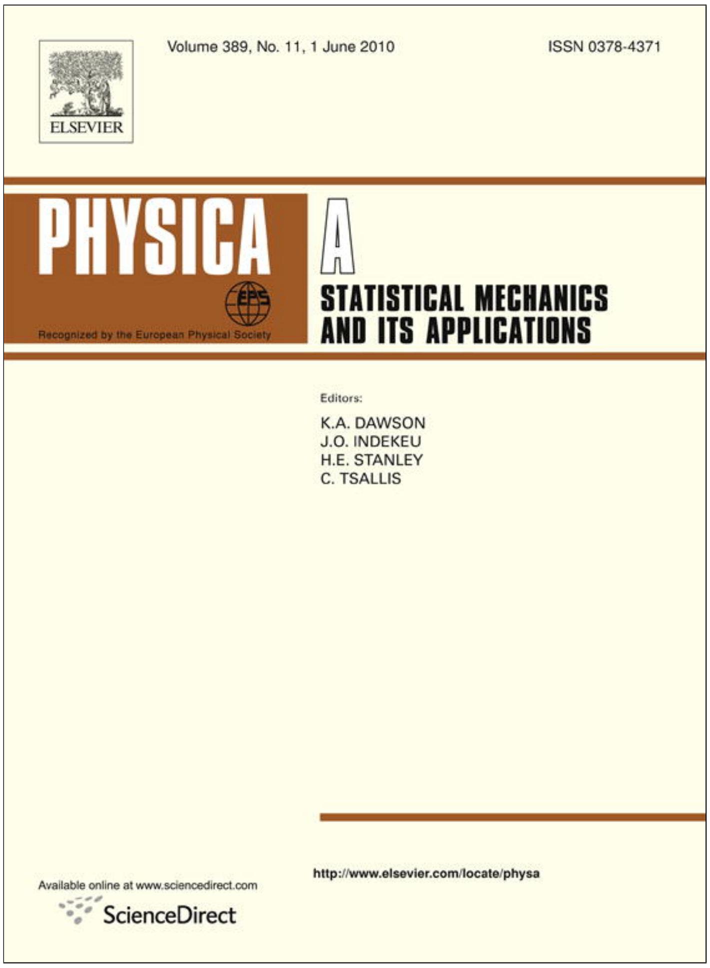
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A fractal comparison of real and Austrian business cycle models

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ABSTRACT

Rescaled range and power spectral density analysis are applied to examine a diverse set of macromonetary data for fractal character and stochastic dependence. Fractal statistics are used to evaluate two competing models of the business cycle, Austrian business cycle theory and real business cycle theory. Strong evidence is found for antipersistent stochastic dependence in transactions money (M1) and components of the monetary aggregates most directly concerned with transactions, which suggests an activist monetary policy. Savings assets exhibit persistent long memory, as do those monetary aggregates which include savings assets, such as savings money (M2), M2 minus small time deposits, and money of zero maturity (MZM). Virtually all measures of economic activity display antipersistence, and this finding is invariant to whether the measures are adjusted for inflation, including real gross domestic product, real consumption expenditures, real fixed private investment, and labor productivity. This strongly disconfirms real business cycle theory.

"…you don't believe theories until they happen to you."

Clifford Odets (1906–1963) *Waiting for Lefty* (1935) [1]

1. Introduction

This paper examines the statistical behavior of a vector of macromonetary data. The Hurst exponent [2] is estimated by Mandelbrot's [3–9] rescaled range and power spectral density function to determine whether the long memory processes are persistent or antipersistent. Real business cycle (RBC) theory [10–12] provides a theoretical expectation of stochastic dependence and persistent long memory for monetary aggregates and real macroeconomic series, and particularly for factor productivity series. According to Austrian business cycle (ABC) theory [13–16], entrepreneurial planners' response to policy-induced credit expansion provides an expectation of antipersistent long memory. Monetary expansion also contributes to antipersistence by degrading the signal quality of the information contained in prices and other macroeconomic data. Entrepreneurial planners' response to the more difficult signal extraction problem can be either to adjust behavioral plans more frequently, or to avoid adjusting their plans in frustration, allowing them to go unadjusted to prevailing market conditions for longer periods. Either response to monetary expansion injects antipersistence.

The paper is organized as follows. A comparison of ABC and RBC theory is presented in Section 2. The data are documented in Section 3. Results are presented in Section 4. Conclusions are provided in Section 5.

2. Business cycles

Following Garrison [17, pp. 71–73], the production possibilities frontier (PPF) model will be used to explicate and distinguish between the Austrian and real business cycle models. Given any endowment of productive resources and

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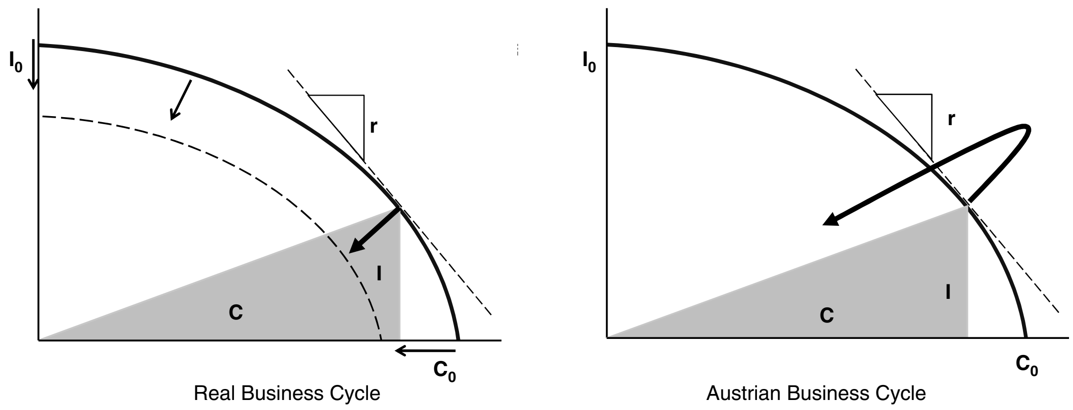

Fig. 1. RBC (Left) and ABC (Right) recessions illustrated with production possibilities frontiers.

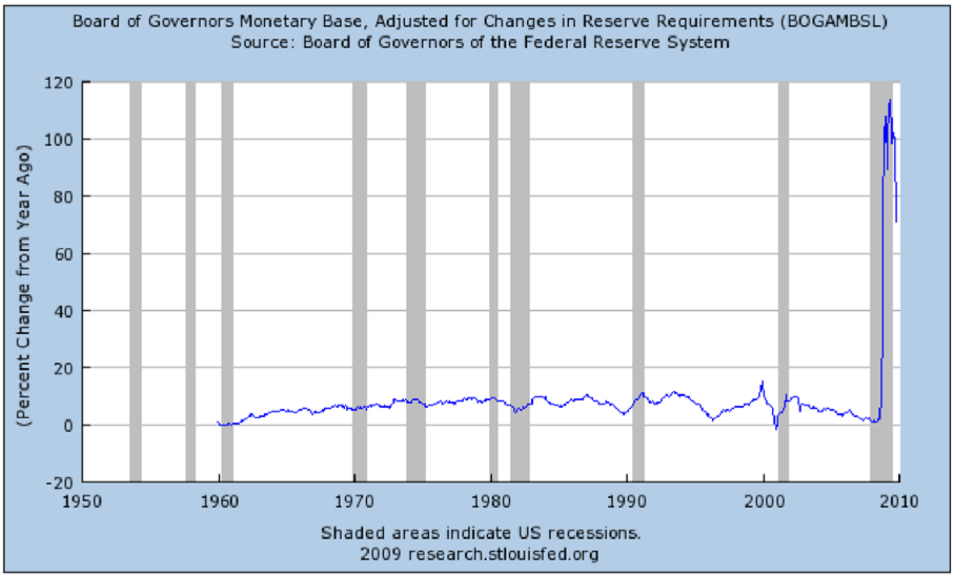

Fig. 2. Monetary base: original data trace.

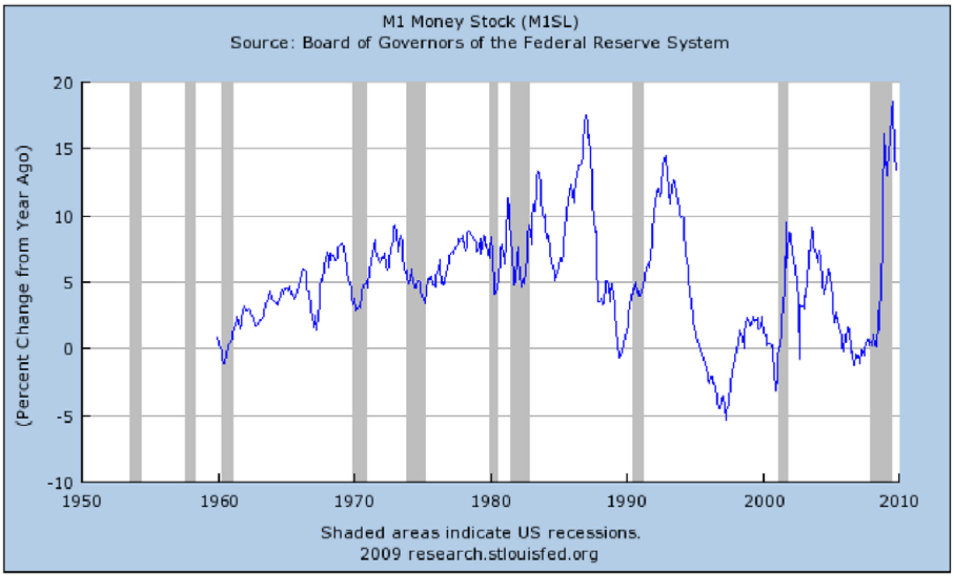

Fig. 3. M1 original data trace.

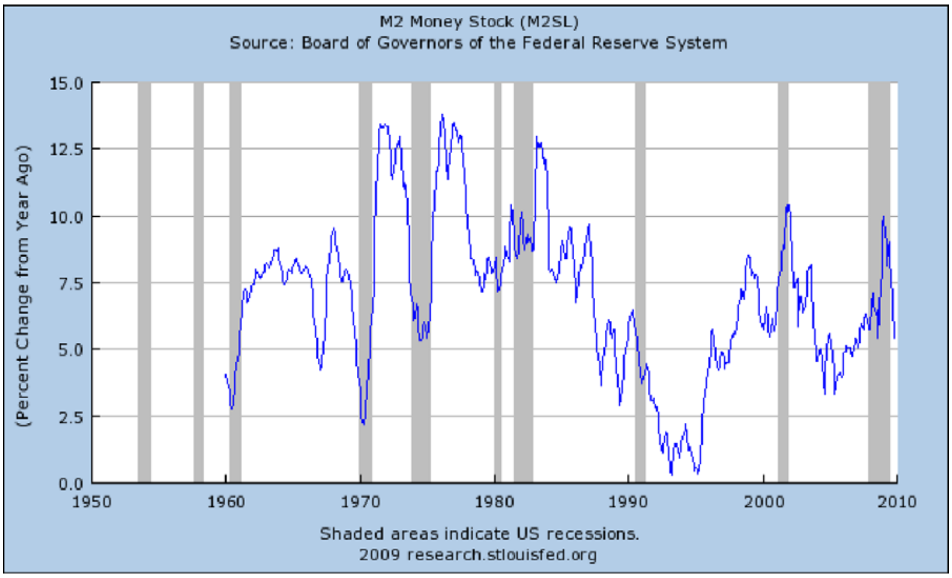

Fig. 4. M2 original data trace.

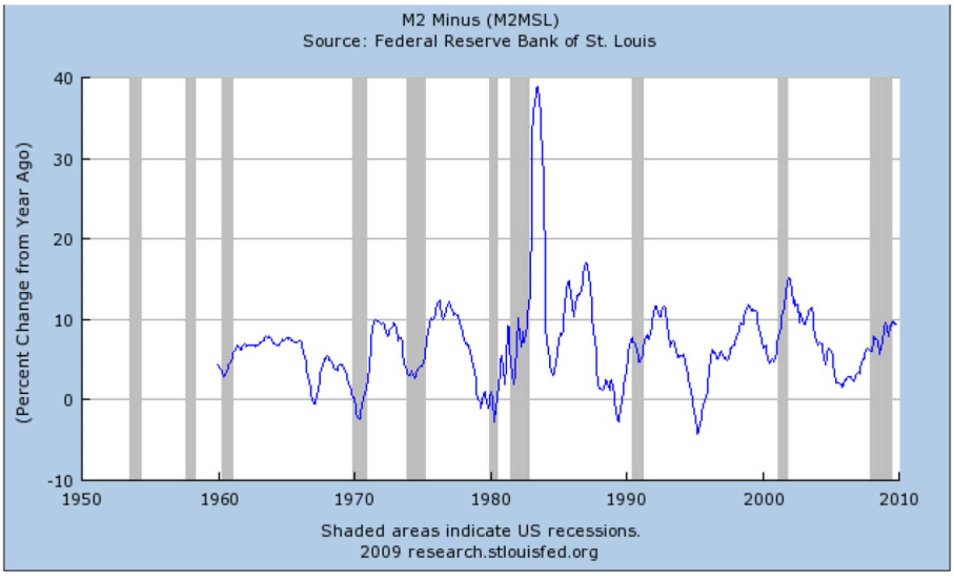

Fig. 5. M2 minus original data trace.

Table 1
Austrian v. real business cycle theory: Statistical expectations for aggregated data.

