How Economic Theory Went Wrong

by Andrew Smithers

Well-managed economies grow at a decent pace while keeping unemployment and inflation at low and stable levels. By these criteria, all major developed countries have been run incompetently for the past two decades. They have experienced stagnation of output and incomes, the worst recessions since the Great Depression, and, more recently, a surge in inflation. Support for liberal democracy has been seriously endangered by this failure of economic policy.

In a previous article in this journal, "Monetary Policy, Tax Policy, and Investment,"[1] I explained that, while economic policy has been appallingly bad, it is wrong to blame either central bankers or governments. Official policy must be rationally based on accepted theory and, as today's consensus theory is wrong, the economy cannot be well managed until this theory is replaced. It would have been unfair to blame eighteenth-century doctors for bad medical practice, and it is unfair to blame economic policymakers today for their bad management. We should not blame the ignorant for their ignorance. Economists in central banks and treasury departments believe what they were taught when young; and students are still being taught similar nonsense when they study macroeconomics at universities and finance at business schools. Academic economists today are making a similar mistake to that made by British generals in the 1790s. In the words of James Thomas Flexner, "Washington learned the lessons of the American war . . . because he had no conventional lessons to unlearn. The British and the Hessians, on the other hand, suffered the confusion common to acknowledged experts when their expertise ceases to function."[2]

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The basic errors of the current consensus were introduced when the discipline was being developed after World War II. Macroeconomics barely existed as a discipline before the Depression. It was assumed, with little debate or analysis, that output rose steadily, with its fluctuations being unfortunate but mild, as demand responded to changes in short-term interest rates and could therefore be boosted by central banks if it were weak. The Depression exposed the inadequacy of existing economic theory to deal with a dramatic collapse in employment and output. We were fortunate that John Maynard Keynes was able to show that massive unemployment could be avoided by using government budget deficits to boost demand. Keynes observed that there are circumstances, which he called liquidity traps, when cuts in interest rates could not always increase demand. When monetary policy is incapable of reducing high levels of unemployment, fiscal stimulus is needed, which involves increasing government expenditure or reducing tax revenue.

Despite the great opposition that heterodox views always generate, events proved too powerful for change to be resisted, and the assumed expertise entrenched in academia crumbled. As old ideas were no longer held to be gospel, economics was in turmoil after the war. It had become an exciting subject and great intellectual efforts were made to produce a macroeconomic theory which incorporated Keynes's ideas and included a way to manage the economy through the combined use of both monetary and fiscal policy. The result would eventually become the consensus theory, which is currently taught to undergraduate and graduate students. Following much hard work, the result is a mathematically coherent model of the economy, whose conclusions follow logically from a small number of assumptions. Its only fault is that these conclusions are wrong.

From Untestable to Incorrect

In any model of how the world operates, be it about physics, medicine, or economics, if the assumptions are wrong, it is highly likely that the conclusions which follow from them will also be wrong. This is what happened with the neoclassical synthesis. Its mistaken assumptions have become, over the past seventy years, so deeply embedded in academia that they are exceptionally hard to change. It is not only difficult for academics to unlearn what they learned when they were students; they must accept the bitter pill that their teaching and the papers on which their prestige rests are fundamentally invalid.

Economists are often accused of excessive reliance on math due to "physics envy." As Paul Krugman wrote in 2009, "The economics profession went astray because economists, as a group, mistook beauty, cloaked in impressive-looking mathematics for truth."[3] This is a criticism, however, to which I only partly subscribe. The failure of consensus economics is not primarily caused by an excessive reliance on algebra, but through basing sound mathematical reasoning on mistaken assumptions. The glaring errors of current consensus economics come from a failure to insist that hypotheses must be capable of being tested against data and proved to be robust when so tested.

Nothing in science is ever proved; knowledge is encapsulated in models, and the one currently assumed to be correct is simply the best we currently have, and we arrive at the decision about which model is best by debate. The debate involves three main processes: one consists in testing the model's conclusions to ensure that they follow logically from the assumptions, and the others are to test both the assumptions and the conclusions which follow from them to see that they are consistent with data evidence. Algebra is an excellent tool for checking that a model is self-consistent and is, therefore, a valuable tool for economists, though Krugman is correct that mathematical rigor, which shows the self-consistency of a model's assumptions and conclusions, is sometimes assumed to validate the assumptions. Mathematics is a useful tool for checking models, but it produces dangerous nonsense when the consistency of the model is assumed to justify the assumptions. As Ricardo Caballero and others have pointed out, this is a far from rare mistake among economists.[4]

Such errors are often the sad result of bad luck rather than bad judgment. When the consensus theory was being developed, there were little data available which could be used to check the model. It could not be based on evidence and was, by necessity, aprioristic—founded on assumptions whose validity cannot be tested. Aprioristic models, insofar as they are untestable, cannot have the status of being scientific.

