H. Aldcroft and P. Fearon (eds.), *British Economic Fluctuations 1790-1939* (London, 1972), pp. 188-219.

II. *The Historiography of British Business Cycles*

According to the National Bureau of Economic Research's definition, business cycles are wavelike fluctuations in aggregate economic activity of one to twelve years in duration. What distinguishes the cycle from random disturbances to trade is its recurrent nature and the systematic relationship of fluctuations in national product to the level of activity in different sectors. Without passing judgment on the theories of business fluctuations discussed in this paper, it is impossible to date the birth of the cycle.[4] But whether the business cycle is viewed as a specific characteristic of industrial economies or a universal concomitant of the market mechanism, there would be general agreement that it was fundamentally transformed by the process of industrialization. Hence, this note considers only the business cycle in industrial Britain, from the 1830s onward.

Like the output fluctuations they purport to explain, theories of British business cycles experience recurrent waves of popularity. Perhaps the most durable of these explanations is that fluctuations in export demand provided the impetus for the trade cycle. This explanation has been applied equally to both halves of the XIXth century: for the period prior to 1850, Gayer, Rostow and Schwartz argue that business cycles in Britain " were, in large measure, a function of fluctuations in the export demand for textiles; " similarly, Ford argues that " ... the proximate cause of cyclical fluctuations in the United Kingdom from 1860 to 1914 lay in the behavior of exports of goods and services, aided sometimes by home investment... "[5] Even authors primarily concerned with other factors concede that British business cycles " ... tended to shape in function of foreign business fluctuations."[6]

There are a number of potential explanations for the appeal of the export-based theory of the trade cycle. Perhaps the most obvious is the large and growing share of exports in British national income. Between the 1830s and 1880s Britain's ratio of exports to national income more than doubled, and by the end of the period, exports and property income from abroad accounted

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[4] For a discussion of these matters, see PHILIP MIROWSKI, " The Birth of the Business Cycle," paper presented to Council of European Studies Conference on Periods and Cycles in Europe (Washington, D.C., May 1982)

[5] A.D. GAYER, W.W. ROSTOW and A.J. SCHWARTZ, *The Growth and Fluctuation of the British Economy, 1790-1850* (Oxford, 1953), p. 533; A.G. FORD, *op. cit.*, p. 35. See also A.G. FORD, " Overseas Lending and Internal Fluctuations, 1870-1914," in J. SAVILLE, *Studies in the British Economy, 1870-1914*, Special Edition of the *Yorkshire Bulletin of Economic and Social Research* XVII (1965), pp. 25-26; A.G. FORD, " Notes on the Role of Exports in British Economic Fluctuations, 1870-1914," *Economic History Review* XVI (1963-4), pp. 328-337. For a skeptical view, see R.C.O. MATTHEWS, " The Trade Cycle in Britain 1790-1850," *Oxford Economic Papers* 6 (1954), pp. 1-32.

[6] J.A. SCHUMPETER, *Business Cycles* (New York, 1939), p. 367.

for nearly one-third of GNP at factor cost. It is argued that exports are likely to have mattered simply because they were such a large component of national product. Another reason for the popularity of exports as an explanation for the trade cycle is the amplitude of their fluctuation. For William Beveridge, the fact that exports fluctuated more widely than industrial production was *prima facie* evidence that export fluctuations were the cause and business cycles were their consequence.[7] Finally, the export-based theory of the trade cycle is appealing because of its consistency with a broad spectrum of theoretical models. In models with sticky wages, a rise in export demand has multiplier effects which stimulate output and employment.[8] In full employment models which include a full set of asset markets and assume a degree of international capital mobility, a rise in export demand leads to a sequence of balance of payments surpluses that increase the domestic money supply and raise the price level. Thus, the result that increased export demand raises nominal GNP is common to a wide range of theoretical models.

Several variants of the transmission mechanism from export demand to domestic production have been posited. Most take exports as autonomous and aggregate supply as elastic. There is, for example, the standard multiplier analysis, which predicts that the sensitivity of domestic production to a change in export demand is a declining function of the marginal propensities to save and import.[9] Such simple models rarely include a role for relative prices, which some historians, such as Lewis, argue are the critical channel through which export fluctuations were transmitted. Lewis suggests that declining export demand exerted downward pressure on British industrial production through its terms of trade effect; by reducing the relative price of British exports of manufactures, it increased the cost of importing from abroad the raw material inputs required for industrial production.[10]

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[7] WILLIAM BEVERIDGE, *Full Employment in a Free Society* (New York, 1945); see also ALDCROFT and RICHARDSON, *op. cit.*, chapter 2.