Austrian business cycle theory		Real business cycle theory	
Persistently expansionary policy	Antipersistence	Factor productivity	Persistence
Long-lived producer goods	Antipersistence	Time-to-build	Persistence
Entrepreneurial-planners' disequilibrium-adjustment	Antipersistence	Technology shocks	Persistence
Policy inconsistency	Antipersistence	Response of entrepreneurial planners	Persistence

Note: Monetary and fiscal policy may be inconsistent and may not be persistently expansionary, as during the 1930s [22,23], or in Japan during the 1990s [24]. When policy is intermittently expansionary and contractionary, or inconsistent, it may also cause macroeconomic aggregates to display antipersistence.

technology, the resources can be combined to produce various combinations of n outputs. The production possibilities frontier is graphed in n-dimensional space with each output on a different axis. Though it is customary to present this model to illustrate a highly stylized, two-output economy, if aggregate output is divided into consumer goods used to satisfy current wants and measured by consumption expenditure, and producer goods intended to satisfy expected future wants and measured by investment expenditure, all productive activity can be subsumed by this particular two-output case. Then

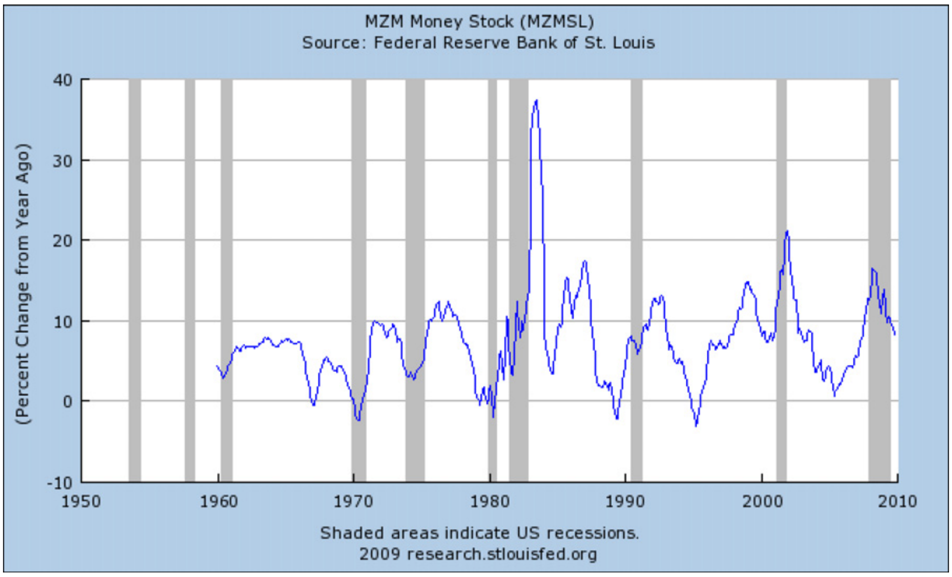

Fig. 6. MZM original data trace.

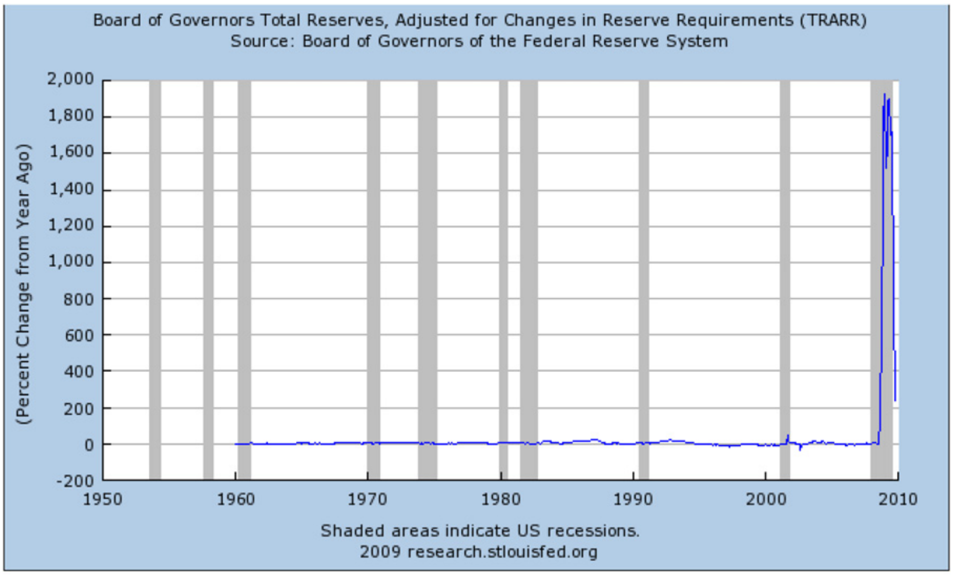

Fig. 7. Total reserves original data trace.

the equation of the PPF can be represented as the first-quadrant of the ellipse

$$C^2/C_0^2 + I^2/I_0^2 = 1$$

where investment is graphed on the vertical axis and consumption on the horizontal, C is the variable amount of consumer goods produced each period, I is the variable amount of producer goods produced each period, C_0 is the x-intercept of the PPF representing the maximum amount of consumer goods which could be produced if all resources were devoted solely to consumer goods production, and I_0 the y-intercept representing the maximum amount of producer goods which could be produced. The intercepts I_0 and C_0 scale the PPF and increase as technology improves or more resources are acquired—either event allows the production of more output.[1] The actual solution of C and I chosen depends on the rate of time preference, the ratio between the relative price of investment and consumer goods [18]—the solution is the tangency between the

[1] The foci of the ellipse occur on the consumption axis at $(\pm f, 0)$ where $f^2 = C_0^2 - I_0^2$, (assuming consumption is the major axis). The foci do not have any obvious economic interpretation, but because of their relationship with the intercepts through the Pythagorean theorem, the value f can be used to scale the PPF as well as C_0 and I_0.

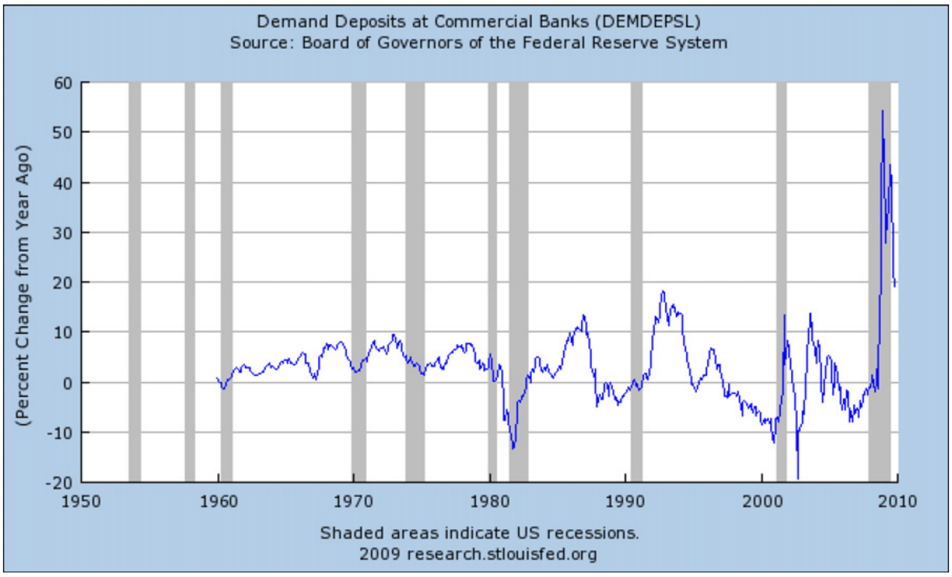

Fig. 8. Demand deposits original data trace.

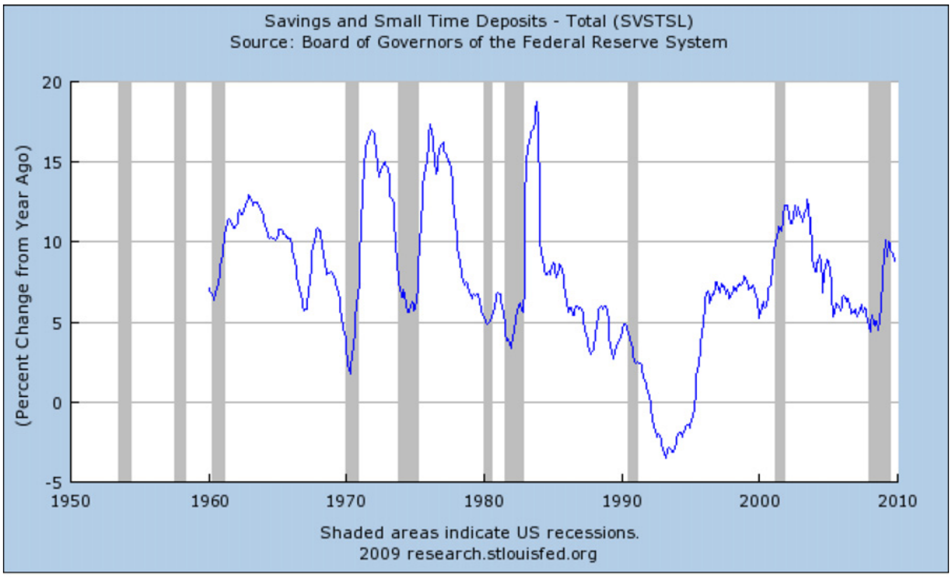

Fig. 9. Savings and small time deposits original data trace.

market interest rate r and the slope of the PPF:

$$r = -(CI_0^2)/(IC_0^2).$$

Market interest rates track the rate of time preference in the absence of inflationary expansion of the money supply. The ellipse has the desirable property that it yields appropriate corner solutions if the rate of time preference becomes infinite ($C = C_0; I = 0$) or zero ($C = 0; I = I_0$). A movement along the frontier results whenever the rate of time preference changes, substituting producer for consumer goods or vice-versa. Households earn income for providing the productive resources used to produce output, and act in each period on their time preferences by dividing household income into saving and consumption expenditure. Through financial intermediation, the amount saved each period is lent to firms to finance investment; however, monetary inflation results in an overabundance of loanable funds over and above aggregate household saving, and results in depression of the interest rate below the rate of time preference. This lowered market interest rate causes households to save less and consume more in response to the lowered reward for saving. In fact, investment can only exceed saving because of the newly created money injected into the economy. As the additional liquidity diffuses throughout the economy, it also degrades the information content of prices and other economic data on which agents rely for making decisions, lowering the quality of coordination among producers, and between producers and consumers.

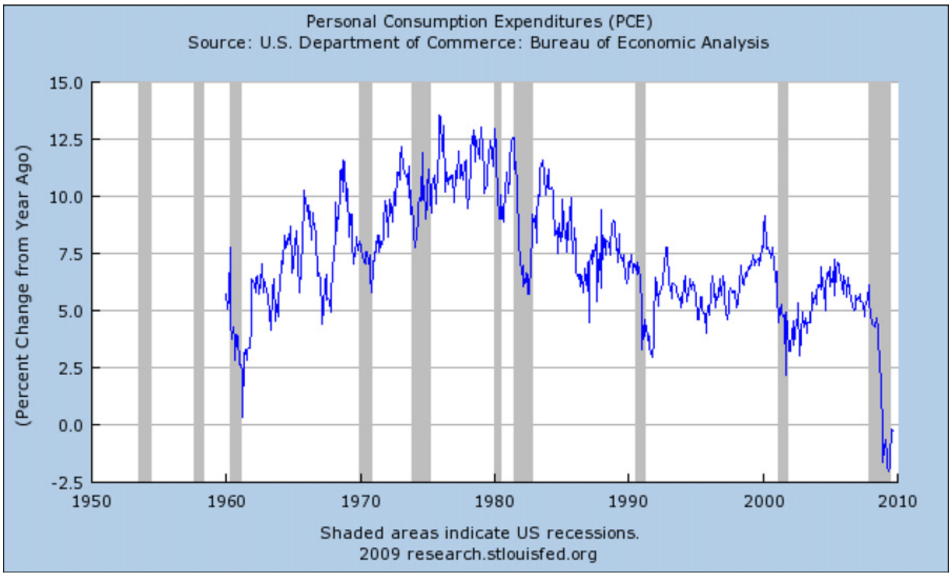

Fig. 10. Personal consumption expenditures original data trace.

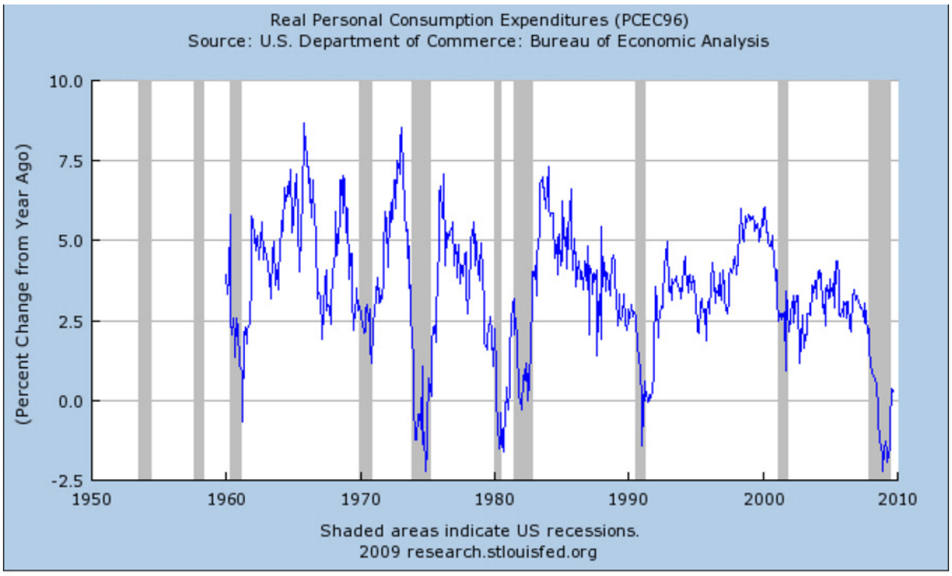

Fig. 11. Real personal consumption expenditures original data trace.

Although quantitatively more output is produced during an economic expansion lauded as an era of blessed prosperity, not all production plans started can be completed successfully.

According to ABC theory, the unsustainable boom progresses because both C and I rise together, moving the economy from a starting point on the PPF, to an unsustainable point outside the frontier (right panel of Fig. 1). ABC recessions are clearly disequilibrium responses to unsustainability, because resources squandered during the expansion can no longer sustain the economy on the PPF. Recession occurs as the economy collapses inside the frontier. If macromonetary aggregates have long memory, the character of this long memory should be antipersistent unless monetary inflation and recessions have both been absent. Secular growth implying a scaling increase of C_0, I_0, and f, and an outward shift of the PPF, may occur simultaneously, but monetary inflation results in the economy moving to an unsustainable point *outside* the PPF. The resulting collapse of the economy necessarily displays antipersistence, due to the systemic misallocation of scarce resources during the expansion, because the economy does not merely return to the PPF during a recession, but necessarily falls below it.

