Why Didn't Economists Predict the Great Depression?

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Abstract

Economists failed to forecast the Great Depression, perhaps largely because they had lacked reason to theorize about business cycles. This paper tries to explain the lack of incentives. Since theory is a public good, the market produces too little of it. One non-market incentive, *ex post* fame, may be proportional to the value of the theory -- and thus induce more theory as its value grows. But fame comes from explaining famous events. A theory may explain a potential disaster so well as to enable policymakers to avert it. Since the event does not occur, its explainer cannot become famous. Theorists who anticipate this paradox will avoid work on the potential event; theorists who work nonetheless on events never to occur will become obscure. Another factor retarding business-cycle theory is scale economies. Learning-by-doing can induce theory by cutting its cost. Scale economies favor the first theories to be well-developed. These dealt with markets – not with business cycles – in the decades before the Depression which redirected attention to macroeconomics. (*JEL* classifications: B10, E32)

I. Introduction

The Great Depression bemused economists of the day. "The slump in trade and employment and the business losses which are being incurred," Keynes (1963: 148) said in 1931, "are as bad as the worst which have ever occurred in the modern history of the world."

Economists were caught off-guard. In late October 1929, the Harvard Economic Society had announced that "despite its severity, we believe that the slump in stock prices will prove an intermediate movement and not the precursor of a business depression such as would entail prolonged further liquidation" (Allen 2000: 280-1). One of the finest economists ever to write about money, Irving Fisher, had said on October 17 that New York stock prices were on "what looks like a permanently high plateau" (Allen 2000: 281).

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[1] For related discussions, I thank John Dixon, Nikolai Povetkin, and participants in a KIMEP seminar.
Email ltaylor@kimep.kz. Readers who wish a non-technical version of the paper may request it from me or retrieve it from L:/Leon Taylor/Taylorglyphics/Working papers .

The lack of explanations for the Depression troubled economists as much as did the magnitude of the event. "Most monetary theorists," wrote Lionel Robbins (1931: xii), "seem to have failed utterly to apprehend correctly the nature of the forces operative in America before the coming of depression, thinking apparently that the relative stability of the price level indicated a state of affairs necessarily free from injurious monetary influences."

Some economists blamed shallow theories. "…If it were asked whether understanding of the connection between money and prices has made great progress during these years [of the Great Depression] at any rate until very recently, or whether the generally accepted doctrines on this point have progressed far beyond what was generally known a hundred years ago," wrote Friedrich Hayek (1931: 2), "I should be inclined to answer in the negative." As for employment, "the fundamental theory underlying it has been deemed so simple and obvious that it has received, at the most, a bare mention," wrote Keynes (1991: 4-5) in 1936. One thinks of John Stuart Mill's warning that undebated ideas devolve into meaningless shibboleths.[2] To Keynes (1991: 7), "the only detailed account of the classical theory of employment" was Arthur Cecil Pigou's *Theory of unemployment.*

Six years earlier, Keynes had written the *Treatise on money* out of discontent with the usual monetary explanation of the depression unfolding. "…When we turn to the work of economists, whose proper business is 'the abstract thinking of the world,' it is noticeable how little serious writing on monetary theory there is to be found anywhere, prior to the stirrings of the last few years….Half-baked theory is not of much value in practice, though it may be half-way towards final perfection" (Keynes 1950b: 405-6). Some blame attached to Alfred Marshall, who "in his anxiety to push economic theory on to the point where it regains contact with the real world, was a little disposed sometimes to camouflage the essentially static nature of his equilibrium theory..." (Keynes 1950b: 406-7). Now the world required analysis of an economy that had fallen out of static equilibrium.

Mainstream economists had predicted that the falling prices of the Depression would revive demand for goods, re-creating jobs. But the price level in the United States fell by a third over four years without triggering strong recovery. In his journalism, Keynes urged the government to spend its way out of depression. When *The general theory of employment, interest and money* came out in 1936, graduate students of economics snapped up copies hot off the printing press. Its "success…was merely symptomatic of,

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[2] "If…the mischievous operation of the absence of free discussion, when the received opinions are true, were confined to leaving men ignorant of the grounds of those opinions, it might be thought that this, if an intellectual, is no moral evil, and does not affect the worth of the opinions, regarded in their influence on the character. The fact, however, is that not only the grounds of the opinion are forgotten in the absence of discussion, but too often the meaning of the opinion itself. The words which convey it cease to suggest ideas, or suggest only a small portion of those they were originally employed to communicate. Instead of a vivid conception and a living belief, there remain only a few phrases retained by rote; or, if any part, the shell and husk only of the meaning is retained, the finer essence being lost….Then are seen the cases, so frequent in this age of the world as almost to form the majority, in which the creed remains as it were outside the mind, incrusting and petrifying it against all other influences addressed to the higher parts of our nature; manifesting its power by not suffering any fresh and living conviction to get in, but itself doing nothing for the mind or heart, except standing sentinel over them to keep them vacant" (Mill 1973: 513-5)

or perhaps helped decisively, the displacement of what is called microeconomics with macroeconomics," Hayek (1995: 60) wrote in 1963.[3]

The question posed in 2008, about the financial crash, would also have resonated in 1933: Why hadn't economists anticipated the most important downturn of the century? I will argue that economists shied away from producing macroeconomic theory because they did not expect to capture enough operating benefits to cover fixed costs. Also, theory is subject to scale economies: The more ideas available, the easier to create another, by building upon an existing idea. Early breakthroughs in microeconomics had attracted theorists away from macro.

Spillovers and scale economies affect all theory. The failure to predict the Great Depression was conspicuous because the event was, not because it posed unusually knotty problems to theorists. In part, the problem was one of a self-unfulfilling prophecy: Had economists anticipated the Depression, chances would have increased for averting it.

This paper attempts theory and case studies. A simple probabilistic model suggests that the number of theorists, and the amount of effort by each, may especially determine the chances of creating a successful theory (Section II). A brief history of macroeconomic thought (Section III) also indicates the importance of these two factors. Both may be inhibited by the nature of theory as a public good. A nonmarket incentive for theorizing – the prospect of fame – may increase the supply of theory for likely events but decrease it for unlikely events (Section IV). Scale economies in theorizing may also reallocate effort away from models of unlikely events, partly by exposing the theory-producing industry to market power (Section V). Uncertainty over whether theory should precede or follow fact-gathering may also curtail theorizing (Section VI). A case study of the theory of money supply suggests that the lack of theory for unlikely events may induce cumulative and damaging effects in the real world over time (Section VII).

II. A toy model

A mathematical abstract of the main question – why we lacked business-cycle theory – may suggest factors to analyze. This section models the probability that economists develop no such theory. The model is simple since, at this point, only general features of the problem interest us.

X_i measures the unsuccessful effort by economist i to develop a macroeconomic theory. We need not specify the dimension of X_i. It may refer to the number of journal rejections or of weeks spent on research. X_i is a random variable independent of X_j for all $j \neq i$.

All n economists have the same background and thus the same probability p that any unit of X_i will succeed in producing a viable theory. The economists work independently of one another.

The probability that any unit of effort succeeds is independent of other units. Consider economist i. If her first unit of effort has a 1% chance of success, then so does her second unit. Completing her first unit does not enhance the chances of success of her next unit.

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[3] Hayek (1995: 60) continued, "It was a development for which the Marshallian tradition was more disposed than the Austrian or the Lausanne [*e.g.*, Walrasian-Paretian] or the Jevonian or the American tradition."

The probability that $X_i = k$ follows a binomial distribution:

$$p_{X_i}(k) = (1-p)^k.$$

The sum of all failed attempts by economists to develop the given theory is

$$W = \sum_{i=1}^{n} X_i.$$

The probability distribution for W follows directly:

$$p_w(W = nk) = (1-p)^{nk}.$$

The term nk measures the total unsuccessful effort to develop the theory. If 10 economists each devote two weeks to research, then the total failed effort is 20 weeks.

The probability of at least one success among the nk efforts is

$$V(p,n,k) = 1-(1-p)^{nk}.$$

Equation 1

This equation has an economic interpretation. The parameter n reflects the degree of actual (not potential) competition among suppliers of theory. The probability p reflects the stock of published macroeconomic theory; a greater stock makes additions to it more likely, by providing theorists with more material. Also, p reflects the extent to which learning-by-doing generates macroeconomic theory. Finally, k reflects the attraction of alternative lines of research such as microeconomic theory. An increase in the opportunity cost of writing business-cycle theory reduces the effort k that the theorist is willing to devote to it.

Equation 1 raises the possibility that changes in n or k, the power terms, will affect the probability of no success more strongly than will p itself. The first derivatives of V bear this suspicion out in most cases (Appendix B). Critical elements in providing macroeconomic theory may include the number of theorists and the amount of work that each would devote to business cycles. The attraction of an alternative endeavor may affect n and k and thus the amount of macro theory published. The stock itself of macro theory may play a secondary role.

The second partials of V show diminishing returns to p, n and k. Perhaps early choices of the three parameters affect V, and consequently the stock of macro theory, more powerfully than do later choices.

In sum, a toy model suggests that the number of business-cycle theorists, and the amount of effort that each is willing to devote to his work, may help explain the lack of theory. The model confirms common sense.

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III. Historical background

The reluctance to innovate in theory is of long standing and may help explain why, by the late 19th century, macroeconomic theory had become the neglected stepchild of economics. A narrative might put this idea in perspective.

III. A. Chronology. Early economists took more interest in economic growth than in the business cycle, perhaps partly because of the growing populations of the day. François Quesnay, writing in 18th-century France, attributed growth of a national economy to agriculture, the only industry that could generate a net product. (This argument may have stemmed from the visibility of the unconsumed surplus of the harvest.[4]) A contemporary French economist, Anne Robert Jacques Turgot, was even more explicit about the economic primacy of land.[5] Adam Smith (1976), who had devoted the brief Book III of *The wealth of nations* to "the different Opulence of Progress in different Nations," regarded real investment as a spur to growth.[6] The focus of early growth theorists on particular inputs might have disposed later work toward microeconomics.

Eighteenth-century economists did provide concepts that would prove key to the theory of business cycles much later. Some of these concepts were templates for reasoning. The use of physical analogies dates back at least to Quesnay's analysis in 1758 of a stable equilibrium, which had drawn upon William Harvey's studies of blood circulation a century before (Schumpeter 1978: 323). (Quesnay had been a surgeon (Monroe 1948: 340).) A few years later, Turgot likened the circulation of money in the economy to that of blood in the body; and the interest earned, to a thermometer.[7] On the other hand, early economists identified some errors in macroeconomic reasoning that would persist into the 20th century. In a 1752 attack on mercantilism, David Hume (1948: 330) identified a fallacy of composition that would become familiar in distinctions between changes in relative prices and those in the price level. He was criticizing the precept that a nation grows wealthier by accumulating gold and silver money. "We

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[4] Quesnay (1948: 341) wrote: "The *productive Expenditures* are employed in agriculture, meadows, pastures, forests, mines, fishing, &c. to perpetuate riches in the form of grain, beverages, wood, cattle, raw materials for the handicrafts, &c.

"The *sterile Expenses* are made upon handicraft products, housing, clothing, interest on money, servants, commercial expenses, foreign commodities, &c." Italicization and capitalization in the passage are in the original text.

The apparent farm surplus might have been illusive. The historic use of agricultural serfs might have concealed the opportunity costs of farm labor. Also, Quesnay may have underestimated the long-run value of manufacturing, since France had few large factories in 1758.

[5] "Land is always the first and sole source of all riches; it is land which, as a result of cultivation, yields all revenue; it is land also which furnished the first fund of advances prior to all cultivation" (Turgot 1948: 353).

[6] Book I argues that in areas with low transport costs, the self-interest of merchants in seeking new customers would cause markets to expand. This would enable workers to specialize -- and thus to produce more, partly because profit-seeking inventors would tailor machines to their skills.

[7] "[The] continual advance and return of capitals…*constitutes what ought to be called the circulation of money*, that useful and fruitful circulation which enlivens all the works of Society, which sustains movement and life in the body politic, and which may well be compared to the circulation of the blood in animal bodies" (Turgot 1948: 365; italics in the original). Also, "the current interest on money loans may…be regarded as a kind of thermometer of the abundance or scarcity of capitals in a nation, and of the extent of the enterprises of all kinds to which it can devote itself" (Turgot 1948: 371).

fancy, because an individual would be much richer, were his stock of money doubled, that the same good effect would follow, were the money of every one increased; not considering, that this would raise as much the price of every commodity, and reduce every man, in time, to the same condition as before."[8]

In addition to criticizing methodology, 18th-century macroeconomists adumbrated dynamic analysis. Quesnay (1948) roughed out the income multiplier that would become a staple of Keynesian models nearly two centuries later.[9] Turgot (1948) saw in 1766 that lengthy production required advances to input owners.[10] But early economists did not pull together these elements into a theory of the business cycle, perhaps because they had not detected a cycle in the real world. An exception was Jean-Charles-Léonard Sismondi (1991: 104-5), who pointed out that current savings determine future consumption by providing the wherewithal to spend. A change in savings affects current and future consumption and can move the national economy away from equilibrium.