[8] Deane and Habakkuk, along with many other British economic historians, seem to think in terms of this model in connection with the period 1780-1850. PHYLLIS DEANE and H.J. HABAKKUK, "The Take-Off in Britain," in W.W. ROSTOW (ed.), *The Economics of Take-Off into Sustained Growth* (New York, 1963), pp. 63-82.

[9] See A.K. CAIRNCROSS, *Home and Foreign Investment, 1870-1913* (Cambridge, 1953), pp. 129-130; J.R.T. HUGHES, *Fluctuations in Trade, Industry and Finance* (Oxford, 1960), p. 38; D.J. COPPOCK, "The Climacteric of the 1890's: A Critical Note," *Manchester School* XXIV (1956), p. 30. For a variation on this theme, see J.R. MEYER, "An Input-Output Approach to Evaluation of the Influence of Exports on British Industrial Production in the Late XIXth Century," *Explorations in Entrepreneurial History* 8 (1955), pp. 12-34.

[10] W.A. LEWIS, "International Competition in Manufactures," *American Economic Review Papers and Proceedings* 47 (1957), p. 580. See also J.S. PESMAZOGLU, "Some International Aspects of British Cyclical Fluctuations, 1870-1913," *Review of Economic Studies* 16 (1949-50), pp. 117-143.

Perhaps the most compelling argument for the export-based theory of the trade cycle is founded on the exogeneity of major shocks to Britain's export markets. Ford and others assert with little reservation that "[e]xports were exogenous, determined by the growth of populations and incomes abroad over which events in Britain had little influence."[11] It scarcely could be maintained that economic conditions in the British Isles played an important role in the Continental revolutions of 1848, the Crimean War, the Mutiny, the American Civil War, or the Turko-Russian War, each of which had a profound impact on the Victorian economy. Moreover, each of the major cyclical downswings of the late Victorian period was associated with deteriorating economic conditions abroad: in the United States in 1873, in Latin America and Australia in 1890, and in the United States once again in 1907.[12]

At the same time, there are reasons to doubt that the fluctuation of British exports was independent of domestic market conditions. Unusually buoyant demands by British industry for the products of the staple trades surely encouraged British producers to sell a larger proportion of their output at home and to make less available for export. Moreover, Britain's own overseas lending may have stimulated foreign demand for the exports of her staple industries. British investors manifested a systematic preference for bonds issued by countries with strong commercial ties to the British market, and recipients of capital inflows from London regularly turned to the British export market for steel rail, machine tools, and industrial equipment. Even when they obtained their capital goods from American or Continental sources, their purchases stimulated demands in the U.S. or Europe for the products of British industry. In both cases, foreign export demand should be seen as little more than a channel by which the effects of fluctuations in overseas investment were transmitted to the rest of the British economy.

Evidence as to the link between overseas investment and export values is tenuous at best. Cairncross and Saul have questioned whether this evidence supports the existence of any simple relationship between export demand and the direction of investment.[13] Typically, a cyclical decline in export demand was accompanied by a rise in the share of British saving invested domestically. The contractionary influence exerted by the fall in export demand was largely offset by the stimulus provided by increased investment demand at home. Similarly, a cyclical upswing in export demand typically coincided with an increased propensity to invest abroad. Resources formerly employed in the

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[11] Ford, "The Trade Cycle in Britain, 1860-1914," in Floud and McCloskey, *op. cit.*, p. 37. But see also p. 38 for the author's second thoughts.

[12] Schumpeter, *op. cit.*, pp. 312-313.

[13] This argument applies principally to the period prior to 1890. See Cairncross, *op. cit.*, pp. 187-209; S.B. Saul, *Studies in British Overseas Trade 1870-1914* (Liverpool, 1960), chapter 5.

production of investment goods could simply be reallocated to the export sector. Even if export fluctuations are properly viewed as autonomous, there is no reason to assume that they necessarily were associated with movements in national product.[14]

Historians who trace the origin of commodity market disturbances to domestic rather than foreign sources tend to focus on fluctuations in residential construction. Like exports, construction was a large and volatile component of Britain's gross national product for much of the XIXth century. Between 1880 and 1914, the share of new dwellings in gross domestic fixed capital formation remained steady at roughly twenty percent, but the share of capital formation in national income fluctuated with the business cycle. Changes in the volume of new construction directly affected the livelihood of labourers, raw material suppliers and engineers, and indirectly influenced activity in many other sectors. Nevertheless, as with exports, it is difficult to rule out the possibility that the positive association between building and GNP derived from the influence of income on construction. Following Thomas, fluctuations in residential construction are frequently linked to long swings in the rate of migration.[15] When migration from Europe to America was high, it is argued, residential construction in Britain was depressed, and as emigration declined, the construction industry recovered. This suggests only that emigration was a proximate cause of fluctuations in house building. It does not rule out the possibility that changes in domestic economic conditions induced the emigration that subsequently was reflected in British residential construction.

