Money and Prices in the Nineteenth Century:
Was Thomas Tooke Right?

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Two broad explanations of long-term sustained movements of the price level have coexisted since the earliest evolution of economic ideas. Nineteenth century price history is no exception to this generalization. In recent work dealing with the issue, W.W. Rostow and W.A. Lewis[1] have forcefully argued that real, not monetary, forces explain major periods of inflation and deflation in both the United States and Great Britain from 1797 to 1914. For them, changes in the relative growth rates of agricultural output[2] induce changes in the relative prices of major commodities and in the overall price level. They regard monetary forces as passive, with money supply determined by demand and velocity a will o' the wisp.[3]

Their argument, essentially a restatement of the views of Thomas Tooke in A History of Prices (1857),[4] emphasizes the role of changing costs as the determinant of price level movements.[5] Accordingly, their argument is similar to the modern cost-push or supply shock-induced explanation for recent inflationary episodes.[6]

In this paper we examine the Rostow-Lewis position from a modern quantity theory of money perspective and empirically test two major implications of their view. Our paper is thus both a challenge to the tradition of Thomas Tooke and a contribution to the modern policy debate about the causes of inflation.

Section 1 of the paper reviews the modern quantity theory explanation of inflation or deflation. Section 2 presents a statement of the views of Rostow and Lewis on the relationship between money and prices, and section 3 critically evaluates the Rostow and Lewis position. Section 4 presents two simple tests of the relative prices theory of inflation, and section 5, a brief conclusion.

1. The Modern Quantity Theory Approach to Price Level Changes

    The modern quantity theory of money argues that secular trends in the
price level are determined by the growth of the money supply relative to the
long-run trend growth of real output, assuming a stable secular trend in the
demand for money.[7] The mechanism by which changes in the quantity of money
affects nominal income (both prices and output) is by the community's
adjustment of its actual to its desired real money balances. Thus an increase
in the quantity of money raises actual balances above their desired level.
The community restores portfolio equilibrium by increasing its expenditure
above its income receipts, the excess of desired expenditure above income
initially leading to an increase in real output, then a rise in the price
level.[8]

    The transmission mechanism induces expenditure on assets as well as on
goods and services. Thus changes in interest rates on both financial and
nonfinancial assets play a role in the adjustment mechanism.

> "Changes in (the) money supply have three different effects on
> changes in interest rates. First, the familiar liquidity
> effect, the short-run tendency of an increase in monetary
> growth to lower interest rates. This effort is
> short-lived and is overtaken by the second effect, the
> tendency of a rise in the monetary growth rate to produce
> a subsequent rise in nominal income and thereby to increase
> demands for credit and money and raise interest rates. The
> third effect is that of price expectations. Nominal rates
> of interest will be higher than the real rate if it is
> expected that prices will rise... . Hence nominal interest
> rates tend to be higher during periods of secular price rise
> than of price fall."[9]

    It is assumed that the demand for money is determined by forces independent

of the supply of money. Over the long run the community's demand for money (desired real money balances) are postulated to be a stable function of expected long-run income, the opportunity costs of holding real balances relative to other assets — both financial and nonfinancial — as well as institutional variables such as the degree of monetization and financial development.[10]

In contrast, the supply of money is determined by three proximate determinants: the stock of high-powered money (H) (the sum of hand to hand currency and commercial bank reserves), the deposit-reserve ratio (D/R), and the deposit-currency ratio (D/C). The three proximate determinants reflect, respectively, the behavior of the monetary authorities, the commercial banks, and the public.

Modern quantity theorists argue that in periods of flexible exchange rates, such as the suspension period of 1797-1821 in British monetary history and the greenback episode of 1861-78 in U.S. monetary history, H is under the control of the monetary authorities. On the other hand, under a system of fixed exchange rates, such as the classical gold standard which prevailed over much of the period 1821-1941, H is determined by the balance of payments. The deposit-reserve ratio is affected by legal reserve requirements, banks' expectations of currency movements into and out of their vaults, and interest rates. The deposit-currency ratio is affected by interest rates, income, and the public's preference for holding coin and currency. Over most of the pre-World War I era both the U.S. and the U.K. deposit and currency ratios, called the money multiplier $(\frac{M}{H})$, exhibited stable behavior, with H, the key proximate determinant of change in the money supply.[11]

As noted, under flexible exchange rates, the quantity of H is completely determined by the monetary authorities, dramatically illustrated by the paper-money-induced wartime inflationary episodes of 1797-1815 in Great Britain and

1861-65 in the United States. By contrast, under the gold standard, for any one country the stock of high-powered money, and hence the money supply, is determined by the stock of monetary gold, which in turn is a function of the balance of payments. Under the classical gold standard, divergences between the domestic price level and the world price level would automatically induce gold flows and corresponding changes in the domestic money supply until in the long run purchasing power parity would be restored.[12] In the short run, however, the monetary authorities by engaging in sterilization operations (changing the composition of H between international reserves and domestic credit) could prevent movements in the monetary gold stock from influencing the stock of high-powered money, leading to greater expected variance in the G/H ratio in the short run (year to year) than over the long run.[13]

Under the gold standard, gold discoveries and technological advances in gold mining and processing represented a key source of monetary disturbances. Evidence linking the gold discoveries to world wide monetary expansion and world wide inflation is not lacking.[14] The modern quantity theory, following a long tradition, also argues that a commodity money standard, such as the gold standard, would ensure a stable price level over the long run — that the relationship between the exchange value of money (the inverse of the price level) and the marginal cost of producing gold, by determining the profitability of gold mining, would influence the amount of gold produced and put to monetary use. Thus in periods such as the 1880's, both rising world real output and the decision by many major countries to join the gold standard, put downward pressure on the world price level, raising the exchange value of gold relative to its production cost. This induced resources to flow into gold mining activity and into the search for new sources of gold, eventually leading to

both technical advances and to gold discoveries, a rise in the world price level, and fall in the exchange value of money towards equilibrium.[15]

An important element of the modern quantity theory approach is the distinction between movements in the absolute price level and movements in relative prices. The absolute price level, as noted, is determined by monetary forces, given the level of real output. Relative prices are determined by the real forces affecting the demand and supply curves for individual commodities. Changes in real forces, such as major technological advances or changes in tastes, will affect the price of one commodity relative to another, and can affect the money price of individual commodities but cannot directly affect the price level.[16] The only way relative price changes can affect the overall price level is by changing the supply of money, its velocity of circulation, or the level of real output.[17]

Finally, the modern quantity theory approach does not recognize the distinction between cost-push (pull) and demand-pull inflation but argues that "inflation is everywhere and always a monetary phenomenon." According to cost-push theory, autonomous increases in major costs, such as the price of energy, steel or wheat, will lead to increases in the overall price level, assuming that industry prices are based on a simple mark-up over input prices and that the overall price level is just the sum of industry prices (assuming a low degree of substitution between commodities in the short run).[18] Moreover, such an increase in prices can then induce a wage-price spiral if unions succeed in maintaining the real wage of their members. It is then argued that the cost-induced increase in the price level would be associated with a reduction in real output unless offset by accommodative monetary policy or unless velocity were passive. Once accommodative monetary policy is followed, it is difficult

to distinguish between cost-push and other sources of inflation. Accommodative monetary policy, however, is primarily a post-World War II phenomenon,[19] so its relevance to nineteenth century experience must first be established.

In a nutshell, the modern quantity theory view argues that, regardless of the cause, monetary growth in excess of real output growth is required for sustained increases in the price level (i.e., inflation) to persist.[20]

2. Real Factors as the Key Determinants of Price Level Changes

In this section we summarize the views of Rostow and Lewis that nonmonetary forces represent key determinants of sustained price level movements.