Expansionary monetary or fiscal policy results in antipersistent behavior of macromonetary aggregates as entrepreneurial planners respond to the accounting profits automatically generated from being able to pay resource prices

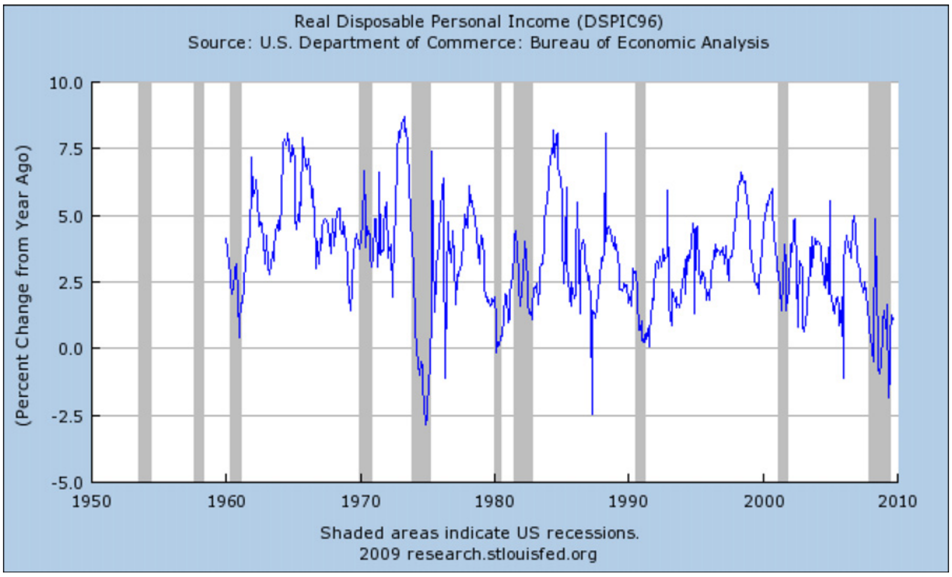

Fig. 12. Real disposable personal income original data trace.

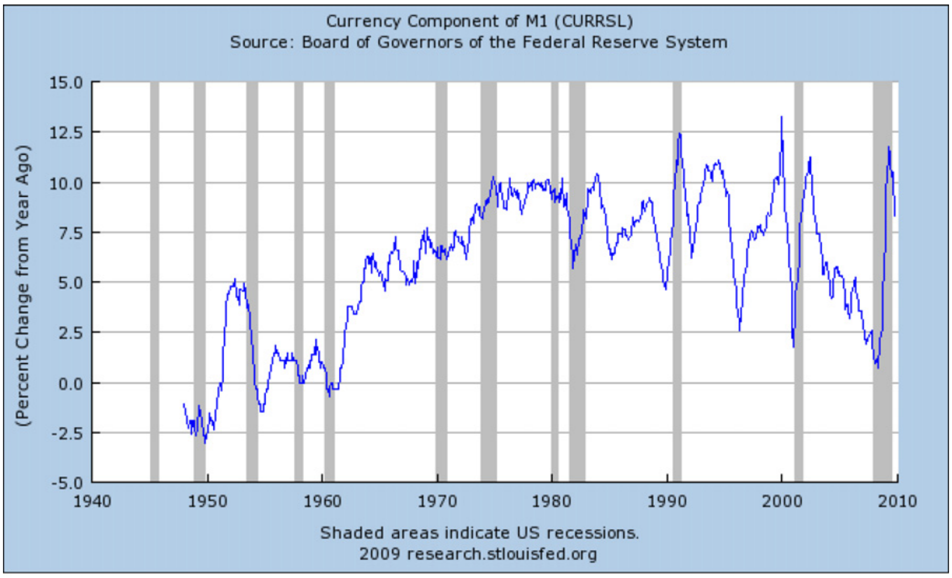

Fig. 13. Currency in circulation original data trace.

prior to inflation and receive output prices afterward [19]. These inflationary accounting profits are greatest in industries where monetary injection occurs first, elevating demand and employment in those industries, and also has a disproportionate impact on production which takes the longest time to complete. The fact that capital equipment is long-lived and must be reallocated to most productive uses also contributes to an expectation of antipersistency. Persistent long memory could occur in the ABC model only in the absence of monetary inflation.

Real business cycle (RBC) models attempt to explain the business cycle in terms of adjustment to random, unexplained, and unobservable changes in factor productivity. When technology improves or factor costs fall, factors become more productive and producers respond by increasing employment and output. Real business cycle theory assumes the PPF shifts due to periodic technology shocks which are persistent, so an unusual series of negative shocks results in an economic downturn, and a series of positive shocks is required to end the downturn. Plosser's [12] canonical RBC model only requires persistence in factor productivity, which exogenously causes the PPF to contract inward causing recessions (left panel of Fig. 1), and expand outward for recovery and secular growth. It remains a mystery why this should occur, though it is clear that RBC recessions do not imply a retrogression of technical knowledge. Recessions occur in the RBC model only due to repeated inward shocks to the frontier, signaled by persistent reduction of the scaling variables. Some RBC models [10]

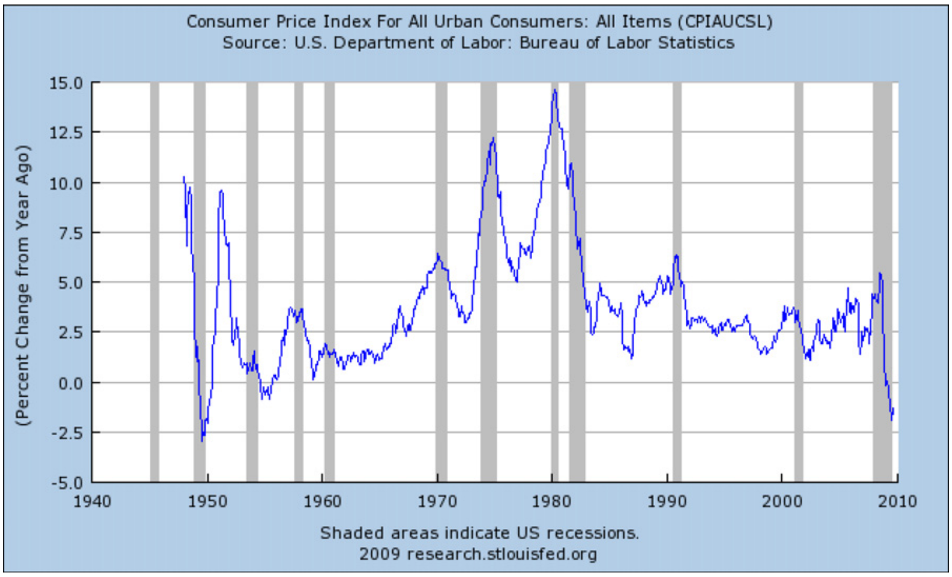

Fig. 14. Consumer price index original data trace.

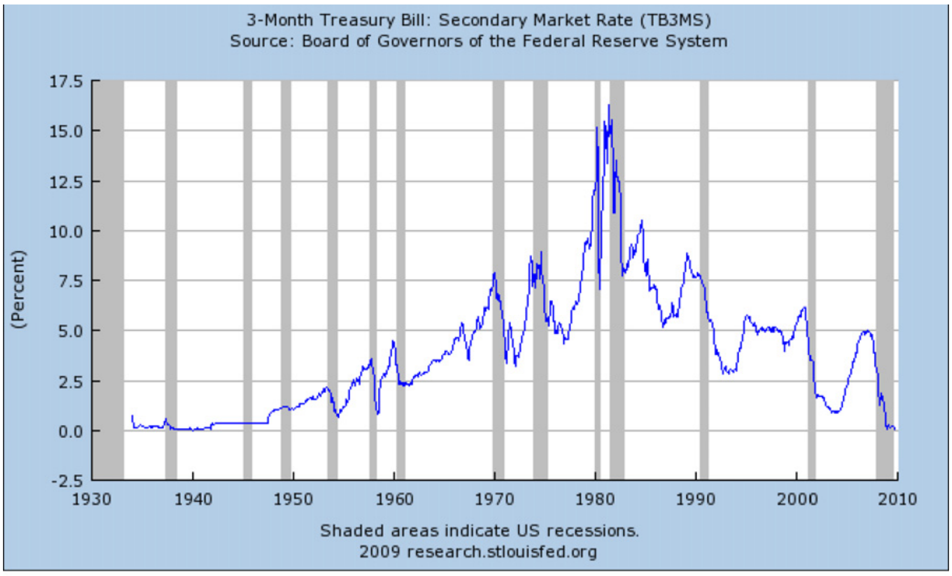

Fig. 15. 3-month treasury bill secondary market interest rate original data trace.

rely on capital equipment's long installation period or time-to-build before it can be used to produce output to introduce persistent changes in factor productivity, but this mechanism is not essential to RBC theory. Technology shocks and the entrepreneurial response they evoke need not be correlated or persistent in RBC theory, but unless they are persistently negative, there will be no recessions, and unless they are persistently positive, there will be no recovery or economic growth.

A main assumption of RBC theory is that individuals and firms respond optimally all the time and the economy never leaves general equilibrium. Chian et al. [20] introduce a model which shares some characteristics of RBC models. Ma et al. [21] showed this model could exhibit fractal behavior in simulations. Unfortunately, although it describes the dynamics of the output process with great generality and effectiveness, it does not model either resource inputs or their productivity. Since resource productivity and employment both vary over the business cycle, this model offers at best a partial explanation, being more descriptive than explanatory. Table 1 summarizes the expectations for long memory contributed by ABC and RBC theory. The persistent long memory predicted by RBC theory is significantly different from the antipersistent long memory predicted by ABC theory.

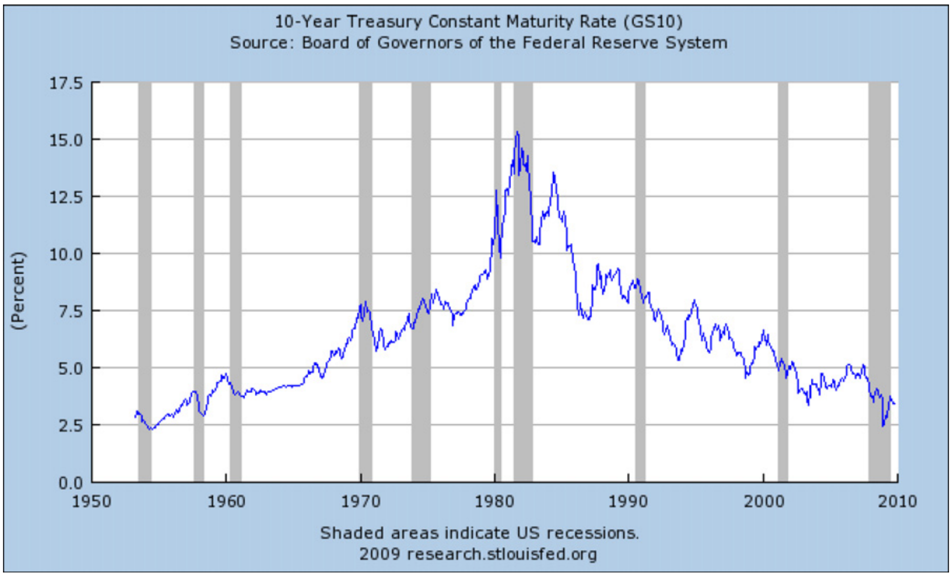

Fig. 16. 10-year treasury bond constant maturity rate original data trace.

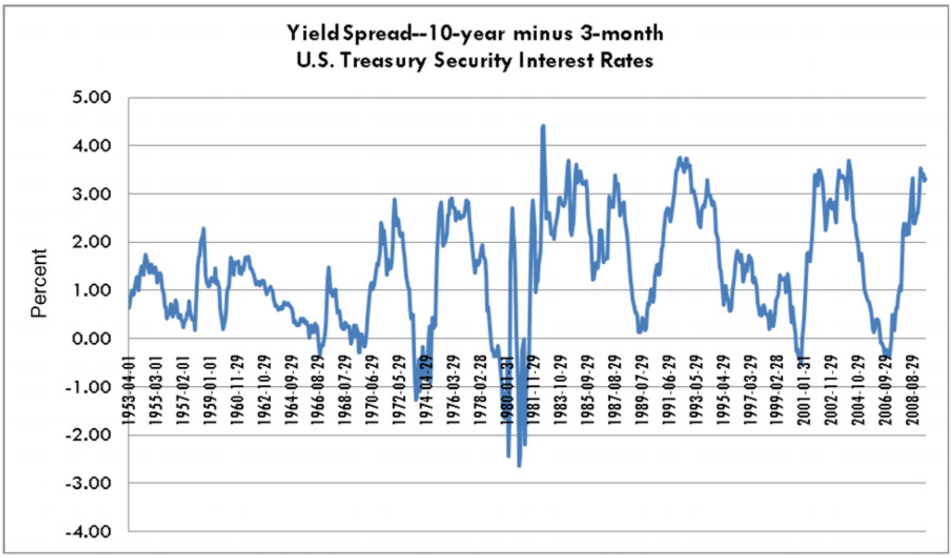

Fig. 17. Yield spread original data trace.

3. Data

The data are monthly and quarterly observed monetary aggregates, aggregate expenditures, and price and output indices, and productivity ratios. The data, their ranges, and frequency of observation are presented in Table 2. Graphs of the original data traces are presented in Figs. 2–26. All original data series except the two interest rates and the term spread derived from them were seasonally adjusted by the government body which collects them. Each series was rendered stationary by taking the percent change from one year prior, further ensuring that seasonal patterns were removed prior to analysis.

4. Results

This section discusses estimates of the Hurst exponent H to characterize the form of stochastic dependence. H is estimated by conventional rescaled range (R/S) and power spectral density. Although detrended fluctuation analysis (DFA) [25] is more commonly used by physicists, it has been shown that Hurst exponents estimated by DFA and power spectral density are related through an integral transform and have similar standard errors [26]. Heneghan and McDarby conclude that "DFA and spectral measures provide equivalent characterizations of stochastic signals with long-term correlation". It will be seen, however, that the standard errors from these methods are extremely high.

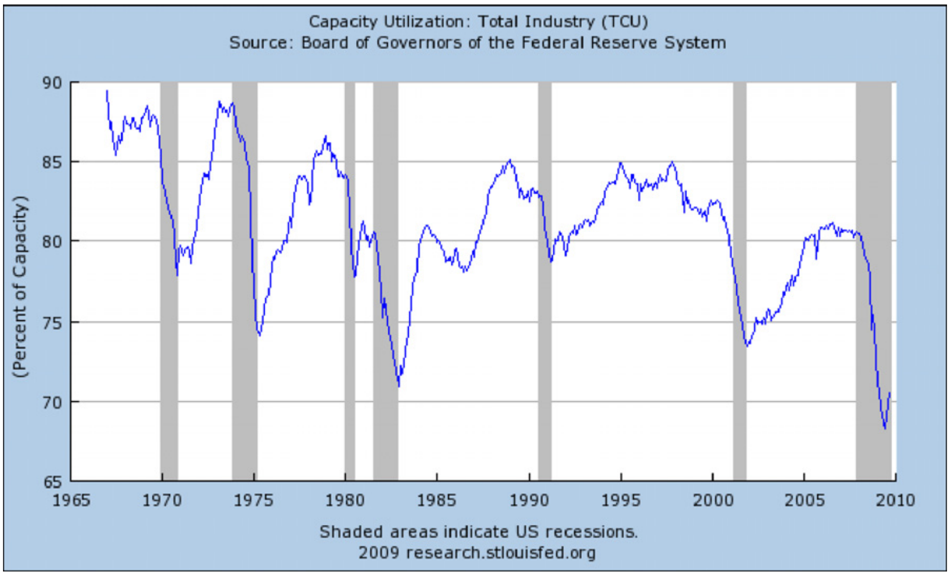

Fig. 18. Capacity utilization rate original data trace.

