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Sandra J. Peart

University of Richmond, spcart@richmond.edu

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SUNSPOTS AND EXPECTATIONS: W. S. JEVONS'S THEORY OF ECONOMIC FLUCTUATIONS

BY
SANDRA J. PEART

I. INTRODUCTION

W. Stanley Jevons's statistical study of periodicity has received much scrutiny (Aldrich 1987), but less attention has been given to his theoretical position on economic fluctuations, a circumstance which T. W. Hutchison justly finds surprising considering that "Jevons maintained that *aggregate* instability, and the distress it caused, presented profoundly serious problems, and devoted some of his most strenuous economic research to their explanation" (Hutchison 1988, p. 6). This paper takes up the challenge to examine the development of Jevons's thought on economic fluctuations from the early 1860s until his death in 1882.

I shall distinguish in what follows between Jevons's "theory of economic fluctuations," i.e. his explanation for how sunspots cause fluctuations, and his study of periodicity which attempted to prove that periodic solar variation constituted the mechanism causing periodic economic fluctuations.¹ My main concern shall be to highlight the less appreciated explanation for *how* sunspots are said to cause periodic economic fluctuations. In that regard, by 1875, expectations figured prominently in Jevons's account: Harvest-generated fluctuations altered prices and then commercial "moods." Consequently, investors altered investment decisions, thereby multiplying the direct effect of the harvest cycle.

Baldwin-Wallace College. I would like to thank R. D. C. Black, S. Bostaph, J. Chant, C. Heinicke, S. Hollander, D. Laidler and this journal's anonymous referees for helpful comments, as well as participants in the University of Toronto History of Economic Thought Workshop and the History of Economics Society annual 1990 meeting (Lexington, VA). Any remaining errors are my responsibility. Financial support has been provided by the Social Sciences and Humanities Research Council of Canada, the Ontario Government, and the College of William and Mary.

1. I do not attempt to add to the literature on Jevons's contribution to the study of periodicity, applied statistics, or econometrics. See Aldrich 1987, Morgan 1990, pp. 18-26, and Stigler 1982.

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Jevons's thought on fluctuations evolved considerably from 1862 until 1882. Early on, his research focused on seasonal fluctuations and nominal price variations, and touched on the business cycle only peripherally; he accepted apparently without modification John Mills's² characterization of the "credit cycle." Even then, however, Jevons seemed to have been uneasy with Mills's analysis as a full-fledged explanation of fluctuations—*lacking* as it did the initiating cause for "commercial moods" to alter. Eventually, (by 1875), he explicitly acknowledged that the explanation was lacking, and provided what he believed to be the missing piece of the puzzle. What Jevons added to the understanding of economic fluctuations was the argument that it was solar-generated agricultural fluctuations that periodically altered "moods." This mood alteration and the subsequent alterations in investment decisions multiplied the effect of the harvest fluctuation and caused the full-fledged business cycle.

It emerges that, in its final formulation, Jevons's theory of economic fluctuations was neither wholly exogenous, nor wholly endogenous. But there is more endogeneity than Jevons has been given credit for, and the transmission mechanism (from the sunspot to the economic cycle), is more sophisticated than has generally been recognized. Like John Mills, Jevons emphasized the role of expectations or moods in the cycle, moods which he believed to be unstable—"ever ready to break into a ripple." What Jevons added to Mills after 1875 was the argument that moods alter cyclically *as a result of changing price signals*. Jevons appreciated that agents' reactions to price signals might create self-fulfilling expectations concerning the development of an economy through time, an argument now widely accepted by analysts of fluctuations.

Much of the groundwork for Jevons's explanation of economic fluctuations had been prepared by Mills, a prominent member of the Manchester Statistical Society. Jevons's earliest analysis of fluctuations has much in common with the position taken by Mills, who relied in turn upon J. S. Mill's *Principles of Political Economy* [1848].³ This is the subject of section II. Section III analyzes Jevons's sunspot papers, written from 1875 until 1882,⁴

2. John Mills (1821-1896), presented "The Bank Charter Act and the Late Panic" to the National Association for the Promotion of Social Science at Manchester in 1866, and succeeded Jevons as President of the Manchester Statistical Society in 1871. Jevons corresponded frequently with Mills, used Mills's diagrams in his 1876 lectures, and referred students to Mills's 1867 article, "On Credit Cycles, and the Origin of Commercial Panics."

3. Mills refers to J. S. Mill's *Principles* and his *Logic* in "On Credit Cycles." In addition, there is one letter from Mill to Mills which discusses monetary policy; see note 30 below.

4. These include "The Solar Period and the Price of Corn" (1875), "The Periodicity of Commercial Crises and Its Physical Explanation" (1878a), "Commercial Crises and Sun-Spots" (1878b, 1879a), "The Solar Influence on Commerce" (1879b), and "The Solar Commercial Cycle" (1882). The papers are referred to by the volume in which they are published (Jevons 1884, or Black 1972-81, 7). All emphases are in the original text.

in which Jevons departed from Mills by declaring the need for an explanation of alterations in moods, and positing sunspots as that explanation. Jevons's position concerning monetary policy in the context of economic fluctuations is the subject of section IV. In section V some criticisms that have been levied against Jevons's theory of fluctuations are discussed. Here I demonstrate also that a key contributor to later cycle theory, A. C. Pigou, adhered to a similar explanation of the cycle.

II. EARLY ANALYSES: J. S. MILL, JOHN MILLS, AND W. S. JEVONS

In his *Principles*, J. S. Mill argued that crisis periods characterized by excess commodity supply and capacity (compared to "normal" or quiescent levels), were driven by altering expectations. Here we find a description of "Some accident which excites expectations of rising prices, such as the opening of a new foreign market, or simultaneous indications of a short supply of several great articles of commerce," which "sets speculations at work in several leading departments at once" (Mill 1962-, 3, p. 542).