Six major points of difference emerge between the modern quantity theory of money and the emphasis by Rostow and Lewis on nonmonetary forces as the key determinants of periods of inflation and deflation. For them,

    i.   Changes in relative prices of major commodities (relative costs) are the major cause of price level changes.

   ii.   The money supply is passive and velocity is flexible.

  iii.   Gold discoveries and changes in the monetary gold stock play a minor role in the analysis of inflationary episodes.

   iv.   The interest rate is the indicator of monetary effects and movements in it prove monetary forces to be passive.

    v.   Secular price trends in the nineteenth century are not episodic and do not reflect the adjustment of a commodity money standard. Instead, they are an integral part of the workings of a unified theory of the Kondratieff cycle.

   vi.   The distinction between the long run (secular trends) and the short run (cycles) is invalid since the long run can only be viewed as a series of short-run events.

i. Changes in Relative Prices as the Key Cause
    of Price-Level Changes

Passages from the works of both authors may be cited to illustrate this

view. Given the assumption of "passive and flexible monetary systems,"[21]

"upward or downward movements of the relative prices of major commodities

could affect that statistical abstraction of our own creation we call the

price level."[22] Thus, for example, in his discussion of the British economy

in the period 1790-1850 Rostow stated that

> "... a disproportionate rise (or fall) in the price of wheat was
> not the movement of a relative price, compensated for by the
> contrary movement of other prices, within a fixed money (or
> money income) ceiling: it yielded a rise (or fall) in 'the price
> level'."[23]

A similar view is stated by Lewis when he argues that a slowdown of U.S.

agricultural output after 1900 led to a rise in the relative prices of agri-

cultural relative to industrial products:

> "Now changes in the prices of wheat, wool and cotton would
> communicate themselves to most other agricultural commodities.
> A commodity could be a substitute on the side of demand,...,
> or it could be a substitute on the side of supply... . If
> one can explain why important food and fibre prices altered,
> most other agricultural commodities fall into line. And if
> one can explain agricultural prices in general, the jump to
> industrial prices does not involve too large a gap."[24]

Indeed, Lewis proceeds with evidence he regards as favoring the role of real

forces in explaining the Kondratieff price cycle from 1866 to 1913. He

regresses five-year moving averages of the logs of the prices of four major

commodities (wheat, cotton, wool and coffee) for the core industrial nations

on the monetary gold stock, industrial output as a proxy for demand, and output of the commodity in question as a proxy for supply, and a time trend. He finds that regressions including demand and supply as well as the gold stock explain variations in commodity prices better than the gold stock alone.[25]

The view that price level changes are just the sum of changes in individual money prices, caused by changes in demand and supply conditions in individual markets, can be traced back to the mid-nineteenth century writings of Thomas Tooke. Tooke explained the inflationary episode of 1797-1815 as caused by such factors as bad harvests, the continental system, higher tariff rates, depreciation of the exchange rate, and high interest rates, while the subsequent period of deflation was explained by a series of good harvests, the removal of the continental blockade, reduced freight rates, appreciation of the currency, a decline in interest rates and technological improvements.[26]

According to Rostow, the analysis of periods of deflation is no different from that of inflation, i.e., the price level will be affected in both cases by changes in costs working independent of changes in real output.

> "In my formulation, the rate of change in costs helps determine the rate of change in prices as well as in T, creating a higher or lower demand for money to which the monetary system passively responds."[27]

Indeed, Rostow explicitly subscribes to a cost-push theory of inflation,[28] which he applies to three trend periods of inflation: 1797-1815, 1848-73, and 1897-1914 and two periods of deflation, 1818-48 and 1873-96, for both Great Britain and the United States. He attributes the Napoleonic wartime inflation both to the underlying rise in the relative prices of agricultural relative to industrial products,[29] as well as a list of special factors associated with the wartime increases in real costs of important items,

such as grain and raw cotton, and wartime-induced increases in demand. The monetary system is assumed to be passive.[30] He attributes both the 1848-73 inflation episode and that of 1897-1914 also to nonmonetary factors,[31] the key underlying factor in both episodes being a rise in the relative prices of agriculture (mainly wheat) and of industrial products, aggravated by the allocation of investment to the unproductive activities of war and gold mining.[32] He explains the intervening deflationary episodes by declining commodity prices, as well as by declining costs of major industrial products and of freight rates.[33]

ii. Passive Money Supply and Flexible Velocity

For the 'cost-push' or 'relative prices' theory of price-level movements to hold, either M or V must be passive. Theories that view the money supply as passively responding to the needs of trade derive from a tradition in monetary theory traceable back to the eighteenth century and beyond.[34] The passive M^S argument can be interpreted in either of two ways: first, the commercial banking system always supplied the bank credit business demanded and movements in the deposit reserve and deposit currency ratios dominated movements in high-powered money (the monetary gold stock); second, the central bank always validated any inflation produced by real forces to offset any induced decline in real output or rise in unemployment.

The first theme is dominant in the Rostow-Lewis view. Two quotations from Rostow's work document the case for him:

> "As a matter of trend, the monetary systems of the major
> advanced economies were sufficiently flexible to adjust
> to the requirements for money as determined by other factors
> at work in the world economy or in national economies."[35]

"The availability of increased gold [in the 1850's]
permitted Britain and others to expand their circulation
of coins in an inflationary setting decreed by other
factors; but the effective quantity of money necessary
to finance the expansion of goods and services, at
higher prices, required the evocation of enlarged credit
instruments, notably bills of exchange."[36] [emphasis ours]

Lewis makes the case as follows:

"The banks were able to meet the demand for money not because
their reserves were growing rapidly [the U.S. 1892 to 1906]...
but because it was safe to increase the ratio of deposits to
reserves,... and this was safe to do because the public's
demand for deposits was rising so rapidly,... . The stock
of gold held by the Treasury could potentially have played
a role, via the banks' holding of cash, but cash grew
relatively slowly, and the ratio of bank to public holdings
of cash was about the same in 1906 as in 1892."[37]

In addition, both authors state that velocity is flexible or the demand
for money unstable. Thus, to quote Rostow,

"the rapid decline in costs and relative prices reduced
[1879-96], in my view, the demand for money below the
level which would otherwise have obtained, and the path
of M. responded."[38]

and according to Lewis,

"If the quantity of money and output grew at more or less
constant rates over the long period [the U.K. 1893 to 1913],
how was the swing in prices sustained, in monetary terms?
The answer is by changes in the velocity [GNP divided by M_2]
of circulation, which fell sharply during the downswing of
prices, and rose sharply during the upswing."[39]

On the above grounds the authors both argue that the historical evidence presented by modern quantity theorists such as Friedman and Schwartz (1963), Cagan (1968) and Higgonet (1957), linking price level movements to independent monetary changes, can be reinterpreted to produce opposite conclusions.

> "As for the Friedman and Schwartz analysis of long period price trends as a dependent variable, responding to independently determined trends in real output and the money stock, A Monetary History is in no sense a demonstration. It is, simply, an assertion by hypothesis of the direction of causation in the quantity theory identity."[40]

The passive money supply argument is based on two strands to be developed below, that the monetary gold stock was an accessory not a cause of changes in the money supply for countries on the gold standard, and that the passive response of bank-created money to business conditions can be observed in interest rate behavior.

iii. De-emphasis on the Role of Monetary Gold
and Gold Discoveries

As a corollary of the passive M^S view, Rostow and Lewis argue that the effects of changes in the monetary gold stock on money supply were not important in the United Kingdom or the United States during the gold standard era. They cite the lack of correlation using short-term data between the monetary gold stock and bank reserves as well as the inability to detect significant interest rate responses to gold flows.[41]

Thus, Rostow states:

> "...the strictly monetary effects of the new gold, operating through central bank reserves and interest rates, do not appear to have been important."[42]

and notes in discussing the monetary effects of the gold discoveries of the
1850's and 1890's:

> "In the 1850's and 1890's increased gold was available, and,
> in the case of Britain, a good deal flowed into circulation,
> although the Bank's reserve did not increase. The United
> States did increase its gold holdings and circulation in this
> interval; but it was only after 1900 — that is, after the
> big initial surge in world prices — that the Bank of France
> and the Reichsbank increased substantially their central
> reserves... . [I]f the increase in gold production had not
> occurred from the late 1880's but the other inflationary
> forces had operated ... an abandonment of the gold standard
> was not the only realistic option nor a protracted depression
> of demand ... [T]he substitution of paper for coin was a
> widely available option consistent with the gold standard...
> I conclude, in short, that expanded gold mining was in these
> years one of the inflationary forces at work; that the
> additional gold available permitted banking systems to
> accommodate to the rise in prices without greater structural
> changes in the monetary mechanism, than those in any case
> proceeding;"[43]

In a slightly different vein, W.A. Lewis argues that in the period 1880
to 1913 "the ratio between the stock of gold and the stock of money was
changing all the time. It is therefore rash to assume that changes in the
stock of monetary gold in this period were exactly reflected in changes in
the stock of money."

> "The evidence is clear for the United Kingdom. ... [T]he stock
> of money rose at a more or less constant rate no matter what
> was happening to the stock of monetary gold. ... One cannot
> use changes in the quantity of money in the UK to explain
> the UK price level."[44]

Although gold discoveries did have inflationary effects on the world economy, it was because of 'real rather than merely monetary' factors,[45] which diverted resources from productive to unproductive uses "and in this aspect, like a war, or the building of a pyramid, gold was a price raising factor, quite apart from any possible effect it might have on central bank reserves, the rates of interest, and the willingness of banking systems to lend."[46]

The point is restated:

> "Gold-mining...was a form of investment tending to raise
> world prices, both because gold-mining was involved, and
> because of the considerable period of gestation involved
> in the opening up of new territories."[47]

and, finally, both authors pay lip service to the classical commodity theory of money linking gold mining activity and gold discoveries to trends in the price level, but downplay its importance.