The monetary explanation of the trade cycle has a long and distinguished lineage, with origins in Cairnes and Jevons. The central argument is familiar and follows logically from the quantity equation: assuming a stable income velocity of money, a rise in the British money supply should have produced some combination of higher prices and increased production. To the extent that monetary expansion lowered interest rates and put downward pressure on velocity, these effects would have been moderated. Disagreement centres on the channels through which monetary impulses were transmitted and on the division of changes in nominal income between prices and production. One of the more influential monetary interpretations of the British experience in the second half of the XIXth century is due to Hawtrey. In Hawtrey's analysis, the central factor underlying the trade cycle was the instability of the

[14] See C.K. Harley and D.N. McCloskey, "Foreign Trade: Competition and the Expanding International Economy," in Floud and McCloskey, *op. cit.*, pp. 62-63.

[15] B. Thomas, *Migration and Economic Growth* (Cambridge, 1954), pp. 175-176; E.W. Cooney, "Long Waves in Building in the British Economy of the Nineteenth Century," *Economic History Review* XIII (1960-1), pp. 257-269; H.J. Habakkuk, "Fluctuations in Housebuilding in Britain and the United States in the Nineteenth Century," *Journal of Economic History* 22 (1962), pp. 198-220.

supply of bank credit.[16] At the trough of the business cycle, Hawtrey argued, bankers were likely to conclude that they possessed excess reserves, leading them to lower the interest rate charged for trade credit and raising the money multiplier. Firms would be encouraged to build up their inventories, further stimulating production and spending, both of which were financed in part by additional bank lending. As the volume of loans expanded, bankers eventually would be led to the conclusion that reserves were dangerously low, inducing them to restrict credit, which would raise interest rates and reduce the money multiplier. Firms would be forced to liquidate inventories, initiating a downswing in the trade cycle. From there, the process began anew.

The role of money and credit in the mid-century trade cycle was challenged in the XIXth century by the Banking School, whose members argued that the effects of changes in the money supply were neutralized by off-setting changes in the circulation of bills. Collins has presented evidence for the 1830s and 1840s suggesting that the gross value of bills created was an increasing function of the interest rate.[17] To the extent that interest rate fluctuations reflected changes in the money supply, his findings support the Banking School. However, Collins' evidence alone does not rule out the possibility that variations in currency circulation and bank credit were offset only partially by changes in the supply of bills.

A more telling criticism of the monetary theory is based upon the constraints imposed by Britain's adherence to the gold standard. Given the free convertibility of sterling into gold at a fixed rate of exchange, the Bank of England could permit the banking system to increase the volume of trade credit only at the expense of its stock of reserves. The Bank, although willing to tolerate small, temporary internal drains and minor, reversible external drains, was unwilling to accept a persistent decline in its reserves. Thus, it was in no position to initiate a change in monetary conditions and repeatedly may have been forced to counteract changes in money supply initiated in other parts of the banking system.[18]

Taken to its logical conclusion, this view suggests that the Bank of England not merely was unwilling but actually was incapable of controlling monetary conditions for any extended period.[19] If economic activity in Bri-

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[16] What follows is an interpretation of R.G. Hawtrey, *Good and Bad Trade* (London, 1913). See also R.G. Hawtrey, "The Trade Cycle," in R.G. Hawtrey, *Trade and Credit* (London, 1928).

[17] M. Collins, "Monetary Policy and the Supply of Trade Credit," *Economica* 45 (1978), pp. 379-390. On the views of the Banking School, see W. Newmarch, "An Attempt to Ascertain the Magnitude and Fluctuations of the Amount of Bills of Exchange," *Journal of the Statistical Society* 14 (1851), pp. 143-183.

[18] See also D.H. Robertson, "A Survey of the Modern Monetary Controversy," in H.S. Ellis (ed.), *Readings in Business Cycle Theory* (Philadelphia, 1944), pp. 311-329.

[19] D.N. McCloskey and J.R. Zecher, "How the Gold Standard Worked, 1880-

tain and abroad depended on real factors, and if prices and interest rates were linked internationally through purchasing power and uncovered interest parities, then the demand for money would have remained beyond the Bank of England's control. With international capital mobility insuring the equality of money supply and money demand, the Bank should have been capable of affecting the composition of the monetary base between reserves and domestic credit but not the quantity of money in circulation. Had officials within the Bank attempted to expand money supply more rapidly than money demand, Britain would have incurred balance of payments deficits until the external drain had restored supply to the level of demand.