Prominent analyses of business cycles appeared in the early 19th century, when they may have been induced by the economic convulsions of the Napoleonic wars. That a national economy passed through recessions and recoveries was proposed in the heyday of the English "Currency School," an early form of monetarism. The so-called "state of trade" seemed to follow "an established cycle," wrote Lord Overstone in 1837, "First we find it in a state of quiescence – next, improvement – growing confidence – prosperity – excitement – overtrading – convulsion – pressure – stagnation – distress – ending again in quiescence."[11] This anticipated Keynes' notion that "animal spirits" – itself a concept dating to the 1700s – could touch off exuberant, destabilizing swings in real investment (Keynes 1991: 161-3).[12] In 1925, Hayek (1999a: 101) regarded Overstone's passage as an expression "with the utmost rigor [of] the basic tenets of the modern theory of 'business cycles.'" The "chief culprit" in recession was overexpansion of industries producing raw materials and physical capital, instigated by banks lending excess funds at low rates of interest (Hayek 1999a: 105-6). The Austrian recommendation – to damp oscillations of income by limiting paper money – originated with the Currency School (Hayek 1999a: 146). Early economic theory might have provided the framework for

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[8] Hume (1948: 330) continued: "It is only in our public negotiations and transactions with foreigners, that a greater stock of money is advantageous; and as our money is there absolutely insignificant, we feel, by its means, all the ill effects arising from a great abundance of money, without reaping any of the advantages."

[9] In Quesnay's (1948: 340-8) model, expenditures on consumer goods are "sterile" because they leak out of the economy. On the other hand, expenditures on inputs are "productive" because they regenerate output. All expenditures are either sterile or productive. Quesnay implies that income Y sums all rounds of spending on inputs. Denote the share of sterile expenditures in all expenditures as s. Given an initial expenditure on inputs of X, Quesnay suggests (nonmathematically) that $Y = X + (1-s)X + (1-s)^2X + \ldots (1-s)^nX + \ldots$. Summing the geometric series yields $Y = X/s$.

[10] "All classes of work in agriculture, industry or commerce require advances. Even if the earth were cultivated by hand, it would be necessary to sow before reaping; it would be necessary to live until after the harvest" (Turgot 1948: 352). For the merchant, the "advance" is inventory (Turgot 1948: 362-4).

[11] Lord Overstone, *Reflections suggested by a perusal of Mr. J. Horsley Palmer's pamphlet on the causes and consequences of the pressure on the money market*, London. I draw upon the quotes in Marshall (2003: 346) and Hansen (1964: 216). Overstone (Samuel Jones Loyd) was a leading advocate of strict control of paper money, implemented by England's Parliament in 1844 (Marshall 2003: 355).

[12] According to Ephraim Chambers, animal spirits were "a fine subtile juice, or humour" at the interface of body and mind. This was in Chambers' *Cyclopaedia: Or, an universal dictionary of arts and sciences*, fifth edition, 1741 and 1743. I draw upon the quote in New (1997: 598-9).

business-cycle analysis that fact-gathering lacked, had modern economists developed the first glimmerings of intuition.

Economists of the early 19th century also had enduring insights into the nature of money. Henry Thornton (1807), an English economist and member of Parliament, distinguished between real and nominal rates of interest, as well as between the market rate of interest and the "natural" rate that equaled the expected rate of return to a dollar of physical investment (Blaug 1986: 243-5).[13] Ricardo (2002: 261-301) provided elements of the quantity theory of money in 1811.

Concomitant with Overstone and Thornton, Sismondi (1991: 101-7, 303-7) also presaged modern macroeconomic theory. In his scheme, production, consumption and revenues were sides of the same prism. Normally, all three were equivalent in value; but a disturbance in any might throw the economy out of equilibrium.[14] Consumption would lag production when employers reduced wages in order to build profits, forcing workers to cut back spending. Until savers reinvested in production, total consumption would fall below output.[15] Price competition prevented employers from raising wages by passing on the increase to consumers; and workers would not demand higher wages, because they were pressed by population growth (which enlarged labor supply) and by a government hostile to unions.[16]

As Sismondi saw it, the root of aberrations in the business cycle was dynamic. By definition, national income equaled national spending at any moment. But an increase in hoarded saving reduced spending and thus income. In Year 1, let spending equal 50 and saving 0; then income equals 50. In Year 2, people again receive 50 in income but now hoard 10. Consumption falls to 40. This reduces income in Year 3 to 40. Income will remain depressed until the hoards are spent on consumer goods or invested in capital, which returns the economy to full employment. Sismondi may have appreciated the role of time in the macroeconomy more fully than did other economists, until Dennis Robertson and Friedrich Hayek wrote in the 1920s.

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[13] On the nominal versus the real, Thornton (1807: 7) wrote: "In one sense, [commercial credit] may be increased by paper. I mean, that the nominal value of the existing goods may be enlarged through a reduction which is caused by paper in the value of that standard by which all property is estimated. The paper itself forms no part of the estimate."

Thornton's book remained obscure over the late nineteenth and early twentieth centuries until Hayek revived interest in it.

[14] "…A derangement of the mutual proportion subsisting among production, revenue and consumption becomes equally prejudicial to the nation, whether the production give a revenue smaller than usual, in which case a part of the capital must pass to the fund of consumption; or whether, on the contrary, this consumption diminish, and no longer call for a fresh production. To cause distress in the state, it is enough that the equilibrium be broken" (Sismondi 1991: 105).

[15] In the interpretation of Blaug (1986: 228-9), consumption falls below output because new technologies reduce labor demand.

[16] "…The struggle instituted among producers to take customers away from each other leads to production at an ever-lower price….The first effect of competition has been a lowering of wages….Business can expand; but if its expansion leads to a shrinkage of what was previously paid as a wage, and as interest on every thousand francs, consumption will not stay in step with production, and the overall result will never be a greater prosperity….From a fault in social organization…comes a steady increase in the working population, and a supply of hands as a rule greater than the demand for labor….It is in the interest of the working class to submit to a reduction of wages, be that it has really increased in numbers, or that demand for its labor has been decreased by machines. If it would take advantage of its numbers and destroy the machines, the police and army would drive them away" (Sismondi 1991: 303-6).

Sismondi's prediction of deficient aggregate demand dovetails with Keynesian and Marxist characterizations of the business cycle.[17] He also had a theory of excess supply, stemming from the producer's misreading of price signals. In Wesley Clair Mitchell's interpretation of Sismondi, the product price was the producer's only information about demand. When the price misled one firm into producing too much, it would also mislead them all, because none took into account what rivals would do. Excess output resulted. "…The faster the increase in production," summarized Mitchell (1927: 6), "the wider will be the gap between last year's income and this year's output."[18] It is not clear why firm managers would repeatedly underestimate supply.

By 1850, economists commonly recognized cycles in national economies.[19] *The Communist manifesto* anticipated growing destruction in the "periodical return" of "commercial crises."[20] In *Principles of political economy*, the economics textbook of choice at that time, John Stuart Mill (2006: 741-2) wrote of "commercial revulsions" that followed on the heels of speculation and excess capital.[21] In 1867, John Mills concluded that an excessive, and eventually inimical, demand for loans occurred in almost every decade.[22]

In the second half of the 1800s, most mainstream economists, newly obsessed with price theory and loath to take on issues that seemed intractable, ignored the business cycle. Their paltry macroeconomic research focused on recessions.[23] One exception was the French economist Clement Juglar. His business cycle passed through prosperity, crisis and liquidation, because of how people saved and invested. His model seemed consistent with this idea, familiar from Sismondi: When investment fell short of savings, firms would go bankrupt because households wouldn't spend excess savings.[24] Marx,

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[17] Blaug (1986: 229) wrote: "…The Keynesian flavor is even stronger in Sismondi than in Malthus, and it is he and not Malthus whom Keynes should have hailed as his forerunner." Richard Hyse (1991) translated Sismondi's *Nouveaux principes d'économie politique* (1819) into English.

[18] Also see Kresge (1991a: 15).

[19] Hansen (1964: 217) wrote: "By 1848 both the use of the term 'commercial crises' and also the periodicity of these crises appear to have come more or less into general use."

[20] "It is enough to mention the commercial crises that by their periodical return put on its trial, each time more threateningly, the existence of the entire bourgeois society….And how does the bourgeoisie get over these crises? On the one hand by enforced destruction of a mass of productive forces; on the other, by the conquest of new markets, and by the more thorough exploitation of the old ones. That is to say, by paving the way for more extensive and more destructive crises, and by diminishing the means whereby crises are prevented" (Marx and Engels 2002: 225-6; see also Hansen 1964: 217).

[21] Mill (2006: 660) wrote: "The frequent recurrence during the last half century of the painful series of phenomena called a commercial crisis, has directed much of the attention both of economists and of practical politicians to the contriving of expedients for averting, or, at the least, mitigating its evils." Also see Blaug (1986: 104).

[22] Mills regarded as an "unquestionable fact that almost every 10 years there occurs a vast and sudden increase of demand in the loan market followed by a great revulsion and a temporary destruction of credit….Commercial credit runs through the mutations of a life, having its infancy, growth to maturity, diseased overgrowth, and death by collapse." John Mills (not John Stuart Mill), 1867, Credit cycles and the origin of commercial panics, *Transactions of the Manchester Statistical Society*. I draw this quote from the excerpt in Hansen (1964: 220).

[23] In 1924, Hayek (1999: 101) wrote: "…It was only in the last decade that economists, especially in English-speaking countries, shifted their focus from isolated recession phenomena to [cyclical] fluctuations."

[24] Clement Juglar, 1860, *Dies Crises commerciales et de leur retour périodique en France, en Angleterre et aux États-Unis*. I draw on the discussion in Hansen (1964: 218-9).

whom Schumpeter (1962: 40-41) credited with discovery of the business cycle, also blamed lapses in aggregate demand. Innovation triggers rising output and income, but the resulting increase in wages induces capitalists to substitute machines for labor. This leads to unemployment, reduced spending by those who lost their jobs, and to recession.

Much modern work on the business cycle may have begun in 1894 with the Russian Mikhail Tugan-Baranovski. In his theory, firms invest too much, stimulating recovery and no-holds-barred spending until national savings are too skimpy for firms to borrow. Unable to finance planned operations, they must cut planned production. Recession ensues. This much of the story is Keynesian (vintage 1930).[25] Unlike the later Keynes, and like the neoclassical economists, Tugan-Baranovski assumes that the downturn pulls down prices. Those on fixed incomes gain from the lower prices, and they bank some of their new wealth. Flush with funds, the banks finance a new round of investment by firms, and the economy recovers.

While acknowledging a debt to Tugan-Baranovski, Keynes in 1930 criticized him for assuming that savings that had accumulated during the recession would somehow be directed to real investment. Keynes also preferred Schumpeter's explanation of variations in investment (a few entrepreneurs would innovate hugely successful products) to Tugan-Baranovski's (the unequal distribution of wealth led to fluctuations in the savings rate, reflected in the investment rate).[26] Keynes (1950: 100-1) seemed to contend that Tugan-Baranovski's assumption of unequal wealth was arbitrary, while Schumpeter at least traced income fluctuations to the fact that banks couldn't long stabilize the economy.[27]

Expectations, vital to business-cycle theory today, rarely entered it seriously until 1925, when Arthur Spiethoff, a specialist in cycles, built on Tugan-Baranovski's analysis.[28] In equilibrium, the natural rate of interest equaled the rate set by the money

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[25] Keynes (1950b: 100) wrote: "I find myself in strong sympathy with the school of writers…of which Tugan-Baranovski was the first and the most original…."

[26] Presumably, Tugan-Baranovski meant that as some wealth shifted from the rich to the poor, the average rate of savings would fall, since the poor had to consume a larger share of their wealth than the rich in order to survive. Had all households the same wealth, all also would have the same savings rate, so a shift of a dollar from one to another would not affect the average savings rate.

[27] Keynes (1950: 100) seems to have relied on the "short summary" of Tugan-Baranovski in Wesley Mitchell's *Business cycles.* Perhaps for this reason, Keynes' critical comparison of Schumpeter to Tugan-Baranovski was not entirely clear. Keynes (1950: 100-1) wrote: "The fault of Tugan-Baranovski lay in his holding, or at any rate implying, that [uninvested] savings can…accumulate during depressions…and…[are] then gradually used up during booms, and also in his suggesting that this failure in savings to become materialized in investments at a steady rate is due to the unequal distribution of wealth instead of to Schumpeter's 'innovations' in conjunction with a failure of the banking system to respond in such a way as to preserve the desirable degree of stability."