While credit extension and contraction are characteristic of the cycle, they are not, Mill argued, the cause of fluctuations; the crisis of 1847 is explained, for example, in terms of increased "foreign payments," caused by a high cotton price and "an unprecedented importation of food," which along with railway speculation, created some contraction in the loan market (*ibid.*, p. 543). Mistaken speculation is said to have occurred during periods of "over-trading;" Mill stressed also that capital is sunk in railways and "other works of uncertain profit" (*ibid.*, p. 741). Further, the "willingness to lend" is said to vary throughout the cycle, being "greater than usual at the commencement of a period of speculation, and much less than usual during the revulsion of credit" — falling to a minimum during the "panic" or trough (*ibid.*, pp. 650-51). The rate of interest, correspondingly, varied cyclically.⁵

For Mill the cycle has roots in the real sectors of the economy, and features of the cycle include price, credit, output, and employment fluctuations. He stressed the role of speculation and altering investors' expectations in the cycle, but left the explanation for these alterations largely unspecified. There is little appreciation in *The Principles* of ongoing fluctuations occurring with a decennial periodicity. By contrast, John Mills

5. Mill linked this cyclical variation to economic growth. For it is when the profit rate falls secularly that risky projects are taken on, and speculation begins. See Link 1968, p. 167. On the role of "professional traders" and "rash speculators" in the speculative phase of the cycle, see Forget 1990.

appreciated this regularity, or “striking uniformity in the periods of their occurrence,” i.e. ten years, and this very uniformity convinced him that the decennial cycle must be explained by a single cause (Mills 1867, pp. 13-14).⁶ Mills characterized the crisis as the “destruction, in the mind, of a bundle of beliefs” regarding credit that in turn caused a drain on capital: “The panic period is therefore marked by great scarcity of mobile capital; because, though not less in quantity than before, it is drafted off into a thousand unusual channels to perform the functions commonly exercised by Credit” (ibid., p. 19).

Mills specified that different commercial moods characterized the phases of the cycle, moods which determined the amount of loanable funds and investment activity forthcoming. The “post-Panic” stage featured unused capital, dormant enterprises, and low profits and prices.⁷ During the “revival period,” the number of new companies increases, and existing companies expand. Credit in these two phases draws upon previously unengaged capital (ibid., pp. 21-25). During the speculative phase, credit grows “out of proportion” to capital reserves, prices rise, “unproductive investment” and “excessive commitments” occur.⁸

Mills’s characterization of the cycle, as well as his focus on the importance of commercial moods, were accepted by Jevons throughout his career.⁹ In Jevons’s early writings that touch on the issue of economic fluctuations, however, several differences emerge between Mills and Jevons. First, Jevons was more struck than Mills by *harvest* fluctuations; in 1862 he remarked that “Every branch of industry and commerce must be affected more or less by the revolution of the seasons” (Jevons 1884, p. 2). And secondly, even at this early date Jevons recognized the fact that he later stressed, that a complete theory of economic fluctuations required an explanation for fluctuations in investors’ moods.

Jevons’s earliest thinking concerning fluctuations is reflected in the

6. In fact, the decennial nature of cycles had been documented in 1857 by the founder of the Manchester Statistical Society, William Langton. Mills refers to Langton’s 1857 paper (Mills 1867, pp. 12-13). For letters from Langton to Jevons, see Black 1972-81, 4, pp. 209-11, 214-15, and 220.

7. Mills cited J. S. Mill’s *Principles* in support of his argument that the expansionary period was characterized by rising prices and profits, while the contraction was characterized by falling prices and profits (ibid., p. 21).

8. Mills maintained, further, that the speculative phase was partially checked by convertibility, although (like J. S. Mill) he admitted that suspension of convertibility had on several occasions mitigated the worst features of the panic (Mills 1967, pp. 36-37). See below.

9. Mills, however, also maintained that speculation plays a part in *creating* cyclical pressure: speculation is said to place goods on the market faster than they can be absorbed, and prices begin to fall. Eventually loanable capital and “stable forms of credit” (long-term sunk capital such as railways), are strained and the collapse occurs (Mills 1867, pp. 27-28).

notes accompanying his 1862 statistical diagram ("A Diagram showing the Price of the English Funds, the Price of Wheat, the Number of Bankruptcies, and the Rate of Discount"),¹⁰ *A Serious Fall in the Value of Gold Ascertained* [1863], and an 1865 letter to J.E. Cairnes.¹¹ Perhaps because the cycle was not his main concern in these studies, his reasoning is not always clear; most important, he failed to specify the causes of "overinvestment." Jevons referred to corn as "capital," and maintained that abundant harvests were linked to high real accumulation rates; but he did not adequately explain this link. The implication of the earliest remarks seems to be that bumper crops assure plentiful availability of the major wages good and thus money funds for accumulation (although the presumed process is by no means always spelled out in detail).¹²

In the notes accompanying his 1862 diagram Jevons maintained (without elaboration) that wheat, "being the principal article of food," constituted "the most important part of the capital of the country" (Jevons 1884, p. xiv). Crop failures "naturally" were "followed by the indications of a scarcity of capital," a rise in the rate of interest. Thus harvest fluctuations caused variations not only in corn prices but also in the rate of interest, and capital "undertakings":

A low price of corn, low rate of interest, with few bankruptcies, and a high price of the funds, lead to the employment of capital in vast undertakings at home and abroad. Capital gradually becomes less abundant compared with the demand, and in the revolution of the seasons, the scarcity is suddenly increased by a failure of the harvest, and a rise in the price of corn. The rapid ascent of the rate of interest is necessarily followed by a sudden flood of bankruptcy,

10. Jevons originally intended this to be part of an extensive collection of diagrams in his proposed "Statistical Atlas," the "chief interest" of which consisted "in the light thrown on commercial storms" (to Herbert Jevons, 7 April, 1861; Black 1972-81, 2, p. 427). For a complete description of the intended contents of the Atlas, see Black 1972-81, 2, pp. 425-27, and 461.

11. "On the Study of Periodic Commercial Fluctuations" [1862] touches briefly on the issue of fluctuations. Jevons recommended that the procedures used in meteorological studies be adopted by political economists: "all commercial fluctuations should be investigated according to the same scientific methods with which we are familiar in other complicated sciences, such especially as meteorology and terrestrial magnetism" (Jevons 1884, p. 40).

