THE "PLUCKING MODEL" OF BUSINESS FLUCTUATIONS REVISITED

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Abstract

Some twenty-five years ago, I suggested a model of business fluctuations that stresses occasional events producing contractions and subsequent revivals rather than a self-generating cyclical process. Evidence for the past quarter-century, like evidence presented earlier for a longer period, supports the view that the model is a useful way to interpret business fluctuations and has sufficiently important implications to justify further empirical work for both the United States and other countries.

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The recent surge of renewed interest in business cycles in general, and of real business cycles in particular, brought to mind a "plucking model" of business fluctuations that I suggested some twenty-five years ago but that has since sunk into complete oblivion.[1] I was led to the model in the course of investigating the direction of influence between money and income. Did the common cyclical fluctuations in money and income reflect primarily the influence of money on income or of income on money? One of the five kinds of evidence that I examined was the "serial correlation of amplitudes of cycle phases."[2]

As I wrote, "Is the magnitude of an expansion related systematically to the magnitude of the succeeding contraction? Does a boom tend on the average to be followed by a large contraction? A mild expansion, by a mild contraction?" To find out, I calculated rank difference correlations between measures of the amplitudes of expansions and successive contractions in three different series for the period 1879 to 1961. The three series were rate of change of the stock of money, a physical index of general business, and clearing-debits as an indicator of dollar value change in general business.

Similarly, I asked the same question, except starting with a contraction in the given series and correlating its amplitude with the amplitude of the succeeding expansion.[3]

The results were striking. For all three series the correlation was

trivial between the amplitude of an expansion and the amplitude of the succeeding contraction. On the other hand, for both the rate of change of the money stock, and the physical index of general business, the correlation was high and statistically significant between the amplitude of a contraction and the amplitude of the succeeding expansion. For clearing-debits, this correlation too was low.

I concluded, "There appears to be no systematic connection between the size of an expansion and of the succeeding contraction, whether size is measured by physical volume or by dollar value." On the other hand, a "large contraction in output tends to be followed on the average by a large business expansion; a mild contraction, by a mild expansion," though that is not so for the dollar value of the expansion and contraction.

I went on,

> "This phenomenon, if it should be confirmed by a fuller analysis of data for the United States and other countries, would have important implications for the analysis of business cycles in general, not solely for our monetary studies. For one thing, it would cast grave doubt on those theories that see as the source of a deep depression the excesses of the prior expansion [the Mises cycle theory is a clear example].[4] For another, it would raise serious questions about both the analytical models, in terms of which most of us have come to approach the analysis of cycles, and the statistical methods we use to analyze them.
>
> "Our analytical models generally involve a conception of a self-generating cycle, in which each phase gives rise to the next, and which may be kept going by a sequence of random shocks, each giving rise to a series of damped perturbations. The corresponding physical analogy is of an electrical network in which responses are described by sine waves. The asymmetric serial correlation pattern suggests that this analogy may be misleading, that a better one is what can be termed a plucking model. Consider an elastic string stretched taut between two points on the underside of a rigid horizontal board and glued lightly to the board.

Let the string be plucked at a number of points chosen more or less at random with a force that varies at random, and then held down at the lowest point reached. The result will be to produce a succession of apparent cycles in the string whose amplitudes depend on the force used in plucking the string. The cycles are symmetrical about their troughs; each contraction is of the same amplitude as the succeeding expansion. But there is no necessary connection between the amplitude of an expansion and the amplitude of the succeeding contraction. Correlations between the amplitudes of successive phases would be asymmetric in the same way the [observed] correlations ... are. Expansions would be uncorrelated with succeeding contractions, but contractions would be correlated with succeeding expansions. Up to this point, the peaks in the series would all be at the same level. To complete the analogy, we can suppose the board to be tilted to allow for trend and the underside of the board to be irregular to generate variability in the peaks, which would also introduce something less than perfect correlation between the size of contractions and subsequent expansions.