Why Keynes seemed to find the assumption of an unequal distribution of wealth arbitrary is unclear. As a matter of chance alone, millions of households are not likely to all have the same wealth. In addition, Spiethoff's work may have been more eclectic than Keynes seems to suggest. According to Schumpeter (1994: 1126-7), Spiethoff used the consumption of iron as a guide to the expansion of capital. Iron use could fluctuate due to changes in demand (presumably Keynes had this in mind) or to a lack of capacity to produce iron.

[28] "Arthur Spiethoff devoted his entire professional life to the study of a single subject, business cycles," noted an historian of economic thought, Mark Blaug (1986: 239).

Psychological interpretations of money were not new. Thornton (1807:2) defined commercial credit as "confidence."

market, Spiethoff suggested. Banks financed expansions in industries enjoying rising profit rates due to innovation. When technological change boosted the natural rate of interest, banks lent to those firms that they believed would pay off at this increased rate. Since banks were not always right, they wound up over-financing industrial equipment and under-financing consumer goods. The economy went into crisis, maintained Spiethoff, a German historicist and a friend of Schumpeter's (Schumpeter 1994: 816-7; Blaug 1986, 239-240). In short, banks were too confident that innovations would succeed.

Nearly 60 years earlier, John Mills had advanced the same idea. In a recovery, businessmen with rose-tinted glasses undertook projects that would fail (Hansen 1964: 220). In the consequent recession, timidity would block recovery. Similarly, John Stuart Mill in his 1848 textbook had emphasized overly pessimistic forecasts. In the "speculative" state, noted *Principles of political economy*, firms expecting a fall in supply might produce more than they could sell.[29] Such writers might agree with John Mills that "the malady of commercial crises is not, in essence, a matter of the purse but of the mind."[30]

In sum, until the Great Depression, work on business cycles focused on excess supply (Overstone, John Stuart Mill, Marx, Tugan-Baranovski), with some research into deficient demand (Sismondi and Juglar) and financial mistakes (John Mills, Spiethoff). The underlying theme was disequilibrium between savings and investment. This might arise from real factors, such as bad weather that reduces harvests, or from psychological factors, some of them monetary. Real-factor theories dominated some periods (*e.g.*, the late 1800s) and psychological theories others (the mid-1800s).[31] In general, 19th-century theories (like today's) were technical in that, before Spiethoff, perhaps only Marx had associated business cycles with capitalism -- according to Schumpeter (1994: 1127), who read in 10 languages.[32] Before the hyperinflations and depressions following World War I, few economists painted a big picture of the macroeconomy. Over the last half-century, we've observed similar patterns. In the race for adherents, real and psychological theories swap leads from time to time, with institutional theories back in the pack.

To some intellectual historians at the time, macroeconomic theory early in the 20th century added little to the offerings of a century before. Any student of money in the first half of the nineteenth century knows that "hardly any idea in contemporary monetary theory…was not known to one or more writers of that period," wrote Hayek (1931: 2). Lacking interest in money, modern theorists lacked it in business cycles, too. They

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[29] Mill wrote that in the "expectant, or speculative, state….an impression prevails, whether well-founded or groundless, that the supply of one or more great articles of commerce, is likely to fall short of the ordinary consumption….Effects of the same kind may be produced by anything which, exciting more than usual hopes of profit, gives increased briskness to business….This is a state of business which, when pushed to an extreme length, brings on the revulsion called a commercial crisis…" (Mill 2006: 662-4; Hansen, 1964: 217-8).

[30] John Mills, Credit cycles and the origin of commercial panics. I draw on the quote in Hansen (1964: 220).

[31] The Keynesian Hansen (1964: 219) wrote: "The ideas contained in [Juglar's] book are cast in terms of the mid-19th century view that crises are predominantly a monetary, banking and financial phenomenon. The role of investment in fixed capital is not yet recognized."

[32] One might also mention Marx's co-author of *The Communist manifesto*, Friedrich Engels, and U.S. President Thomas Jefferson's treasury secretary, Albert Gallatin (Hansen 1964: 217).

excluded money from their analysis because its presence could have destroyed their cherished notion of equilibrium for an economy (Hayek 1932: 238).

Keynes had criticized the lack of dynamic analysis. Schumpeter (1962: 32) was almost as severe about heterodox theory. Marx "had no adequate theory of enterprise and his failure to distinguish the entrepreneur from the capitalist, together with a faulty theoretical technique, accounts for many cases of *non sequitur* and for many mistakes."

After their bimetallic debate ended early in the 1890s, British economists wrote little about money until the rampant global inflation after World War I.[33] In the United States, where the bimetallic controversy continued well into the 1910s, economists (notably Irving Fisher) labored far more on monetary theory than did their cousins across the waters (Keynes 1911: 393-4).

Monetary theory did not improve until global depression kindled interest in it. "When I look back to the early 1930s," said Hayek (1995: 49) in 1963, "they appear to me much the most exciting period in the development of economic theory during this century" – not least, surely, because of his running controversy with Keynes.

Oases of creativity just after the turn of the 20th century included Irving Fisher's work on how inflationary expectations affected interest rates – an elaboration on Thornton's themes; and Dennis Robertson's *Banking policy and the price level*, on motives for savings. But Piero Sraffa (1932: 42) remarked about Hayek's *Prices and production* that "there is one respect in which the lectures collected in this volume fully uphold the tradition which modern writers on money are rapidly establishing, that of unintelligibility."[34]

In general, although economists had glimpsed the nature of business cycles as early as the 1820s, few developed full-blown theories until the downturns early in the 20th century had demonstrated their destructive power.[35] Few had focused on business cycles, aside from Marx -- and the careful Spiethoff, whose his most influential work followed the hyperinflations of the early 1920s (Blaug 1986: 239-40).[36]

III.B. History of monetary theory. A case study of one field of theory – the effects of money on national economies – may suggest reasons for the lack of sustained work on macro theory before the 1920s.

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[33] According to Keynes, the oral tradition for monetary theory in British universities before the war was more advanced than the written work.

[34] A prominent American economist complained that Sraffa himself was unintelligible. " I wish," Frank Knight confided to Oskar von Morganstern i n1932, "[Hayek] or someone would try to tell me in a plain grammatical sentence what the controversy between Sraffa and Hayek is about. I haven't been able to find anyone on this side who has the least idea" (Lawlor and Horn 1992: 318; also see Caldwell 1995a: 37).

Knight was perturbed by the lack of cohesion in macroeconomic argument. In March 1933, in another letter to Morganstern, Knight wrote: "In general, I'm in a perfectly low 'depression' over the state of economics, and the Hayek-Sraffa altercation with which my essay [on capital] is remotely connected is a case in point. I would like to see some headway which I do not see towards establishing terms and concepts in which economists could talk to each other and when they argue, argue issues rather than disputing the meaning of each other's assertions. (I haven't seen anyone who could tell what Sraffa and Hayek were arguing about)" (Lawlor and Horn 1992: 318).

[35] Marx may be an exception.

[36] Of Spiethoff, Schumpeter (1994: 1126) writes: "The main reason why his work developed so slowly was his heroic resolve to carry out a vast program of minute factual research single-handed – practically without any research assistance at all." One might have said the same for Schumpeter.

Lassitude befell the analysis of money as it had that of growth – through lapse of related news events. Early in the 19th century, "the study of the causes which govern the value of money was taken quite seriously," wrote Alfred Marshall (2003: 79 and 90) in 1923, with Ricardo in mind. "Men's thoughts were then much occupied with the economic basis of political security as well as of general well-being….The violent disturbances of public credit and prices, which were caused by the devastations and the alarms of the Napoleonic wars, set a singularly able and well-informed group of students and men of affairs at work on the problem; and they left very little to be added as regards fundamentals by their successors."

Late classical and neoclassical writers ignored the young shoots. They were intrigued primarily by determinants of relative prices; determinants of the price level came second. Marshall worked out Ricardo's argument (1973: 103-4) that a market price sometimes depended on demand in the short run but always on supply in the long. To these writers, money was merely the broker of exchanges. It didn't affect the relative values of goods exchanged.

John Stuart Mill (2006: 506) elaborated on this theme of Ricardo's.[37] "…The mere introduction of a particular mode of exchanging things for one another, by first exchanging a thing for money, and then exchanging the money for something else, makes no difference in the essential character of these transactions," stated *Principles of political economy*, the economics textbook of choice in the mid-19th century. "It is not with money that things are really purchased….There cannot…be intrinsically a more insignificant thing, in the economy of society, than money; except in the character of a contrivance for sparing time and labor. It is a machine for doing quickly and commodiously, what would be done, though less quickly and commodiously, without it: And like many other kinds of machinery, it only exerts a distinct and independent influence of its own when it gets out of order." Money affected the national economy only in the rare episode of disequilibrium.

This trivialization of money may have disposed economists to study microeconomics instead. Keynes (1991: vi) was unusual. When he began work on *A treatise on money*, published in 1930, he "was still moving along the traditional lines of regarding the influence of money as something so to speak separate from the general theory of supply and demand." For most economists, the analysis of money presented no challenges, since it was only a commodity, subject to the same laws of value – the same sorts of functions for supply and demand -- as apples and horsecarts (Mill 2006: 506-7; Blaug 1986: 164-7). As late as the turn of the 20th century, textbooks emphasized the physical properties of a useful money, as if it were just a good, rather than its implications for the macroeconomy.[38] More than a decade before *The general theory*, Keynes (2000: 152),

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[37] "The relative market value of hats and shoes is regulated by the demand and supply of hats, compared with the demand and supply of shoes, and money is but the medium in which their value is expressed. If shoes be doubled in price, hats will also be doubled in price, and they will retain the same comparative value. So if corn and all the necessaries of the laborer be doubled in price, labor will be doubled in price also; and while there is no interruption to the usual demand and supply of necessaries and of labor, there can be no reason why they should not preserve their relative value" (Ricardo 1973: 104).

[38] Horace White's (1908: 15) textbook, *Money and banking*, said "the requisites of a good kind of money are portability, homogeneity, durability, divisibility, cognizability, and stability of value." Only the last attribute is explicitly macroeconomic, although the preceding one affects expectations. White continued, "These requisites are found to exist in the greatest perfection in gold." But judging by his criteria, the

then a monetarist, worried that the public would confuse nominal value for purchasing power. "It is not easy, it seems, for men to apprehend that their money is a mere intermediary, without significance in itself, which flows from one hand to another, is received and is dispensed, and disappears when its work is done from the sum of a nation's wealth."

The assertion of money neutrality may seem to have, if nothing else, the virtue of clarity. In reality, macroeconomists long remained ambivalent about money. Adam Smith regarded it as "the great instrument of commerce" but of peripheral interest because its value was nominal.[39] As late as 1911, Joseph Schumpeter echoed this disparagement; money was a mere "cloak of economic things" (Schumpeter 1996: 51). But his *Theory of economic development* also said the money market "is always, as it were, the headquarters of the capitalist system, from which orders go out to its individual divisions, and that which is debated and decided there is always in essence the settlement of plans for further development" (Schumpeter 1996: 126).

Apart from such caveats, economists belittled money. This resulted from, and in, the belief that macroeconomics was merely an aggregate version of microeconomics. Money didn't matter, because it was not vital to any particular market (except the money market). Schumpeter (1989: 14) thought aggregation an error and illustrated with a metaphor. "We may be interested in the processes of life going on in [a] dog, such as the circulation of the blood, its relation to the digestive mechanism, and so on. But no matter how completely we master all their details, and however satisfactorily we succeed in linking them up with each other, this will not help us to describe or understand how such things as dogs have come to exist at all."

By 1936, this view -- that the macroeconomy exceeded the sum of its parts -- was becoming influential. Keynes named his book *The* general *theory* because it avoided the fallacy of composition inherent in treating the macroeconomy as just an aggregate. "I mean by [a general theory] that I am chiefly concerned with the behavior of the economic system as a whole,— with aggregate incomes, aggregate profits, aggregate output, aggregate employment, aggregate investment, aggregate saving rather than with the incomes, profits, output, employment, investment and saving of particular industries, firms or individuals. And I argue that important mistakes have been made through extending to the system as a whole conclusions which have been correctly arrived at in respect of a part of it taken in isolation."[40] For example, "*the importance of money essentially flows from its being a link between the present and the future*" – a point overlooked in static aggregate theory (Keynes 1991: 293; italics in the original). To

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ideal money might have been a brick (Charles O. Hardy; I draw on the quote in Friedman 1951: 208-9). In the ninth century before the birth of Christ, the Spartan legislator Lycurgus used lumps of iron (Hume 1948: 331).