When data started to become available, the consensus model became testable. And when tested, the evidence falsified the model. Consensus theory has therefore moved from being unscientific, because it was untestable, to being simply wrong because it fails when tested. Without data, consensus theory was necessarily aprioristic and had the bad luck to choose its assumptions badly. Even at the time, this did not go unnoticed, as several economists held that serious errors were present in its assumptions. Four of these critics, in particular, stand out in hindsight as having been proved correct.

When Nicholas Kaldor criticized consensus theory for its aprioristic and thus unscientific approach, he wrote that "one must not fall into the error of supposing that assertions about reality can be derived from *a priori* assumptions. Whether well-behaved homogeneous-and-linear production functions exist or not is a question of fact. They cannot be presumed to exist as a consequence of some basic postulate. . . ." He also remarked on "the intellectual sterility engendered by the methods of Neo-classical Economics."[5]

Robin Marris criticised the way in which the new consensus oversimplified by dividing the economy into only three sectors: government, private, and foreign. By failing to make a distinction between the business and household sectors, the neoclassical model assumed that those running companies would behave as if they owned the companies they ran. He argued that it was necessary to divide the private sector into two—a household sector and a business sector—as the decision-makers in the business and household sectors were motivated differently; they had, in economic terms, different utility functions. He therefore began "from the proposition that corporate directors may subject corporate policy decisions to utility functions of their own."[6]

Fortunately, the distinction between companies and their owners is so obvious that national accounts separate the data on businesses from those that apply to households. It is therefore easy to show, from the way the two sectors behave, that Marris was correct in his criticism. Nevertheless, the error of consensus theory in conflating business and households into one sector was compounded by another: the model also assumes that shareholders are concerned with the value of their companies' balance sheet net worth rather than with their share prices. This has led to considerable confusion in economic analysis and policy.

Hyman Minsky argued that the economy could not be kept in balance by any combination of monetary and fiscal policy. These tools could not prevent the bouts of instability engendered by financial speculation and the periodic crises that followed. Minsky therefore claimed that "Modern orthodox economics is not and cannot be a basis for a serious approach to economic policy."[6]

Milton Friedman pointed out that, while the consensus model sought to include interest rates, it had no role for money, and claimed that ignoring the relationship between the amount of money in circulation and the size of the economy's output was another serious error, notably with respect to inflation.[8]

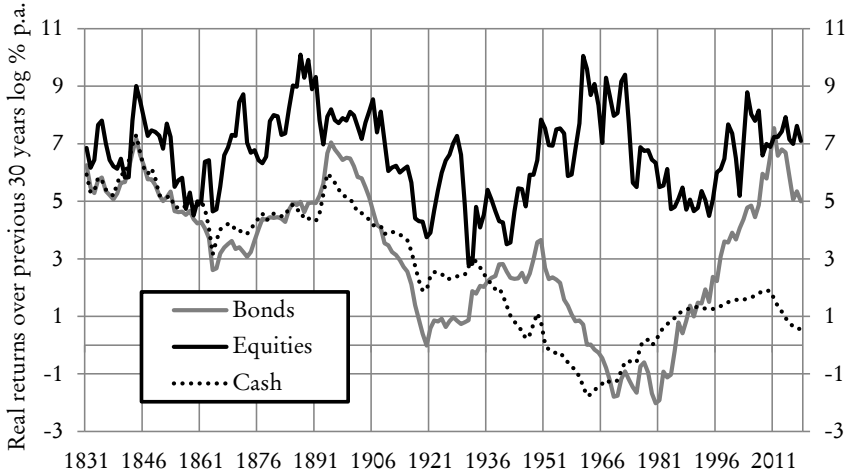
These four criticisms were ignored when the neoclassical model was developed and, now that data have become available, not only does each

of these objections seem totally vindicated but eminent economists have recently added another major criticism. Nobel laureate George Akerlof and MIT professor Ricardo Caballero have argued that we do not live in an economy whose stability can be maintained solely by keeping demand at its equilibrium level. The conclusion of consensus theory—that we live in a world in which stability can be maintained if one single equilibrium condition is achieved—follows logically if the cost of the capital needed to finance new investment varies only with fluctuations in real short-term interest rates, but Akerlof has argued that this assumption oversimplifies Keynes's work.