12. Jevons maintained that low corn prices led to high accumulation rates. He did not always, however, explain this link, which might reflect two possibilities: i) a low corn price generates high surplus (taking the form of profits), available for investment; or alternatively, ii) a low price of corn that leaves money wages roughly unchanged, and releases purchasing power to spend on manufactured wage goods or luxuries. By 1878, Jevons explicitly endorsed the latter; see below.

and a general revulsion of credit, which brings incalculable loss and disappointment upon all classes.¹³

Apparently relying upon the observations made during the course of work on the statistical diagram, Jevons became convinced that harvest alterations were causally related to economic cycles. His argument in *A Serious Fall* was that these harvest fluctuations “hasten or retard” various cyclical forces at play emanating from the *non-agricultural* side: “The bountiful or scarce supplies of food with which Providence favours us in the several seasons strongly contribute to hasten or retard the several periods of abundant capital or investment, and again those of scarcity and revulsion” (*ibid.*, p. 48). He was already convinced that economic fluctuations were the norm, that their initial cause was “multiplied” throughout the cycle, and that the cycle followed natural laws: “The current of human business is ever ready to break into a ripple. A good or bad season marks it with a crest or a trough, and the fluctuation multiplies and continues itself. Yet, according to a known principle, it insensibly tends to fall into place with the fluctuations of nature, which it may obey but cannot rule.”

Jevons conceded that the “remote cause” of ongoing fluctuations—the force generating observed regular cycles—remained unknown (*ibid.*, p. 27); but he asserted that it “seems to lie in the *varying proportion which the capital devoted to permanent and remote investment bears to that which is but temporarily invested soon to reproduce itself*” (*ibid.*, p. 28).¹⁴ He described how “permanent investments in houses, ships, improvements of land, manufactories, mines, railways, foreign loans or undertakings” are “multiplied at certain periods” and consequently temporarily “absorb the means of subsistence of the community.” Successful investment schemes are said to cause rising prices, since the growth of demand for intermediate goods outstrips the growth of supply (“Their production being incapable of any but slow extension, their prices rise”), and rising prices result in “a mania for speculative investment” (*ibid.*, p. 29). A “revulsion” follows, “due no doubt to the previous great permanent investment,” resulting in a “dearth of capital, or loanable money,” an occasion “accelerated by the failure of the harvest, or some event which cuts off a large part of the

13. This position is reiterated in correspondence with Richard H. Hutton, 1 September, 1862 (Black 1972-81, 2, p. 450). Note the implication regarding deviations in aggregate supply and aggregate demand. This matter is taken up below.

14. This striking passage is cited as evidence of an early capital theory of the cycle by Black (1981, p. 20 and 1987, pp. 1011-12), and by Robbins (1972). My assessment agrees with Laidler’s suggestion that the sunspot analysis supplements the capital theory (Laidler 1982, pp. 341-41).

anticipated gains of the country.”¹⁵ The role of agriculture appears as a disturbance, which multiplies already existing cyclical forces at play. “Panic” and “the collapse of credit” result (*ibid.*, p. 31).

In correspondence early in 1865 Jevons reiterated his view that there is a “tendency to a periodic recurrence of fixed investment” which plays a key role in economic fluctuations. Again an agricultural shock is said to play a reinforcing role should it coincide with prolonged activity of trade and *fixed investment*, or a dampening role, should “natural events” reverse the cycle:

I must confess my expectation judging from the present prolonged activity of trade & *fixed investment* that a collapse will occur of serious magnitude not far from ten years after 1857...a fall in the price of cotton if it should coincide by chance with a rise in the price of corn which may be anticipated, & renewed & intensified pressure in the money market must occasion a reverse. But, though there is I believe *some tendency to a periodic recurrence of excessive fixed investment* & consequent scarcity of capital, all matters of trade are of course constantly liable to disturbance & reversal by political or natural events (Jevons to J. E. Cairnes, 5th January, Black 1972-81, 3, pp. 64-65).

Already, therefore, Jevons was convinced that during a cyclical expansion some apparently quantitatively strategic industries increase “fixed investment” and produce more than their “normal” levels of output, and that an expansion of credit occurs. He did not specify here why the “reverse” occurs.¹⁶

It was another 10 years before Jevons returned to fluctuations.¹⁷ In 1875-76, he delivered a series of lectures at Owens College, and three of these

15. See Laidler for a discussion of the role of credit institutions in prolonging the speculative upswing and generating the turning point (1982, pp. 341-43). He remarks that after 1866 Jevons searched for a reason for the credit contraction; in my account Jevons searched for a reason for the altered expectations that led bankers to contract credit. Laidler recognizes, but does not elaborate upon, the “strong psychological element” underlying Jevons’s analysis of cycles (*ibid.*, p. 343).

16. Presumably the increase in corn prices was caused by a harvest shock, combined with some speculation based upon expectations of the shock (that is, “which may be anticipated”). Jevons may also have had in mind the transfer of resources from agriculture to “fixed investment” during the upturn of the cycle causing increased corn prices.

17. Two papers, “The Variation of Prices, and the Value of the Currency since 1782” [1865] and “The Depreciation of Gold” [1869], followed up on the research in *A Serious Fall*, while a third, “On the Frequent Autumnal Pressure in the Money Market and the Action of the Bank of England” [1866], examined *seasonal* fluctuations in currency, and monetary policy. I return to the latter in section IV.

focused on economic fluctuations, reiterating in the main the position of John Mills. In the second, "Commercial Fluctuations Since 1836," Jevons's perspective altered slightly compared to that above; he now argued that the effect of low corn prices is an increase in "floating capital" — a remark which suggests that corn is not itself capital. While he still maintained that variations in corn crops were related to accumulation rates, his main argument was that low corn prices (reflecting bumper crops in the face of low demand elasticity), ensure increased surplus income to spend on manufactures. The justification for this reasoning is formally outlined in the *Theory of Political Economy* [1871], where Jevons cited Smith's reasoning that satiety occurs faster with food than with luxuries (Jevons 1871, p. 149, also see pp. 151, 157, Black 1972-81, 5, p. 45). In this Lecture, however, Jevons never explicitly addressed how harvest-generated expenditure changes were related to alterations in investment. Bumper crop years are said to cause low corn prices that create a (monetary) surplus which in turn provides a source for accumulation, and "manufactures increase rapidly." Because of a low elasticity of demand for corn, consumers then spend freely in other directions (Black 1972-81, 6, p. 121). Speculative elements played a key role in the cycle; in the years of 1844-46 "took place the extraordinary railway mania, when everybody who had money put it into railway shares, and the amt. of companies started and the engagements made are extraordinary" (ibid., p. 123). Following crop failures in 1846, "there was a great speculation in the corn trade." Good harvests in 1847 led to a series of great failures in the corn trade (ibid., p. 123).¹⁸

In the third Lecture on fluctuations, "Bank of England and Money Market Generally," Jevons summarized the features of the trade cycle, which, following Mills, was said to be characterized by pro-cyclical variations in prices, railway expenditures, workers' savings, bullion, banking reserves, note circulation, coin issues, and bills created, and by counter-cyclical variations in pauperism, bankruptcy and the rate of discount (ibid., pp. 130-31).¹⁹ Thus fluctuations occurred in prices and credit, as well as output and employment.