Table 2
Macromonetary data used to estimate the Hurst exponent.

Variable (FRED descriptor)	Range	Frequency	Seasonal adjustment	*N*
MB monetary base (BOGAMBSL)	1959-01-01 to 2009-10-01	M	SA	598
M1 transactions money (M1SL)	1959-01-01 to 2009-09-01	M	SA	597
M2 savings money (M2SL)	1959-01-01 to 2009-09-01	M	SA	597
M2M M2 minus small time deposits (M2MSL)	1959-01-01 to 2009-09-01	M	SA	597
MZM money zero maturity (MZMSL)	1959-01-01 to 2009-09-01	M	SA	597
RES total bank reserves (TRARR)	1959-01-01 to 2009-10-01	M	SA	598
DD demand deposits (DEMDEPSL)	1959-01-01 to 2009-09-01	M	SA	597
SAV savings deposits (SVSTSL)	1959-01-01 to 2009-09-01	M	SA	597
PCE personal consumption expenditures (PCE)	1959-01-01 to 2009-09-01	M	SAAR	597
RPCE real personal consumption expenditures (PCEC96)	1959-01-01 to 2009-09-01	M	SAAR	597
RDPI real disposable personal income (DSPIC96)	1959-01-01 to 2009-09-01	M	SAAR	597
CUR currency in circulation (CURRSL)	1947-01-01 to 2009-09-01	M	SA	741
CPI consumer price index (CPIAUCSL)	1947-01-01 to 2009-09-01	M	SA	741
R3M 3-month T-bill secondary market interest rate (TB3MS)	1934-01-01 to 2009-10-01	M	NSA	910
R10Y 10-year T-bond constant maturity rate (GS10)	1953-04-01 to 2009-10-01	M	NSA	679
TERM term spread (=GS10 − TB3MS)	1953-04-01 to 2009-10-01	M	NSA	679
TCU total capacity utilization (TCU)	1967-01-01 to 2009-09-01	M	SA	513
IIP index of industrial production (INDPRO)	1919-01-01 to 2009-09-01	M	SA	1077
PROD worker productivity (=INDPRO/CIVEMP)	1948-12-01 to 2009-10-01	M	SA	730
LPRODQ hourly worker productivity (OPHPBS)	1947-01-01 to 2009-07-01	Q	SA	247
RGDP real gross domestic product (GDPC96)	1948-01-01 to 2009-07-01	Q	SAAR	247
NGDP nominal gross domestic product (GDP)	1948-01-01 to 2009-07-01	Q	SAAR	247
PGDP potential real gross domestic product (GDPPOT)	1950-01-01 to 2019-10-01	Q	SAAR	280
FPI fixed private investment (FPI)	1947-01-01 to 2009-07-01	Q	SAAR	247
RFPI real fixed private investment (FPIC96)	1947-01-01 to 2009-07-01	Q	SAAR	247

Notes: Data from the Federal Reserve Bank of St. Louis http://research.stlouisfed.org/fred2/. M = monthly observations, Q = quarterly. SA = seasonally adjusted, NSA = not seasonally adjusted, SAAR = seasonally adjusted at annual rates, i.e., the amounts reported are twelve times the amount actually realized in a given month or four times the amount in a given quarter (after seasonal adjustment).

Power spectral density *H*'s will be taken to govern over conventional rescaled-range estimates, which are presented in Table 3 for comparison. The monetary base and M1 transactions money are antipersistent, even through the veil of seasonal adjustment and taking the percent change from one year prior. M2 savings money, M2 minus small time deposits, and MZM money of zero maturity exhibit persistence, which evidently comes from some of the saving components not included in M1 or the monetary base. Total bank reserves, total demand deposits, and currency in circulation are all antipersistent with $H < 0.50$. These are components of M1, but also of M2, M2 minus, and MZM. Savings deposits are persistent, and appear to be a sufficient cause of the persistency observed for all the broader monetary aggregates, M2, M2 minus, and MZM. Savings assets are held as stores of value, and could reasonably be expected to exhibit persistency. Transactions assets such as currency and demand deposits are routinely used for exchange, and their level would be expected to fluctuate more freely.

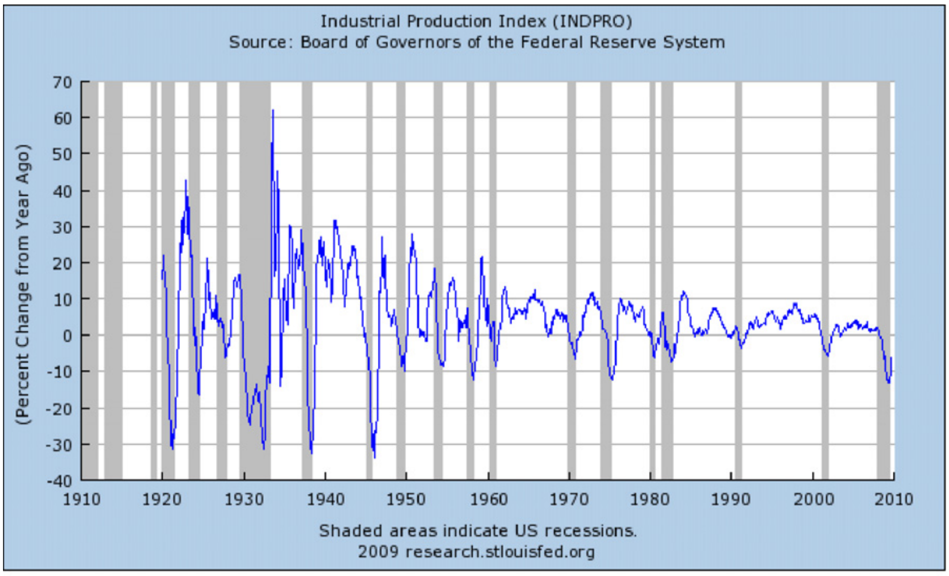

Fig. 19. Industrial production index original data trace.

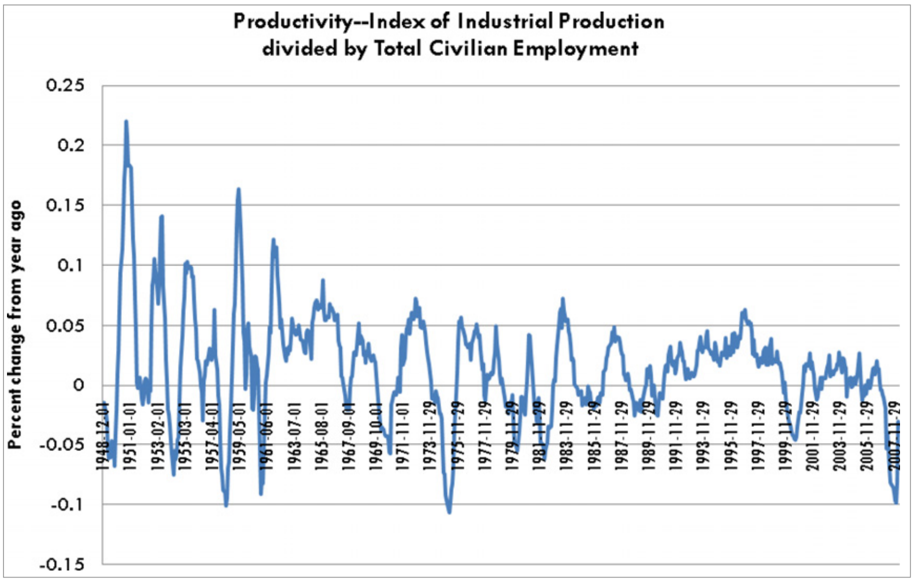

Fig. 20. Productivity ratio original data trace.

Nevertheless, people are thought to desire money balances for future potential transactions and investment opportunities, and it is extremely surprising to find clear evidence of antipersistence in these assets and monetary aggregates (Figs. 27–51).

Both real and nominal consumption expenditures are antipersistent. Apparently the monetary inflation which distinguishes the real or inflation-adjusted value from the nominal or inflation-unadjusted value contributes to make the observed variable less antipersistent, rather than more. This is also surprising, but clearly economic agents' expectation of a persistently rising price level is consistent with this finding. Antipersistency of consumption expenditure can be the fundamental cause of the antipersistency observed for transactions money (M1) and its components. It is particularly difficult to reconcile antipersistency of consumption expenditure with the Keynesian theory of the consumption function [34, pp. 89–131, chs. 8–10].

Real disposable personal income, which households divide in each period into personal consumption and personal saving, has one of the lowest H's (0.185). The consumer price index has an H of 0.448, which barely suggests deviation from normality. The three-month and ten-year nominal interest rates do not provide any evidence of antipersistence; however, the term spread, the difference between long- and short-term rates, has an H of 0.327. The capacity utilization rate and the index of industrial production both have low H's indicating antipersistency. Two measures of labor productivity are antipersistent, and it is rather remarkable that hourly productivity, the more sensitive measure, is more antipersistent with

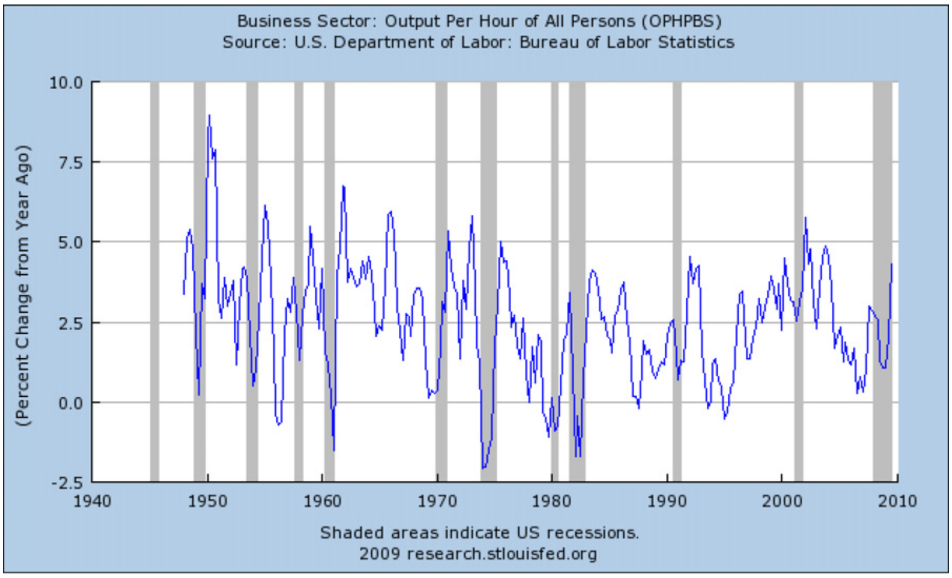

Fig. 21. Business output per worker hour original data trace.

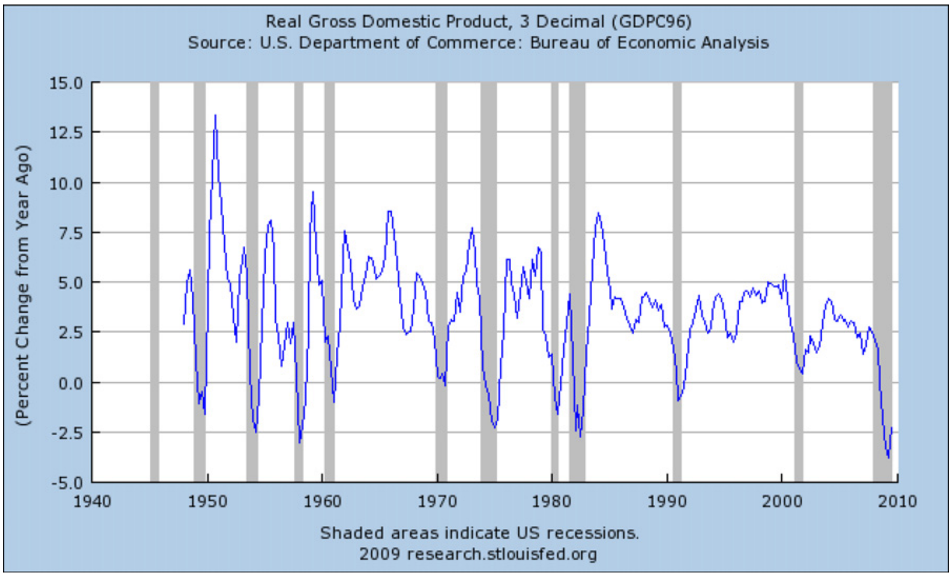

Fig. 22. Real GDP original data trace.

$H = 0.046$, compared with output per worker employed with $H = 0.299$. Real GDP has a very low $H = 0.105$, while the H for nominal GDP is somewhat higher (0.233), though still very low. As with personal consumption expenditures, the lower H observed for the real (inflation-adjusted) quantity may be attributed to agents' expectations of a persistently rising price level. Potential real GDP is persistent. This is an estimate of what the economy should be able to produce at natural rate employment, approximately six percent unemployment. It is estimated by the Congressional Budget Office in a manner which assures a very smooth series, and it is projected about ten years into the future. It is not surprising that the estimated H is 0.648. Fixed private investment, gross investment spending net of changes in inventories, is well-known to be highly volatile, and the low H's (0.084 for nominal investment, 0.086 for real) are not surprising.