> "I don't believe the connection has ever been documented
> for the pre-1914 gold discoveries; and the lags were very
> long indeed. The response of gold production to a rise
> in its real price (a decline in the price level) was
> extraordinarily delayed: from 1815 to mid-century; from
> 1873 to the late 1880's. But barring evidence to the
> contrary, I'm inclined to allow for this palpably logical
> but unproven linkage."[48]

iv. Interest Rates as an Indicator of Monetary Pressure

An important element in the Rostow-Lewis view that monetary forces are not a major determinant of the price level lies in their conception of the role of the interest rate in the transmission mechanism. For them, an excess of supply of or demand for money will affect economic activity through

the liquidity effect on short-term interest rates. Thus, periods of monetary
stringency should be accompanied by rising market interest rates and periods
of monetary ease should be accompanied by falling interest rates.[49]

Using the short-term interest rate as the indicator of monetary pressure,
Rostow then argues that monetary factors could not be more than a contributing
factor to the upper turning point of the business cycle. Moreover, comparing
the movements of the Bank of England's bank rate and short-term money market
rates, he observes that the bank rate always rose after the business cycle
turning point; hence monetary stringency was not the cause of crises in the
nineteenth century British economy.[50]

> "Bank rate consistently lagged behind the rise in the
> market-rate and rose most sharply at times of panic,
> well after the upper turning-point. The broadly passive
> action of the Bank is not final evidence against a monetary
> theory of the upper turning-points; but it is persuasive
> when placed in the whole setting of the Bank directors'
> view of their function."[51]

Lewis, in a similar vein, argues that raising bank rate may have been
a minor factor in affecting economic activity between 1875-80 and 1885-90.[52]

Instead of monetary forces explaining the turning points in cycles,
emphasis is placed on real factors. Thus, Rostow states that rising interest
rates "made cost conditions different from those which had been expected
when various investment commitments were undertaken, and they carried
psychological overtones as well... . The expected rate of return over costs
was being altered by a simultaneous fall in the expected rate of return by
a rise in costs. From these basic alterations in the complex of forces
determining the volume of investment, rather than from a short-term credit
shortage (or a deceleration of M), the turning point seems to have occurred.

Like the supply of labor or commodities or fixed capacity, the short-term money supply set a limit to the extent to which expansion could proceed... But that limit was certainly more elastic than for other factors of production, so long as confidence prevailed."[53]

Finally, in the Rostow-Lewis view, secular declines of interest rates in periods of deflation and rising interest rates in periods of gold discoveries provide evidence against the monetary explanation of price determination. Thus, the secular decline in interest rates in the deflationary period 1815-50 "is something of an embarrassment to the monetary explanation of price movements."[54] For Rostow, the 1850's in Great Britain was a period of "high interest rates, a falling Bank ratio of bullion to liabilities, falling ratios of cash to deposits in joint stock banks, and chronic pressure on the monetary system... The necessary monetary expansion was accomplished by a massive increase in bills of exchange."[55] Similarly, he sees the 1890's as a period when high interest rates is evidence against a major role of the gold discoveries in explaining price level movements. Indeed, he characterizes both periods as suffering from a gold shortage.[56]

v. The Kondratieff Cycle

According to Rostow and Lewis, trend price-level movements in the nineteenth century world economy are part of a general 50-year cyclical pattern in major economic variables including industrial production, interest rates, and the real wage, called the Kondratieff or long wave.[57] The first cycle runs from a trough about 1790, to a peak in 1815, and a trough about 1848; the second cycle runs from 1848 to 1896, with a peak about 1873, and a third cycle extends from about 1896 to 1920.[58] Both authors argue that the key determinant

of trend movements in the price level is the terms of trade (relative prices) between agricultural (primary) and industrial (manufactured) products.[59] The change in relative prices follows from a change in relative supply conditions between the two types of commodities.[60] This is caused by a change in the balance between population growth and the growth of demand as industrial output extends and interacts with the limited availability of usable land reserves, especially of land suitable for growing food products such as wheat.[61] The key relative price throughout the period 1790-1914 is the price of wheat.[62] According to both authors, a rise in the price of wheat (as well as other basic foods) relative to industrial products, caused by total world demand running up against the supply constraint of usable land, such as occurred in the 1790's, late 1840's, and the 1890's, will encourage new investment in wheat-producing land. However, there will be significant gestation lags before the new land becomes productive, especially if the opening up of territories, such as the U.S. midwest in the 1850's and Canada, the Argentine, and Australia in the 1900's, is involved.[63] Investment in infrastructure, etc. will cause the overall price level to rise.[64] Once the new lands have been settled and world wheat output has expanded, the terms of trade turns around as does the overall price level.[65]

> "Protracted upward shifts in the relative prices of basic
> commodities were seen as the catalyst setting in motion
> the overshooting process, by inducing enlarged investment
> in capacity capable of producing such commodities; consequent
> protracted periods of decline in relative prices..., led to
> a decline of investment in the capacity to produce basic
> commodities. Since demand for these commodities increased
> more steadily than capacity, in response to the continued

expansion of population and the trend expansion of industry, the relative neglect of investment in basic commodities ultimately caused undershooting and a reversal of relative price movements when surplus capacity (including stocks) was worked off. The general price level, interest rates, income distribution within and among nations, as well as the patterns of investment, reflected this erratic cyclical process which can now be traced back for almost two centuries."[66]

In addition to the role of the terms of trade in explaining the Kondratieff price cycle, other forces of importance are: the role of innovation, of leading sectors, and of aggravating factors such as wars, gold discoveries, and other unproductive investment.[67]

In general, since the late eighteenth century, technological change in key industrial products by shifting down cost curves and raising aggregate real output leads to a decline in the overall price level.[68] This process occurs in waves because of the tendency of investment in leading sectors such as cotton textiles, iron and steel, and the railroad, to cluster, leading to initial overshooting and later undershooting of investment.[69] According to the Rostow-Lewis view, after the leading sector has been adopted for a number of years, its influence on aggregate output declines, and before new leading sectors can be put in place, overall output growth declines, tending to offset the normal Kondratieff downswing in prices.[70]

Finally, the price cycle is aggravated by forces lending to unproductive investment: wars and gold discoveries. Rostow argues that the Napoleonic wars in the first Kondratieff cycle, the Crimean war in the second, and the Boer and Spanish-American wars in the third Kondratieff, by diverting resources from productive to unproductive uses, aggravated the underlying

inflation phase of the trend cycle.[71] The gold discoveries in the late 1840's

in California and Australia, and in the 1890's in South Africa and the

Klondike, performed a similar inflationary function by diverting resources

from productive to unproductive uses.[72]

vi. Methodology

A major difference between the Rostow-Lewis view and that of the modern

quantity theory concerns the distinction between the short run and the long

run. The modern quantity theory, following the Marshallian tradition,

distinguishes the sets of forces operating over the short run (annual to

cycle) from those operating over the long run (trend periods), whereas

Rostow[73] describes the long run as just a series of short runs.

No distinction in vocabulary is made between the analysis of the long

and the short run. A long-run movement in prices, in time, is regarded as

an accumulation of short-run movements; analytically, "long period ... factors

are introduced into the analysis over short periods of time."[74]

Thus, to determine the long-run effects of money on prices, Rostow and

Lewis examine a series of short-run (year to year) movements in the gold/money

ratio, interest rates, real output, and the price level.

> "The analysis of prices in terms of broad trends can be
> quite misleading unless it is related to what actually
> occurred in the specific time periods when those trends
> found their way into history."[75]

When these short-run linkages prove difficult to detect, they argue that

each short-run episode can be better explained by real forces. The assumption

that the long run is just the accumulation of short runs then leads to the

conclusion that monetary forces could not be an important determinant of

price level movements.[76]

In short, Rostow states:

> "My criticism of both the long-term and cyclical application
> of the quantity theory comes to rest, then, on its inability
> to bring into play the changes in technology, industrial
> capacity, infrastructure and the supply of foodstuffs and
> raw materials which, in my view, are critical to an under-
> standing of both long-term price trends and business cycles.
> We need a dynamic theory of production and prices to explain
> price trends and business cycles: for trend analysis an
> exogenous T is insufficient; for cycle analysis, the implicit
> or explicit Marshallian short-period framework does not
> capture reality. It follows from this view — that the
> Marshallian long-period factors are in movement even over
> short periods of time and must be introduced into useful
> analyses — that the distinction between short-period and
> long-period analysis can be illusory... . I would hold that
> movements in prices, production, and indeed, the components
> of the money stock must be tracked and explained over short
> periods of time, with long-period forces introduced into
> short-term analysis... . We enter an unreal world of our
> own fabrication when we abstract trend relations from their
> erratic, unfolding short-period historical context."[77]

3. A Critical Evaluation of the Rostow and Lewis Approach

In this section we evaluate the six points of difference between the modern
quantity theory and the Rostow-Lewis real explanation of nineteenth century
price level movements.