[39] Smith (1976: 309 and 313) wrote: "Money, the great wheel of circulation, the great instrument of commerce, like all other instruments of trade, though it makes a part, and a very valuable part of the capital, makes no part of the revenue of the society to which it belongs….In order to put industry into motion, three things are requisite: Materials to work upon, tools to work with, and the wages or recompense for the sake of which the work is done. Money is neither a material to work upon nor a tool to work with; and though the wages of the workman are commonly paid to him in money, his real revenue, like that of all other men, consists not in money, but in money's worth; not in the metal pieces, but what can be got for them." Ricardo (1811: 284) quoted this passage.

[40] Keynes, Introduction to the French edition of *The general theory of employment, interest and money*.

neoclassical economists, this denial of simple aggregation stemmed from an incomprehension of microeconomics. "Maynard," the Marshallian economist Gerald Shove, of Cambridge, reportedly complained, "had never spent the 20 minutes necessary to understand the theory of value."[41]

III.B.1. The effects of policy on theory. Economists' concern with immediate policy not only stunted the construction of sturdy theory; it often substituted for it. John R. Commons (1925: 44) expressed the institutionalists' contempt for models: "People in general do not learn a new thing by reason and theory; they learn it by hard knocks." Evidently, since people do not theorize, they cannot be theorized about.

The importance of policy to theory sometimes threatened to convert the latter into a popularity contest, asserted economists who were likely losers. People "persistently disregarded" Austrian proposals because they "hurt in the application," commented Hayek (1945; 1995: 233). "Then Lord Keynes assured us that we had all been mistaken and that the cure could be painless and even pleasant" – just keep spending until reaching full employment. "The argument was not less effective because it was couched in highly technical language. It gave the support of the highest scientific authority to what had always been the popular belief, and the new view gained ground rapidly."

Just as he had criticized Smith, Schumpeter (1936: 791-2) complained that *The general theory* was policy advocacy in search of a theory. Keynes "pleads for a definite policy [government spending in downturns], and on every page the ghost of that policy looks over the shoulder of the analyst, frames his assumptions, guides his pen. In this sense, as in another, it is Ricardo all over again….It is…vital to renounce communion with any attempt to revive the Ricardian practice of offering, in the garb of general scientific truth, advice which – whether good or bad – carries meaning only with references to the practical exigencies of the unique historical situation of a given time and country. This sublimates practical issues into scientific ones, divides economists – as in fact we can see already from any discussion about this book – according to lines of political preference, produces popular successes at the moment, and reactions after – witness the fate of Ricardian economics – neither of which have anything to do with science. Economics will never have nor merit any authority until that unholy alliance is dissolved."[42] The reader of *The general theory* may disagree with the specifics of this

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[41] Robinson (1962: 79). I draw upon the quote of this passage in Hayek (1995: 59).

[42] Also see McCraw (2007: 274).

Schumpeter (1994: 473, 1171 and 470) compared Keynes to Ricardo in his "felicitous combination" of theory and policy. Keynes' "work is a striking example of what we have called…the Ricardian Vice, namely, the habit of piling a heavy load of practical conclusions upon a tenuous groundwork, which was unequal to it yet seemed in its simplicity not only attractive but also convincing." General readers, Schumpeter said, adopted the theories of these two economists because they agreed with the recommendations. But, Schumpeter implied, Keynes was also like Ricardo in his preoccupations outside academic economics (Ricardo operated on the stock market until retiring rich at age 42). "This is a striking proof of [Ricardo's] splendid powers, but also the reason why his work, lacking as it did the benefit of full concentration during the third decade of his life, which is of decisive importance in a thinker's career, never penetrated down to the deepest depths, besides remaining badly finished in a formal and technical sense: We have before us the record of a wrestler who fought his matches with his right hand tied behind his back."

Schumpeter said he himself had few followers because he was a poor leader. "…Even in my scientific activity and in spite of an 'oeuvre' a fraction of which would have been enough for 'fame,' I do

assessment (few pages of the book explicitly discuss corrective policy), and perhaps even consider Schumpeter's potential jealousy of a more successful contemporary macroeconomist -- and yet recognize Schumpeter's emphasis on truly general theory.[43]

Newsworthy events may affect monetary theory only with a lag. Hayek (1931: 2-3) illustrated the negative relationship between current policy and current theory: "The Italy of the sixteenth century has been called the country of the worst money and best monetary theory." Perhaps only sustained events could lead to sustained theory. In contrast, a particular business cycle comprised transient events.

III.C. Conclusions. Why did it take more than a century for macroeconomic theories of disequilibrium to catch on? I will consider two reasons. Theory is a public good, so markets will provide too little of it. Theory thus limits itself: It is hard to build upon ideas too scarce to find. Also, producing theory is subject to scale economies. Once microeconomics had accumulated critical mass, theorists would prefer it to macro, increasing the relative disadvantage of the latter. A major news event could reverse this trend by offering fame to theorists who could explain the event. The *ex ante* lack of theory increases the probability of the event, strengthening the proclivity of theory to explain rather than predict.

IV. Theory as a public good

IV.A. Spillovers. A conventional market won't produce enough ideas, for reasons additional to the usual ones for public goods. To sell an idea, its producer must disclose enticing features of it to the prospective buyer. This reduces its sales value.

Any buyer requires information about a product before purchasing it. But, for simple products, the loss of net value from initial sales is made up by repeat sales. To sell the first box of Cereal X, the producer must pay to prepare and print nutritional facts on the back of the box. If the buyer is satisfied with the first box, he will buy more. Revenues from these repeat sales may cover the fixed cost of preparing the information about nutrition.

To some extent, a complex idea may also be sold repeatedly to a given buyer, since he may forget part of it over time. The part remembered may persuade him that the entire idea is worth repurchasing. But he may need to consume a simple, vivid idea only once.

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not carry weight," he wrote in his diary in 1942. "For I am typically 'unleaderly' – in fact I am a man without an aura (and without antennae)..." (McCraw 2007: 403).

[43] "Of course," Schumpeter wrote to a young correspondent in 1928, "the building up of a qualitative theory of the economic process is the great task of this generation" (McCraw 2007: 567). The same could be said today.

The reader may judge the depth of Schumpeter's guarded envy of Keynes from his comment in February 1937 to Oscar Lange: "…What I find so difficult to understand is that so obviously bad workmanship is so readily condoned by people who know what good workmanship is." Schumpeter did not engage in a discussion with students and faculty at Harvard about *The general theory* "precisely because I did not wish to give myself the opportunity of displaying what may look like and perhaps is ungenerosity and bad temper." At the same time, Schumpeter wrote cryptically to another economist: "I am more pessimistic about the future than you are – I do not believe that either dictators or any other people ever fail on the score of idiocy. For this is what humanity loves. In the particular case before us, I have been much struck by the fact that the majority of our very best young people are almost fanatically for Mr. Keynes' book and this phenomenon seems to be fairly general" (McCraw 2007: 275).

For products like cereal, requirements to disclose information impose production costs, such as those for printing, which new technology may reduce. But disclosure of an idea reduces its value directly and permanently. A novelist may discover cheaper ways to research books; but this cannot eliminate the need to disclose a bit of the plot in order to sell the novel.

The buyer of an idea may be able to convey it to other people, preventing the producer from selling to them at a high price. The magnitude of this problem depends on the complexity of the idea. A film may be too intricate to convey in conversation. Unless buyers can replicate the physical product cheaply, the producer can continue to sell it in the future. But an economic theory lacks physical dimension. Its buyer can convey it in an e-mail message or a conversation for no more than the cost of the time involved.

Like any monopolist, the theorist may try to protect his rents by raising the fixed costs that rivals would face in replicating his product. A model that uses advanced math may reduce the number of rivals who otherwise could divert rents to themselves by bettering the analysis. This strategy creates social value by encouraging thinkers to learn skills that may apply to diverse areas. But a paradox of intellectual industries is that two characteristics of a good idea – clarity and simplicity – will quickly destroy its private rents by making it easy to understand and hence improve.[44] In general, traits of a product that make it cheap to replicate may reduce the incentive to invent it.

Most monopolists can replicate their product more easily than their rivals can and so may threaten to flood the market before rivals can recover fixed costs. The threat may be credible if rivals would give up someday rather than threaten entry forever. This threat may not be credible for the theorist. Given the Web, replication may have no fixed costs. The rival can copy and paste as quickly as the inventor. If the latter anticipates this Mexican standoff, then she may not try to develop her theory, since it may have a zero expected value at best.

Even theorists who prefer influence to income may fail to capture spillovers. Suppose that compensation is in the form of citations. The inventor of an enduring idea will find that these diminish over time as her concept becomes so universal as to be regarded public property.

In summary, the potential producer of an idea may anticipate the loss of so much revenue that she will decide not to develop the idea, even when its social value would have exceeded its cost.

IV.B. Reputation. To the problem of under-providing ideas, fame may be a non-market solution. The theorist's repute can reduce the amount of information that she must disclose to sell her idea. If she doesn't peddle the idea in a normal market, her fame may still enable her to command a higher salary from an institute, such as a college, that will sell the information for her. She may cash in on her talents for clarity and simplicity.

Fame in a given audience is earned for work that interests a large share of it. Schumpeter (1994: 185) regretted that he was not like Adam Smith, whose "argument and material were enlivened by advocacy which is after all what attracts a wider public: Everywhere, the professor turned his chair into a seat of judgment and bestowed praise

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[44] For those accustomed to equations, math may express an idea more clearly than words can. In any event, the result of a modeling method matters more than its motive. All this notwithstanding, the theorist has an incentive to use techniques as barriers to entry.

and blame."[45] In the short run, newsworthy work, such as policy advocacy, will interest more people than will more general analysis even if the latter includes the news event as a special case. Policy motivates theory. If the national economy fades from the headlines, then in time macroeconomic theory may languish. In the first half of the 19th century, frequent "commercial crises" had attracted economic analysis, leading in 1844 to Parliament's regulation of bank notes (Mill 2006: 660).

Pre-emptive theory destroys its own reward. An accurate theory of economic collapse may help prevent it. If the collapse never occurs, then it cannot make its theorist famous. A potential theorist aware of this paradox may pursue other lines more likely to pay off, such as advocating policies for events already in the news.

She need not be aware of the paradox for it to take effect. Theorists who model events that will never occur shall be sidelined by analysts of actual events, since the latter are more vivid and hence attract more public attention. Over time, the share in all analyses of those devoted to events yet to happen, will diminish.

Contemporary analyses of the Industrial Revolution illustrate how policy affects economic analysis. In 1817, Ricardo (1973: 95) focused on economic growth, manifest in "the increase of population…the extension of agriculture…the increase of shipping and manufactures…the building of docks…the opening of numerous canals, as well as…many other expensive undertakings; all denoting an increase both of capital and of annual production." Up through the early 1800s, the pubescent discipline of economics had addressed the effects on economic growth of trade restrictions that had been justified by mercantilism and embodied in Britain's Corn Laws. The bullionists, dating to the 14th century at least, contended that the nation should restrict outflows of silver and gold because these metals represented wealth. Adam Smith famously destroyed this argument in *The wealth of nations*, in 1776: True wealth lay in the power of labor to produce.[46] By 1811, Ricardo (1811) had published four editions of a tract criticizing Parliament's restriction of species sales by the Bank of England, enacted in 1798.

After Parliament repealed the Corn Laws in 1846, macroeconomics gradually gave way to microeconomic analysis. How would – and should -- market prices direct resources?[47] "…During the last quarter of the 19th century and beyond," writes an historian of economic thought, Donald Winch (1973: xvi-xvii), "there was a definite movement away from classical macro-dynamics towards the microeconomic problems of allocation and efficient use of resources." It was as if macroeconomists, having freed

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[45] Elsewhere, Schumpeter contradicted himself: He sensed that fame on the street had garnered him few academic followers (McCraw 2007: 403).

[46] For Smith (1976: 1), the nation's wealth consisted of its capacity to satisfy consumers. Capacity depended on labor.

Economists commonly distinguish between the bullionists and the later mercantilists who have garnered some modern sympathy. Roll (1992: 48-56) thought such distinctions overstated. All mercantilists sought to accumulate treasure in order to grease the wheels of the economy. Josiah Child pointed out in the late 17th century that an increase in treasure would lead to lower rates of interest, which would encourage trade. In *The general theory,* Keynes (1931: 333-371) regarded the mercantilists as prescient for emphasizing the importance of low interest rates to under-developed economies.

[47] Early economists did recognize that relative prices and money supply were not independent of one another. According to Ricardo (1973: 107-8), a tax on raw produce must lower the relative prices of products not using the produce, since the tax would divert a share of the given money supply from purchases of the latter. He seems not to have accounted for money velocity.

international trade to spur growth, felt no need to study another aspect of the national economy, since none seemed as pragmatic.