The absence of very many persistent macromonetary time series is a difficult burden for RBC theory, but the fact that labor productivity is antipersistent is absolutely fatal. Factor productivity must be persistent or a real business cycle cannot occur [12]. Peng et al. [27] and Kuikka [28] found that heart rates and blood pressure exhibit persistent long memory with $H > 0.50$. Similar H's would need to be found consistently to support real business cycle theory, which calls for persistent long memory in macroeconomic series, particularly productivity indices. Antipersistent long memory indicates undamped negative feedback mechanisms, which are apparently what affect the macroeconomic data. Most macromonetary series are antipersistent or pink noise processes with $(0.00 < H < 0.50)$, indicating they are more volatile than a

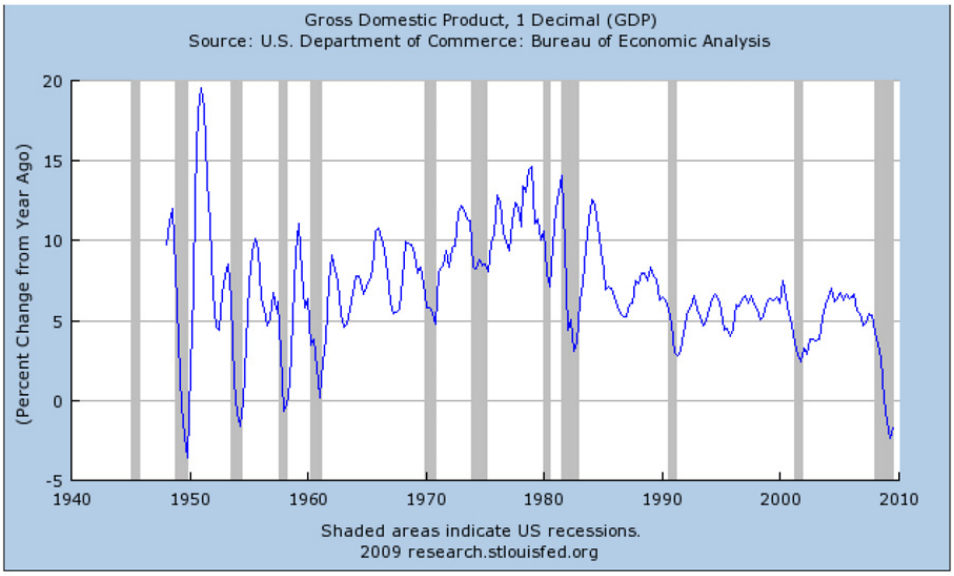

Fig. 23. Nominal GDP original data trace.

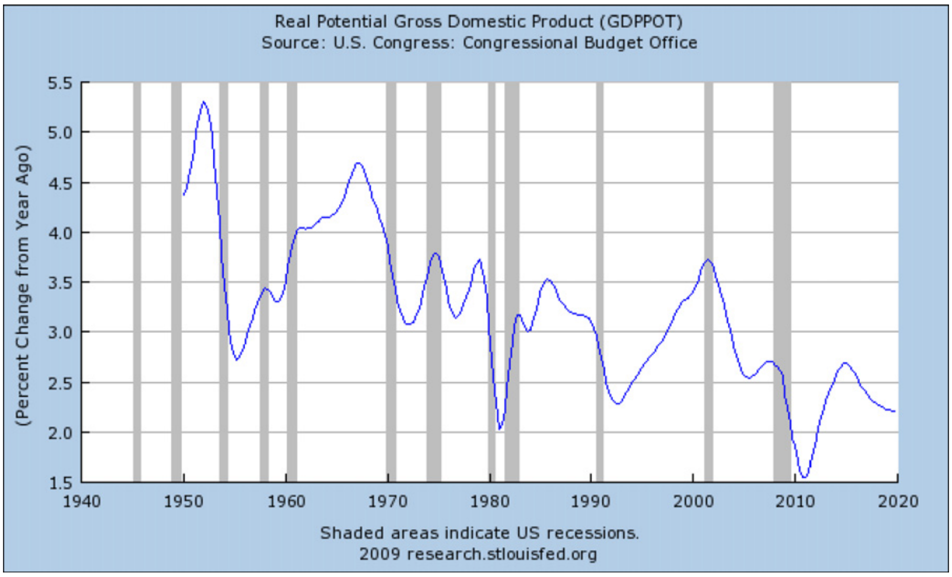

Fig. 24. Real potential GDP original data trace.

random walk, e.g., antipersistent processes are used to model dynamic turbulence. These antipersistent processes reverse themselves more often than purely random series, even with statistical adjustment to remove seasonality. Antipersistence indicates policy makers and/or entrepreneurial planners persistently over-react to new information, imposing more macroeconomic volatility than would maintain in the absence of activist policy, and never learn not to over-react. This observed phenomenon is directly analogous to disequilibrium overshooting [29], in which the market process of adjustment toward final equilibrium is unstable, and never quiets down. These data processes result from undamped negative feedback which imposes more volatility on the economy, like an overactive thermostat which switches on and off too frequently. The signal quality of information flows is significantly degraded by activist monetary policy which impairs the information content of prices and other signaling variables economic agents use to coordinate production and consumption plans.

The overwhelming finding of antipersistence for nearly all series strongly disconfirms real business cycle theory. The productivity indices in particular, would have to exhibit persistent rather than antipersistent long memory to account for real business cycles. Statistical results with the productivity indices suggest that labor productivity does fluctuate randomly, but not in such a manner as could result in the persistent upswings and downswings in output and employment on which real business cycle theory relies.

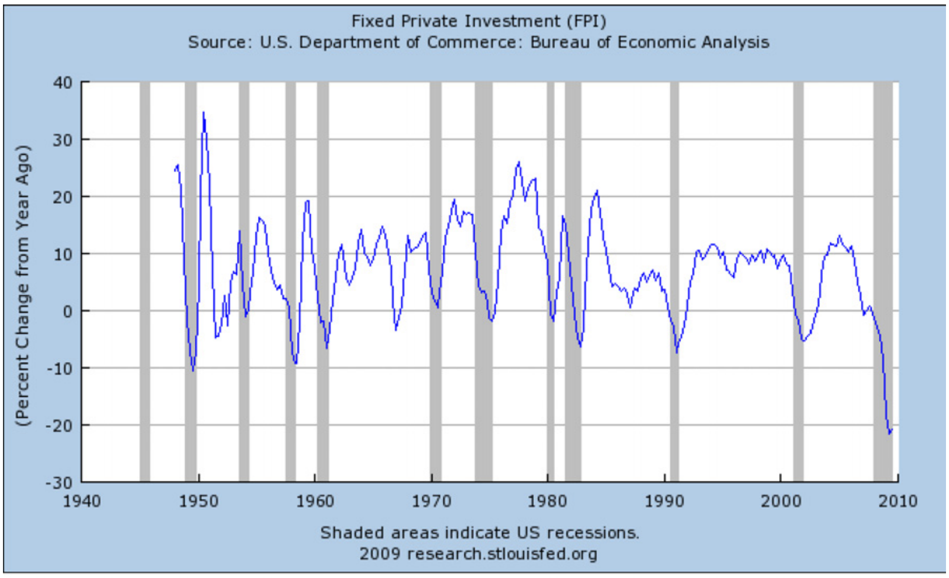

Fig. 25. Fixed private investment original data trace.

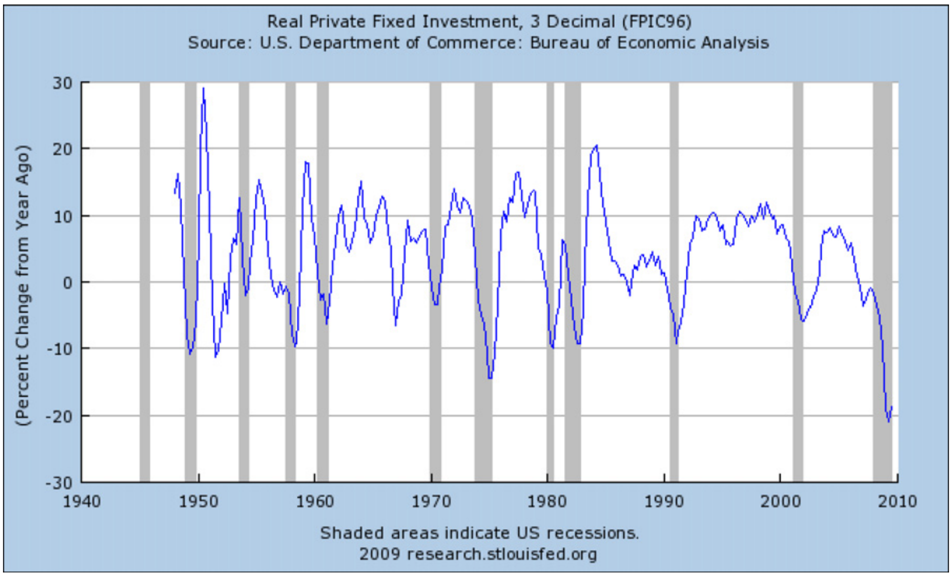

Fig. 26. Real private fixed investment original data trace.

5. Conclusion

Macroeconomic data for a stable and growing economy undisturbed by activist monetary or fiscal policy should have Hurst exponents approximately equal to 0.50, indicating the macroeconomic series change in a purely random, normally distributed manner. Series with long-term trends and non-periodic cycles should display time persistence with $H > 0.50$, unless economic efficiency imposes randomness and normality anyway. Antipersistence or dynamic turbulence has been studied extensively in the physics literature. For example, Sun et al. [30] found that a bifurcation transition from dropwise to filmwise condensation occurs as $H < 0.50$ approaches zero. Most of the H's estimated for macroeconomic time series are in that range, and the unpredictable transition from an unstable inflationary bubble to economic recession seems directly analogous. Mai et al. [31] give a similar interpretation.

Much of the macroeconomic data in this study yield strong evidence of antipersistence. The conclusion suggested is that decision makers are incapable of correctly evaluating economic data, persistently overreact to the arrival of new information, and never learn not to overreact, and this behavioral shortcoming applies to monetary policy makers, money managers, and entrepreneurial planners. It is not clear that all agents necessarily overreact all the time. The economics and organizational behavior literatures generally emphasizes reasons why individual behavior is persistent. This would tend to make it difficult

Table 3
Estimates of H for macromonetary time series by rescaled range and power spectrum.

Variable	N	$N_{(R/S)}$	$H_{(R/S)}$	$s.d._{(R/S)}$	H_{PS}	$s.d._{PS}$
MB monetary base (BOGAMBSL)	598	540/15	0.523	0.0817	0.388	12.60
M1 transactions money (M1SL)	597	540/15	0.538	0.0546	0.419	6.85
M2 savings money (M2SL)	597	540/15	0.569	0.0542	0.589	8.77
M2M M2 minus small time deposits (M2MSL)	597	540/15	0.613	0.0832	0.636	12.00
MZM money zero maturity (MZMSL)	597	540/15	0.612	0.0956	0.647	11.80
RES total bank reserves (TRARR)	598	540/15	0.478	0.0493	0.477	11.00
DD demand deposits (DEMDEPSL)	597	540/15	0.542	0.0359	0.296	8.26
SAV savings deposits (SVSTSL)	597	540/15	0.693	0.0754	0.758	8.87
PCE personal consumption expenditures (PCE)	597	540/15	0.319	0.0484	0.285	5.43
RPCE real personal consumption expenditures (PCEC96)	597	540/15	0.439	0.0303	0.251	10.40
RDPI real disposable personal income (DSPIC96)	597	540/15	0.358	0.0372	0.185	9.60
CUR currency in circulation (CURRSL)	741	720/20	0.531	0.1200	0.375	10.70
CPI consumer price index (CPIAUCSL)	741	720/20	0.667	0.0446	0.448	4.48
R3M 3-month T-bill secondary market interest rate (TB3MS)	910	840/22	0.476	0.0833	0.486	4.37
R10Y 10-year T-bond constant maturity rate (GS10)	679	672/15	0.473	0.0194	0.553	3.64
TERM term spread	679	672/15	0.423	0.0610	0.327	5.96
TCU total capacity utilization (TCU)	513	504/14	0.677	0.0495	0.377	7.00
IIP index of industrial production (INDPRO)	1077	1008/20	0.438	0.1610	0.271	15.60
PROD worker productivity	730	720/20	0.488	0.0999	0.299	20.60
LPRODQ hourly worker productivity (OPHPBS)	247	240/11	0.146	0.0132	0.046	12.80
RGDP real gross domestic product (GDPC96)	247	240/11	0.252	0.0311	0.105	16.00
NGDP nominal gross domestic product (GDP)	247	240/11	0.241	0.0175	0.233	9.02
PGDP potential real gross domestic product (GDPPOT)	280	240/11	0.740	0.0341	0.648	6.25
FPI fixed private investment (FPI)	247	240/11	0.243	0.0342	0.084	7.85
RFPI real fixed private investment (FPIC96)	247	240/11	0.278	0.0288	0.086	9.44

$N_{(R/S)}$ gives the number of observations used to calculate H by R/S and the number of window-interval lengths used.

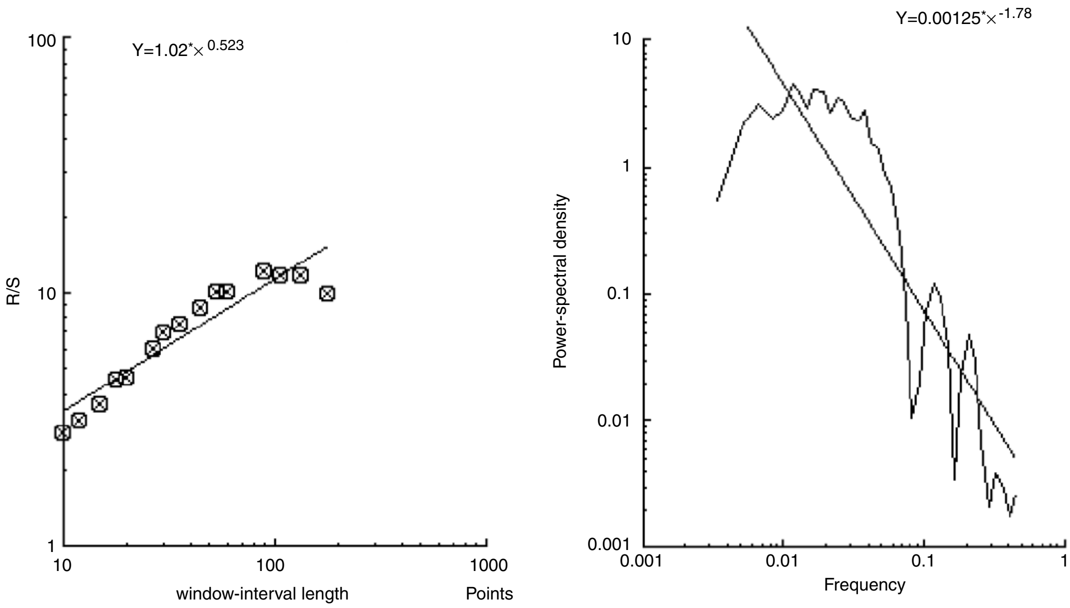

Fig. 27. MB monetary base (BOGAMBSL) R/S and power spectra plots.

for a complex self-organized system like the macroeconomy to correct itself until after a critical magnitude of error has accumulated—which comes about more as a consequence of group dynamics and interdependent behavior. Even if a small number of actors overreact, this can be sufficient to create a cycle.