As a backdrop to our discussion, we present in Table 1, a statistical
summary of some important characteristics of the U.S. and U.K. economies in
the 1880-1913 gold standard period.[78] Part I, rows 1 to 4 display the average
annual growth rates of the components of the equation of exchange: the money

Table 1. Some Important Characteristics of the United States
and United Kingdom Economies 1880-1913

	United States			United Kingdom		
	1880-1913	1880-96	1897-1913	1880-1913	1880-96	1897-1913
	(1)	(2)	(3)	(4)	(5)	(6)
I. Average annual percentage rates of growth in:						
1. Money Stock	6.2	4.7	7.7	2.1	2.3	2.0
2. Velocity	-3.0	-4.4	-1.5	0.0	-1.0	0.9
3. Implicit Price Deflator (1929 =100).	0.3	-1.6	2.2	0.2	-0.6	1.1
4. Real Output (1929 = 100).	2.9	1.9	4.0	1.9	1.9	1.8
II. Average level of (coefficient of variation):						
5. Velocity (V)	2.26 (.465)	2.31 (.115)	2.21 (.313)	1.99 (.206)	1.97 (.112)	2.01 (.089)
6. Money Multiplier $(\frac{M}{H})$.	3.86 (.072)	3.75 (.043)	3.97 (.084)	4.17 (.084)	3.87 (.046)	4.47 (.039)
7. High Powered Money, Monetary Gold Stock Ratio $(\frac{H}{G})$.	2.24 (.147)	2.46 (.121)	2.01 (.089)	2.08 (.027)	2.07 (.024)	2.09 (.030)
8. Money, Monetary Gold Stock Ratio $(\frac{M}{G})$	8.52 (.107)	9.12 (.097)	7.93 (.055)	8.67 (.088)	8.01 (.057)	9.34 (.022)
III. Fraction of change in the Stock of Money (total change = 1.00) attributable to change in:						
9. High Powered Money	.632	.525	.654	.521	.592	.582
10. Deposit Reserve Ratio	.078	.102	.140	-.062	-.050	-.131
11. Deposit Currency Ratio	.200	.316	.156	.584	.410	.585
12. Interaction	.009	.057	.502	-.043	.048	-.036
IV. Elasticities from Regressions (t-values)						
13. Real Money, Real Income[1]	1.095 (34.373)	1.465 (9.388)	1.182 (27.234)	.935 (39.917)	.840 (10.920)	.762 (17.180)
14. Real Money, Interest Rate[1]	-.111 -(1.775)	-.121 (-1.194)	-.156 -(2.983)	-.074 -(4.432)	-.102 -(3.219)	-.048 -(3.350)
15. Money, High Powered Money[2]	1.106 (41.739)[a]	.813 (13.222)	1.278 (29.113)	1.587 (29.990)	1.250 (8.925)[a]	1.672 (19.306)
16. High Powered Money, Gold[3]	.760 (29.222)	.615 (4.118)	.754 (35.901)	.990 (25.690)[a]	1.230 (16.005)	.627 (26.751)
17. Money, Gold[4]	.851 (32.690)	.591 (5.649)	.964 (23.481)[a]	1.590 (23.100)	1.567 (8.456)	1.047 (14.960)[a]

Notes:

(1) $\log(\frac{M}{P}) = A_0 + A_1 \log(\frac{Y}{P}) + A_2 i + e$

(2) $\log M = B_0 + B_1 \log H + u$

(3) $\log H = C_0 + C_1 \log G + v$

(4) $\log M = D_0 + D_1 \log G + w$

a   not statistically different from one at the five per cent level.

Sources and definitions of data used:

Money Stock: United States: Annual averages, centered on June 30, of quarterly figures of sums of currency held by the public plus adjusted deposits at all commercial banks, from M. Friedman and A.J. Schwartz, Monetary Statistics of the United States, New York, NBER, 1970, pp. 61-66;

United Kingdom: Annual data centered on June 30 of the sums of currency held by the public plus adjusted deposits at all commercial banks. Source: M. Friedman and A. Schwartz, Monetary Trends of the United States and the United Kingdom, forthcoming.

Real Output: United States: Net National Product in 1929 dollars: Based on unpublished estimates, 1869-1909, provided by Robert E. Gallman, and worksheets underlying Simon Kuznets, Capital in the American Economy: Its Formation and Financing, Princeton for NBER, 1961.

United Kingdom: Net National Product in 1929 dollars from C. Feinstein, National Income, Expenditure and Output of the United Kingdom, 1855-1965, p. 14.

Implicit Price deflator (1929 = 100). Sources ibid.

Velocity: Nominal NNP divided by Money Stock

Proximate Determinants of the Money Stock: United States: from M. Friedman and A. Schwartz. A Monetary History of the United States, Princeton, NBER 1963. pp. 799-800.

United Kingdom: M. Friedman and A. Schwartz. Monetary Trends of the United States and United Kingdom, forthcoming

Monetary Gold Stock: United States: from P. Cagan Determinants and Effects of Changes in the Stock of Money, 1875-1960. New York-Columbia, 1965, p. 340. United Kingdom: from M. Friedman and A. Schwartz. Monetary Trends

Interest Rate: United States: Annual averages of monthly rates on four to six month commercial paper in New York City from F.R. Macaulay, The Movement of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856. New York, NBER, 1938, pp. A145-A156. United Kingdom: Rate of Interest on Three Month Bank Bills. D.K. Sheppard, The Growth and Role of U.K. Financial Institutions 1880-1967. London: Methuen, 1971, p. 190.

stock; velocity, real output and the price level; for both countries over
the whole 1880-1913 period and for two subperiods: the 1880-96 deflation
episode and the 1897-1913 inflation episode.

In both countries real output grew considerably over the entire period
and in each subperiod, although the U.S. grew significantly faster in the
1897-1913 period. Velocity declined considerably in the U.S. over the whole
period, with most of the decline concentrated in the first period; by contrast,
V was relatively constant in the U.K. The excess of monetary growth over
real output growth adjusted for the trend in velocity, according to the
modern quantity theory view, accounts for the switch from deflation in
1880-96 to inflation in 1897-1913 in both countries.

i. Changes in Relative Prices

Both authors maintain that continuous changes in the relative prices of
major commodities induced by real forces such as changes in technology, or
the depletion of usable land, will continuously lower (raise) the overall
price level. One of the authors, Rostow, invalidly uses the same explanation
for inflation and deflation episodes. In the case of deflation, declining
costs due, e.g., to technical change will lead to a declining price level
as a result of an expansion of real output, without requiring any change
in monetary growth or velocity. In other words, cost-push deflation is
compatible with the modern quantity theory. On the other hand, in the case
of inflation, rising costs must lead to continuous rises in the price level,
without continuously declining real output, but requiring the additional
assumption of monetary accommodation or passive velocity.[79] This case is
quite different from the modern quantity theory approach which attributes
inflation solely to monetary growth in excess of the long-run trend growth

of real output, assuming a stable secular trend in the demand for money.[80]

The cost-push inflation hypothesis assumes that individual commodity and factor prices are inflexible on the downside (at least in the short run), or, to put it in another way, it assumes that resources are not sufficiently mobile to allow the necessary substitution in both production and consumption required when relative prices change, holding nominal aggregate demand constant. Thus, Rostow and Lewis argue that continuous increases in the price of wheat in the 1830's and 1890's led to increases in the overall price level because wheat as the leading food staple in the nineteenth century played such an important role as both an input and as final output. Moreoever, in their view, other agricultural prices moved in a manner similar to wheat prices, because they were affected by the same real forces; and the rise in agricultural prices in turn induced a rise in industrial prices as a result of an increase in money wages. The implicit assumption here is a low elasticity of substitution between labor and other inputs. Alternatively, the reduction in expenditure on nonagricultural commodities consequent on the rise in agricultural prices did not reduce industrial goods prices because their prices were downwardly rigid.