As the Industrial Revolution matured over the 1800s, it called attention to the rapidly changing structures of markets, a transformation due in part to liberalization of trade.[48] Industrialization drew labor and capital away from agriculture, in which the most fertile tracts conferred market power and rents upon their owners, and toward factories, each earning just normal profits in the long run due to the constraints of competition. The subsequent redistribution of income – among wages, profits and rent – had been a basic theme of Ricardo's *Principles of political economy and taxation.*

V. Scale economies in doing theory

As an industry, macroeconomic theory may fail to attract producers because of high barriers to entry. Since theorists learn by doing, veterans have an edge.

Even Ricardo stuck to issues that seemed most susceptible to analysis. "Political Economy you think is an enquiry into the nature and causes of wealth," he wrote to Malthus in 1820. "I think it should be called an enquiry into the laws which determine the division of the produce of industry amongst the classes who concur in its formation. No law can be laid down respecting quantity, but a tolerably correct one can be laid down respecting proportions. Every day I am more satisfied that the former inquiry is vain and delusive, and the latter the only true objects of the science."[49]

The extended interest in microeconomics over most of the 19th century created a corpus of work that was relatively easy to supplement. So, theorists preferred microeconomics to macro, increasing the gap between the marginal costs of creating the two. The differential analysis of Stanley Jevons and Carl Menger led to additional applications of calculus to microeconomics. How to extend the calculus to macroeconomics was less obvious.

For example, optimization seemed more sensible for individuals than for organizations. Was it meaningful to claim that a government sought to maximize utility (or anything else)? Schumpeter (1908-9) criticized analysis of social welfare for presuming that an aggregate of individual preferences meant anything; since the preferences of one person could not be compared to those of another, they shared no basis. Without a credible theory of organizational behavior, macroeconomic theorists were reduced to arbitrary assumptions. To Ricardo (1973: 145), a labor tax would reduce labor demand because "the produce of taxes is generally wastefully expended, they are always obtained at the expense of the people's comforts and enjoyments, and commonly either diminish capital or retard its accumulation." Ricardo did not justify his conclusion that government generally wastes money; indeed, he noted that a free citizenry would not long endure such waste.[50]

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[48] "Notwithstanding the immense expenditure of the English government during the last 20 years, there can be little doubt but that the increased production on the part of the people has more than compensated for it. The national capital has not merely been unimpaired, it has been greatly increased, and the annual revenue of the people, even after the payment of their taxes, is probably greater at the present than at any former period of our history" (Ricardo 1973: 95).

[49] From a letter by Ricardo to Malthus, October 9, 1820. Quoted in Keynes (1991: 4).

[50] Elsewhere, Ricardo (1973: 118 and 157) wrote: "Every new tax becomes a new charge on production, and raises natural price. A portion of the labor of the country which was before at the disposal of the

V.A. Choosing to do theory: A mathematical model. A simple analysis may pull together skeins of the ideas discussed. The economist will attempt business-cycle theory if he believes that its expected value is positive. If he expects many rivals, then he will doubt that he will be the first to develop the theory and so may abandon it. On the other hand, a larger stock of relevant theory will cut his modeling costs.

Notation follows. The stock of theory is *S*, measured in units of information. There are *m* rival economists who are also thinking of developing the theory of interest. To our economist, the dollar value of fame from being the first to develop the theory is *F*, a function that decreases in *m.*

The opportunity cost of developing the theory, expressed in dollars, is the function *C*, which decreases in *S* because of economies in creating related ideas. The number of possible relationships among ideas – themselves new ideas – increases by a factorial of the number of ideas. The *S*th idea generates *S-1* connections and hence *S-1* ideas. Given *S* ideas, adding *k* more will create a total stock of $2^k(S+1)-1$ ideas, *k = 1, 2, 3,…* (Appendix B).

Denote an economic outcome that can make its predictor famous as *j = 1, 2, …, J*. For example, *j* may express a mild recession or a strong recovery, given conditions A_j. The probability that *j* occurs is $Pr_j\,[A_j]$. The probability that our economist is the first to model *j* successfully is $Pr_x[A_j, X]$, where *X* denotes her idiosyncratic traits. That these two probabilities are independent seems natural to assume.

Given *j*, the expected net value to the economist of attempting the model is

$$\Pr_j[A_j] * \Pr_x[A_j, X] * F[j,m] - C[j,S].$$

Equation 2

The equation is simple to interpret. Whether or not her attempt to develop the theory succeeds, the economist must incur the cost *C*, so its weight is 1. She benefits only if her theory succeeds and if the event modeled occurs, so we weight this benefit by the product of the two probabilities. She will attempt the theory if the value of Equation (2) is positive.

To link Equations (1) and (2), interpret an idea as a unit of information. Adding an idea to a stock of *S - 1* ideas generates *S – 1* more, excluding the *S*th idea itself. For simplicity, denote the fixed cost of ideas as *1* and the variable cost of an idea as *0* aside from the cost of generating it from the current stock of ideas. The average total cost of the new *S -1* ideas is

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contributor to the tax is placed at the disposal of the state, and cannot therefore be employed productively. This portion may become so large that sufficient surplus produce may not be left to stimulate the exertions of those who usually augment by their savings the capital of the state. Taxation has happily never yet in any free country been carried so far as constantly from year to year to diminish its capital. Such a state of taxation could not long be endured; or if endured, it would be constantly absorbing so much of the annual produce of the country as to occasion the most extensive scene of misery, famine and depopulation.…There are no circumstances under which taxation does not abridge the enjoyments of those on whom the taxes ultimately fall, and no means by which those enjoyments can again be extended but the accumulation of new revenue."

Equation 3

$$\frac{1}{S-1}.$$

This converges on a marginal cost of zero as *S* increases indefinitely.

V.B. The structure of the economics market. One reason for the lagged response of theory to events may have been that the market for economic ideas was an oligopoly. Enjoying scale economies, influential economists may have felt little competitive pressure to address the relatively difficult issues of macroeconomics (difficult, because unexplored).

To Hayek (1995: 50), Keynes was just one of the "eager young men [who] were trying hard to find what of the work of other schools they could usefully incorporate into their local tradition" at not only Cambridge but also at "London, Harvard,…Vienna, and Stockholm, and a few Italian, French, and German universities" in the Twenties. All were improvising on the "great founders" – Marshall, Walras, Pareto and Carl Menger.

That only a few economists dominated theory may have magnified the impact on it of random events. In 1895, Marshall had meant to put macro on a firm footing, as he had done for micro. The second volume of the *Principles of economics* would have addressed credit and employment. But by the time that he wrote *Money, credit and commerce* (1923), soon after turning 80, his health was failing (Keynes 1951: 209-10, 214-5). His project, initially to be of three volumes, was "heavy, and achievement has been slow: Therefore it has seemed best to publish without further delay the present volume, which aims at accomplishing one-half of the task. A little progress has been made in regard to the second half: And, although old age presses on me, I am not without hopes that some of the notions, which I have formed as to the possibilities of social advance, may yet be published" (Marshall 2003: 6) Less than two years later, Marshall died. Few, aside from his former student Keynes, took up his cudgels.

VI. Theory first – or facts?

Their concern with current policy may have led some economists to put facts before theory. In any event, their failure to anticipate the Great Depression may have stemmed immediately from a dearth of either facts or ideas. In turn, this deficit may have resulted from indecision over which, facts or ideas, should come first. The dichotomy is familiar from the argument over method (*Methodenstreit*) between German historicists and Austrian theorists in the 1880s.[51] I will begin with the case for beginning with facts, then turn to the one for theory.

VI. A. Beginning with fact. Schumpeter (1994: 12-3), whose first book analyzed the *Methodenstreit*, insisted on inducing economic theory from history.[52] "…If, starting my

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[51] Carl Menger's contributions to the debate were *Problems of economics and sociology* (1883) and *Die Irrthümer des Historismus in der deutschen Nationalökonomie* (The fallacies of historicism in German political economy, 1884). Schmoller replied in his journal, *Jahrbuch für Gesetzgebung* (Yearbook for Legislation) (Blaug 1986: 160-3 and 213-4).

[52] Schumpeter (1989: 9) conceded the importance of some analytical tools, such as price indices and elasticities, which were fashioned independently of historical study.

work in economics afresh, I were told that I could study only one of [theory, statistics and history] but could have my choice, it would be economic history.…" Economic processes were creatures of history. Because economists disdained history, their errors were more likely to be historical than theoretical or statistical. Keynes (1950b: 408) agreed: Macroeconomists needed data. "Monetary Theory, when all is said and done, is little more than a vast elaboration of the truth that 'it all comes out in the wash.' But to show this to us and to make it convincing, we must have a complete inventory."

Keynes' rival, Schumpeter, who taught economic theory at Harvard, agreed that facts came first. "…It is always of utmost importance for us to be thoroughly masters of the economic history of the time, the country or the industry, sometimes even of the individual firm in question, before we draw any inference at all from the behavior of time series," Schumpeter (1989: 7) wrote in the ill-received *Business cycles*. "We cannot stress this point sufficiently. General history (social, political and cultural), economic history, and more particularly industrial history are not only indispensable but really the most important contributors to our understanding of our problem. All other materials and methods, statistical and theoretical, are only subservient to them and worse than useless without them." Succinctly: "Any serious attempt at analytic and even at practical control of the business cycle must be an historical one in the sense that the key to the solution of its fundamental problems can only be found in the facts of industrial and commercial history (Schumpeter 1935: 5)."[53]

By this view, scholars certainly must document an economic process – such as a business cycle -- when it undergoes a sudden sea-change. In 1886, the U.S. commissioner of labor declared that the ongoing downturn differed sharply from its predecessors. The first order of business was to take inventory of downturns in the preceding half century "to determine the nature of the present industrial depression." The Bureau of Labor would do so "without the conceit of expecting to evolve any economic law relative to the cause or causes of depression, or to lay down in any dogmatic way any positive remedial solutions of such depressions."[54]

In at least some recent periods, Schumpeter may have surpassed Keynes in professional influence. As of 2009, searches of computerized databases turned up more contemporary references to the former than to the latter. See also Giersch (1984, 1987).

[53] Sometimes Keynes was almost as inductive as Schumpeter. Much of *The general theory* assumed a fixed price level, because Keynes (1991: 295-6) had not observed in the early Thirties that deflation always revived aggregate demand. "…If there is perfectly elastic supply so long as there is unemployment, and perfectly inelastic supply so soon as full employment is reached, and if effective demand changes in the same proportion as the quantity of money, the Quantity Theory of Money can be enunciated as follows: 'So long as there is unemployment, *employment* will change in the same proportion as the quantity of money; and when there is full employment, *prices* will change in the same proportion as the quantity of money.'" But "…instead of constant prices in conditions of unemployment, and of prices rising in proportion to the quantity of money in conditions of full employment, we have in fact a condition of prices rising gradually as employment increases." Since a flexible price level had not done its job, it was not important to a theory, even to one labeled "general." Keynes (1991: 298) twitted mathematical economists for producing "mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols." G. B. Richardson regarded Keynes as "surely exceedingly English and in direct descent from the English empirical philosophers." G. B. Richardson, Schumpeter's *History of economic analysis*, *Oxford Economic Papers* (new series) 7, June 1955. I draw upon the quote in McCraw (2007: 465).

[54] Carroll D. Wright, *The first annual report of the Commissioner of Labor,* 1886, page 11. I draw upon the quote in Hansen (1964: 222-3).

Other disciplines shared this perspective in the American era of progressivism. "The life of the law has not been logic; it has been experience," wrote Oliver Wendell Holmes, Jr. in 1881. "…The law embodies the story of a nation's development through many centuries, and it cannot be dealt with as if it contained only the axioms and corollaries of a book of mathematics."[55]

Facts are vital, but need they precede theory? Historicists explained that facts must come first, in order to produce theory comporting with them. Intuition was an unreliable starting point. Economists should gather facts first because the business cycle was too complex for familiar analogies, said Gustav von Schmoller. Wesley Clair Mitchell (1927: 462) disavowed the need "to determine how the fact of cyclical oscillations in economic activity can be reconciled with the general theory of equilibrium, or how that theory can be reconciled with facts."[56] One should first detail all phases of the business cycle – and only then induce a theory. The notion of an equilibrium does not much help us understand a phenomenon that comprises many sub-processes; at a given time, some of these are in equilibrium and some aren't. In the same spirit was the statement of principles by the young American Economics Association. Members looked "not so much to speculation as to historical and statistical study of actual conditions of economic life…" (Tindall with Shi 1992: 840).