The view that the level of economic activity at home in conjunction with economic conditions abroad completely determined the demand for sterling attaches little significance to the pound's unparalleled status under the Classical Gold Standard as a reserve and vehicle currency. The Bank of England's unquestioned commitment to sterling's convertibility, plus the ready liquidity provided by the London money market, endowed the pound with attributes unique among national currencies. No other unit of account was used so widely to invoice and settle transactions between residents of different countries. There is a presumption, therefore, that assets denominated in sterling were imperfect substitutes for those denominated in other national currencies. Were this the case, the Bank of England could have altered the relative price of sterling and foreign assets through intervention in financial markets, thereby influencing asset demands along with asset supplies.

The view that British monetary conditions responded passively to the trade cycle also has been criticized for neglecting the Bank of England's capacity to influence economic activity at home and abroad. Triffin has suggested that by raising its discount rate, the Bank could increase the cost to primary producers of maintaining inventories of staple exports.[20] Higher carrying costs then led to inventory liquidation in the primary producing regions and depressed the relative prices of Britain's staple imports. Thus, by raising Bank rate, the authorities could enhance Britain's terms of trade, increase the real value of British income, and stimulate the demand for money relative to the supply, encouraging a specie inflow. On this account, causation runs not from money and credit to output, but from Bank rate to national income and from there to the money market.

1913," in J.A. Frenkel and H.G. Johnson, *The Monetary Approach to the Balance of Payments* (Toronto, 1976), pp. 357-385; T.C. Mills and G.E. Wood, "Money-Income Relationships and the Exchange Rate Regime," *Federal Reserve Bank of St. Louis Review* 60 (1978), p. 24.

[20] Robert Triffin, "The Myth and Realities of the So-Called Gold Standard," in Robert Triffin, *The Evolution of the International Monetary System* (Princeton, 1964), pp. 2-20.

This brief discussion provides the barest sketch of competing explanations for the XIXth century business cycle in Britain. It highlights the common difficulty confronting the proponents of every potential explanation for the trade cycle. That difficulty is more than merely demonstrating that fluctuations in export demand, residential construction and monetary conditions were systematically related to XIXth century business cycles. It is the difficulty of showing also that movements in those variables were in some sense responsible for, and not merely a function of, the cyclical fluctuation of the British economy.

III. *Some Time Series Evidence*

In principle, the relationship of exports, construction and monetary conditions to gross national product could be explored with a structural model of the Victorian economy. Economic theory and historical evidence could be used to specify behavioural relationships governing the actions of individuals and organizations, as in the models estimated by Tinbergen for the period 1870-1914 and by Jonson for the years 1880-1970.[21] The model could be used to examine feedbacks from national income to its components and interrelationships among the determinants of the overall level of activity.

In practice, however, it is questionable whether the structural models at our command can be used as a basis for convincing tests of the various theories of the trade cycle. There is little agreement on how to model the channels through which autonomous impulses influence aggregate economic activity. Economic theory and historical evidence should be used to guide the construction of models, but which theory, and what evidence? The problem can be posed in another way. For a system of simultaneous equations used to determine national income, exports, construction and the money stock to be econometrically identified, all variables cannot appear in all equations. Any model must include a certain number of explanatory variables that are exogenous by assumption. For such a model to be properly identified, assumptions based upon economic theory or other *a priori* knowledge must be invoked to justify the decision to omit potential linkages among variables. Yet, when the very purpose of the exercise is to identify the channels through which cyclical impulses were transmitted, rather than to estimate the relative importance of channels already identified, this procedure is tantamount to assuming one's conclusions.

Before specifying a structural model, it may therefore be useful to apply statistical techniques that impose relatively few restrictions on the channels through which real and monetary impulses are transmitted to aggregate eco-

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[21] JAN TINBERGEN, *Business Cycles in the United Kingdom, 1870-1914* (Amsterdam, 1951); P.D. JONSON, " Money and Economic Activity in the Open Economy," *Journal of Political Economy* 84 (1976), pp. 979-1012.

nomic activity. In the remainder of this note, some recently developed time series methods are utilized to this end.[22] These techniques are essentially statistical tests of antecedence that provide evidence on the timing of innovations in the variables analyzed. The results address the question of whether one variable helps to explain the subsequent path of another. If so, then a reasonable structural model must include links through which the first variable is permitted to influence the subsequent behaviour of the second.