There are at least three difficulties with this analysis. First, as noted above, how can downward price rigidity be used to rationalize cost inflation without viewing it as a problem in the case of deflation? No evidence is available of major institutional changes, changes in market structure, or other forces, leading to price rigidity, between the several deflationary and inflationary episodes of the nineteenth century.

Second, dividing the economy into two highly aggregated sectors, namely, agriculture and industry, and viewing "the one as providing inputs

to the other ... ignores the wide disparity of growth rates within the sector and the continuous process of substitution between factors in the long run as their relative prices change."[81]

Third, evidence exists against the assumption of price inflexibility in the pre-World War I era. According to at least one study, the relative prices of both agricultural and industrial commodities fluctuated widely around the mean overall price level.[82]

Lewis interprets the results of regressions of major commodity prices (P_i) on the monetary Gold Stock (G), demand (D), supply (S) and a trend (t) — equation (1):

(1) $\log P_i = B_0 + B_1 \log G + B_2 \log D + B_3 \log S + B_4 t + e,$

as evidence in favor of the influence of real forces on the price level. However, his results can be reinterpreted as consistent with the modern quantity theory approach.

According to that approach, in a regression of the overall price level, or of individual money prices, on the ratio of money (gold (G)) to real output (y) and a time trend — equation (2):

(2) $\log P_i = B_0 + B_1 \log \left(\frac{G}{y}\right) + B_2 t + e',$

one would expect to observe a positive association; or if money (gold) and real output were each entered separately as independent variables — equation (3):

(3) $\log P_i = B_0 + B_1 \log G + B_2 \log y + B_3 t + e'',$

one would expect a positive coefficient on the money (gold) variable and a negative coefficient for real output. In his estimation, Lewis uses industrial

output for the four (core) industrial countries as a proxy for demand for
the commodity, and (core) output for each commodity as a measure of supply.
However, each of these variables must be highly correlated with a "true"
measure of aggregate real output for the core countries. Hence, the fact
that Lewis observes negative signs for his supply variable in the majority
of regressions, when it is included as an explanatory variable in addition
to that of gold, and similar results for the demand variable in a smaller
number of cases, is really evidence consistent with the modern quantity
theory.

ii. Passive Money Supply and Flexible Velocity

A key assumption for the cost push or relative price theory of price-
level movements to hold is that either velocity or the money supply is
passive.

Passive velocity implies that the demand for money function is unstable.
Yet evidence exists back to 1870 for the U.S. and for different countries
that the demand for money function is stable.[83]

As evidence of stability in the demand for money function, for both
the U.S. and the U.K. in the 1880-1913 period we present in rows 13 and 14
of Table 1 both the real income and interest elasticities of a demand
for money function estimated for each country. As is evident, there is
little change in either elasticity between the successive subperiods of
deflation and inflation in each country, surely evidence of stability. Indeed,
a Chow test revealed no significant difference between the two subperiods
at the five percent level for the U.S. and at the one percent level for
the U.K.[84] Moreover, the interest elasticity is always low, evidence against
a possible liquidity trap.

Finally, it should be emphasized that functional stability in the demand for money (or velocity) function is not the same thing as numerical stability (the meaning emphasized by Rostow and Lewis). Indeed, the coefficient of variation in velocity for the U.S. over the 1880-1913 period was a high .465 compared to that of .206 for the U.K. (See Table 1, row 5). Such seemingly high variability does not necessarily reflect greater instability in the U.S. demand for money (velocity) function, but the results of a more rapidly changing economy experiencing both more rapid and more variable monetary and nominal income changes.

The passive money supply argument suggests two possibilities:

(1) the monetary authorities followed an accommodating monetary policy to offset reduced real output and rising unemployment;

(2) the commercial banking system always supplied the bank credit required by economic activity, and, movements in high-powered money, though exogenously determined, were dominated by movements in the money multiplier.

The first seems unlikely in the nineteenth century context,[85] and the evidence is not consistent with the second possibility.

The arithmetic of the proximate determinants of the money supply, when applied to the 1880-1913 period reveals high-powered money to be the key proximate determinant of change in the U.S. money supply over the entire period, and for each of the two subperiods; for the U.K., H along with the deposit currency ratio were the important determinants of change.[86]

An alternative measure of the importance of high-powered money as a determinant of monetary change is the elasticity of the money stock with respect to high-powered money, derived from a regression of money on high-

powered money. These elasticities reported in Table 1, row 15 are statistically significant, and not far from one in magnitude in both countries, suggesting a close correspondence between movements in high-powered money and the money stock.

Finally, although the money supply multiplier $(\frac{M}{H})$ varied somewhat from year to year for both countries, yet over the long periods it was relatively stable, as can be seen in the small coefficients of variation in row 6.

iii. Role of Gold

As a corollary of the passive money supply view, Rostow and Lewis argue that the effects of changes in the monetary gold stock on money supply were not important in either the U.S. or the U.K. during the gold standard era.

The effect of gold flows on the domestic money supply depends upon the stability of the ratio of high-powered money to the monetary gold stock $(\frac{H}{G})$ as well as the stability of the money supply multiplier. Under the rules of the gold standard one would expect the $(\frac{H}{G})$ ratio to be relatively stable, reflecting a country's commitment to allow its domestic money supply and price level to alter sufficiently to maintain external balance. The evidence for both the U.S. and the U.K. is consistent with the rules of the game over the whole of the 1880-1913 period when both countries were on the gold standard.

As can be seen in row 7 of Table 1, the coefficients of variation of $(\frac{H}{G})$ are relatively low for both countries, although somewhat higher for the U.S. Moreover, the elasticity of the stock of high-powered money with respect to the monetary gold stock (row 16) from a regression of high-powered money on gold was statistically significant and was close to one for both the U.S. and the U.K. over the whole period.[87]

In the very short run, however, the ratio may vary considerably, reflecting sterilization operations by the monetary authorities. And indeed, this happened in the U.S. case in the 1880's and 1890's, but it was not significant enough to cut the link between gold and money, a step necessary to substantiate the Rostow-Lewis position.

Finally, as evidence against the view that the effects of changes in the monetary gold stock on the money supply were not important, we present in row 17 of Table 1 the elasticities of the stock of money with respect to the monetary gold stock derived from a regression of the money supply on gold. These elasticities are statistically significant and generally close to or greater than one. Moreover, the $(\frac{M}{G})$ ratio reflecting movements in both the $(\frac{M}{H})$ and $(\frac{H}{G})$ ratios was relatively stable over the whole period reflected in the low coefficients of variation in row 8.

iv. Interest Rates as an Indicator of Monetary Pressure

Emphasis by Rostow and Lewis on interest rates as an inverse indicator of the effects of excess supply or demand for money is misleading. It fails to distinguish the negative liquidity impact effect of monetary change on interest rates from the medium and longer-term positive income and price expectations effects. Or, to put it another way, Rostow and Lewis do not distinguish between nominal interest rates and expected real rates of interest. This problem is especially acute in periods of rapidly rising prices such as the 1850's and the 1890's.[88]

v. The Kondratieff Cycle

The points made in (i) above in discussing the relative cost theory of inflation and deflation episodes are relevant here as well. One could argue

that Rostow's emphasis on wheat as the key primary product in the nineteenth century Kondratieff price cycle and the price of energy as the key product in the twentieth century is implicit evidence in favor of long-run substitution.[89]

Moreover, Rostow's emphasis on the role of leading sectors is unsupported with respect to his definition and identification of industries which qualify, to the timing of their linkage effects to prices, and to the significance of their impact on the development of major industrial countries.[90]

vi. Methodology

Is it not an inconsistency on the part of Rostow and Lewis to argue that the long run represents a series of short-run events and to criticize Friedman and Schwartz and Cagan for distinguishing long-run from short-run evidence, and yet to emphasize a very long-run theory which has yet to be subject to test?

4. The Evidence from Tests of Hypotheses

One hypothesis implicit in the Rostow-Lewis view is that movements in the price level are determined by the terms of trade between primary product prices and manufactured product prices. The quantity theory view is that movements in the price level are determined by the ratio of money to output. It might seem that a possible test would be to run the following regressions:

$$\log \overline{P} = \beta_o + \beta_1 \log \left(\frac{M}{y}\right) + e \tag{4}$$

$$\log \overline{P} = \beta_o + \beta_2 \log (TOT) + e' \tag{5}$$

$$\log \overline{P} = \beta_o + \beta_1 \log \left(\frac{M}{y}\right) + \beta_2 \log (TOT) + e'' \tag{6}$$

where $\overline{P}$ is the price level, $\left(\frac{M}{y}\right)$ the ratio of money to output, and TOT, the terms

of trade variable, defined, say, as the ratio of agricultural prices to industrial prices. The test involves a comparison of the size and significance of the money coefficient versus the terms of trade coefficient. If the modern quantity theory approach is correct then β_1 should be significant in equation (3) with β_2 insignificant; if Rostow and Lewis are correct, the opposite should prevail.