All models simplify by cutting out variables that do not affect their validity; oversimplification means cutting out too much, so when applied to any specific example, it is a polite way of saying that the model is wrong. As equity provides the bulk of the capital needed to finance investment and is more expensive than debt, this oversimplification of consensus theory requires that share prices and equity returns fluctuate with short-term real interest rates. Yet, as I show in *The Economics of The Stock Market* and illustrate in figure 1, they don't.[9] As the chart shows, the returns on equity fluctuate around a stable mean, whereas those for short-term interests rates and bonds wander in unrelated ways. Thus, while the logic of the neoclassical synthesis has been impeccable, its failure is simply due to its assumptions.

Looking back at the postwar history of economic thought, the criticisms of Kaldor, Marris, Minsky, and Friedman should not have been ignored, and this failure can be summarised by saying that we live

FIGURE 1. U.S. CASH, BOND, AND EQUITY REAL RETURNS OVER 30 YEARS



Sources: Jeremy Siegel, Elroy Dimson, Paul Marsh and Mike Staunton, S&P 500, and BLS.

in an economy which does not have a single equilibrium. Akerlof, paraphrasing Caballero, has called this mistake "one-deviation-at-a-timisim."[10] Economic theory must therefore be revised so that these criticisms are no longer ignored, and economists must accept that we live in an economy in which several different equilibria must be maintained for stability.

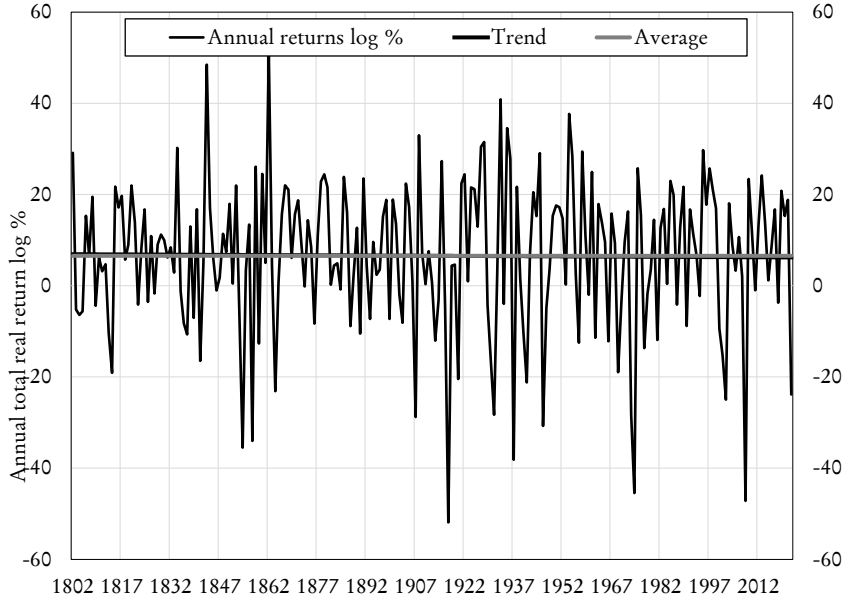
Yet it is not enough simply to show that the current consensus is wrong; it must be replaced by a better one, not only for teaching theory but also for policy. We must have a sound theory if we are to avoid the failures of economic management which have been such a sad feature of the twenty-first century. To be an improvement, the new model must be as logically coherent as consensus theory, but differ crucially in that its assumptions must be testable and robust when tested.[11]

A Better Model

As all four of the older historic criticisms, together with the more recent questioning of its single-equilibrium conclusion, are valid, the model that replaces the current consensus must satisfy all five of these objections. This requires replacing the assumptions of the consensus model with empirically derived postulates, along with the pragmatic addition of policies which avoid rapid growth in the ratio of money to output.