18. "These are not matters of currency. They involve the whole industry of the country. If we investigated the matter fully we should find a very considerable fraction of the world's population had been during this interval taken away from their ordinary pursuits and devoted to railway making." Railway, timber and brick speculation was "brought to a head" by the "price of corn" (ibid., p. 123). Speculation was emphasized also in the first Lecture (ibid., p. 115 f).

19. Jevons presented diagrams of these variations to the class, based upon John Mills's 1867 paper, to which he suggested students refer (ibid., p. 132). This constitutes Jevons's most careful description of cycles. He was criticized by his contemporaries for his lack of attention to the features of fluctuations (see Black 1972-81, 4, p. 300).

III. THE DEPARTURE FROM J. S. MILL AND JOHN MILLS

While John Mills had emphasized the cyclical nature of moods, he left the explanation for altering moods unspecified. Sometime around 1875, this explanation began to preoccupy and trouble Jevons, who, while fully accepting Mills's characterization of the cycle, eventually went beyond Mills in suggesting, first, that mood alterations required explanation, and secondly that harvest fluctuations were the initiating cause of ongoing fluctuations in the commercial mood. It is in "The Solar Period and the Price of Corn" [1875] that for the first time we encounter sunspots. In the series of papers written between 1875 and 1882 Jevons outlined more fully a theory of economic fluctuations which continued to rely upon the notion of a corn-generated surplus. Here he explicitly attributed the cycle to a common initiating cause (allowance being made always for disturbing causes which alter the course of the cycle)—namely, fluctuations in the corn harvest due to weather variations. He moved to a fuller treatment of the repercussions of harvest alterations—arguing that merchants, bankers and investors base their credit and investment decisions on observed data concerning the harvest. The notion of a real investment cycle *with no underlying cyclical cause* disappeared from Jevons's analysis, and the crop cycle no longer impinged upon already existing cyclical investment forces, but instead took precedence in the analysis.

An important feature of the sunspot papers is that Jevons now focused on the cyclical variation in commercial moods, and *sought* an economic explanation for these variations. Understandably, since he was indeed seeking for this explanation, there is a piecemeal quality to these papers. I examine each major sunspot paper briefly first, and then draw together the implications of my investigation.

In "The Solar Period," Jevons concurred with John Mills's argument that "public moods" were "the principal part" of cyclical fluctuations, but suggested that alterations in moods were caused by "outward" or "external events" which "excite hopefulness at any one time or disappointment and despondency at another." Further, he argued, "it seems...very probable that these moods of the commercial mind, while constituting the principal part of the phenomena, may be controlled by outward events, especially the conditions of the harvests" (Jevons 1884, pp. 203-204). It is by way of harvest cycles, caused by solar activity, that price signals are created that produce "variations of despondency, hopefulness, excitement, disappointment and panic":

Assuming that variations of commercial credit and enterprise are essentially mental in their nature, must there not be external events to excite hopefulness at one time or disappointment and despondency at another? It may be that the commercial classes of the

English nation, as at present constituted, form a body, suited by mental and other conditions, to go through a complete oscillation in a period nearly corresponding to that of the sun-spots. In such conditions a comparatively slight variation of the prices of food, repeated in like manner, at corresponding points of the oscillations, would suffice to produce violent effects.

Jevons thus attempted to demonstrate that "the harvest and the price of grain...depend more or less upon the solar period, and will go through periodic fluctuations in periods of time equal to those of the sun-spots" (ibid., pp. 194-95). Having shown "that there is an average variation in the price of corn to the extent of some 16 or 20 per cent recurring at these intervals," he suggested that these price "variations form the impulses, as I apprehend, which produce the rolling of the commercial ship" (ibid., p. 204).²⁰ But serious difficulties remained. Most important was the fact, recognized by Jevons, that "the same data would give other periods of variation equally well" (to John Mills, 3rd Jan., 1877, Black 1972-81, 4, pp. 188-89). Jevons consequently withdrew the paper from publication. In the summer of 1877, he wrote "Credit Cycles," chapter xiv of the *Primer of Political Economy*, (a work intended for a non-specialist audience), where he remarked upon a decennial tide in business, the cause of which "is not well understood," though he reiterated that "commercial crises are connected with a variation in weather" (Jevons 1877, p. 120).

Jevons continued working on the connection between commercial crises and sunspots, and until late 1878 he relied upon the causal mechanisms sketched above, maintaining that fluctuations were generated by alterations in commercial moods caused by harvest cycles, which created price fluctuations observed and interpreted by investors and speculators. In August, 1878, he presented "The Periodicity of Commercial Crises" to the British Association, where he argued that no accidental cause such as wars, tariff reforms, or foreign competition, "is sufficient to explain so widespread and recurrent a state of trade" since these real causes did not recur periodically (Jevons 1884, p. 206; see also Black 1972-81, 7, p. 91). Instead, only a periodic cause — "some great and widespread meteorological influence recurring at like periods" — could explain the "recurrence" of economic fluctuations (ibid., pp. 206, 207). Here Jevons reiterated Mills's suggestion that cycles were caused by the periodic variations of "mental action," a commercial panic being "the destruction of belief and hope in the

20. Jevons's concern in this work was proving that the variation in agricultural prices occurred with the periodicity of the crop cycle, and his attention was directed towards establishing the correlation; he failed to explain here the relationship between the crop cycle and investment.

minds of merchants and bankers" (ibid., p. 215).²¹ Again he stressed that the regularity of commercial panics suggested that they were provoked by a common external cause, a change in the industrial environment. Again also, it is evident that Jevons was seeking an explanation of observed regular variations in commercial moods:

...I can see no reason why the human mind, in its own spontaneous action, should select a period of just 10.44 years to vary in. Surely we must go beyond the mind to its industrial environment.... When we know that there is a cause, the variation of the solar activity, which is just of the nature to affect the produce of agriculture, and which does vary in the same period, it becomes almost certain that the two series of phenomena, credit cycles and solar variations, are connected as effect and cause (ibid., pp. 215-16).