A scenario rendering this finding more intuitive is that information relevant to a nation's macroeconomic performance arrives frequently, most often in infinitesimal increments, and seemingly at random. Decision makers habitually ignore the vast majority of this information as unimportant or irrelevant until it accumulates a critical mass to which they must finally respond. Once realizing they have ignored important and relevant information, decision makers compensate for their history of informational sloth by overreacting. There is no expectation that each agent shares the same response threshold. The expression "informational sloth" can just as validly be characterized as "filtering out noise".

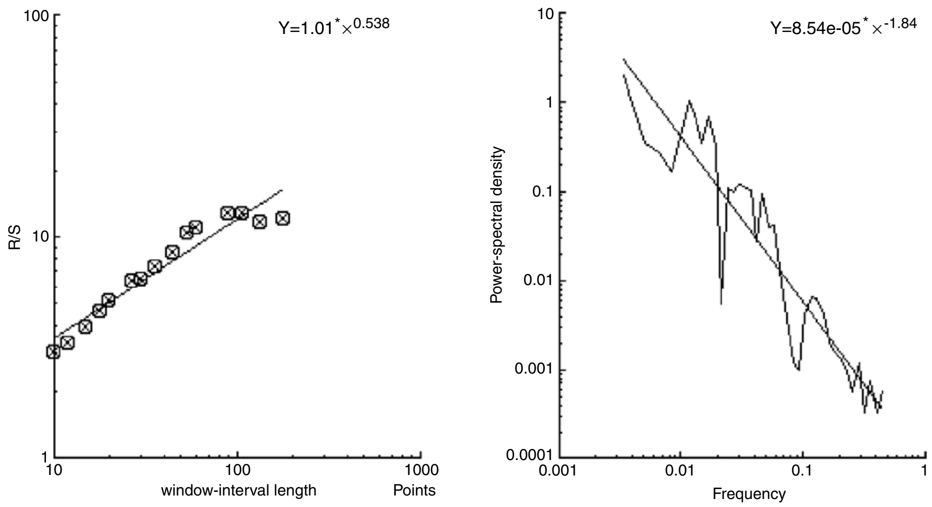

Fig. 28. M1 transactions money (M1SL) R/S and power spectra plots.

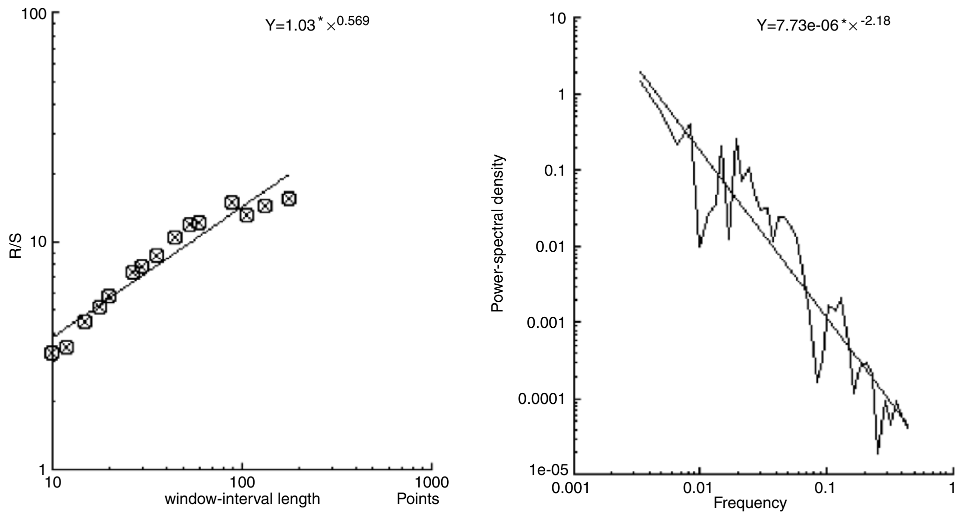

Fig. 29. M2 savings money (M2SL) R/S and power spectra plots.

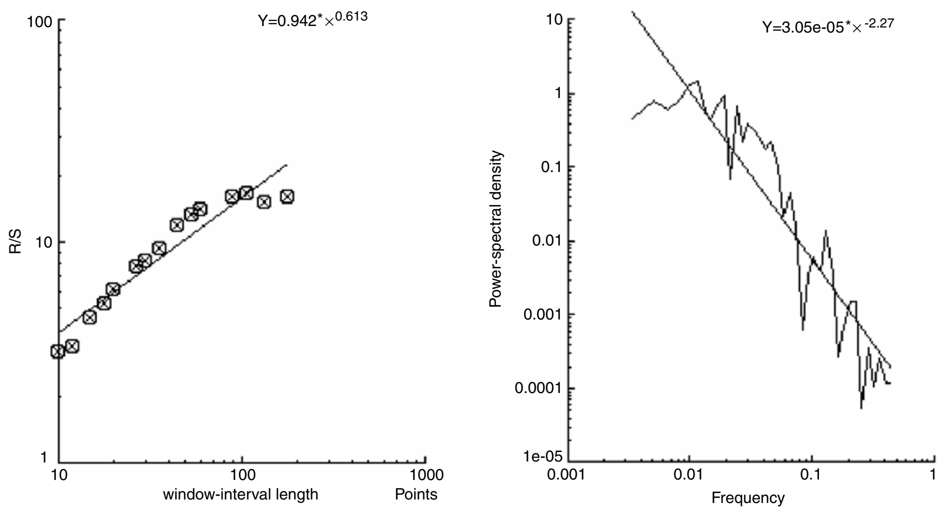

Fig. 30. M2M M2 minus small time deposits (M2MSL) R/S and power spectra plots.

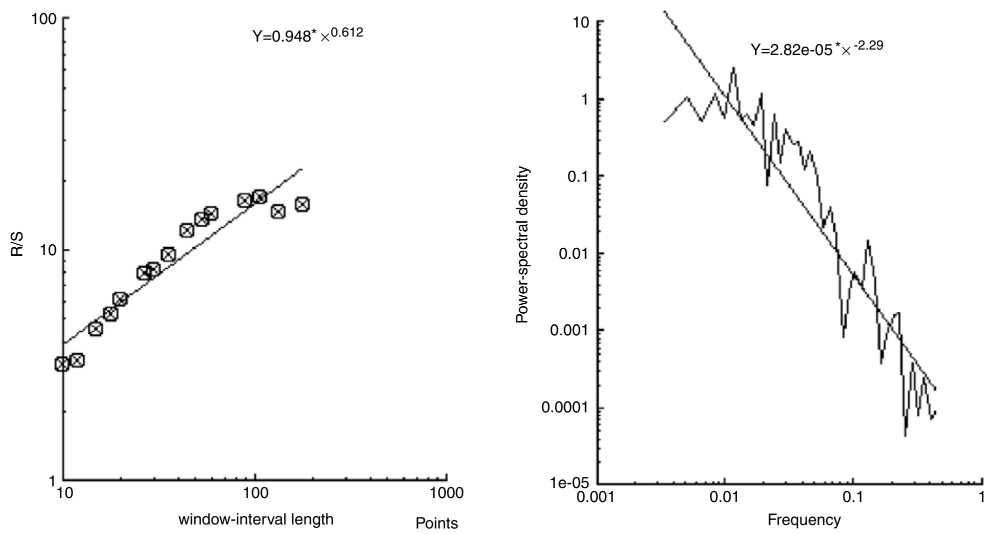

Fig. 31. MZM money of zero maturity (MZMSL) R/S and power spectra plots.

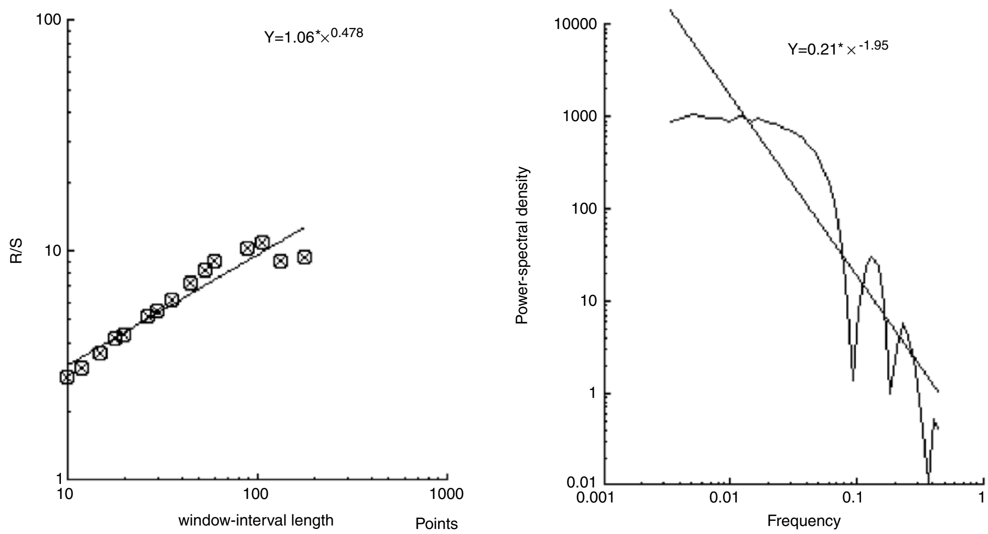

Fig. 32. RES total bank reserves (TRARR) R/S and power spectra plots.

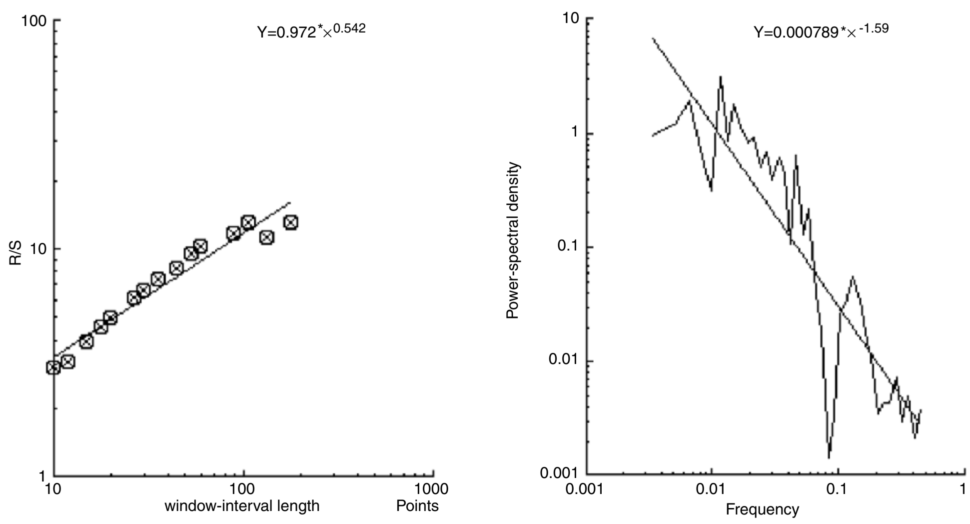

Fig. 33. DD demand deposits (DEMDEPSL) R/S and power spectra plots.

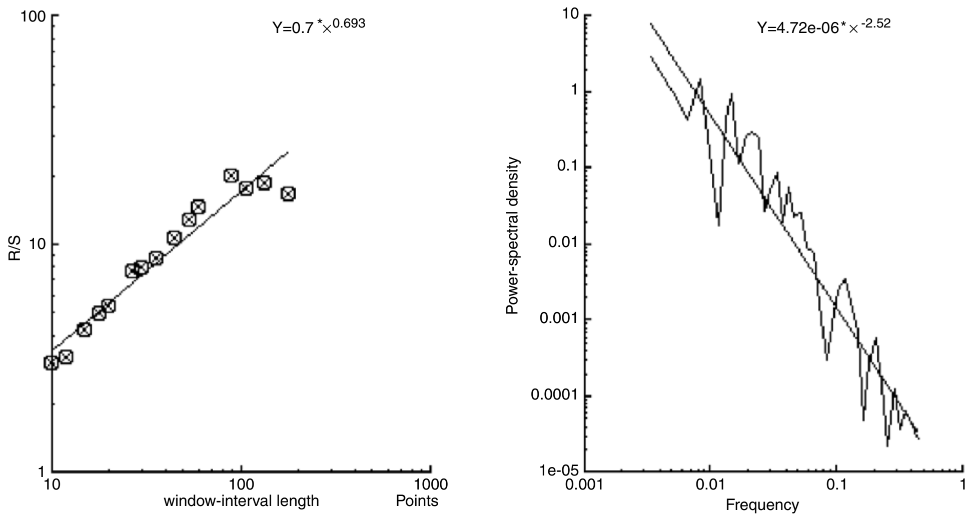

Fig. 34. SAV savings deposits (SVSTSL) R/S and power spectra plots.

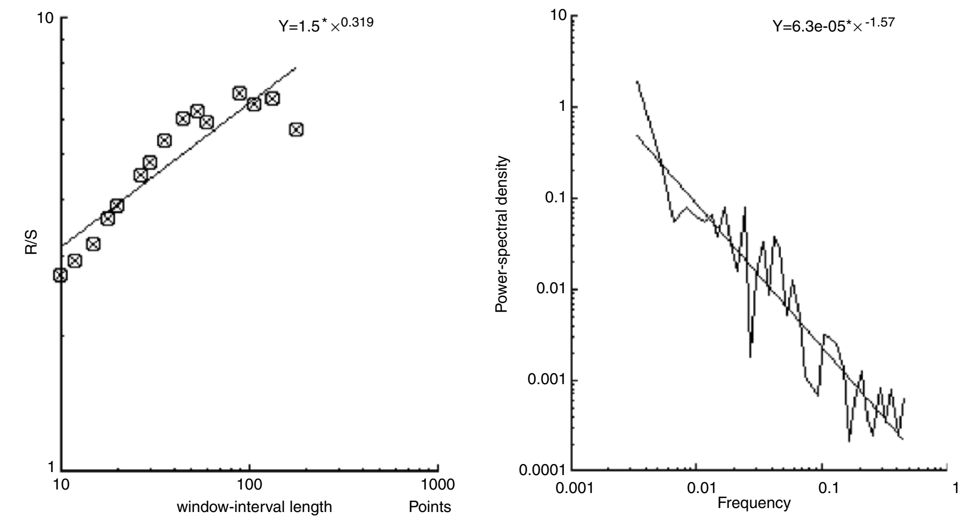

Fig. 35. PCE (nominal) personal consumption expenditures (PCE) R/S and power spectra plots.