Table 2 presents regressions of equations (4), (5) and (6) using annual data over the 1881-1913 period for the U.S. and the U.K. combined together and treated as one entity.

Initially, we experimented with regressions for each country taken in isolation. However, under the Classical gold standard it would be incorrect to treat each country as if it were a closed economy since each country in such a monetary system must be viewed as an open economy with its money supply tied to the world price level through its balance of payments. Moreover, the TOT variable would reflect world prices. For a small open economy with a fixed exchange rate, close correlation between the overall price level and the prices of major traded goods is not validly interpreted as indicating that prices of major traded goods determine the overall price level. Both, in our view, are the common consequences of the influence of the ratio of the world money stock to world real output.[91]

To derive the 'world' aggregates, we added together the money stocks and real output for each country converted into U.S. dollars. Then we combined the price deflators (using a common base year) weighting them by their respective shares in combined NNP. The terms of trade variable (TOT) is Lewis' world price of primary products divided by the world price of manufactured products.[92]

Table 2. Regression Results for the Terms of Trade hypothesis and the Modern Quantity Theory of Money: United States and United Kingdom combined: Annual Data 1881-1913

$$\log \overline{P} = \beta_0 + \beta_1 \log \left(\frac{M}{y}\right) + e \qquad (4)$$

$$\log \overline{P} = \beta_0 + \beta_2 \log (TOT) + e' \qquad (5)$$

$$\log \overline{P} = \beta_0 + \beta_1 \log \left(\frac{M}{y}\right) + \beta_2 \log (TOT) + e'' \qquad (6)$$

Coefficients of Independent Variables (t-values in parentheses)

Equation	β_0	β_1	β_2	Adjusted R^2	Standard error of estimate	Rho	Durbin-Watson	$F_{(6)(4)}$	$F_{(6)(5)}$
A. Levels									
(4)	-1.203 -(6.657)	.667 (3.281)		.234	.035	.884	1.46		
(5)	-1.740 -(31.204)		.470 (1.731)	.059	.039	.894	1.50		
(6)	-1.141 -(6.311)	.686 (3.492)	.492 (2.110)	.305	.033	.932	1.39	4.15*	22.40*
B. First Differences								$F_{(6')(4')}$	$F_{(6')(5')}$
(4')	-.004 -(0.467)	.680 (3.291)		.241	.035	.191	1.96		
(5')	-.001 -(0.126)		.410 (1.541)	.042	.040	.144	1.94		
(6')	-.005 -(0.704)	.748 (3.901)	.526 (2.428)	.349	.033	.225	1.87	5.13*	15.09*

Notes and Sources:

$\overline{P}$: U.S. NNP deflator (1929 = 100) plus U.K. NNP deflator (1929 = 100), adjusted by weights in combined U.S., U.K. current NNP. Source: see Table 1.

M: U.S. Money Stock plus U.K. Money Stock converted to U.S. dollars. Source: ibid.

y: U.S. Real NNP (1929 = 100) plus U.K. Real NNP (1929 = 100) converted to U.S. dollars. Source: ibid.

TOT: World price of primary products divided by world price of manufactured products from W.A. Lewis. Growth and Fluctuations 1870-1913. London. Allen and Unwin, 1978. pp. 280-281.

* signifies statistically significant at the five per cent level.

We ran the regressions in levels and to correct for autocorrelation we used the Cochran-Orcutt procedure. However, the Dubin-Watson Statistics still indicated the presence of autocorrelation and so we ran the regressions in first differenced form. In addition, we present the F ratios from a sequential F test performed to determine the significance of adding an extra independent variable to each of equations (4) and (5).

In general, the results from the regressions in Table 2 give support to the modern quantity theory approach. In both sets of regressions, the terms of trade variable, though significant in equations (6) and (6'), accounts for only a small fraction of adjusted R^2. One possible explanation for the significance of TOT is that the level of aggregation is still too low — that both the terms of trade and the combined price deflators are affected by similar influences external to the U.K. and the U.S.[93]

Our second test is of the Rostow-Lewis hypothesis that wheat prices are a key cause of price movements in primary products. Our test was to regress the prices of five non-wheat agricultural commodities using annual data for the U.S. over the 1870-1913 period[94] on the money-real output ratio and first, the price of wheat flour, and then the price of wheat for grain — equation (7):

$$(7) \quad \log P_i = \beta_o' + \beta_1' \log (\frac{M}{y}) + \beta_2' \log P_W + u.$$

Table 3 gives the results. If Rostow and Lewis are right, and wheat prices are a key cause of price movements in primary products, then the coefficient of the wheat price should be highly significant, more so than the coefficient of the money-output ratio. However, only in the equations for the price of cotton, and the wheat flour equation for sugar is the wheat

Table 3

Regression Results of U.S. Data, 1870-1913:
Log of the Price of Each of Five Agricultural Commodities
on the Log of Money Minus Real Output and the Log of
the Price of (a) Wheat Flour or (b) Wheat for Grain

$$\log P_i = \beta'_0 + \beta'_1 \log \left(\frac{M}{y}\right) + \beta'_2 \log (P_w) + u \qquad (7)$$

Dependent Variable: Price of		Coefficients of Independent Variables (t-values in parentheses)					
		β'_0	β'_1	β'_2	RHO	Adjusted R^2	Durbin-Watson
1. Irish potatoes	(a)	1.06 (2.33)	0.83 (3.08)	0.00 (0.00)	-.132	.203	2.02
	(b)	0.86 (2.18)	0.66 (2.32)	0.19 (1.13)	-.161	.235	2.03
2. Cotton	(a)	3.37 (9.58)	1.10 (5.27)	0.25 (3.67)	.144	.583	1.95
	(b)	3.66 (15.38)	0.92 (5.31)	0.57 (5.65)	-.131	.748	2.03
3. Tobacco	(a)	1.24 (2.12)	1.33 (3.86)	-0.12 (-1.00)	.427	.266	1.93
	(b)	0.78 (1.56)	1.14 (3.18)	0.14 (0.77)	.409	.267	1.89
4. Corn	(a)	3.61 (10.55)	1.04 (5.13)	-0.01 (-0.21)	.163	.406	1.97
	(b)	3.55 (11.70)	1.01 (4.63)	0.01 (0.11)	.163	.406	1.97
5. Refined Sugar	(a)	-2.59 (-0.91)	0.44 (1.84)	0.30 (2.69)	.999	.209	1.82
	(b)	-2.06 (-0.66)	0.42 (1.62)	0.06 (0.74)			

Source:

Prices of agricultural commodities: U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957, Washington, D.C., 1960, Series K-267 (corn for all purposes); K-271 (all wheat for grain); K-303 (cotton); K-309 (tobacco); K-312 (Irish potatoes); E-102 (wheat flour); E-103 (refined sugar).

Money stock: See Table 1.

Real output in 1929 dollars: See Table 1.

price significant. If there were, in fact, low substitutability as Rostow and Lewis suggest, one would expect to observe it in the relation between the price of wheat and other food staples. The data reject the hypothesis.[95]

5. Conclusion

In this paper, we reviewed the modern quantity theory approach to price level changes as the effect of excessive or deficient growth of the money stock relative to the exogenously determined trend growth of real output. We then examined six aspects of the view espoused by Rostow and Lewis that nonmonetary forces are the key determinants of inflation and deflation, and challenged the arguments they offered.

Finally, we presented econometric tests of two implications of the Rostow-Lewis view. The first test of the hypothesis that the terms of trade between primary and manufactured products, rather than the money real output ratio was the key determinant of late nineteenth century price level movements, was not supported by the evidence for the combined U.S. and U.K. economies. The second test of low substitutability — that movements in wheat prices were the key determinant of movements in the prices of other primary products — was also found not to be consistent with the evidence.

Rostow and Lewis are writers in the tradition of Thomas Tooke, who regarded changing costs as the determinant of price level movements. Contemporary works that deny the existence of a relationship between money and prices remind us of Schumpeter's reference to Tooke and Newmarch's history of prices as "marred in many particulars by inadequacy of theoretical equipment and a certain 'wooliness'."[96]

Footnotes:

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[1] See Lewis (1978); Rostow (1978a) and earlier statements of his views in Gayer et al. (1975), Rostow (1948), Rostow (1975), Rostow and Kennedy (1979), Rostow (1978b).