By way of causality, Jevons stressed, first, that "merchants and bankers are continually influenced in their dealings by accounts of the success of harvests, the comparative abundance or scarcity of goods" (ibid., p. 216), and secondly, that since "by far the largest part of the population have but a small margin of income remaining when their necessary expenditure on food has been provided for...it is now well known to manufacturers that an active demand for their produce is to be expected only when food is cheap" (ibid., p. 217). Alterations in the Indian harvest also played a role, since abundant "harvests in certain parts of the earth" yielded brisk trade with British manufacturers (ibid., p. 219):

It might seem that the Tenterden Church steeple and the Goodwin Sands are not more remotely connected than the cotton-mills of Lancashire, the paddy-fields of India, and the spots on the sun; yet the connection is obvious when we carefully trace it out. The depressed trade of Lancashire at the present time is generally attributed to the slackness of the export trade to India, which is due to the scarcity of food in many parts of that country, this scarcity absorbing the whole earnings of the poorer classes (ibid., pp. 217-18).²²

In late 1878 Jevons reiterated that "the principal fluctuations in European commerce" were caused by fluctuations in trade "with India, China, and probably other parts of the tropical and semi-tropical regions." Moreover, the severity of fluctuations was linked to credit institutions: those nations "which trade most largely to those parts of the world, *and which give long*

21. Even his choice of words is similar to that of Mills; see the passage cited above, p. 246.

22. Jevons suggested as early as 1877 that solar variation "makes bad harvests and deranges many enterprises in different parts of the world" (Jevons 1877, p. 120).

credits to their customers...suffer most from these crises" (Jevons 1884, pp. 232, 233).

In a letter to *The Times* dated 17 January, 1879, Jevons outlined particularly carefully how the weather shock worked its way through the economic system. Here he argued that expectations of economic performance based upon observed trade patterns lagged behind actual economic potential; agents consequently incorrectly forecast profit-maximizing investment rates. A series of good crops in "India, China, and other tropical or semi-tropical countries" was expected to lead to an unusual demand for British manufactures, and induced manufacturers to expand capacity in anticipation of sustained increased demand: "Good trade in Lancashire and Yorkshire leads the manufacturers to push their existing means of production to the utmost and then to begin building new mills and factories" (Black 1972-81, 5, p. 10). But when "a mania of active industry is thus set going in Western Europe," Jevons argued, "the solar radiation is waning," and high crop prices in England, China and India reduce the demand for manufactures, so that the increased capacity which manufacturers have planned for is no longer required: "When our manufacturers are prepared to turn out a greatly increased supply of goods famines in India and China suddenly cut off the demand." A temporary excess capacity is said to result: "Our practical men...just manage to make demand and supply not meet. Their arrangements are made about five years too late; just when they are in the depths of despondency they ought to be actively preparing for the coming favourable change in the Indian trade, and when they are all hopeful and excited the real opportunity has already slipped by" (*ibid.*, p. 11).

On several occasions Jevons specified that the size of the harvest fluctuation was not as important as its periodicity. Thus in 1875 he argued that "a comparatively slight variation in the prices of food repeated in like manner" might create the cycle (above, p. 252). In "The Periodicity of Commercial Crises," he suggested that what merchants and bankers responded to was not the actual size, or variation, of the harvests, but accounts of its success (above, p. 253). The Indian famines are likened in "Commercial Crises and Sun-Spots" to a "match which fires the inflammable spirits of the speculative classes" (Jevons 1884, p. 243). Underlying Jevons's analysis throughout his career, is a firm belief that swings in commercial mood occur when investors react to non-stationary price signals. Jevons insisted in each of the sunspot papers that moods were the stimulating cause of the economic cycle²³ — his point being simply that the mood alterations were linked to harvest cycles via observed changes in

23. As we have seen, the argument that commercial "moods" were inherently unstable was by no means new; in 1863, also, instability was said to be the norm.

agricultural prices and trade patterns. Merchants, bankers and producers are myopic, since they are not able to foresee and plan for the course of the agricultural cycle.

In his unpublished paper, "The Solar Influence on Commerce" [1879], Jevons reiterated that the intensity of the sun's rays affected the growth rates and prices of crops (and then animals), and consequently altered trade patterns. Again the cycle is said to entail complex "transactions of currency, credit & speculation":

Now the solar influence, assuming it to be periodic in amount, will undoubtedly produce variations in industry, which variations will be periodic, but the several effects will follow in a chain at successively greater intervals after the occurrence of the cause. The greater intensity of the sun's rays will alter the condition of the atmosphere; this will affect the growth of crops, the price of vegetable food, subsequently the price of animal food; the currents of trade will then be varied in amount & direction, and the influence, if sufficiently great, will more or less manifest itself in the most complicated transactions of currency, credit & speculation (Black 1972-81, 7, p. 93).

Jevons here insisted, however, that "many of the remote effects of solar variation will be beyond the power of our insight" because of "great disturbing causes, such as wars, social disturbances, changes in currency and other social institutions, mutations of fashion & habit, etc, etc" which might cause fluctuations, and counter or reinforce the effects of weather. In fact, early in 1879 he argued that the American crisis of 1873 was "an exceptional event, due to the breakdown of inflated paper currency prices," and "not one of the decennial series at all" (to *The Times*, 17 January, Black 1972-81, 5, p. 11).

By the end of March 1879, Jevons referred to the "required keystone to my commercial crisis theory," the "wonderful periodicity" of Indian corn prices (to T. E. Jevons, 31 March, Black 1972-81, 5, p. 36). The "missing link required to complete the first outline of the evidence" was expounded in a letter to *The Times* dated 19th April, 1879, where he argued that periodic famines in India, revealed by wheat prices at Delhi between 1763 and 1838, influenced her ability to purchase British manufactured goods (ibid., pp. 45, 46-47).²⁴ While this was now cited as the "stimulating cause" of the cycle, Jevons again insisted that "the extent of the commercial mania

24. "The state of things is not equally bad in all parts of the country; it chiefly affects Lancashire & Yorkshire where industry depends much upon foreign trade" (Black 1972-81, 7, p. 91). This is more in line with the analysis contained in *The Coal Question* [1865] and *A Serious Fall*, where Jevons stressed that Britain was primarily a manufacturing nation.

or crisis” was not directly related to the fall in demand for manufactured goods:

The impulse from abroad is like the match which fires the inflammable spirits of the speculative classes. The history of many bubbles shows that there is no proportion between the stimulating cause and the height of folly to which the inflation of credit and prices may be carried.... I feel sure the explanation [of the change in commercial mood] will be found in the cessation of demand from India and China occasioned by the failure of harvests there, ultimately due to changes of solar activity (*ibid.*, p. 48).