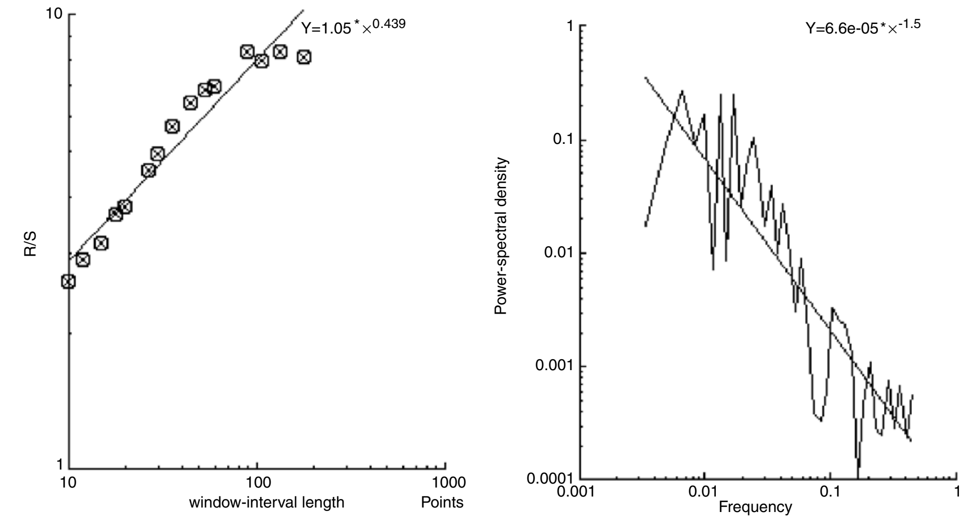

Fig. 36. RPCE real personal consumption expenditures (PCEC96) R/S and power spectra plots.

If some agents ignore available information as a coping mechanism, this interpretation has very negative implications for the efficient market hypothesis. Furthermore, if monetary inflation is in fact best considered as cascade phenomenon, where

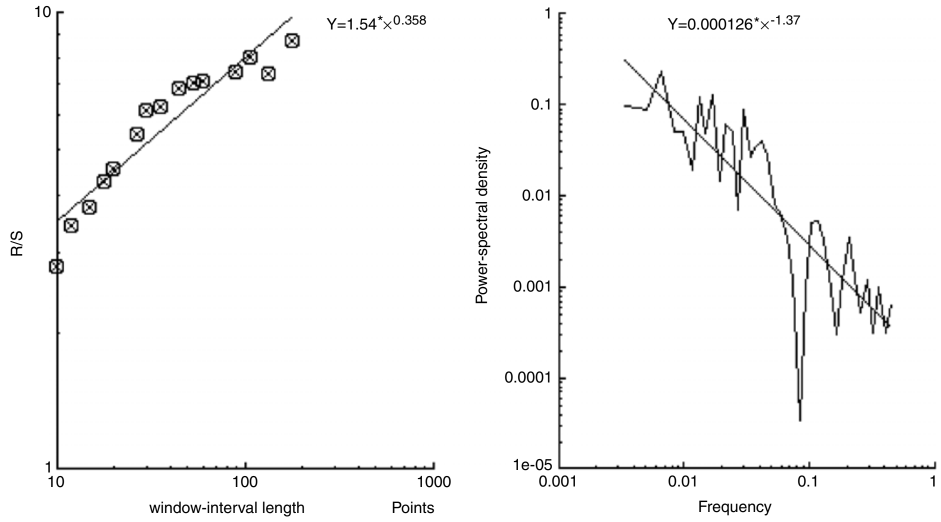

Fig. 37. RDPI real disposable personal income (DSPIC96) R/S and power spectra plots.

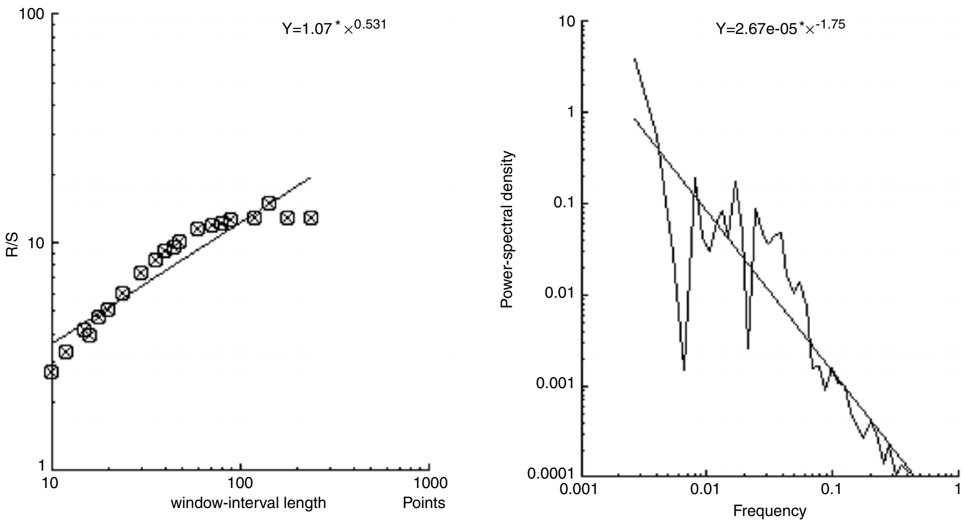

Fig. 38. CUR currency in circulation (CURRSL) R/S and power spectra plots.

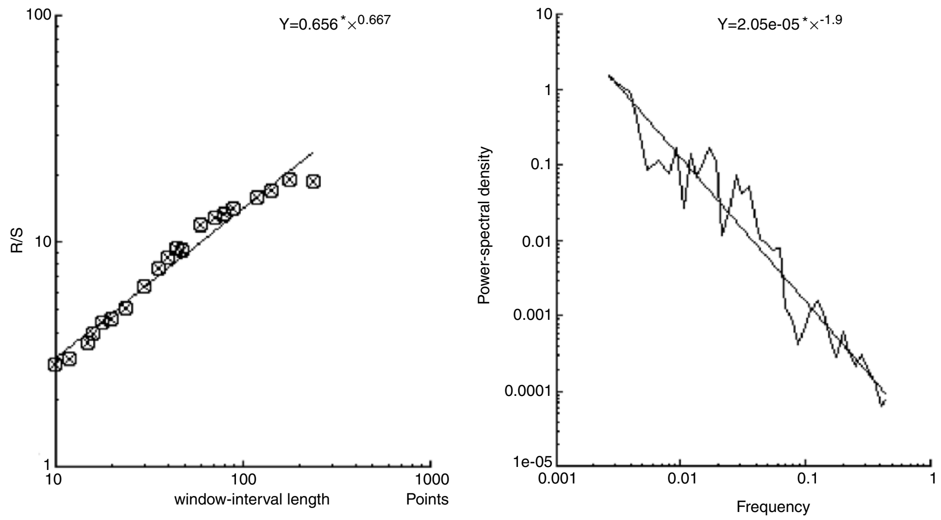

Fig. 39. CPI consumer price index (CPIAUCSL) R/S and power spectra plots.

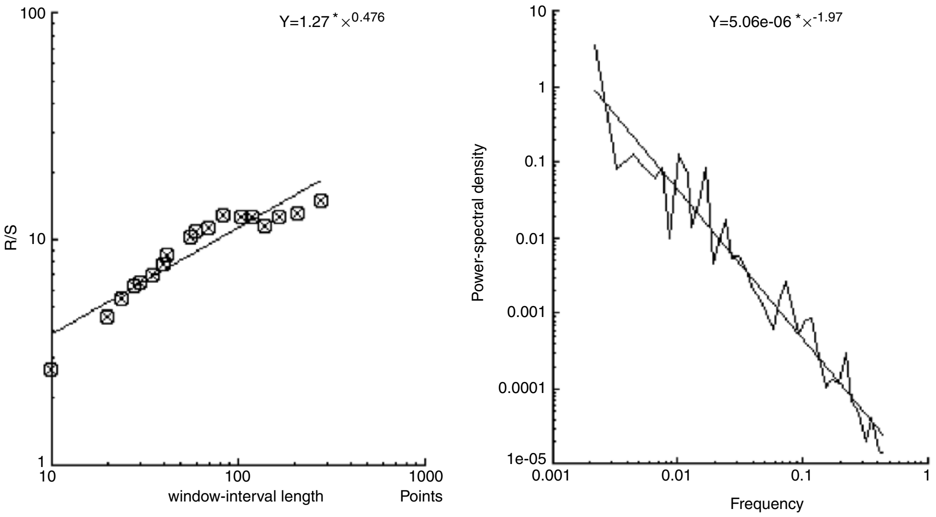

Fig. 40. R3M 3-month T-bill secondary market interest rate (TB3MS) R/S and power spectra plots.

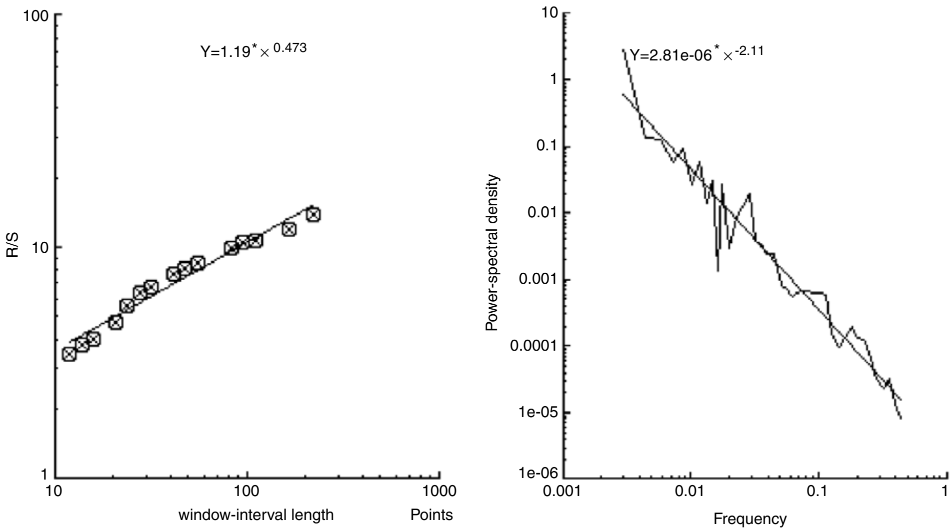

Fig. 41. R10Y 10-year T-bond constant maturity rate (GS10) R/S and power spectra plots.

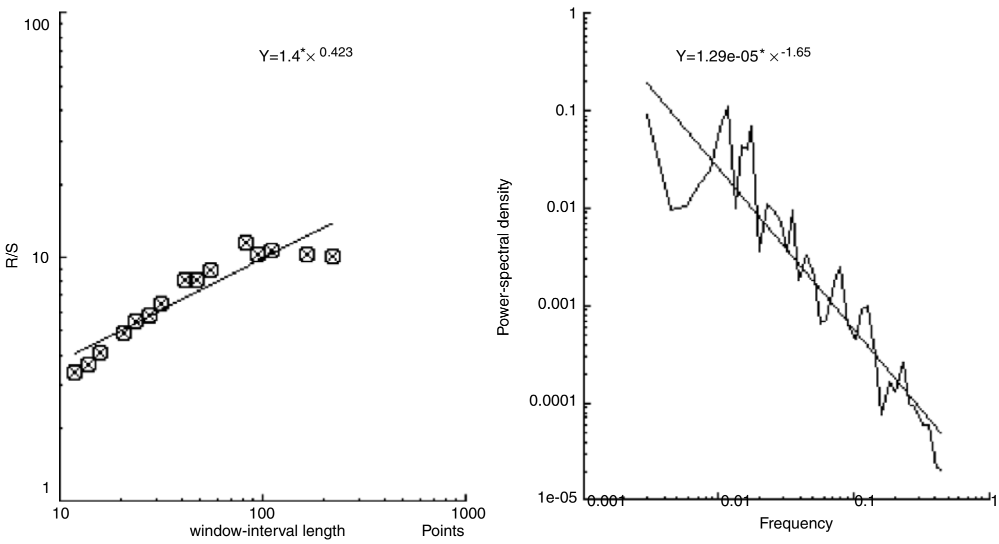

Fig. 42. TERM term spread (=GS10 − TB3MS) R/S and power spectra plots.

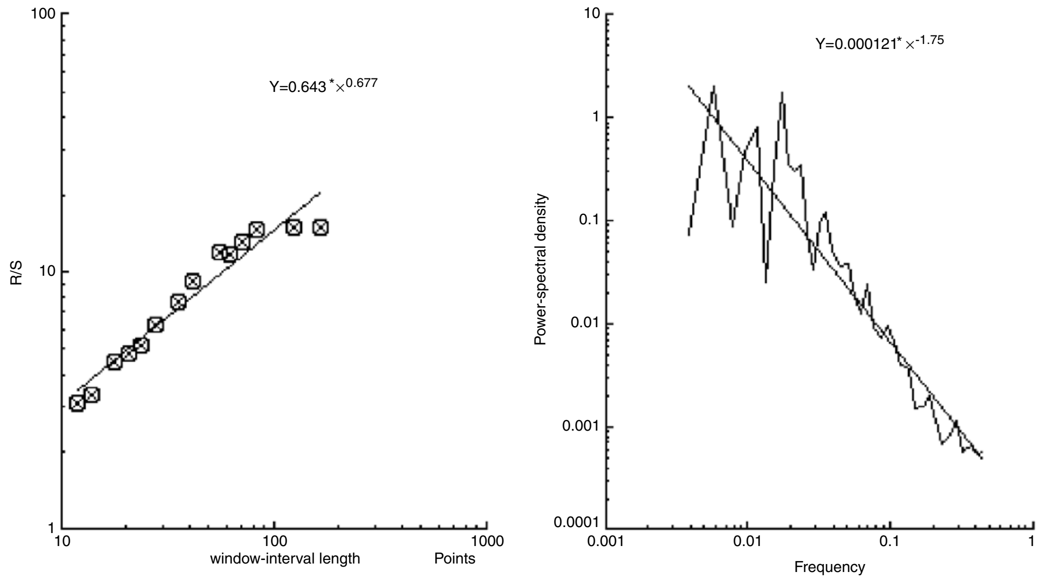

Fig. 43. TCU total capacity utilization (TCU) R/S and power spectra plots.