[2] Lewis (1978, p. 81); Rostow (1978b, pp. 164-168); Rostow (1978a, p. 4).

[3] Rostow (1978b, pp. xiii); Rostow (1978a, p. 40 and p. 43); Lewis (1978, p. 93).

[4] For the Tooke view, see Gayer et al. (1975, pp. 629-631) and Rostow (1978a).

[5] Rostow (1978a, p. 13).

[6] Gordon (1975a), (1976); also Selden (1959).

[7] This can be simply restated in terms of the familiar equation of exchange:
(1) $MV = Py$,
where M stands for the supply of money, V its income velocity of circulation, P the overall price level and y the level of real national output.

The demand for money — the quantity of real cash balances desired $(\frac{M}{P})^D$ — will vary inversely with velocity if we assume the income elasticity of demand for money equals one. See Friedman (1969) and Laidler (1977).

Expressing (1) in terms of annual growth rates, where ^ denotes the percentage annual rate of change, we have:

(2) $\hat{M} + \hat{V} = \hat{P} + \hat{y}$

The modern quantity theory argues that $\hat{P}$ is determined by the difference between $\hat{M}$ and the sum of $\hat{V}$ and $\hat{y}$, where it is assumed that $\hat{V}$ is determined by a stable set of forces and $\hat{y}$ is determined by real factors independent of the monetary system.

[8] See Friedman (1969).

[9] Schwartz, Preface to Gayer et al. (1975, p. xii).

[10]Factors affecting the degree of monetization will impart a positive secular
trend to the demand for money (negative trend to velocity) while factors
affecting financial development will impart a negative trend to the demand
for money (positive trend to velocity). See Bordo and Jonung (1981) for a
discussion of the institutional determinants of velocity.

[11]See Friedman and Schwartz (1963b) for the U.S. evidence 1867-1914; for the
U.S. 1834-1859, see Bordo (1975b); and for the U.K. 1879-1914, see Bordo
(1977) and (1980). For evidence on the 1880-1913 period, see Table 1 below.

[12]According to the classical price specie flow mechanism (in its simplest
version), as explicated by David Hume, a major disturbance, such as a gold
discovery in California, would first raise the U.S. money supply (to the
extent that new gold was monetized and not exported directly). Then with
a lag this would raise the U.S. price level, and hence raise the price of
exports relative to imports from, say, Great Britain, inducing a balance
of payments deficit on current account, a gold outflow, and a decline in the
U.S. price level, with the deflationary process ameliorated somewhat by
short-term capital flows from the United States to Great Britain. In short,
considerable lags are postulated.

Contrary to the Hume-price specie flow mechanism, the monetary approach
to the balance of payments argues that there will be no lags in the movement
of world prices because of instant arbitrage. (See McCloskey and Zecher,
1976.) In the most rigid version of the theory, a gold discovery will only
increase the domestic price level to the extent that it raises the world
money supply and hence raises the world price of traded goods. For a small
open economy such as the United States of the 1850's, the prices of inter-
nationally traded goods would be determined in world markets and kept
comparable in different countries by international arbitrage, and prices
of domestic goods and services are kept in line with prices of internationally
traded goods by domestic arbitrage.

[13]For the evidence, see Table 1 and section 3 below.

[14]The earliest discussion of the worldwide transmission of the California gold
discoveries is in Cairnes (1873). Also see Jevons (1909) and Bordo (1975a).
For a discussion of the 1897-1914 episode, see Friedman and Schwartz (1963b).

[15]See Cagan (1965) for a discussion of the commodity theory of money and some
tentative evidence of a long inverse lag between changes in price trends
and changes in gold production. For evidence of long-run world price
stability under commodity standards see Schwartz (1973) and Jastram (1977).
Klein (1975) argues that the commodity standard has effectively broken down
only in the post-World War II era.

[16]Schwartz, Preface to Gayer et al. (1975).

[17] This is not to say that changes in the quantity of money cannot affect relative commodity prices in the short run. As Cairnes (1873) argued, monetary change will affect relative prices depending on short-run supply elasticities. Also see Bordo (1980) for recent U.S. evidence of significant relative price effects of monetary change.

[18] See Popkin (1977) and the collected essays therein. Cost-push inflation can also be initiated by monopoly unions seeking higher wages for their members, or by firms with monopoly power seeking higher profit margins. See Karnosky (1976) who demonstrates that a supply shock, such as the oil embargo, can permanently raise the price level, temporarily raise the inflation rate, but cannot permanently cause a sustained rise in the price level.

[19] See Gordon (1975a) for evidence for, and Parkin (1977) for evidence against the importance of accommodation in the post-World War II period.

[20] One way to reconcile the monetary approach to inflation with competing views is in terms of the political economy of the sources of monetary change. Indeed, Gordon's essay (1975b) on the demand for and supply of inflation goes part way in explaining the reasons why governments engage in rapid monetary expansion.

[21] Rostow (1978a, p. 4).

[22] Ibid. In Rostow (1948), he states: "No distinction is made between the treatment of individual prices, and the price level. Index numbers of prices are regarded as a summary of individual prices, not as 'the value of money'." Also see Rostow (1978b, pp. xlvii, p. 148), and (1978a, pp. 43a, 44, 89, 93).

[23] Ibid., p. 5.

[24] Lewis (1978, pp. 80-81).

[25] Ibid., pp. 72-77.

[26] Gayer et al. (1975, pp. 629-31, 642-44); Rostow (1948, p. 60); Rostow (1978a, p. 6).

[27] Ibid., p. 7.

[28] Rostow (1978a, pp. 14-14a), where he identifies his view with "modern econometric exercises where...it is assumed that 'prices are basically determined as a markup on unit labor cost.' Changes in unit labor cost incorporate changes in the rate of technical progress as they affect labor productivity as well as short-run influences on the money wage rate. For example, Kuh and Schmalensee (1973) define the steady-state value of the money wage as a constant times the product of the average real product of labor and the price level. The price level thus emerges as the money wage

divided by the average real product of labor. The quantity theory of money, taken as an identity, can, in these terms, be rewritten as $MV = K \frac{W}{AP} T$ with K a constant [markup], W the steady state money wage, AP the average real product of labor and T real national income. In this system, when dynamized, the rate of change of productivity is the driving variable, assuming still a flexible and passive monetary system."

[29] Rostow-Kennedy (1980). The emphasis on changes in the relative prices of agricultural and industrial products forms the basis of the Rostow-Lewis mechanism of the Kondratieff cycle to be discussed below.

[30] Gayer et al. (1975, p. 642).

[31] Rostow (1978b, p. 86).

[32] Rostow-Kennedy (1979, pp. 39, 41); Rostow (1978a, p. 27). Also see Lewis (1978, p. 27), who attributes the 1897-1914 inflation to the rise in relative prices of agriculture and of industrial products.

[33] Rostow-Kennedy (1979, p. 35); Rostow (1948, p. 151); Rostow (1978a, p. 56); Rostow (1978b, pp. 164-8).

[34] See L. Mints (1945) for the historical origins of the "real bills doctrine."

[35] Rostow (1978a, pp. 3-4, 40, 43, 43a).

[36] Rostow (1978a, p. 27). Also see Gayer et al. (1975, p. 656) and Rostow (1948, p. 22), where it is argued that the gold standard did not impose a severe constraint on the banking systems of the nineteenth century.

[37] Lewis (1978, p. 92).

[38] Rostow (1978a, p. 90). Also ibid. p. 81, where he argues that the evidence for both the U.K. and the U.S. (over the period 1883-96 and 1896-1913 for the U.K., 1882-92, 1892-1913 for the U.S.), that the money supply expands further in periods of declining prices than periods of rising prices can be explained by "basic developments in the economy which altered the relation between income and the money supply as well as institutional changes which altered bank reserve ratios" (p. 82).

[39] Lewis (1978, p. 89); also see p. 91, where the author uses a comparison of changes in the growth rates of the components of the equation of exchange between 1882-92 and 1892-1906 for the U.S. to argue that the explanation for the turnaround in price levels may come from the velocity of circulation. "The U.S. economy was monetising rapidly in the last quarter of the nineteenth century... . The banking habit was growing rapidly as the country urbanised... . Faced with the situation that money supply contributed 0.9 and a rise in the velocity of circulation of 2.6, we may hazard that there was a demand-induced inflation, and not an inflation originating primarily in an increase in the supply of money" (p. 92).

[40]Rostow (1978, p. 65). He argues that "the monetary and financial system emerges from Cagan's study as responding passively to demands induced by fluctuations in business activity; but Cagan never examines the forces determining such fluctuations" (p. 74); and he criticizes Higgonet for being "insensitive to the fact that a simple correlation between bank deposits (or even the money stock) and national income...tells us nothing about the direction of causation" (p. 78).