In sum, the downward portion of the cycle was said to involve solar-generated alterations in what Jevons called the industrial environment which, working through increased agricultural prices and altered international spending patterns, impinged upon expectations concerning profitability in British manufacturing. Trading and investment behaviour altered, investment projects being delayed and reduced in size. Recovery, on the other hand, involved buoyant demand as a result of a succession of good harvests which stimulated confident expectations, an expansion of investment, new companies formed, and credit. An inflation of prices resulted from unwarranted credit expansions, and the banking system's loan to reserve ratio fell. The height of this “bubble” did not depend directly upon the depth of the trough, or the empirical magnitude of previous bumper crops, being instead determined by expectations concerning overall economic performance and financial conditions. The crisis, an “explosion of commercial folly followed by the national collapse,” involved also some erroneous expectations, “bad trading and speculation” that produced inflated values which ultimately collapsed (Black 1972-81, 6, p. 117). And shortages of capital remained key ingredients to the crisis (*ibid.*, 5, p. 134).²⁵ From 1875 until 1882, Jevons maintained that sunspot activity caused alterations in moods which led to this bad trading and speculation (see also *ibid.*, p. 171). While he found many causes of altering moods, the only regularly recurrent (i.e. decennial) cause which he found that altered moods was the harvest cycle.²⁶

It is generally accepted that Jevons adhered to “the Say-Mill rigmarole about ‘the impossibility of general gluts’” (Hutchison 1988, p. 5; see also

25. Clearly, however, Jevons gradually changed his emphasis from an earlier focus on capital, to the later focus on “moods,” and the cause of their variation, price fluctuations due to sunspots.

26. In “The Periodicity of Commercial Crises,” Jevons insisted that “The cause [of “so widespread and recurrent a state of trade”] can only be found in some great and widespread meteorological influence recurring at like periods” (Jevons 1884, p. 206).

Peach 1987, p. 1018).²⁷ Jevons's strictures against the over-production theory are well known. In the *Theory of Political Economy*, he suggested that the "doctrine [of over-production] is evidently absurd and self-contradictory" (Jevons 1871, p. 202). How might we reconcile this position with the theory of economic fluctuations outlined above? Jevons allowed in the *Theory* that "supplies must be *suitable* — that is, they must be in proportion to the needs of the population." Over-production is not possible in all branches of industry at once, but it is possible, in some as compared with others (*ibid.*, p. 203). He thus accepted that while secular over-production was logically impossible, some industries could over-produce temporarily. But in fact Jevons proceeded farther. For as we have seen, he insisted that temporary over-production occurred cyclically as a result of investors misreading the state of the market. While he stood by Say's Law as a proposition concerning the secular course of output, then, Jevons clearly acknowledged that over-production, financed by credit, occurred throughout the cycle, and the severity of over-production was firmly linked to credit institutions.

IV. MONETARY POLICY AND FLUCTUATIONS

The scope for monetary policy was remarkably limited in Jevons's analysis, being restricted to the speculative up-swing and crisis periods (Mints 1945, pp. 178f). There is no discussion of active monetary policy in the context of the cyclical downturn.²⁸ Perhaps because his first concern was improving the stability of the banking system, cyclical unemployment did not figure in Jevons's policy analysis. While the harvest variation could not be prevented by policy makers, sound monetary policy might mitigate and shorten the resultant banking crisis. Jevons believed that convertibility was one means to this end, since it prevented unwarranted increases in lending during the speculative upturn.²⁹ He championed the 1844 Bank Act, arguing that it restricted "only the illegitimate expansion of the note currency" ("On the Frequent Autumnal Pressure in the Money Market," 1866, in Jevons 1884, pp. 179-80, also see Black 1972-81, 4, p. 77). Foreign

27. In Black's account it is Jevons's "complete" adherence to the Law of Markets which prevented him from elaborating an over-investment theory of cycles; he never developed "the idea that plans to save and plans to invest might not coincide" (Black 1981, p. 20; 1987, pp. 1011-12).

28. This position was shared by Jevons's contemporaries (see Laidler 1988). In the context of his discussion of trade unions, however, Jevons recommended a broad system of education to correct the "one great defect" of the working classes, their "want of thrift and providence." The result would improve the lot of labourers not only secularly, but also throughout the cycle (Peart 1990b).

29. See Black 1972-81, 4, p. 77.

drains on bullion were not to be accommodated by the banking system (Jevons 1875, pp. 340-42). But internal drains were divided into purely temporary fluctuations, which should be accommodated, and irregular alterations, which should not be accommodated since these were not attributable to currency regulations.

In the 1866 study Jevons concluded that a "concurrence of causes" created autumnal drains on currency (Jevons 1884, pp. 170-72). Expediency thus required that the Bank increase its reserves before October and then allow them to fall below the normal or average level, "knowing that the excess of currency issued will in the natural course of events return" (*ibid.*, p. 179). While "normal," "temporary," or "regular" currency drains should be accommodated, unusual demands for money were to be handled by market forces, bankers raising the "terms of advance," and "restricting their amount." Jevons believed that the 1844 and the 1845 Bank Acts allowed this policy.

Remarkably (since his research on the cycle proved otherwise), Jevons never allowed in this context that decennial economic fluctuations might be considered "regular," or "normal" variations, and thus require accommodation. Instead, he included "deficient harvests" in "abnormal changes" in 1866, and in 1878 correspondence with Mills he reiterated that "a judicious raising of the bank rate in good time would do much to mitigate [cyclical] panics" (Black 1972-81, 4, pp. 231-32). The suspension of the 1844 Bank Act during the severe credit shortage of 1847 is said on one occasion to have restored "confidence"; yet Jevons refrained from lending this measure unqualified support, and never went so far as to suggest a general rule for suspension (see Black 1972-81, 6, pp. 129, 123). In this regard, both J. S. Mill and John Mills went beyond Jevons by allowing that an "authorized departure from the letter of the Act in times of crisis" would do much to mitigate the panic, and in reality constituted "a more effectual carrying out of [the Bank Act] spirit."³⁰

On balance, Jevons argued that sudden collapses in money markets, were caused by "bad banking" as opposed to "bad currency [laws]," and to prevent these collapses he recommended that bankers follow responsible lending policies, raising interest rates and restricting loans during speculative periods, and that cash reserves held by banks be increased throughout the year, but especially before predicted drains (Jevons 1875, 322-24; see also letter to J. Mills, 23 November, 1866, Black 1972-81, 3, p. 140).