"In this analogy, the irregular underside of the rigid board corresponds to the upper limit to output set by the available resources and methods of organizing them. Output is viewed as bumping along the ceiling of maximum feasible output except that every now and then it is plucked down by a cyclical contraction. Given institutional rigidities in prices, the contraction takes in considerable measure the form of a decline in output. Since there is no physical limit to the decline short of zero output, the size of the decline in output can vary widely. When subsequent recovery sets in, it tends to return output to the ceiling; it cannot go beyond, so there is an upper limit to output and the amplitude of the expansion tends to be correlated with the amplitude of the contraction.

"For series on prices and money values, the situation is different. The very rigidity in prices invoked to explain the decline in output may mean that the declines in prices vary less in size than the declines in output. More important, there is no physical ceiling, so that there is nothing on this level of analysis to prevent the string from being plucked up as well as down. These differences make it plausible that the asymmetric correlation would be much less marked in money-value series

than in output and perhaps entirely absent in price series. This is so for the [observed] correlations.... The same conclusion is suggested also by graphic inspection of a wide variety of physical-volume and price series. A symmetric pattern of downward pluckings can be clearly seen in many of the physical-volume series; such a pattern is much less clear in the price series; and, in some price series, symmetric upward pluckings seem about as numerous.

"The contrast between the physical-volume and dollar-value or price series can be put somewhat differently. The indicated pattern in physical-volume series is readily understandable regardless of the reason for the cyclical fluctuations in the series -- of the source of the pluckings, as it were. A similar pattern in value or price series would have to be explained by some similar pattern or asymmetry in the source of the cyclical fluctuations, some factor that prevents upward plucking from being as important as downward plucking....

"The simplest interpretation of [the correlation as a whole] is that the pattern for business is a reflection of the pattern for money. In terms of our analogy, every now and then the money string is plucked downward. That produces, after some lag, a downward movement in economic activity related in magnitude to the downward movement in money. The money string then rebounds, and that in turn produces, after some lag, an upward movement in economic activity, again related in magnitude to the upward movement in money. Since the downward and subsequent upward movements in money are correlated in amplitude with one another, so are downward and subsequent upward movements in economic activity. Since the upward and subsequent downward movements in money are not correlated in amplitude, neither are the upward and subsequent downward movements in economic activity.... [O]ur historical studies have uncovered a number of episodes that correspond precisely to the notion of downward pluckings of the money string."

Clearly, however, the downward plucks need not be monetary. The OPEC oil crisis is a striking example of a non-monetary downward pluck that has occurred since the preceding paragraphs were written, and undoubtedly there are many others. Indeed, it has become fashionable in the recent business

cycle literature to emphasize technological change as the chief source of disturbances. Such disturbances clearly may play a role, though I believe that the recent literature has exaggerated their importance relative to monetary disturbances.

In terms of the language that has become more common in recent years, the underside of the rigid board, "the ceiling of maximum feasible output," may well be approximated by a purely random walk, with all sorts of disturbances producing perturbations in it, including the recently popular technological disturbances.

Unfortunately, so far as I know, no one has explored whether the asymmetrical correlation pattern holds for other countries or for longer periods for the United States. We now have some twenty-five years of additional data for the U.S. I have calculated a few correlations for this period like those for the earlier period for real and nominal GNP as measures of physical and dollar-value fluctuations. However, these twenty-five years provide only five complete cycles, or five pairs of observations, or three degrees of freedom, which are too few on which to base any confident judgment. (My earlier analysis used 15 pairs or 13 degrees of freedom.) Not surprisingly, none of the correlations was high enough to be statistically significant. However, they did not contradict the asymmetrical correlation pattern.[5]

Direct examination of the basic data provides much stronger evidence connected with the "plucking model." Figure 1 plots the natural logarithm of the level of real GNP from 1961 on. I have superimposed a hypothetical maximum feasible output simply by connecting the (log of the) 1971.1 peak with the (log of the) final observation for 1988.2. The series is consistent with an initial and three later downward major plucks. Most important,

the peaks closely fit the hypothetical maximum, while no similar line could be drawn through the troughs.