In addition to philosophical arguments for beginning with facts, one was pragmatic: Specification yielded quick results, which had pedagogical value. Induction engendered impatience to deal with the facts, since their short-run impact was better understood than their long-run causes. Indulging this impatience might humor American students of economics. "It has been my feeling for sometime," wrote Moore, then at Columbia University, "that one of the chief reasons why the pure science of economics does not attract students is the absence of inductive demonstrations of its fundamental tenets."[57]

VI. B. Beginning with theory. Schumpeter, who emphasized the importance of history, also warned that it may lead one into an error of theory. One must distinguish correlation from causation. "Starting from the common-sense impression that the interest rate is an important factor in business situations, we may jump to the conclusion that it is the causal factor responsible for booms and slumps. In fact, almost always a low rate of interest precedes a boom and a high rate of interest a slump. If this were enough to establish causal connections, this proposition would be one of the safest of our science. Yet, it is wrong and could be proved to be so, even if no statistical fact ever contradicted it" Schumpeter (1989: 10). This implies that we must begin with theory in order to give meaning to facts, which he had denied three pages earlier. Such ambiguity can make a researcher hesitate.

The traditional Austrian position was clear: A complex world requires simplifying theory. Facts in any number were worthless unless arranged. All research rooted in deduction, since induction had to assume *some* theory, if only to identify the facts that merited consideration. Induction, borrowed partly from trigger-happy behavioral

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[55] Oliver Wendell Holmes, Jr., *The common law*. I draw upon the quote in Tindall with Shi (1992: 839),

[56] Mitchell may have inclined more toward theory than he was wont to admit (Friedman 1950; Blaug 1986: 168).

[57] I draw upon the excerpt of Moore's letter in Spiegel (1991: 648). Moore continued: "I have, therefore, assumed that the present generation of scholars could render most effective service by attacking inductively the problems which you and others have treated so brilliantly in a deductive manner." Moore wanted to test statistically some "conclusions of pure economics."

psychologists early in the 20th century, focused uselessly on specific elements. More vital were the relationships among these elements, which could be espied only through intuition, argued Hayek (1999a: 102). Induction could never yield the bumper crop of insights harvested by deduction from first principles.

Even if induction "ultimately offers a comprehensive description of all essential features, which is the hallmark of all theories, in its initial stages (to which it remains largely confined), it is incapable of providing the sort of comprehensive insight that can be gained from any theory that is deduced from general economic principles." Induction cannot uncover causes of economic oscillations. "Even those researchers who rely on the new methodology [induction] therefore tend, consciously or unconsciously, to revert to the explanations drawn from 'abstract' theory when they set out to attack the root cause of economic fluctuations." The question was not whether to start with theory but when to be done with it.

The difficulty was that economists confined themselves to theories that could be tested through econometrics. Economists, Hayek (1995: 61) said in 1963, seemed to think that since statistics were the only data that they could measure, these were "the real facts with which they deal." Theories must explain these facts. "When it comes to the mechanisms of change, the chain of cause and effect which we have to trace in order to be able to understand the general character of the changes to be expected, I do not see that the objectively measurable aggregates are of much help." But since statistical tests required statistics, which were paltry in the case of business cycles, many economists sought to gather data first.

To Hayek (1995: 60-1), the concurrent rise of Keynesian macroeconomics and of econometrics, in the mid-Thirties, was no coincidence. Both relied on summary statistics that masked changes in relative values.[58] Both rooted ultimately in the Marshallian approach (presumably that of *Money, credit and commerce*).[59]

For Hayek (1931: 31-2), all study of the business cycle had to start with a theory of general equilibrium, since the problem was to explain why actual use of resources fell short of one's expectation of their full employment. We can explain economic phenomena only by building on "the concept of a tendency towards an equilibrium." To proceed systematically, "start with a situation which is already sufficiently explained by the general body of economic theory. And the only situation which satisfies this criterion is the situation in which all available resources are employed."

Having no theory as a framework for decisions, American bankers around the turn of the 20th century resorted to *ad hoc* rules. "With intuitive methods gauging the business cycle and rule-of-thumb measures for evaluating credit risks," wrote historian Robert Wiebe (1967: 21), "they relied on stabs of shrewdness, not long-range wisdom, in conducting their affairs. Bankers at all levels strained to comprehend an increasingly complex, impersonal operation."

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[58] Hayek criticized a founder of the Econometric Society, Joseph Schumpeter, for abandoning his earlier opposition to aggregate analysis.

[59] "The success of [*The general theory*] was merely symptomatic of, or perhaps helped decisively, the displacement of what is called microeconomics by macroeconomics. It was a development for which the Marshallian tradition was more disposed than the Austrian or the Lausanne [e.g., Walrasian-Paretian] or the Jevonian or the American tradition" (Hayek 1995: 60).

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Rules-of-thumb fashioned from statistical research could not satisfy the intellect. And they could lead to mutually contradictory policies across countries, since the data selected to estimate the rules might have expressed international differences that were superficial. For example, in the early 1920s, macroeconomists in the United States and Germany, who had documented price fluctuations over the business cycle, proposed to stabilize the value of a unit of currency. These proposals did not suit the monetary theory developing in England, and especially in Austria, where economists recognized that technological breakthroughs would raise productivity and cut the price level, both permanently (Hayek 1999a: 108). A fascination with statistical estimation had misled economists away from the theory of individual decisions and toward fits of Irving Fisher's version of the equation of exchange, the main virtue of which was simple specification (Hayek 1931: 2-5).

Treating fact-gathering as the first and foremost task might dispose one to the convenient theory that if event A preceded B, it must have caused B. If the fact collector has no theory in mind, then the simplest to adopt is *post hoc, ergo propter hoc*. For example, a distinguished American historian wrote of the U.S. depression in the 1870s: "While overbuilding the railroads had brought depression, it had created a commercial reservoir which for years afterward sustained much of the economy, including the railroads themselves" (Wiebe 1967: 1)[60] One might ask: If new rail miles enabled economic growth, then in what sense were they overbuilt? And, overbuilt or not, in what sense could they have created a depression?

Perhaps the historian had in mind that a falling price level would discourage entrepreneurs from borrowing to finance investment projects, since – had prices kept falling -- they would have had to pay off the loans in dollars that had more purchasing power than those they had borrowed, given the nominal rate of interest.[61] But had creditors and lenders truly expected falling prices, then they would have redesigned the loan to their mutual satisfaction – by lowering the interest rate -- rather than give up a deal that they regarded as to their mutual profit. Real investment would not have fallen until borrowers and lenders (seizing the collateral) abandoned the projects for some reason. Their late expectation of deflation would not have been sufficient reason for this abandonment, since they could have shifted planned production from lowest-price periods (the future) to higher-price periods (today).

In any case, the compelling reason for shutting down a plant for a while is that the output price cannot cover operating cost per unit at any scale of production. General deflation will not activate this condition, since output and input prices fall at the same rate, leaving the margin between them the same.

One might argue that falling output prices hit different industries at different times, misleading the first affected into the belief that demand was falling for their products, justifying padlocks on their plants. Other theories are possible. The historian seemed to have none of these in mind. Inescapable is the suspicion that he attributed depression to the expansion of railroads because the latter had preceded the former.

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[60] The editor of the series to which Wiebe's book belonged, David Herbert Donald (1967: ix), described it as "the standard book in its field."

[61] In fact, Wiebe (1967: 1) discussed deflation just before the passage quoted. "Falling prices and uncertain profits continued to discourage long-term investments even after the American economy might otherwise have enticed Europeans back again."

Before Mitchell had arrived on the scene, Carl Menger's victory in the *Methodenstreit* was manifest in the general reluctance to estimate macroeconomic cycles (Mitchell 1927). A few attempts by heterodox economists survive today, mainly as hortatory warnings to theorists trying to infer from facts. Henry Ludwell Moore, perhaps the first econometrician, undertook statistical studies early in the 20th century in order to test Léon Walras' notion of a general equilibrium. Moore wound up attributing economic oscillations to sunspots. These caused variations in rain that affected farm output (Kresge 1999a: 14).[62] Irving Fisher, an orthodox macroeconomist, scoffed at this non-economic explanation of an economic pattern. "…The [business] cycle idea…implies a regular succession of *similar* fluctuations, constituting some sort of *recurrence*, so that, as in the case of the phases of the moon, the tides of the sea, wave motion, or pendulum swing, we can forecast the future on the basis of a pattern worked out from past experience, and which we have reason to think will be copied in the future. We certainly cannot do that in predicting the weather, or Monte Carlo luck. Can we do so as to business? Not so long as business is dominated by changes in the price level!"[63] Fisher comes close to contending that the price level is random; if so, then presumably it is beyond theory.

Despite the charms of induction, theory before World War I was attracting students -- at least in Europe, where much of the available talent was crowding into the Austrian camp, which had seemingly won the *Methodenstreit*. At the University of Vienna, Joseph Schumpeter studied under Eugen von Böhm-Bawerk -- and under Friedrich von Wieser, himself a student of, and successor at Vienna to, Carl Menger. Hayek also studied under Wieser and researched under Ludwig von Mises. Conceivably, had this Austrian focal point continued to attract analysts, business-cycle theory might have developed rapidly to the point of anticipating downturns. But then came August 1914.

VII. Case study: History of the theory of money supply

An old idea may be a mitigated evil. The long debate that envelops enduring ideas clarifies them, making them easier to combine with others. But a flawed idea may stunt the development of theory by attracting thoughtless adherents until it is unpopular to challenge. One example may be the view that money supply is determined by money demand – an inference from the quantity model of exchange.[64]

Perhaps partly because microeconomics prevailed among theorists, the theory of money supply developed less than that of money demand until the 1930s at least. Microeconomic theory held that generally changes in demand would guide supply at first, since inputs that were fixed in the short run inhibited production plans. Money demand derived from output demand. To buy a chair, the consumer must liquidate some asset. Thus output prices, driven by demand, determine money supply.[65]

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[62] Moore's astronomical theory of the business cycle was as ridiculed as had been William Stanley Jevons' sunspots theory decades earlier. In *Generating economic cycles* (1923), Moore attributed eight-year cycles in prices to transits of the planet Venus of the same duration (Blaug 1986: 171-3).

[63] Irving Fisher, Our unstable dollar and the so-called business cycle, *Journal of the American Statistical Association*, June 1925, vol. xx, 191-2. Quoted in Mitchell (1927: 466); also see Kresge (1999a: 15).

[64] Microeconomics had its shibboleths as well, particularly the assumption of perfect information.

[65] This was the model of "full cost pricing" (Handa 2000: 33).

Ricardo (1973: 87-93) agreed that, under a gold standard, money demand determined money supply. A country with low export prices would attract gold. Its money supply would rise, and the

Total spending on a nation's product sums all prices, each weighted by the number of relevant units sold. This sum must equal money demand -- if people hold money only for spending, as classical economists assumed. Thus total spending determines money supply.

In time, theorists would identify more reasons for holding money. But the principle that money supply was a resultant remained intact. Keynes' *General theory* extended the theory of money demand but adopted the then-conventional notion that monetary authorities would simply supply the amount demanded by people and government.[66]

This view mistook a tautology for an explanation. The best-known of monetary models – the quantity equation of exchange – was an accounting identity: Expenditures equal receipts. That it always held true did not mean that it expressed anything universal about behavior, but theorists treated it as if it did. In their eyes, since the equation quantified money demand, it must also explain money supply. "…In our days," Wicksell (1907: 215) wrote, "demand and supply of money have become about the same thing, the demand to a large extent creating its own supply."[67]

The confusion of an equilibrium condition for a behavioral statement led to oversimplifying of other monetary relations. In one argument, consumers covered rising prices by cashing their bank accounts. Banks replenished their lost funds by purchasing money at higher prices than before. Output prices therefore determined interest rates. The latter could not serve as policy tools.

Neither, being another resultant, could money supply. As late as the early 1920s, the notion that monetary policy could stabilize the economy was novel. The role of the central bank was just to obtain enough gold to enable trade and buy government debt. The Federal Reserve Act of 1913 called upon the central bank to set policy "with a view of accommodating commerce and business."[68] The emergence in the U.S. of inflation that had been suppressed during World War I "required" new dollars – a view that the Federal Reserve would reject only eventually.[69] "It is only over the last 60 years," Hayek (1999: 252) wrote in 1981, "that money has come to be regarded as one of the prime instruments of economic policy in general and a useful way by which political authority could contribute to prosperity."

The precept of passive money supply was official Fed policy. "Federal Reserve notes… are issued only as a need for them develops," a Fed official explained to a Senate

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purchasing power of a unit of its currency would fall. But its government could influence the supply of paper money irrespective of previous prices.

[66] Keynes (2000) in 1923 had outlined a case for manipulating the money supply, through the central bank's purchases and sales of securities, in order to stabilize domestic prices, as Irving Fisher (1912) had long proposed. Fisher (1912: 670) said then-President Woodrow Wilson had proposed essentially the same idea as governor of New Jersey. Fisher (1913, 1911) wrote at greater length elsewhere about his proposal.