30. Mills (1866). Mill supported this position in a Nov. 16th, 1866 letter to Mills (Mill 1962-, 16, p. 1214). See also *ibid.*, 3, pp. 671 f, and Mills 1867, pp. 36-37.

V. CRITICAL EVALUATIONS OF THE THEORY

Jevons's theory of fluctuations relies upon an ongoing series of exogenous shocks to the economic system; consequently commentators such as Joseph A. Schumpeter have been critical of the analysis (Schumpeter 1954, p. 1133). Indeed, the sunspot papers have encountered widespread criticism from Jevons's contemporaries as well as historians of economic ideas. An 1879 study purported to show that sunspots explain the periodicity of wins in boat races (Black 1972-81, 5, p. 51). Mark Blaug's textbook summarizes Jevons's treatment of fluctuations in three sentences, concluding that he "failed to show theoretically how this [sunspot] or any other exogenous disturbance is capable of generating endogenous fluctuations" (Blaug 1985, p. 316). Barbara MacLennan has complained that the studies of fluctuations neglect theory, the theoretical analysis of the cycle being "very slight as compared to the detailed treatment of the data" (MacLennan 1972, p. 64). While praising his ability to manipulate data and extract information from them, Stephen Stigler contends that Jevons's work on the business cycle is an "anomaly" (Stigler 1982, p. 362; and see pp. 364, 354), and a recent assessment concludes that "for some the sunspot analysis has attained the status of joke, whereas for others it is a cautionary parable concerning the pitfalls of inductive argument" (Mirowski 1988, p. 46; see also Morgan 1990, p. 23).

However, once we appreciate the fact that the cycle was, for Jevons, largely a matter of alterations in commercial moods which in turn play upon investment decisions, his analysis of economic fluctuations emerges as more sophisticated than has generally been allowed. It is the case that the sunspot papers are devoted mainly to establishing the correlation between sunspots and fluctuations, relatively little attention being paid to outlining how the harvest alteration impinges upon the wider economy. A telling criticism of Jevons's research in this regard is that he became carried away in the attempt to establish the correlation, and was willing to include weakly-established crisis observations that supported the correlation, and to exclude weakly-established observations which did not. As Mitchell (1928, p. 384) remarked, Jevons was a candid researcher, and yet he was able to fit data to an 11.11 year cycle as well as a 10.46 year cycle. While it is unfortunate that Jevons's attention focused on establishing the correlation, as opposed to outlining the theoretical analysis in fuller detail, his procedure is understandable. For he believed that much of the work that had been accomplished on economic fluctuations before 1875 — the characterisation of cyclical behaviour as well as the emphasis on expectations by J.S. Mill and then John Mills — was sound. Jevons's explanation for the alteration in spending patterns following harvest fluctuations relied upon well established economic principles attributed to Smith (above, p.

250). This left *only* the need to find an explanation for periodic alterations in moods, and then to gather evidence in support of this explanation.³¹ That Jevons felt obliged to seek out the stimulus for altering expectations is evident throughout the sunspot papers. His argument is that merely to posit unexplained alterations in expectations constituted an inadequate explanation of regular cyclical activity. To posit unexplained alterations in investment and credit markets (as Jevons had in 1863 and 1865) would likewise have been to beg the question. Thus while agreeing that "periodic collapses are really mental in their nature," Jevons insisted that the cause of these mental "oscillations" be found.

In "The Solar Period" Jevons encountered some difficulty fitting observed price variations to variations in sunspot activity, and posited unexplained changes in moods (Jevons 1884, p. 226; and see pp. 204-205). Yet this was unacceptable, amounting to the admission that moods vary for no apparent economic reason. Jevons declined to publish the paper or future research on this topic until he could provide empirical evidence to support his economic explanation for why these moods, and through them investment behaviour, altered cyclically. But he stood by the harvest explanation; while he allowed that expectations are affected by a myriad of economic causes that might dampen or amplify the effects of harvest fluctuations, Jevons found no reason for these to generate the "remarkable appearance of regularity and periodicity" that he observed to "characterise these events" (*ibid.*, p. 222). Jevons insisted that what was needed was a temporary shock that impinged upon the economy periodically:

intemperance and various other moral causes...may have powerful influence on our prosperity but they afford no special explanation of a temporary wave of calamity. We can hardly doubt that it will be temporary because on looking back thirty of forty years we find that crises of very similar character, followed by a temporary interruption of industry have repeatedly recurred (Black 1972-81, 7, p. 91).

Thus one might speculate, following Black, that Jevons was drawn to *sunspots* as the ultimate cause of mood alterations because he came to economics via a scientific training and interest in meteorology (Black 1981,

31. This interpretation sheds light on the claim that "evidence of the explanatory links in the causal chain between sunspots and economic cycles" was "not an important consideration" for Jevons (Morgan 1990, p. 25). The causal analysis relied on well established economic principles that, Jevons believed, required little elaboration.

p. 21).³² Jevons did embark on the sunspot research very soon after the publication of his *Principles of Science* [1874] which contains an analysis of the periodicity of sunspot data, as well as the claim, based upon the scientific reputation of the astronomer, Sir John Herschel, that periodic causes generate periodic effects.³³

While the sunspot cycle was the explanation offered for the decennial trade cycle – an explanation which emerged from an observed correlation of the length of these two cycles – the correlation was explained with the aid of economic theory. Specifically, the sunspot cycle was linked to trade cycles via alterations in expectations which followed changes in observed prices and spending patterns. Jevons insisted that an observed correlation which is accompanied by explanation is much more compelling than the correlation alone. Thus he wrote in 1879 that

this *prima facie* probability [of a causal relationship] is immensely strengthened if we can give other reasons for believing that a cause of the nature supposed, apart from the question of its period, is likely to have effects of the kind we are attributing to it. In short, mere equality of period is a perfectly valid ground of inductive reasoning; but our results gain much in probability if we can analyse and explain the precise relation of cause and effect.... [I]t lends much strength to such an inference if we can show that a variation of the nature in question, namely sunspot variation, would be likely to produce variations in commerce which might constitute a commercial crisis (Black 1972-81, 7, p. 94).