I call my attempt at a new theory the Stock Market Model, and its most important difference versus the consensus model is that it acknowledges that the return and cost of equity revolve around a stable average, with fluctuations being unrelated to changes in short-term interest rates or long-dated bond yields. We have 221 years of annual data which we can use to test this assumption and, as I show in figure 2, it is strongly supported by the evidence, as demonstrated by the trend return and the average return being virtually identical.[12] Because real equity returns are mean reverting, the stock market gives above average returns when it is cheap and below average ones when it is expensive, and the extent to which it is over or undervalued will determine the extent to which the return at any one time differs from the average. We can therefore measure the cost of equity by dividing its long-term return by the current value; thus today, when the U.S. stock market is around twice overvalued, relative to its historical mean, we know that the cost of equity is around 3.35 percent, or 6.70 percent divided by two. The stock market does not revert to its mean over any set timescale. If it did, its behavior would be predictable and the effective arbitrage of investors,

FIGURE 2. U.S. REAL EQUITY ANNUAL RETURNS

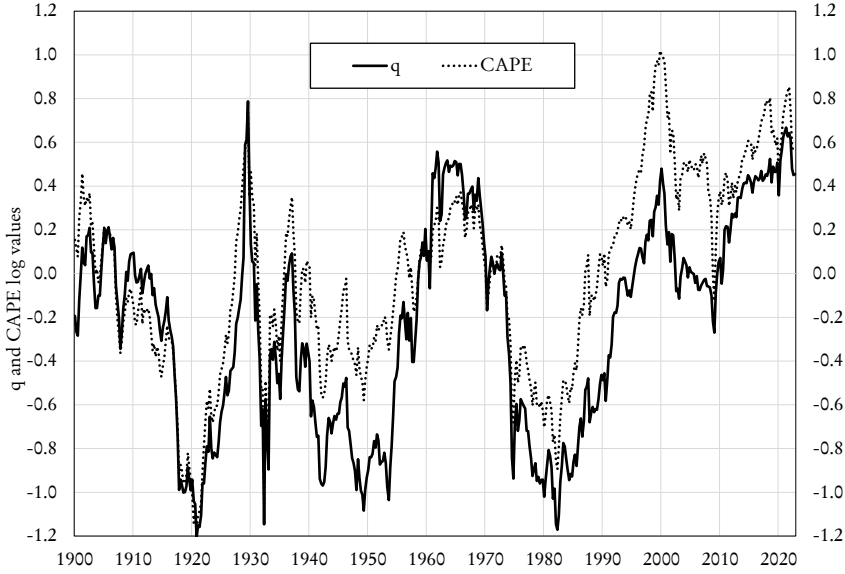


Sources: Jeremy Siegel for 1802–71; Robert Shiller for 1871–2022.

who would sell when it is high and buy when it is low, would ensure that the market could never be misvalued. As the speed of mean reversion varies and cannot be predicted at any one time, however, neither can the return over any set number of years. But when calculating the value of the stock market at any time in the past with the benefit of hindsight, we need to look at subsequent returns not over a specific number of years but over the long term. I have shown that, once we average returns from any given starting point, the average of those returns over future years will vary considerably, but that thirty years of data are sufficient for measuring value by hindsight, as adding more data for additional years ceases to make any significant difference to the results.[13]

The mean reversion of the real return on equity is the central key assumption of the Stock Market Model and, as figure 2 shows, it can be tested and is supported rather than falsified by the data. It thus avoids Kaldor's criticism. With Marris, it insists on dividing the private sector between business and households, and by showing how asset prices become misvalued, it not only includes Minsky's view of financial instability but shows how this can be avoided. While money supply is not part of the model, it allows for the introduction of a third policy instrument which enables the problem noted by Friedman to be avoided.