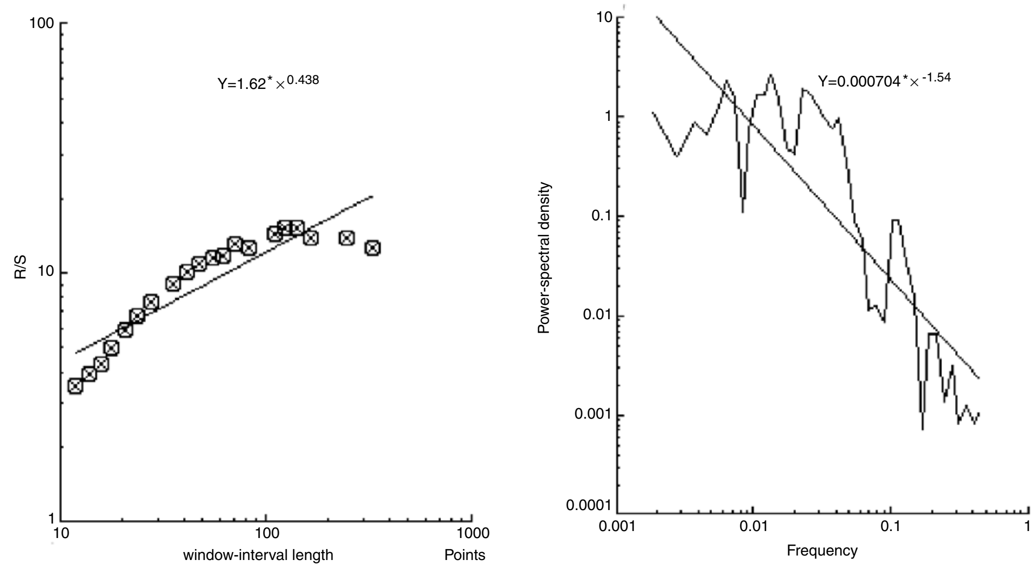

Fig. 44. IIP index of industrial production (INDPRO) R/S and power spectra plots.

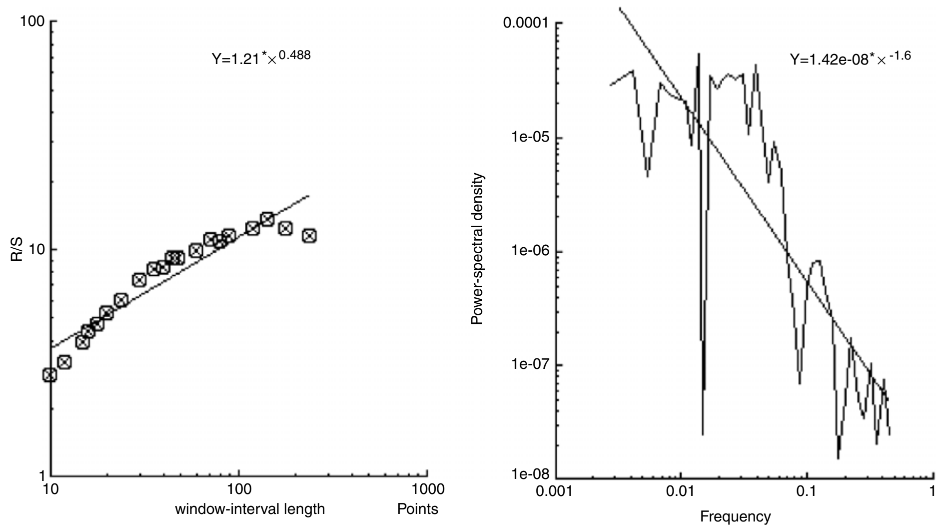

Fig. 45. PROD worker productivity (=INDPRO/CIVEMP) R/S and power spectra plots.

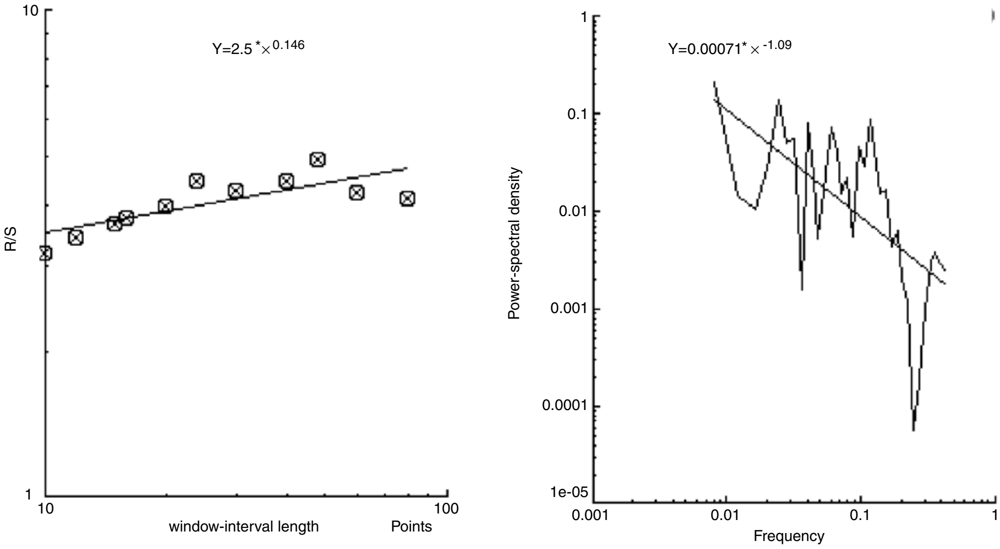

Fig. 46. LPRODQ hourly worker productivity (OPHPBS) R/S and power spectra plots.

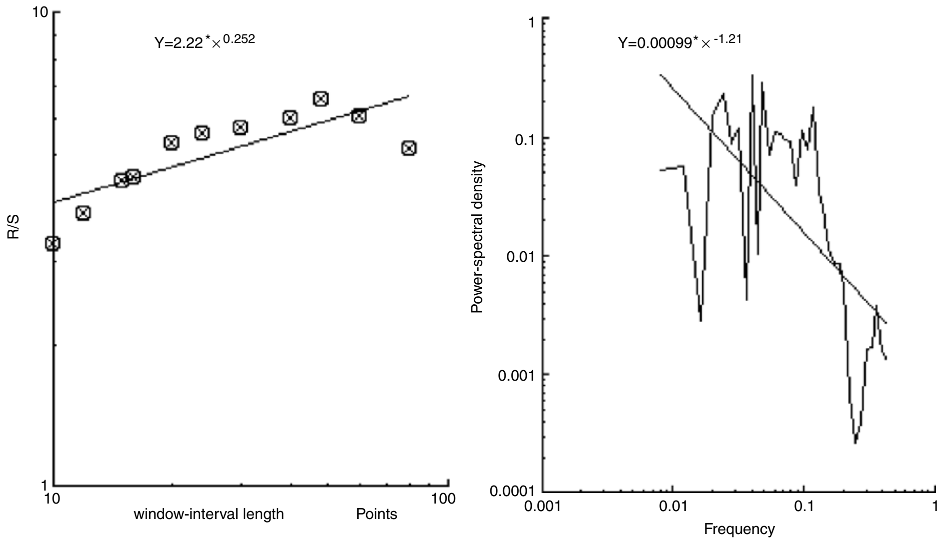

Fig. 47. RGDP real gross domestic product (GDPC96) R/S and power spectra plots.

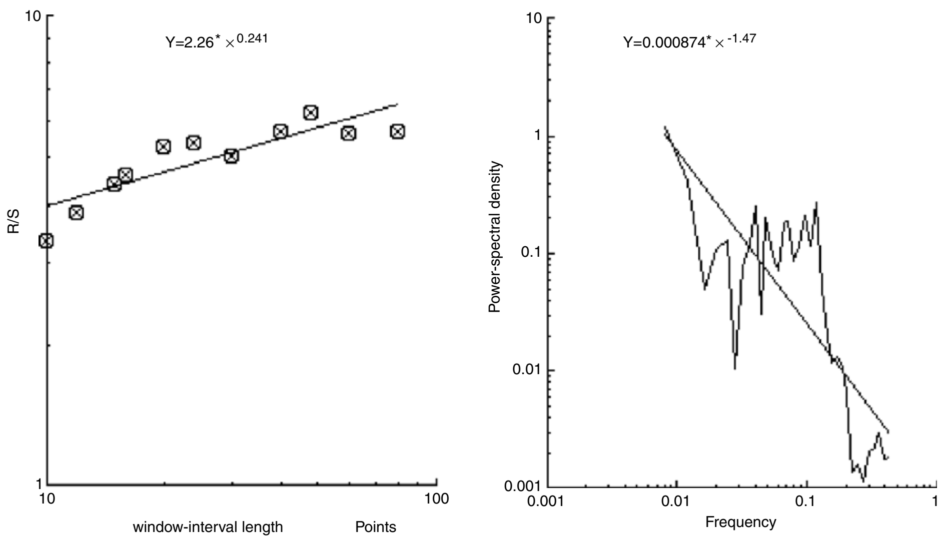

Fig. 48. NGDP nominal gross domestic product (GDP) R/S and power spectra plots.

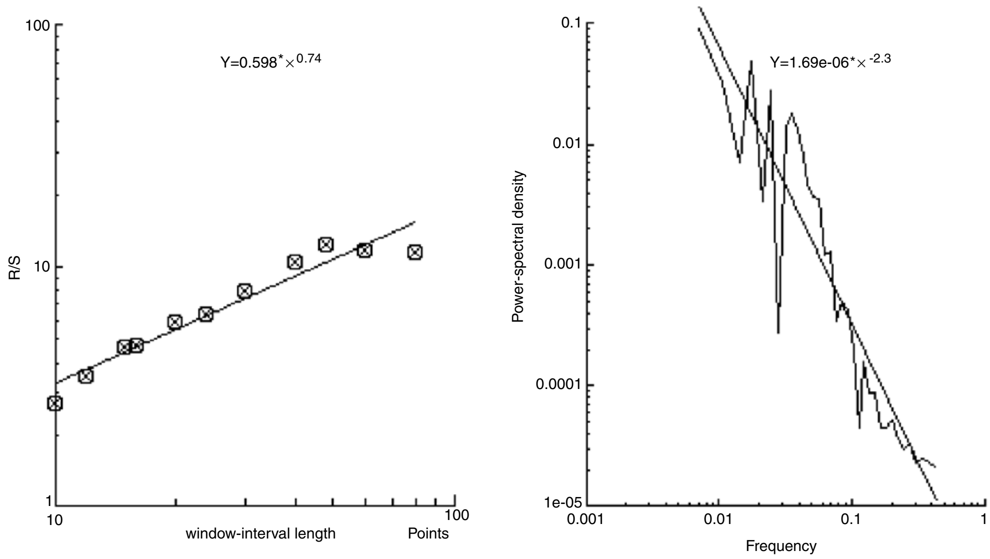

Fig. 49. PGDP potential real GDP (GDPPOT) R/S and power spectra plots.

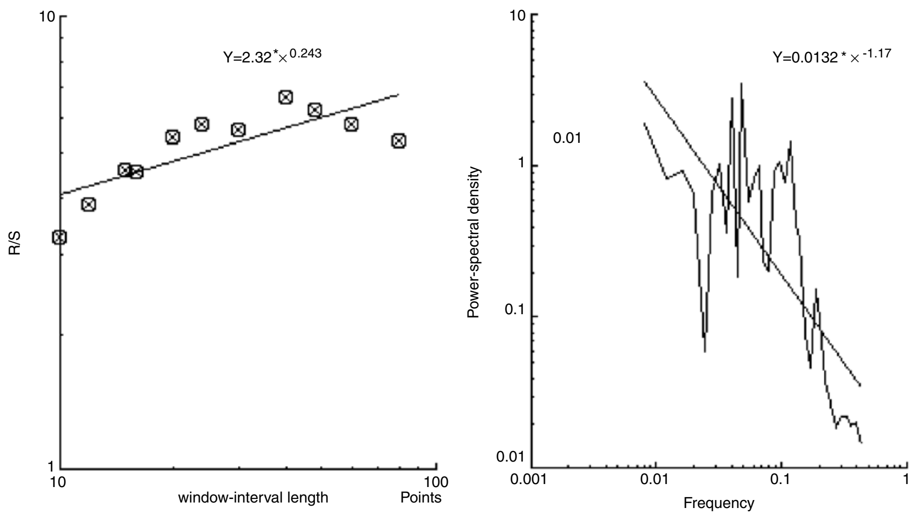

Fig. 50. FPI (nominal) fixed private investment (FPI) R/S and power spectra plots.

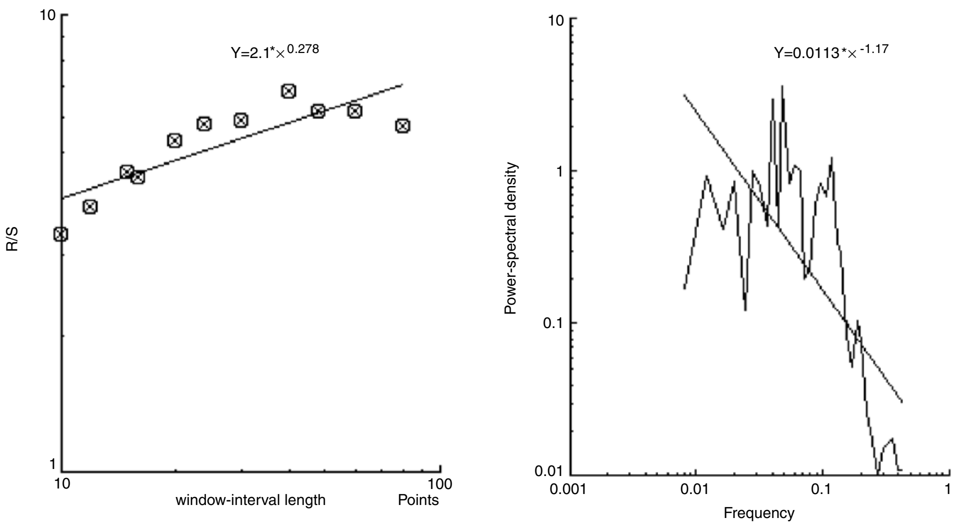

Fig. 51. RFPI real fixed private investment (FPIC96) R/S and power spectra plots.

information and resources are diffused unevenly throughout the economy through Cantillon effects, this seems particularly fatal to the efficient market hypothesis, just as antipersistent resource productivity is fatal to real business cycle theory. This suggests that market efficiency be abandoned in favor of the more general fractal market hypothesis [32, pp. 44–50], [33].

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