Inevitably, it is tempting to interpret the results in terms of causality; hence, these techniques are sometimes loosely referred to as "causality tests." But while causality has unambiguous meanings in logic with direct applications to problems in history, it is unlikely in practice that debates over causality can be resolved through the analysis of historical time series.[23] Rather, these techniques can be used to narrow the range of plausible models consistent with the time series properties of the data. For example, the finding that innovations in one variable, say exports, are econometrically antecedent to another, say national income, may permit us to conclude that it is improbable that fluctuations in exports merely reflect the influence of prior fluctuations in national income.

Of course, problems of interpretation remain. In general, there will exist several interpretations of the trade cycle in Britain consistent with the finding that a certain variable is temporally precedent to another. Without applying economic theory or historical evidence, it is impossible to arrive at definitive conclusions on the basis of such tests. Nonetheless, the results can be used to narrow the range of admissible interpretations of the historical record. As utilized here, these tests are not a substitute for structural models; they merely provide guidance for specifying reasonable structural relations.

The approach to vector autoregression employed in this section is based

[22] C.W.J. Granger, "Investigating Casual Relations by Econometric Models and Cross Spectral Methods," *Econometrica* 37 (1969), pp. 424-438; C.A. Sims, "Money, Income and Causality," *American Economic Review* 62 (1972), pp. 540-552; T.J. Sargent and C.A. Sims, "Business Cycle Modeling Without Pretending to Have Too Much *A Priori* Economic Theory," *New Methods in Business Cycle Research: Proceedings from a Conference* (Minneapolis, 1980), pp. 1-48. For a survey of early contributions, see E.L. Feige and D.K. Pearce, "The Causal Relationship Between Money and Income: Some Caveats for Time Series Analysis," *Review of Economics and Statistics* 79 (1977), pp. 521-533.

[23] For further discussion, see James Tobin, "Money and Income: Post Hoc Ergo Propter Hoc," *Quarterly Journal of Economics* LXXXIV (1970), pp. 301-317; J.R. Hicks, *Causality in Economics* (New York, 1979); Arnold Zellner, "Causality and Econometrics," in K. Brunner and A. Meltzer, *Three Aspects of Policy and Policymaking* (Amsterdam, 1979), pp. 9-54; B.M. Friedman, "The Roles of Money and Credit in Macroeconomic Analysis," Harvard Institute of Economic Research Discussion Paper No. 859 (November 1981).

on work by Sims.[24] In keeping with the spirit of the business cycle theories discussed in the previous section, the systems to be estimated contain five variables: output Q, prices P, exports X, residential construction C, and the money stock M.[25] Each system takes the form:

$$\begin{bmatrix} Q_t \\ P_t \\ X_t \\ M_t \\ C_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \end{bmatrix} + \begin{bmatrix} B_{11} & B_{12} & B_{13} & B_{14} & B_{15} \\ B_{21} & B_{22} & B_{23} & B_{24} & B_{25} \\ B_{31} & B_{32} & B_{33} & B_{34} & B_{35} \\ B_{41} & B_{42} & B_{43} & B_{44} & B_{45} \\ B_{51} & B_{52} & B_{53} & B_{54} & B_{55} \end{bmatrix} * \begin{bmatrix} Q_{t-k} \\ P_{t-k} \\ X_{t-k} \\ M_{t-k} \\ C_{t-k} \end{bmatrix}$$

$$+ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ \gamma_{21} & 0 & 0 & 0 & 0 \\ \gamma_{31} & \gamma_{32} & 0 & 0 & 0 \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & 0 & 0 \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & 0 \end{bmatrix} * \begin{bmatrix} Q_t \\ P_t \\ X_t \\ M_t \\ C_t \end{bmatrix} + \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \\ U_{4t} \\ U_{5t} \end{bmatrix} \quad (1)$$

The a_i are scaler coefficients and the B_{ij} are lag operator polynomials of length four to be estimated below. The U_i are disturbance terms. The γ_{ij} are included to insure the validity of standard hypothesis tests on the B_{ij}. To remove the trend from the time series, each variable is transformed into logarithms and first differences are taken.[26] The convention of including in each regression four lagged values of every variable is maintained throughout.

The data used in these tests are drawn from several different sources. All variables are available for the period 1833-1913 except for the residential cons-

[24] C.A. Sims, "Macroeconomics and Reality," *Econometrica* 48 (1980), pp. 1-48.

[25] Estimating multivariate systems such as (1), rather than simple bivariate relations, reduces the likelihood that two variables are merely reacting with different lags to a common omitted variable. A potential problem with the methodology, that evidence of timing relations may provide misleading information about the direction of influence when expectations about future values of the variables are important, may not present a serious problem in this context, but this limitation should be noted.