[67] Wicksell (1907) attributes this insight to Emil Struck, 1886-7, *Skizze des Englischen Geldmarketes* (Sketch of English money markets), in Schmoller, *Jahrbücher für Gesetzgebung, Verwaltung und Volkswirtschaft im Deutschen Reich* (Yearbook for Legislation, Administration and the Economy in the German Reich), Leipzig.

[68] Federal Reserve Act, Section 14, Paragraph D; quoted in Miller (1921: 186).

[69] The Fed increased discount rates early in 1920 to try to stanch the rising price level. Probably because of the continuing inflow of gold, this increase in the discount rate on commercial paper of more than two percentage points seemed stunningly ineffective to Miller (1921: 190-2). He thought that the Fed should have raised discount rates immediately after World War I.

committee in 1919, "and as they become redundant in any locality they are returned to the Treasury in Washington, or to a Federal Reserve Bank for redemption [in gold]. Thus, there cannot at any time be more Federal Reserve notes in circulation than the needs of the country at the present level of prices require, and as the need abates the volume of notes outstanding will be correspondingly reduced through redemption….The increased volume of Federal Reserve notes in circulation during the past three years, in so far as it is not the result of direct exchanges for gold and gold certificates which have been withdrawn from circulation, is the effect of advancing wages and prices, and not their cause…."[70]

Inflation can never harm people since it occurs only at their pleasure. "The occasion of the issue of a Federal Reserve note is determined not by the bank for itself but for the bank by the community," said a Fed publication in 1919. "The question of whether or not a Federal Reserve note shall be issued is decided by the business and general community in accordance with its circulation needs."[71]

Blithe acceptance of inflation resulted from, and led to, ill-developed theory. Experts of the day "declare roundly that 'the issue of notes has nothing to do with their depreciation,'" wrote Edwin Cannan (1924: 54). "The majority of experts did so in every European country, belligerent and neutral alike, during the war, and in many countries they do so still. Even in Germany the late President of the Reichsbank is said to have believed it to the day of his death, when the paper mark had sunk to a billionth of the value of a gold mark." In 1915, the president of England's Board of Trade vouchsafed that "the line of escape from rising prices must be found in raising wages..." (Keynes 1950b: 171). In 1924, Sir Harry Goschen, chairman of a major British bank, National Provincial Bank, told the public that "I cannot help thinking that there has been lately far too much irresponsible discussion as to the comparative advantages of Inflation and Deflation. Discussions of this kind can only breed suspicion in the minds of our neighbors as to whether we shall adopt either of these courses, and if so, which. I think we had better let things take their natural course." Keynes (1963: 222) commented: "Best of all, perhaps, just to leave Sir Harry to take his natural course."

Bankers and theorists failed to understand that banks could create money by lending their reserves. Cannan (1924: 63) had snorted that money-creation theory was "…all moonshine: Every practical banker knows that he is not a creator of credit or money or anything else but a person who facilitates the lending of resources by the people who have them to those who can use them." To Keynes (1950b: 50), bankers committed this fallacy of composition: Because no one bank could create money of several times more than the original amount of its reserves loaned, neither could the system of banks.

Lacking theory to guide them, central banks may have been passive partly because they observed a self-enforcing mechanism in commercial banking. Keynes said money supply depended partly (and inversely) on the share of deposits that commercial banks

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[70] This quotation of a member of the Federal Reserve Board is from the *Federal Reserve Bulletin,* August 1919, pages 701-702. I draw upon the excerpt in Miller (1921: 183).

The Fed maintained that credit was always helpful -- except that for speculation, which was always harmful. This stance was distilled from notions of the American economist James Laurence Laughlin. He had founded the department of political economy at the University of Chicago and had taught Henry Parker Willis (an author of the Federal Reserve Act) as well as Adolph Cooper Miller (the only economist on the Federal Reserve Board in the early Twenties) (Hayek 1999a: 135).

[71] *Federal Reserve Bulletin*, September 1919, page 814. I draw upon the quote in Reed (1921: 64-65).

locked up in vaults. Pigou had thought that the reserves share of total deposits would depend on activity of the national economy, but Keynes calculated that banks throughout the West had stabilized this share at roughly a tenth.[72] Evidently, most banks had adopted the reserve ratio of the leading private banks, in order to avoid giving the impression of careless lending.[73] Banks had no reason to hold reserves in excess of the standard ratio, since reserves earned no interest, speculated Keynes (1950b: 53-78). A bank's creation of money depended on what other banks were doing; their reserve ratio was a given. The central bank did not have to set it.

Passive adoption of the standard reserve ratio was common even in countries such as Britain where the central bank could have required commercial banks to set aside minimum reserves but did not. Keynes (1950b: 70-4) criticized this failure. "…We ought to be able to assume that the Central Bank will be at least as intelligent as a Member Bank and more to be relied on to act in the general interest." A passive money supply and an active central bank may seem a curious juxtaposition, but Keynes (1950: 30) regarded the Bank of England as "the conductor of the orchestra [which] sets the tempo." The central bank was a welfare-maximizing black box. There was no theory here of an active money supply – or of an active money supplier.

In *A treatise on money*, Keynes (1950b: 163) expanded his black box without filling it. "Perhaps the ultimate solution lies in the rate of capital development becoming more largely an affair of state, determined by collective wisdom and long views. If the task of accumulation comes to depend somewhat less on individual caprice, so as to be no longer at the mercy of calculations partly based on the expectation of life of the particular mortal men who are alive today, the dilemma between Thrift and Profit as the means of securing the most desirable rate of growth for the community's aggregate wealth will cease to present itself." Keynes may have been on shaky ground to assume that the price at which capital can be resold never reflects its expected present value beyond the life of its current owner. But what would infuriate future critics like Milton Friedman was Keynes' cool presumption that state officials would surely come closer to the optimal rate of investment than could the invisible hand.[74] As early as 1766, the public finance theorist Johann Heinrich Gottlob von Justi (1948) had pointed out that monarchs were self-interested and so had to be compelled to raise money from their crown estates first, not from the populace.[75] In this respect, a monetary policymaker has the same temptations as

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[72] The outstanding exception was Germany, where the reserve ratio fell to 2.5% in 1928. Keynes (1950b: 65-6) explained that the commercial banks let their reserves run low because they could always easily replenish them by rediscounting bills at the local branch of the Reichsbank. He feared that this dependence could force the central bank to print money in order to save troubled banks, sparking inflation.

Keynes (1950b: 53) attributes Pigou's claim to his *Industrial fluctuations,* London: Macmillan, 1927, page 259.

[73] Marshall (2003: 135-7) pointed out that the practice of commercial banks of keeping reserves at the Bank of England had evolved naturally in the 19th century. One reason was that the banks could settle their debts with one another easily through transfers between their Bank of England accounts.

[74] Friedman (1997: 22) wrote that Keynes "contributed greatly to the proliferation of over-grown governments increasingly concerned with every phase of their citizens' daily lives…Benevolent dictatorship is likely sooner or later to lead to a totalitarian society."

[75] "It would, indeed, be very desirable if rulers had always limited themselves to these two sources of revenues, domains and prerogatives, and had never opened up the third source, taxes and contributions. Nothing is so subject to abuse, and can so weaken the state, as this source; and it is also human nature to abuse it. Men are seldom prudent managers of their own property; they are either spendthrifts or misers,

a fiscal one: An expansionary policy transfers wealth from a future generation to the present one via the inflation tax, since people rarely recognize inflation immediately. More practically, Hayek argued that no government (or individual) could determine the critical variable, the natural rate of interest; it was unobservable.[76]

Perhaps Keynes had imbibed the notion of a welfare-maximizing central bank from his old teacher. Alfred Marshall (2003: 136-7) had written in 1923 that while the directors of the Bank of England included "many leading business men…it has been stated publicly that, as a general rule, their stakes in the Bank itself are so much less than their stakes in the general commercial prosperity of the country, that they cannot be tempted to sacrifice public interests to those of the shareholders of the Bank….They act with that full sense of responsibility which belongs to public ministers."[77] Apparently, Bank directors believe that monetary policy is so powerful that it can reduce the total return on their non-Bank portfolios by more than it will increase the return on their Bank portfolios. The rationale for this argument is not clear.

The younger Keynes (1914: 622) had regarded most central banks – the Bank of England was a decided exception – as hilariously irrational, thus mirroring the populace. "…In most other parts of the world…a gold reserve is thought of as being some sort of charm, the presence of which is valuable quite apart from there being any idea of dissipating it, -- as the emblem, rather than the prop, of respectability. It would be consistent with these ideas to melt the reserve into a great golden image of the Chief Cashier and place it on a monument so high that it could never be got down again. If any doubt comes to be felt about the financial stability of the country, a glance upwards at the image will, it is thought, restore confidence. If confidence is not restored, this only shows that the image is not big enough." Even a war fund such as Germany's in World War I often went by the board. "Although many countries now hold large quantities of gold, there are but few which pursue a rational policy in regard to it. At considerable cost they build up large reserves in quiet times presumably with a view to the next crisis; but

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and the difference is simply a question of more or less. How can we feel assured, therefore, that they will be good and prudent managers of property not their own, namely, the property of the state?" (von Justi 1948: 385)

[76] In *The general theory*, Keynes (1991: 182-5) abandoned the notion of a natural rate of interest, perhaps partly because his acolyte Sraffa (1932: 42-53) had pointed out that, in principle, such a rate may exist for every commodity in a moneyless economy, implying that the rate is more of a consequence than a determinant of economic activity. *The general theory* said savings and investment were determined respectively by the marginal propensity to consume and the marginal efficiency of capital (basically, the expected net value of additional investment) as well as by the market rate of interest. The natural rate of interest need not determine savings and investment. Monetary policy that tried to sustain the natural rate by holding the supply of money at the "neutral" level was delusive. By accepting that the natural rate automatically equated savings to investment, economists will find themselves "in deep water," Keynes warned. " 'The wild duck has dived down to the bottom – as deep as she can get – and bitten fast hold of the weed and tangle and all the rubbish that is down there, and it would need an extraordinarily clever dog to dive after and fish her up again.'" Keynes (1991: 223) cited Sraffa (1932) on the potential multiplicity of natural interest rates.

Keynes (1991: 243) also noted: "The 'natural' rate of interest…is merely the rate of interest which will preserve the *status quo*; and, in general, we have no predominant interest in the *status quo* as such."

[77] Contrast Marshall's attitude to the fear of Thomas Jefferson that the primary purpose of the Bank of the United States was to create a "moneyed aristocracy" that would exert political power by extending credit to the national government (Bailyn 2004: 50).

when the crisis comes mistaken policy renders them as little able to use the gold as if it were not there at all" (Keynes 1914a: 467).

It is not clear why Keynes suddenly abandoned these strong views. Schumpeter (1946: 506) complained that *The general theory* failed to take banks seriously. "…From first to last, Keynes displayed a curious reluctance to recognize a very simple and obvious fact and to express it by the no less simple and obvious phrase, that typically industry is financed by banks."

Keynes' new, sunny view of central bankers ignored David Hume's cynicism. "A great state," Hume (1948: 334) wrote, "would dissipate its wealth in dangerous and ill-concerted projects; and probably destroy, with it, what is much more valuable, the industry, morals and numbers of the people."[78] Keynes also ignored Adam Smith's argument that altruism may mislead the leader into disaster. "The statesman, who should attempt to direct people in whatever manner they ought to employ their capitals, would not only load himself with a most unnecessary attention, but assume an authority which could safely be trusted, not only to no single person, but to no council or senate whatever, and which would nowhere be so dangerous as in the hands of a man who had folly and presumption enough to fancy himself fit to exercise it" (Smith 1976: 478).[79]

To Austrian economists, who regarded control of money supply as the key to economic stability, the theory of passive money supply held a dangerous implication. Since the central bank merely supplied the money demanded, it had no reason to determine how money related to potential output. So it took no interest in the price level. Under a global gold standard, this link was not critical to understand, since gold for purchases would flow away from high-price nations and toward cheaper environs, eventually eliminating the international price differential. But in a Babel of national fiat currencies, global adjustments were less transparent. By temporarily distorting relative prices, rampant inflation in Region A might induce misallocations that permanently damaged the economy before agents around the world could infer from the real exchange rates (rarely reported in the media) that they should sell instead to Region B.

This danger inhered in the charter of a conventional central bank. It has "the recognized duty…to supply in an emergency – at a price – all that cash that may be needed to repay [commercial bank] deposits," wrote Hayek (1999b: 89). "Yet while the ultimate responsibility to provide the cash when needed is thus placed on the central bank, until this demand actually arises, the latter has little power to prevent the expansion leading to an increased demand for cash." The theory of passive money supply – one might better say "the reality" – held the gun-cotton of the economy's destruction.