This feature of the data is brought out more sharply in Figure 2 which plots year-to-year changes in real GNP. Compared with the average level, the peaks of the series are relatively homogeneous, the troughs extremely variable. I rather arbitrarily plotted the hypothetical maximum year-to-year growth at 6 percent. Again the successive peaks seem pretty much to bump that level, whereas no line could be drawn through the troughs which would have that quality.

The contrast between Figure 2, for real GNP, and Figure 3, for nominal GNP, is striking, illustrating very well the distinction I drew earlier between real and nominal magnitudes. That is illustrated also by Figure 4, for nominal M2. Nonetheless, comparison of Figure 4 with Figure 2 suggests that downward plucks in money generally correspond to downward plucks in real output; and with Figure 3, that both downward and upward plucks in money generally correspond to both downward and upward plucks in nominal income.

All in all, therefore, the evidence for the past quarter-century supports the view that the "plucking model" is a useful way to interpret business fluctuations, though in itself it does not explain the source of the plucks. Further, the asymmetrical correlation pattern has sufficiently important implications for the analysis of business cycles to justify further empirical work on testing its existence for other countries, as well as exploring it further for the U.S. using the additional data that have accumulated in recent decades. The additional U.S. data are not only for the recent past but also for the whole period my earlier analysis covered, and indeed, even for the pre-Civil War period.

NOTES

1. Milton Friedman, "Monetary Studies of the National Bureau," The National Bureau Enters Its 45th Year, 44th Annual Report, 1964, pp. 7-25, reprinted in Milton Friedman, The Optimum Quantity of Money and Other Essays (Chicago: Aldine, 1969), chap. 12, pp. 261-84. The "plucking model" is suggested on p. 274.

2. The subtitle of Section D of Part III of the article (p. 271).

3. Ibid., Table 2, p. 272.

4. "The major qualification that must be attached to our result for this purpose is the definitions of the cycle and of expansion and contraction phases on which it rests. Proponents of the view cited might well argue that what matters is the cumulative effect of several expansions, as we define them, and that the relevant concept of expansion is of a 'major' expansion or a phase of a long cycle."

5. For each series, I calculated correlations for both the total amplitude of the phase and the per quarter amplitude. The correlation coefficients, all based on five pairs of values, for 1960 to 1982, the latest reference turning point designated by the National Bureau as of this writing, are as follows:

	Nominal GNP		Real GNP	
	Total	Per Qtr	Total	Per Qtr
Expansion and Succeeding Contraction	-.04	.57	-.66	.37
Contraction and Succeeding Expansion	-.31	-.43	.45	.11

The results I refer to as "not contradictory" are the contrast between the one negative and one positive correlation for real GNP in the first line in the table, and the two positive coefficients in the second line.