[26] Specific coefficient estimates and the results of hypothesis tests both are sensitive to the manner in which the data are filtered. First differences of logs are used here because, as with many economic time series, this transformation succeeds in removing the trend from the data and in eliminating all evidence of first-order autocorrelation from the residuals U_{it}. Since a different choice of filter may alter the results, it was deemed advisable to choose a reasonable filter before running any regressions and to maintain it throughout, so as to keep the decision of how to filter the data at arms length from the hypothesis tests themselves. On these matters, see Feige and Pearce, *op. cit.*

truction series, which starts in 1870. Deane's estimates of GNP at factor cost are linked to Feinstein's estimates of the same variable for the period 1870-1913.[27] Deane's estimates differ from the earlier Deane and Cole series due to her construction of separate price deflators for raw materials and manufactured goods. The resulting GNP deflator is used as a measure of the price level, while GNP at constant 1900 prices is used as a proxy for Q. Imlah's estimates of the current value of exports of U.K. products are employed throughout.[28] To obtain an estimate of the current value of residential construction, Cairncross' series for the number of houses built in the U.K. is multiplied by Maiwald's index of building costs; this series is normalized to match Feinstein's estimate of the value of residential construction in 1872.[29]

For the entire period, consistent measures of the British money supply exist only for narrowly defined aggregates such as high-powered money: notes and coin outside banks, commercial bank vault cash and private deposits at the Bank of England. The monetary base may have less bearing on the trade cycle than broadly defined measures of the money supply, but attempts to estimate the broader aggregates for even the final three decades of the Victorian period meet with serious difficulties.[30] For purposes of this note, Huffman and Lothian's high-powered money series for the period 1833-1879 is linked to Sheppard's series for the years 1880-1913.[31] Since all other variables are measured as annual flows, the money supply figures should be computed either as annual averages or mid-year stocks. It was necessary, therefore, to adjust to a mid-year basis several components of Sheppard's series (coin in circulation and bank notes in circulation other than those issued by the Bank of England).

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[27] P. DEANE, " New Estimates of Gross National Product for the United Kingdom 1830-1914," *Review of Income and Wealth* 14 (1968), pp. 95-112; CHARLES FEINSTEIN, *National Income, Expenditure and Output of the United Kingdom, 1855-1965* (Cambridge, 1972), T 14-15.

[28] A.H. IMLAH, *Economic Elements of the Pax Britannica* (Cambridge, 1958), pp. 94-95.

[29] CAIRNCROSS, *op. cit.*, p. 156; K. MAIWALD, " An Index of Building Costs in the United Kingdom," *Economic History Review* VII (1954), pp. 187-203; FEINSTEIN, *op. cit.*, T 85-86. Substituting Feinstein's construction figures for the series employed here made little difference for the results, not surprisingly, since Feinstein's figures are based in large part on the Cairncross-Maiwald estimates. Although no attempt is made to calculate an index of residential construction for years prior to 1870, note should be taken of the index of bricks produced annually for the period 1785-1850 in GAYER, ROSTOW and SCHWARTZ, *op. cit.*

[30] See for example M.D. BORDO, " The U.K. Money Supply 1870-1914," *Research in Economic History* 6 (1981), pp. 107-125.

[31] W.E. HUFFMAN and J.R. LOTHIAN, " Money in the United Kingdom," *Journal of Money, Credit and Banking* 12 (1980), pp. 155-174; D.K. SHEPPARD, *The Growth and Role of U.K. Financial Institutions 1880-1962* (London, 1972), pp. 180-181.

With figures for construction available from 1870 only, the full system of equations is estimated for the late Victorian period stretching from 1870 to 1913. For the longer period 1833-1913, a sub-system composed of exports, the money stock, real income and prices is estimated, and this sub-system is estimated separately for the early-to-mid Victorian years 1833-1869 as well to provide a basis for comparison with the full system.[32]

Table 1 summarizes the results of vector autoregressions estimated for the period 1833-1913. The summary statistics reported in the Table are asymptotically distributed as F-statistics; given this asymptotic distribution, they can be used to calculate the probability that the coefficients on lagged values of the independent variables (the B_{ij} in Equation 1) differ significantly from zero.[33] According to this interpretation, the statistic of 5.08 in the first row of Table 1 indicates that we may conclude at a 99 percent level of confidence that fluctuations in real GNP in XIXth century Britain were significantly related to subsequent movements in prices. The economic interpretation of this finding is straightforward: for the quantity equation to hold in the face of an unchanging money supply, any rise in real income should have been followed by a decline in British prices. At the same time, there is little direct support in the fourth row of Table 1 for the view that fluctuations in the supply of high-powered money provided the impetus for the trade cycle.