Also see Lewis (1978, p. 91), who states "...the quantity equation does not indicate causation. We may have one, two or three exogenous variables; or any number of mutually determining variables, from one to four."

[41]See Rostow (1948, pp. 146-147), who cites Phinney (1935) as showing that "little or no correlation existed between the rate of growth of the gold supply and the rate of growth of either bank reserves or bank notes and deposits" over the 1875-1913 period.

[42]Ibid., pp. 22-23.

[43]Rostow (1978a, pp. 36-38).

[44]Lewis (1978, pp. 88-89).

[45]Rostow (1978a, p. 44).

[46]The quotation is from Rostow (1948, p. 22); see also Rostow (1978b, p. 147).

[47]Rostow (1978a, p. 23). See ibid., pp. 26-27, for a discussion of the 1850's, where Rostow correctly identifies his views with those of Newmarch and incorrectly cites Cairnes on the effects of the gold discoveries on the Australian economy; and ibid., p. 38, for a discussion of the gold discoveries in the 1890's.

[48]Rostow (1978a, p. 100); Rostow (1978b, p. 109). According to Lewis (1978, p. 93):

"...the big changes in gold production were due to new discoveries rather than to changes in the output of existing mines. More people look for gold when mining is more profitable because of falling prices than look when mining is less profitable because of rising prices. But looking is not the same as finding. The finding of new large and rich deposits of gold, like those of California, Australia and South Africa, includes such a large random element that one must not incorporate it mechanically into a gold self-generating theory of prices. We accept neither that changes in gold supply caused the changes in prices nor that changes in prices caused the changes in gold supply."

[49] See Rostow (1948, p. 59).

[50] Gayer et al. (1975, pp. 559-63); Rostow (1978b, p. 323).

[51] Gayer et al. (1975, p. 656). For a similar analysis of the Bank of England's passive role in ending the boom of the 1880's, see Rostow (1978a, p. 17).

[52] "Putting Bank Rate up from 2 to 4 percent for six months had little effect on the cost of manufacturing or mining, and can hardly have affected decisions on how much to invest in the iron industry, which was then the most retarded." Lewis (1978, p. 57).

[53] Rostow (1978a, pp. 42-43, 86). Similar views appear in Rostow (1948, p. 61).

[54] Gayer et al. (1975, p. 655).

[55] Rostow (1978a, p. 25).

[56] Ibid., p. 35.

[57] See Kondratieff (1929); Rostow (1978b, Ch. 8, 10-14, 19); Rostow (1945); Rostow-Kennedy (1980); and Lewis (1978, Ch. 1, 3).

[58] Rostow (1978b) (1975).

[59] Rostow (1978b, pp. 103, 299-301); (1978, pp. 12, 27, 29); Lewis (1978, p. 127).

[60] Lewis (1978, p. 87).

[61] See Rostow (1978b) for a lucid examination of the role of changes in the terms of trade over the three cycles.

[62] See both authors, all the works cited above.

[63] Rostow (1978b, pp. 299-301).

[64] Ibid.,p. 148; Rostow-Kennedy (1979, pp. 1-2).

[65] A succinct summary of the underlying model can be found in Rostow-Kennedy (1980).

[66] Rostow-Kennedy (1979, p. 2).

[67] Rostow (1978b, pp. 161-62).

[68] Rostow (1978a, p. 73).

[69] See Rostow (1967) (1960) for a discussion of the leading sector thesis.

[70] Rostow-Kennedy (1980).

[71] Rostow (1948, pp. 20-22, 26-27); (1978a, p. 27); (1978b, pp. 146-47, 193); (1975, p. 753).

[72] Ibid. In (1948, pp. 21-22, 26-27), Rostow refers to capital exports as having an inflationary effect on the British economy by diverting investment from domestic productive uses.

[73] A similar view is implied by Lewis (1978, Ch. 3).

[74] Rostow (1948, pp. 159, 149, 157).

[75] Rostow (1978a, p. 35).

[76] See Lewis (1978, pp. 90-91), where his analysis of short-run movements in the U.K. gold-money ratio, 1880-1913, serves as evidence against the long-run relationship between money and prices.

[77] Ibid., pp. 99-101.

[78] We focus on this period because it was the period when both countries and indeed much of the world were on the gold standard. Both Rostow and Lewis are primarily concerned with explaining world price level movements in this period.

[79] See Dickey (1977), p. 20.

[80] A supply shock can induce a once and for all increase in the price level by the reduction in real output temporarily reducing the demand for money. See Karnosky (1976). To produce a continuing rise in the price level, a continuous series of such shocks would be required. However, the facts that the inflationary episodes of the nineteenth century exhibited growth rates of real output close to those of the deflationary episodes, and were similarly characterized by continuous technological advances suggests that continuous supply shocks is not an appropriate explanation for nineteenth century inflation.

[81] Dickey (1977), p. 14.

[82] See Dickey (1977) for U.S. evidence that prices were flexible for 17 major agricultural and industrial commodities in the 1869-96 period. Earlier evidence for the U.S. gathered in the 1930's by Humphrey (1937), Mason (1938), Mills (1927) and Tucker (1938) suggests that price flexibility did not change appreciably over the 1870-1938 period. Additionally, these authors found that industries dominated by crude products (mainly agricultural products) exhibited greater price flexibility than those dominated by finished (manufactured) products. More recently, Spencer (1977) presented evidence that price inflexibility in the U.S. during the 1870 to 1921 period increased in industries characterized by increasing concentration. It is difficult to evaluate these separate studies because of different methods used in each to measure price flexibility; however, one feature common to all of them is that they are based on the Wholesale Price Index and not transactions prices,

and hence, according to Stigler and Kindahl (1970) would be biased in favor of price inflexibility. A thorough reexamination of the issue of price flexibility in the pre-World War I era and a comparison to the recent period would be of great interest.

[83] See Goldfeld (1973); Laidler (1977); Khan (1974).

[84] For the U.S. F = 4.19; for the U.K. F = 2.41.

[85] However, one may argue that the monetary constitution is an endogenous variable — that countries would switch from gold to silver, or even leave the gold standard during periods of deflation. This question itself is an interesting research topic. However, the evidence for the U.K. over the period 1821-1914 and the U.S. over the period 1869-1914 does not support this argument.

[86] The fraction of change in the stock of money attributable to a change in H was .60 for the U.S. 1869-1914 [Bordo (1975, Table 1)]; .79 for the U.K. 1870-1914 [Bordo (1980)].

[87] A Chow test for the U.K. revealed no significant difference at the five percent level F = 1.016.

[88] Harley (1977) for a discussion of the different effects of monetary change on interest rates in the British money market over the 1873-1913 period. Harley finds that his proxy for expected price change (a geometrically declining weighted average of past price changes) explains most of the variation in short-term money market interest rates. It is only in the transition period between deflation 1873-90 and inflation 1897-1913 that the liquidity effect becomes significant.

[89] This is supported by recent U.S. evidence by Sato (1977) for nineteen industries at the two digit level for the period 1949-65. He finds the elasticity of substitution derived from a nonhomothetic CES production function to be not far from unity for the majority of industries studied.

[90] See Fishlow (1961) and Fogel (1964) for the case against railroads as a leading sector for the U.S.; Deane (1963) for the case against textiles and iron and steel for Great Britain; Marczewski (1963) and Hoffmann (1963) for the French and German evidence.

[91] An alternative way to address the problem of causality between money and the price level, and the price level and the terms of trade, for each country, is to conduct Granger tests of exogeneity. See Granger (1969). However, such a test may be inappropriate if there is a common influence, as we suggest, on both the terms of trade and the price level.

[92] This ratio which begins in 1881 comes from Lewis, Table All, p. 280-81. We also ran similar regressions for the 1870-1913 period. To do this we extended Lewis' TOT variable back to 1870 by constructing a TOT variable for each country using components of the Warren Pearson wholesale price index for the U.S. and the components of each of three different wholesale price indices for the U.K. In this paper we present only the results for the 1881-1913 time span. However, results for the longer period are not markedly different from those presented here.

[93] Indeed, at the single country level of aggregation, the terms of trade variable was considerably more important than the money output ratio.

[94] Comparable data for the U.K. are unavailable.

[95] The money - real income coefficient β_1 may be downward biased because a rise in the price of wheat, other things equal, would in the short run, before substitution occurred, lead to a fall in real income. This bias adds further support to the evidence against the Rostow-Lewis interpretation.

[96] Schumpeter (1939, p. 461 n.).

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