FIGURE 1: NATURAL LOG OF REAL GNP AND HYPOTHETICAL MAXIMUM: QUARTERLY, 1961.1-1988.2

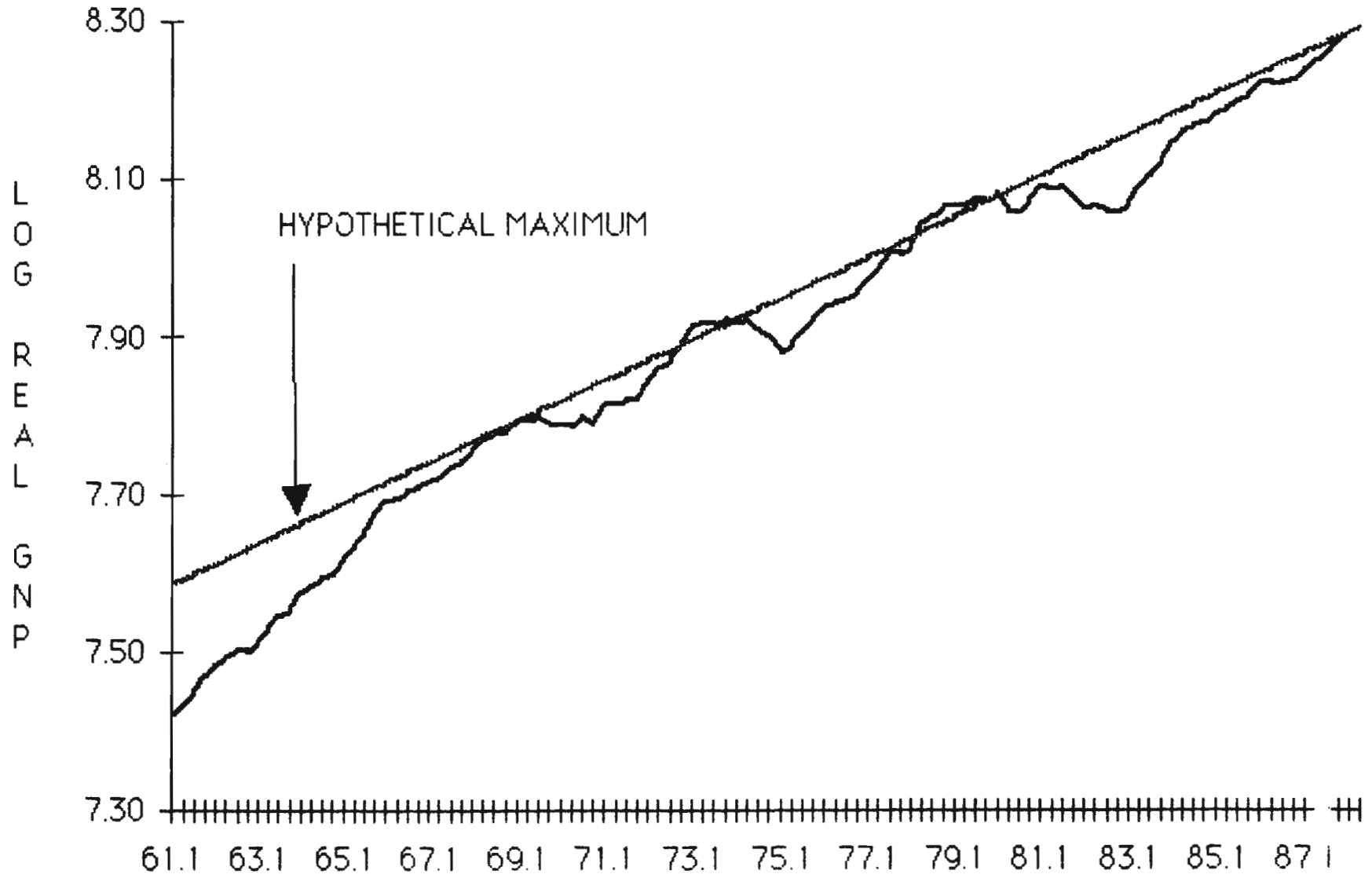

FIGURE 2: ACTUAL AND HYPOTHETICAL MAXIMUM RATE