Sobered, Austrian economists delved into political economy. Their observations of newly-established central banks, such as the Federal Reserve, suggested that a populist bent in the enabling legislation disposed such powerful institutes toward creating money more easily than destroying it. Perhaps it sold money cheaply to powerful clients. "The Federal Reserve Board adopted a policy in order to assist in the war financing which was economically unsound," the Board's governor admitted to Congressional committees in 1920. To provide President Woodrow Wilson with cheap loans financing World War I, the Fed cut its discount rate to below the coupon rates on Treasury bonds. Commercial

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[78] Hume was explaining why, in equilibrium, no nation would hold a disproportionally large share of monetary wealth.

[79] This passage immediately follows Smith's exposition of the "invisible hand."

banks could borrow cheaply from the Fed and lend to the Treasury at a slight profit. "The low rate of interest borne by these [Treasury] bonds was fixed with a view of holding down the expenses of the government as far as possible. Anyway, that is something the Federal Reserve Board has no responsibility for."[80]

Hayek viewed the central bank as a "safety valve" for a troubled credit market; but, due to public demands, it could supply money more easily than withdraw it.[81] The ensuing inflation, if unanticipated by the public, would reduce the real debt of borrowers over time since they could pay off the loan of expensive dollars with cheap ones. Eventually, borrowers would attempt risky projects, since inflation might reduce the cost of financing them. The failure of such projects would lead to unemployment, reductions in consumption, and to recession. Contrary to its presumed purpose, the central bank could increase oscillations of national income.

Keynes implicitly assumed that the more powerful the bank, the better. Policies predicated on this idea could magnify the damages done via a mismanaged supply of money, as the Austrians saw it. In the United States, central bankers of the Twenties often rejected Marshall's argument that the interest rate could allocate money to its most valuable uses. In the recesses of the Federal Reserve, historicist skeptics of monetary theory were apt to view the discount rate primarily as a regulator of the money supply, with the secondary purpose of providing profit to regional Fed banks. The Fed should address efficiency directly, by encouraging commercial banks to pursue some types of loans and to avoid others. Member banks should discourage speculative loans, because these siphoned away money from more productive purposes. (The possibility that speculation might improve the allocation of real capital over time, by shifting it from times of lower value to times of higher, seems to have escaped the anti-theorists at the Fed, although Schumpeter (1996) had noted this efficiency as early as 1911, in *The theory of economic development*.[82]) On the other hand, member banks should provide cheap money to farmers to build silos, in order to cut out the costly middleman in the sale of food to consumers. Such avenues of reasoning could lead to increasingly intricate regulation of real investment, permitting special interests to manipulate the bureaucracy.[83]

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[80] "The principal reason why discount rates were not increased earlier than they were in 1919 was on account of Treasury financing." U.S Senate and House committees on agriculture, joint hearings, Reviewing the activities of the War Finance Corporation, December 3, 1920, pages 62-63. I draw upon the excerpt in Miller (1921: 185-6).

[81] "…Central banks owe their origin to the need to create a safety valve that eases the situation once the money market is overstrained, thereby moderating the fluctuations in the money market when money becomes tight. This intervention fails to have an equally moderating effect on the oversupply of credit, which is responsible for harmful over-investments. It must therefore inevitably tend to generate a steady increase in the volume of credit being utilized and thereby render the recurrence of recession even more unavoidable. Largely because of the public conception of their function, central banks are intrinsically inclined to direct their activities primarily towards easing the money market, while their hands are practically tied when it comes to preventing economically unjustified credit extension, even if they should favor such an action. If central banks are to have a truly stabilizing influence, their capacity to tighten up too liquid a money situation must be at least on a par with their capacity to moderate an existing money shortage, and it must be brought into play with equal frequency" (Hayek 1999: 146-7).

[82] The book, originally in German, was not translated into English until 1934.

[83] With respect to cotton, the Federal Reserve Board stated in 1919: "The Board has consistently advocated during the past five years the policy of orderly marketing of crops. Assuming that adequate warehousing facilities are available, it seems to be in the interest of the consumer as well as of the producer

In 1752, David Hume (1948) offered an incipient behavioral theory of money supply. A thriving economy would attract overseas money, which the thrifty would accumulate in pools large enough for hefty loans. The incidence of thrift was higher in capitalistic societies, since these engendered a desire for wealth and thus for savings to lend out at profit.[84] Later work echoed some of Hume's ideas; Ricardo noted that a national economy with low prices would sell exports for money, causing home prices to rise.[85] But generally, the theory of money supply remained little developed until the 1970s, when sharp inflations in Western economies -- coinciding with development of the economic analysis of political behavior, "public choice" – gave rise to the notion of central bankers as self-interested seekers of influence.[86]

VIII. Conclusions and reflections

Before the 1930s, relatively little analysis in economics concerned unemployment that persisted despite changes in the price level. The lack of macroeconomic theory vital to predicting depressions occurring early in the 20th century may have been due to the relative ease of producing microeconomic theory instead; to uncertainty about whether to rely on induction or deduction; and to the lack of competitive pressure in developing business-cycle theory. Crude simulations of a probabilistic model suggest that these

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that staple commodities remain as far as possible in the hands of producers until sold for consumption. This policy gives the producer the benefit of an average price in that he is not required to 'dump' his products on the market in excessive volume, thereby depressing the price to the advantage of favored consumers or of speculators who do not as a rule pass the advantage on to the consumer." *Federal Reserve Bulletin,* December 1919, page 1109. I draw on the excerpt in Reed (1921: 74).

Needless to say, the Board could have accomplished the same aims by lending to speculators who would buy food in times of excess supply and arrange for its delivery in times of excess demand. Even setting aside the gains to consumers due to this intertemporal efficiency in allocation, it is not clear why competition among speculators would not force them to pass on their profits as well to consumers in the long run, if the Fed was not willing to capture the potential profit with high interest rates on the loans. The point of providing cheap loans to speculators is to lower the major barrier of entry facing potential rivals into that industry.

[84] "…If the employment you give [a man] be lucrative, especially if the profit be attached to every particular exertion of industry, he has gain so often in his eye, that he acquires, by degrees, a passion for it, and knows no such pleasure as that of seeing the daily increase of his fortune. And this is the reason why trade increases frugality, and why, among merchants, there is the same overplus of misers above prodigals, as, among the possessors of land, there is the contrary….

"Those who have asserted, that the plenty of money was the cause of low interest, seem to have taken a collateral effect for a cause; since the same industry, which sinks the interest, commonly acquires great abundance of the precious metals. A variety of fine manufactures, with vigilant enterprising merchants, will soon draw money to a state, if it be anywhere to be found in the world. The same cause, by multiplying the conveniences of life, and increasing industry, collects great riches into the hands of persons, who are not proprietors of land, and produces, by that means, a lowness of interest…

"In [a] conquering country, it is natural to imagine, that [the] new acquisition of money will fall into a few hands, and be gathered into large sums, which seek a secure revenue, either by the purchase of land or by interest….The increase of lenders above the borrowers sinks the interest…" (Hume 1948: 316 and 319-21).

[85] David Ricardo, *The principles of political economy and taxation*, London; J. M. Dent & Sons, 1992, pages 83-87. Ricardo does not mention Hume.

[86] For an example of the sterility and confusion imbuing the theory of money supply in the two decades after World War I, see Gregory (1925).

three factors may have been more important than the current stock of macroeconomic theory in spurring additional research. Also, early decisions affecting the structure of the market for theory as well as incentives for theory may affect the stock of macroeconomic theory more powerfully than will later decisions (Appendix B). But this model is primitive.

The financial crisis of 2008 may have been as shocking as the Great Depression. Perhaps such surprises are inevitable. If economists fashion theory only after the fact, then they may never anticipate the fact. Conversely, the lack of theory over time may lead to major downfalls because of cumulative ignorance.

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Appendix A: Chronologies of publications

Some important works relating to business cycles, before The general theory

1758. François Quesnay, *Tableau économique* (Economic table).

1766. Anne Robert Jacques Turgot, *Reflexions sur la formation et la distribution des richesses* (Reflections on the formation and distribution of riches).

1776. Adam Smith, *The wealth of nations*.

1811. David Ricardo, The high price of bullion: A proof of the depreciation of bank notes, fourth edition.

1819. Jean Charles Leonard Simonde de Sismondi, *Nouveaux principes d'économie politique* (New principles of political economy).

1825. Lord Overstone, *Reflections suggested by a perusal of Mr. J. Horsley Palmer's pamphlet on the causes and consequences of the pressure on the money market*.

1826. Thomas Tooke, *Considerations on the state of the currency*.

1848. John Stuart Mill, *Principles of political economy*.

1860. Clement Juglar, *Des crises commerciales et leur retour periodique en France, en Angleterre, et aux États-Unis* (The commercial crises and their periodic returns in France, England and the United States).

1867. Karl Marx, *Capital: A critique of political economy.*

1894. Mikhail Ivanovich Tugan-Baranowski, history of commercial crises in England.

1906. Irving Fisher, *The nature of capital and income.*

1907. Knut Wicksell, The influence of the rate of interest on prices.

1911. Fisher and Harry G. Brown, *The purchasing power of money: Its determination and relation to credit, interest and crises.*

1911. Joseph A. Schumpeter, *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle.*

1920. Fisher, *Stabilizing the dollar: A plan to stabilize the general price level without fixing individual prices.*

1923. John Maynard Keynes. *A tract on monetary reform*.

1923. Alfred Marshall, *Money, credit and commerce*.

1925. Arthur Spiethoff. Krisen (Crises). Translated into English as *Business cycles* in 1953.

1925. Friedrich A. Hayek, Monetary policy in the United States after the recovery from the crisis of 1920.

1926. D. H. Robertson, *Banking policy and the price level: An essay in the theory of the trade cycle*.

1930. Keynes, *A treatise on money*.

1931. Hayek, *Prices and production.*

Some other important works, cited in this paper

1752. David Hume, Political discourses.

1766. Johann Heinrich Gottlob von Justi, *System des Finanzwesens* (Public finance).

1807. Henry Thornton, *An inquiry into the nature and effects of the paper credit of Great Britain.*

1817. Ricardo, *The principles of political economy and taxation*.

1932. Hayek, Money and capital: A reply.

1942. Schumpeter, *Capitalism, socialism and democracy.*

Appendix B: Mathematical derivations

Function V. The first derivatives of *V* are

$$\frac{dV}{dp} = nk(1-p)^{nk-1},$$

$$\frac{dV}{dn} = -k(1-p)^{nk}\ln(1-p),$$

$$\frac{dV}{dk} = -n(1-p)^{nk}\ln(1-p).$$

Unless *nk* is very large, the last two derivatives will exceed the first, since

$$1-p < e^{1-p}$$

for all *p*, implying that

$$\ln(1-p) > 1-p.$$

Crude simulations suggest that the chances of at least one success are good as long as $n > 1$ and $k > 1$ (Table 1 below; note from Equation 1 that *n* has the same effect on the probability of at least one success as does *k*).

Simulations for model of Depression theory

p	*n*	*k*	*Prob of success*
0.5	1	3	0.875
0.5	2	3	0.984
0.5	3	3	0.998
0.5	4	3	1.000

Table 1

A more sophisticated model of *p(t)* is as a logistic function of *p(t-1)*, due to scale economies in producing theory and to truncations at 0 and 1.

The second partials of *V* are

$$\frac{\partial^2 V}{\partial p^2} = -(nk-1)nk(1-p)^{nk-2} < 0,$$

$$\frac{\partial^2 V}{\partial n^2} = -k^2[\ln(1-p)]^2(1-p)^{nk} < 0, \text{ and}$$

$$\frac{\partial^2 V}{\partial k^2} = -n^2[\ln(1-p)]^2(1-p)^{nk} < 0.$$

In a more general case, a theorist may have *s* publications and *k* failures. The probability that this combination would hold for each of *n* theorists is

$$\left[\frac{(k+s)!}{k!s!}(1-p)^k p^s\right]^n.$$

Counting ideas. Begin with *S* ideas. Add one more. This creates *S* connections with the existing *S* ideas. Since each connection is an idea, we have $S + S + 1 = 2S + 1$ ideas in all. Add another idea. This generates $2S+1$ connections, so the total number of ideas is now $2*(2S + 1) + 1 = 2^2S + 2 + 1$. Adding a third idea increases the stock to $2*(2^2S + 2^1 + 2^0) + 1$ ideas. Generally, the *k*th idea will increase the stock to $2^kS + 2^{k-1} + 2^{k-2} + \ldots + 2^{k-k}$, or

$$2^k S + \sum_{i=0}^{k-1} 2^i .$$

To sum the geometric series in the last term, denote it as M and note that

$$M = 1 + 2 + 2^2 + \ldots + 2^{k-1}.$$

But

$$2M = 2 + 2^2 + \ldots + 2^k.$$

Subtracting, we obtain

$$2M - M = M = -1 + 2^k.$$