The statistics in the third row of Table 1 indicate that export fluctuations were significantly related to subsequent movements in prices. For the period

TABLE 1

QUASI F-STATISTICS FOR VECTOR AUTOREGRESSIONS, 1833-1913

		Dependent Variable			
		Q	P	X	M
	Q	—	5.08*	1.55	0.25
Independent	P	0.68	—	1.53	0.25
Variable	X	0.87	2.55**	—	1.10
	M	1.29	1.26	0.71	—

* Significant at the 99 percent level.
** Significant at the 95 percent level.

[32] The terminology of this section, which defines the early-to-mid Victorian period as stretching from 1830 through 1869 and the late Victorian period as the years from 1870 through 1913, follows W. E. HOUGHTON, *The Victorian Frame of Mind* (New Haven, 1957).

[33] Since no F-statistics or other tests of significance were used in guiding the search for an appropriate specification, test statistics lower than the conventional levels of significance are of interest.

as a whole, there is little evidence that a rise in export demand did other than raise the price of British exports, improve the terms of trade, and stimulate the volume of production in Britain's export trades at the expense of other sectors. On the basis of this sample, it would appear, as Harley and McCloskey have argued, that fluctuations in the demand for British exports merely caused "a reallocation of resources and a restructuring of output." [34]

Table 2 summarizes the results of estimating the entire vector for the years 1870-1913 and the sub-system excluding construction for the years 1833-1869. The two panels of Table 2 reflect the extent to which the implications of this exercise for modeling the early-to-mid Victorian period differ from the implications of the tests for modeling the late Victorian period. For the years 1833-1869, the significant negative correlation between movements in output and subsequent movements in prices, already familiar from Table 1, is evident once again. Other significant correlations for this period are between exports and the monetary base. Throughout the early-to-mid Victorian period, a rise in British exports was followed by an increase in the monetary base,

TABLE 2

QUASI F-STATISTICS FOR VECTOR AUTOREGRESSIONS, 1833-1869 and 1870-1913

1833-1869

		Dependent Variable			
		Q	P	X	M
Independent Variable	Q	·	2.50***	0.82	3.32**
	P	1.31	--	1.31	0.81
	X	1.83	1.70	—	4.20**
	M	2.10	2.07	2.42***	—

1870-1913

		Dependent Variable				
		Q	P	X	M	C
Independent Variable	Q	—	1.50	0.84	1.00	2.71***
	P	0.73	—	0.21	0.87	1.03
	X	1.69	3.15***	--	2.47***	1.95
	M	2.57***	2.15	0.48	—	1.26
	C	1.07	3.28**	0.49	0.51	

** Significant at the 95 percent level.
*** Significant at the 90 percent level.

[34] HARLEY and McCLOSKEY, *op. cit.*, p. 62.

consistent with the specie-flow mechanism, assuming passive behaviour of imports and other components of the external accounts. Similarly, a rise in the monetary base was followed by a decline in British exports, consistent with the view that larger money balances reduced export supply by increasing domestic demands for the products of the staple trades. However, neither exports nor the monetary base were significantly related to the subsequent paths of real incomes or prices.

Evidence for this period on the relationship between fluctuations in real incomes and movements in the monetary base is difficult to interpret. Although fluctuations in real incomes are significantly associated with subsequent changes in the monetary base, the direction of this effect is inconsistent with modern interpretations of the specie-flow mechanism. For the years 1833-1869, a decline in real income typically was followed by a rise in the supply of high-powered money. This finding raises the possibility that the Bank of England systematically varied its note issue in a manner inconsistent with the rules of the gold standard. In the commercial crises of 1847, 1857 and 1866, for example, the Bank, while subject to alarming gold drains, granted the Governor permission to increase the Fiduciary Issue beyond the limits specified in the Bank Charter Act of 1844. For the period prior to 1870 at least, it does not appear that the Bank of England always responded passively to pressures on its reserve position.

Results for the late Victorian period, reported in the lower panel of Table 2, differ strikingly from these just discussed. The correlation between export fluctuations and subsequent movements in the price level, already familiar from Table 1, appears also in the bottom panel of Table 2. Thus, the impact of export shocks on British prices would appear to be primarily a late Victorian phenomenon. Similarly, fluctuations in residential construction systematically affect British prices but not real incomes. There is little support in Table 2 for residential construction as a major determinant of the trade cycle; to the contrary, the evidence supports the view that fluctuations in construction activity derived from the trade cycle itself.