OF CHANGE OF REAL GNP FROM SAME QUARTER YEAR EARLIER: 1961.1-1988.2

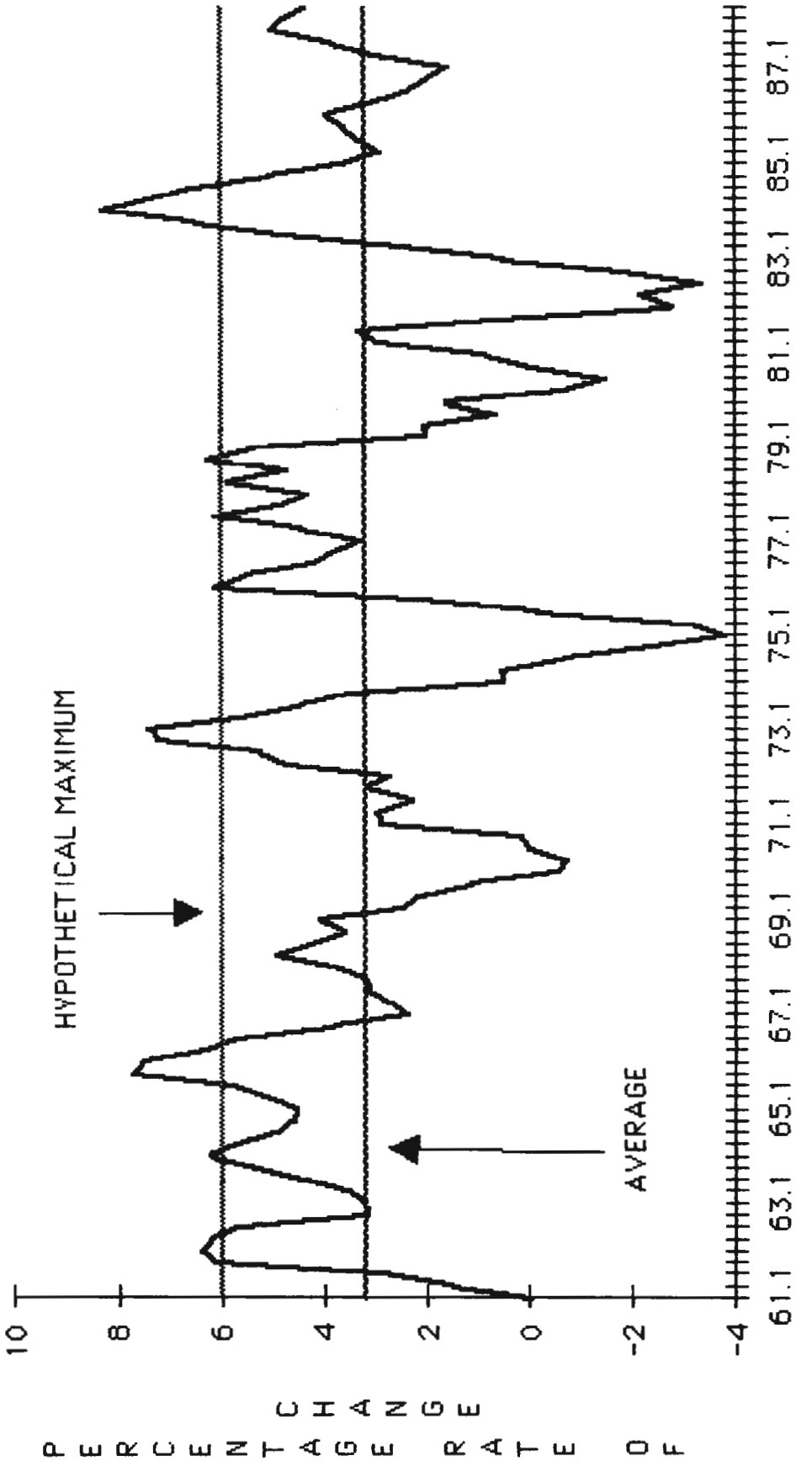

FIGURE 3: ACTUAL AND AVERAGE RATE OF CHANGE OF NOMINAL GNP FROM SAME