It is not the case, then, that Jevons's analysis of fluctuations is devoid of economic theory. Most importantly, denigrations of the sunspot explanation of the cycle neglect an important feature of Jevons's position, namely that it encompasses more than an analysis of how agricultural output alters with direct consequences for aggregate demand. If this had been Jevons's main concern, he would have concentrated on the measurement of crop variations and could never have argued that the depth of the cycle is not

32. Jevons's papers on fluctuations are replete with meteorological analogies; he refers to the "tide" of human affairs, as well as the "currents" of trade. See above and note 11. See also Epstein (1987, p. 15), who argues that Jevons's analysis of fluctuations was "heavily influenced by the fact that data...were limited largely to meteorological records and agricultural reports."

33. See the discussion of the "Principle of Forced Vibrations," in Jevons 1909, pp. 451-52. Here he refers both to the proposition "that the effect of a periodic cause will be periodic," as well as the "discovery of an eleven-year period in various meteorological phenomena," whose influence, "according to the principle of forced vibrations" "will be detected in all meteorological phenomena." See also "The Solar Influence on Commerce" (Black 1972-81, 7, p. 92).

determined by the extent of the famine. Instead, the thrust of his argument is that it is agricultural fluctuations that impinge upon expectations, which in turn affects investment and speculative behaviour, and multiplies the effect of the initial shock. This is Jevons's major contribution to the understanding of economic fluctuations. His position that cyclical variations in weather conditions were responsible for alterations in commercial moods, via economic signals observed and interpreted by agents, as well as by direct changes in demand, added a dimension to Mills's psychological theory of economic cycles. In the light of modern studies of the cycle suggesting that fluctuations "seem to involve agents reacting to imperfect signals in a way which, after the fact, appears inappropriate,"³⁴ Jevons was in this respect well ahead of his time.

Further, Jevons's argument that abnormal or unusual events—such as wars—did not cause economic fluctuations which were characterized by regular features and recurred at regular intervals was an important application of the "common cause" argument, and one which business cycle investigators have recently invoked.³⁵ Thus the very notion that business cycles are alike is said to be "attractive and challenging, for it suggests the possibility of a unified explanation of business cycles, grounded in the *general* laws governing market economies, rather than in political or institutional characteristics specific to particular countries or periods" (Lucas 1983, p. 218).

In *Unemployment*, A.C. Pigou argued that³⁶

variations in real income come about naturally enough as the result of variations in the bounty of nature, and variations in business confidence come about as the result of variations in the mood of business men. At first sight it might seem that these two sets of variations are independent and are likely to start separate trains of causation. As a matter of fact, however, they are often associated together, the changes in mood being themselves caused by changes in the bounty of nature (Pigou 1913, p. 114).

34. Lucas (1983, p. 286), argues that this has been "a commonplace in the verbal tradition of business cycle theory at least since Mitchell." I do not intend to suggest, however, that Jevons relied upon the argument now frequently used by business cycle analysts that agents cannot distinguish between nominal and real changes.

35. Aldrich (1987) argues that Jevons's use of the common cause argument here constituted an early application of probability theory in social science.

36. The evidence below reveals that Jevons's emphasis on the role of expectations in creating fluctuations via changes in investment and credit decisions, as well as his argument that cyclical weather patterns constituted a plausible explanation for mood alterations, were followed by Pigou. I am grateful to D. Laidler for having pointed out this similarity between Jevons and Pigou.

Like Jevons, Pigou insisted that the association between alterations in harvests and moods is not only "consider[ed] to be proved fact" but "is one that we are also led to expect by general reasoning" (ibid., p. 115). "For, after all, it is a tolerably familiar experience that the judgments which people form are biased by their feelings. When they are prosperous, they are apt to look on the sunnier side of doubt. Consequently, good harvests, so far as they directly and indirectly improve the fortunes of the business world, are likely to act as a spur to optimism. Deduction and induction thus, in a measure, corroborate one another, and we may reasonably conclude that, in a considerable number of cases, booms in business confidence have their origin in good harvests" (ibid., p. 115).

Like Jevons also, Pigou concludes that the alteration in expectations itself affects aggregate output: "the aggregate wage-fund is subject *at the same time* to both the two causes of expansion...namely, increased real income *and* increased willingness to employ income in investment instead of holding it in store" (ibid, p. 115; see also p. 118). In short, Pigou insisted that as long as the case can be made for periodic harvest variation, "Jevons's suggestion that the ultimate reason for cyclical movements is to be found in sunspots may, perhaps, contain a larger element of truth than critics have been willing to believe" (ibid., p. 116).

VI. CONCLUSION

Paradoxically, given the identification of sunspots with agriculture, the development of Jevons's thought on trade cycles suggests a growing appreciation of the diminishing importance of corn (or "nature") in the British economy. For while his theory of fluctuations placed much emphasis on the special role of corn, and supported classical speculations—outlined in his own *Theory of Political Economy*—concerning the nature of the demand for necessities, Jevons came to regard Britain as, primarily, a manufacturing nation. By 1878 his analysis of the cycle reflected this belief, for the impetus for the cycle was now said to emerge from altered trade patterns affecting manufacturers generated by cyclical harvest conditions in agricultural nations.

The foregoing characterization of Jevons's theory of fluctuations constitutes a striking reminder that the assumptions of perfect information and foresight, as well as the very strong claims concerning the outcome of unregulated market transactions underlying *The Theory of Political Economy*, were relaxed by Jevons outside that work. We have, first, his lifelong conviction that moods of investors and bankers were unstable, "ever ready to break into a ripple." Jevons devoted much energy to the explanation for why these ripples, or panics, occurred with apparent regularity. Moods, he argued, were determined by and changed with economic variables—

variables used by investors to predict returns to investment. And secondly, fundamental to Jevons's understanding of fluctuations, is the notion of *mistaken* responses by investors and creditors to price fluctuations; these mistaken responses then multiply the direct effect of altered demand for British manufactured goods and cause the full-fledged fluctuation.

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