Perhaps most strikingly, movements of real income in Britain no longer appear to have been significantly associated with subsequent movements in the British price level. Here two distinct and quite inconsistent interpretations suggest themselves. One interpretation is that the independence of British prices from domestic economic conditions reflected the efficient and highly developed state of international markets.[35] Over the course of the century, a number of forces may have conspired to link British prices ever closer to prices in the

[35] This argument is made by DONALD MCCLOSKEY and RICHARD ZECHER, "The Success of Purchasing Power Parity: Historical Evidence and its Implications for Macroeconomics," prepared for the National Bureau of Economic Research conference on the Classical Gold Standard (Hilton Head, South Carolina, March 1982).

rest of the industrialized world while at the same time reducing the leverage the British economy exercised over foreign economic conditions. The steady rise in the share of exports in British national income, along with continuing improvements in oceangoing transportation and international communication, enhanced both incentives and opportunities for commodity arbitrage. After 1880, a growing number of nations in Europe and elsewhere adopted gold standards, rigidifying the link between prices in Britain and abroad. At the same time, as industrialization abroad reduced the share of British manufactures in worldwide production, economic conditions in the British Isles were rendered increasingly incapable of influencing the level of prices in the gold standard world.

An alternative interpretation of the absence of a link between fluctuations in activity and subsequent price changes is based on a vision of pervasive financial and commodity market rigidities that inhibited the economy's adjustment to monetary shocks. In other words, the absence of a significant correlation between real incomes and subsequent price movements may simply reflect the existence of price rigidities and the highly imperfect functioning of commodity and financial market arbitrage. This view has the virtue of consistency with the statistic of 2.57 in the first column of Table 2 reflecting the existence after 1869 of a significant correlation between movements in the monetary base and subsequent movements in real incomes. The standard Keynesian explanation may apply here: a larger money stock would have been willingly held only at a reduced interest rate, but in the presence of imperfectly flexible prices, a decline in nominal rates translated immediately into a fall in real interest rates. Thus, increased financial wealth stimulated consumption, while a lower real interest rate promoted investment. This explanation seems an especially appealing way of viewing the fluctuations in investment, prices and production that occurred between 1890 and the First World War.[36]

IV. *Implications for Future Research*

The trade cycle in XIXth century Britain is the subject of one of the most enduring and contentious debates in the literature on the Victorian economy. Much of that literature is riddled by an inability to distinguish cause from effect — an inability to show convincingly that movements in potential explanatory variables were in a fundamental sense responsible for, and not simply a consequence of, prior fluctuations in the state of trade. Even historians ad-

[36] Barry J. Eichengreen, "Asset Markets and Investment Fluctuations in Late Victorian Britain," *Research in Economic History* (forthcoming, 1983). See also C.K. Harley, "The Interest Rate and Prices in Britain, 1873-1913: A Study of the Gibson Paradox," *Explorations in Economic History* 14 (January 1977), pp. 69-89.

mitting an awareness of this problem all too frequently adopt methodologies that tightly circumscribe the range of conclusions likely to obtain.

This note has reconsidered the association of cyclical fluctuations in incomes and prices with movements in their potential determinants from a more general perspective. The strength of the methodology lies in the fact that the form of the tests is only loosely restricted by prior beliefs. While those tests yield new information about the role of various forces in the fluctuation of the Victorian economy, they yield little guidance concerning the channels through which those cyclical impulses were transmitted. Nonetheless, a number of implications emerge for further study of the trade cycle. For portions of the XIXth century, both export values and residential construction emerge as significant determinants of the nominal value of British GNP. However, both variables appear to have influenced prices primarily rather than the level of economic activity. Reassuringly, export fluctuations do not appear to have derived from the trade cycle itself. The same cannot be said for fluctuations in residential construction.

Many of the unresolved issues raised by the results concern the role of monetary forces in the trade cycle. For the years 1833–1869, fluctuations in Britain's monetary base appear to have resulted from prior fluctuations in the state of trade, but not in the manner predicted for a country playing by the rules of the gold standard. In contrast, for the late Victorian period, fluctuations in the monetary base emerge as the single most significant determinant of the trade cycle. This finding is consistent with other work suggesting that fluctuations in the late Victorian money supply influenced the trade cycle through impact on investment demand. Changes in the rate of inflation or deflation after 1870 appear to have been only partially incorporated into nominal interest rates.[37] Consequent changes in real interest rates stimulated investment demand by reducing the cost of finance. Thus, the central issues to be addressed in future research appear to concern the changes in market structure that enhanced the real effects of monetary fluctuations over the course of the XIXth century.

[37] *Ibid.*