QUARTER YEAR EARLIER: 1961.1-1988.2

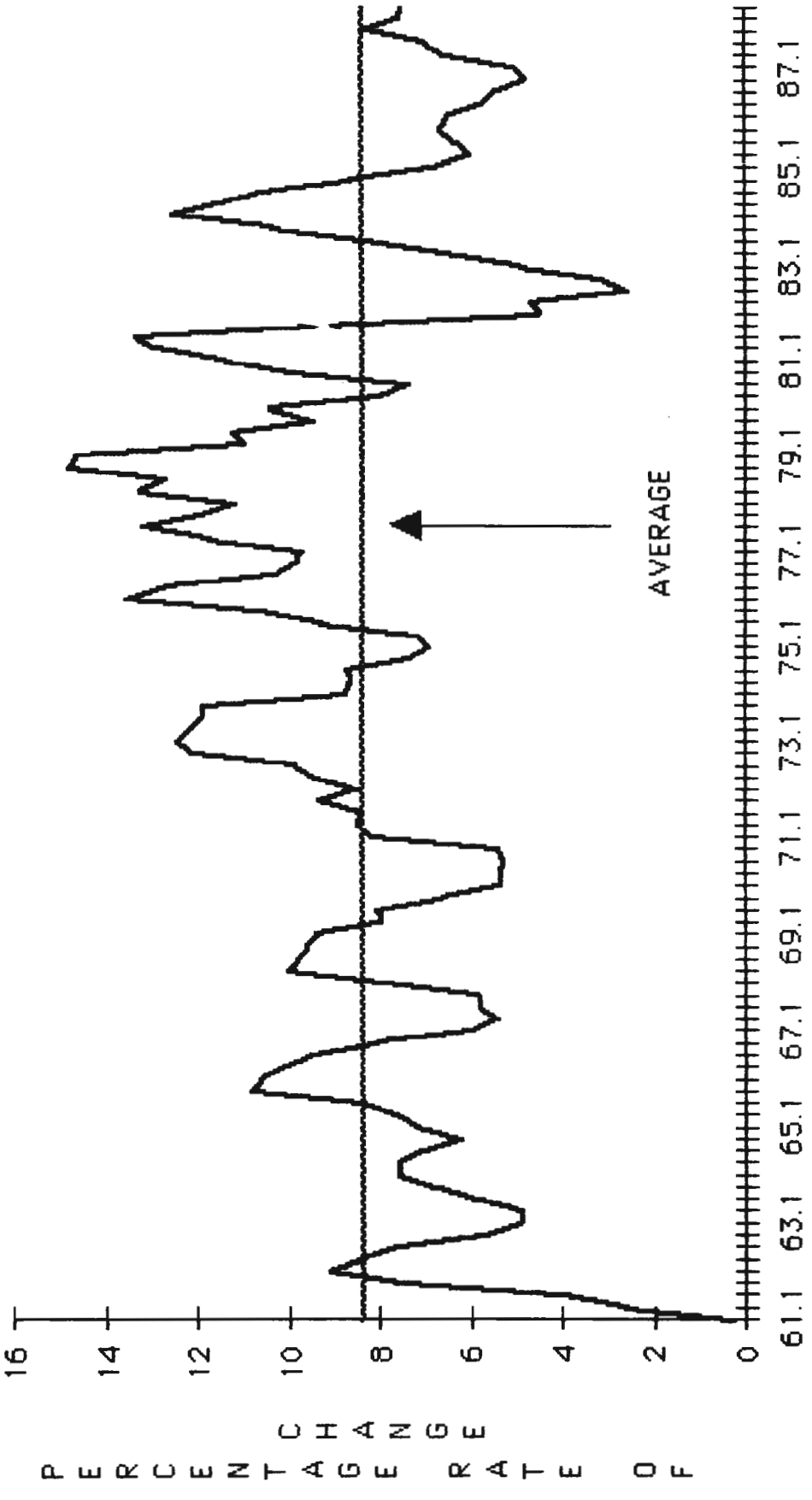

FIGURE 4: ACTUAL AND AVERAGE RATE OF CHANGE OF M2 FROM SAME QUARTER YEAR EARLIER: 1961.1-1988.2