FIGURE 3. U.S. STOCK MARKET VALUE Q AND CAPE

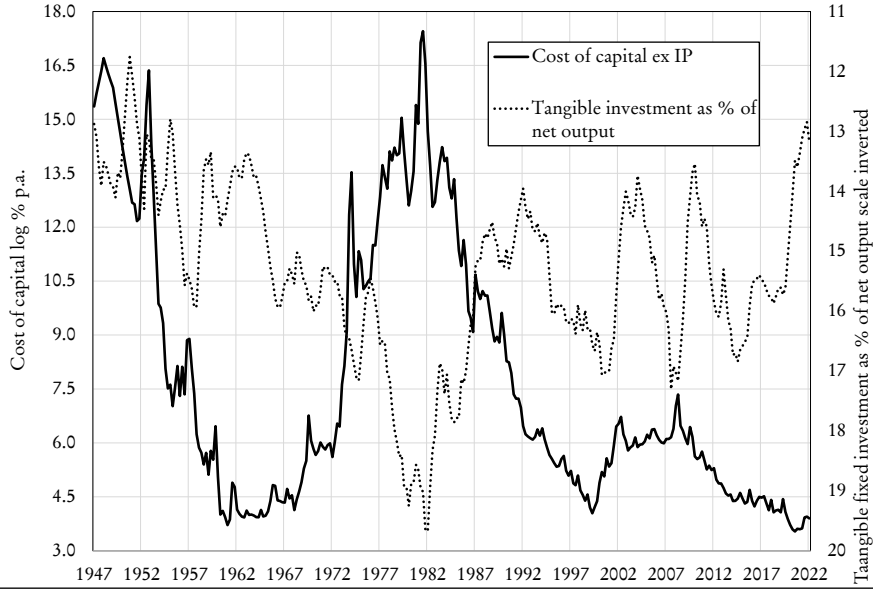


Sources: For q*: Stephen Wright, 1900–52; Federal Reserve B103, 1952–2022; CAPE, Robert Shiller.*

We can measure the cost of equity by dividing its long-term average real return by the current level of the stock market's value, and we can estimate this by using the term *q* or CAPE (the cyclically adjusted price-earnings ratio) which I illustrate in figure 3. These two measures agree with each other, as valid measures must, and they can also be checked and confirmed by hindsight, which involves checking the values derived from historic returns where we have thirty years or more of subsequent data. The resulting calculations show the validity of *q* and CAPE as measures of stock market value.[14] This allows us to calculate the cost of equity capital at any one time even without thirty years of hindsight data. As we know the ratios of equity and debt used to finance companies at any one time, and the cost of that debt in terms of the interest paid, we can calculate the user cost of business capital and test the assumption of consensus theory that investment fluctuates with it—a test, which as figure 4 shows, consensus theory fails.

That shareholders are concerned with the value of their companies' net worth, rather than their share prices, that company managers behave as if they were owners, and that real interest rates and returns on equity fluctuate together, are all key assumptions of the consensus model and are all incompatible with the data. One conclusion which follows logically from these assumptions is that management's decisions to invest fluctuate with the cost of capital to business (termed the user cost of

FIGURE 4. U.S. NONFINANCIAL COMPANY TANGIBLE INVESTMENT AND COST OF CAPITAL



Sources: Federal Reserve Z1 Tables B102 and F103, Fred, and NIPA Tables 1.15 and 1.14.

capital), and this is falsified by the data as figure 4 illustrates.[15] Another, which is that we live in a single-equilibrium economy, depends on the assumption that equity returns and real interest rates fluctuate together, which is incompatible with the evidence illustrated in figure 1.

The evidence therefore demonstrates that both the assumptions and conclusions of consensus theory are false. Yet economists who are aware of these data often choose to ignore them. As Ciaran Driver noted when reviewing *The Economics of the Stock Market*, "Macroeconomics does not seem embarrassed to ignore inconvenient findings."[16] Those who accept that there is a problem to be addressed can choose to incorporate the conclusions that follow from the data on equity returns in a revised model of the economy, or they can assume that the data are wrong. Model revision has so far been the least common response, while those who choose to find fault with the data provide an illuminating insight into the sociology of the economics profession. Once it is recognised that the data conflict with the model, one of the two must be wrong. Those who claim that the data are wrong in preference to the model typically show a degree of certainty which I think is irrational and seems more appropriate to discussions of theology than science.

Stephen Wright and I pointed to one example of blaming the data rather than the model when setting out our concerns about the Federal Reserve's economic policy under Alan Greenspan.[17] We wrote,

> The most celebrated exponent of this approach has been Robert Hall. He proceeds on the assumption that markets *must* be efficiently priced, and therefore that measured *q* must miss out on large amounts of unmeasured intangible capital, which he names 'e.capital'. Apart from its intangible, and hence rather ill-defined nature, Hall's unrecorded e.capital is just like the conventional type and thus it can only have been produced by savings and investment. Both must therefore have been massively under recorded in recent years.[18]

A more recent example was provided by Olivier Blanchard in his presidential address to the American Economic Association. He noted the increase in the value placed by the stock market on current profits that has taken place since the early 1980s, despite the relative stability of the return on replacement cost. "Put another way Tobin's *q* . . . has substantially increased. There are two potential interpretations of this fact. First the capital at replacement cost does not fully capture intangible capital. Second an increasing proportion of earnings comes from rents."[19] It is obvious that, in addition to the two ways in which the data might be wrong, there is a third possibility, which is that the model is the culprit. The wording of Blanchard's paper gives the strong impression that, for him, the idea that the model is wrong has become almost unthinkable.

Secular Stagnation versus Structural Liquidity Trap

Just as the Depression exposed the inability of conventional wisdom to explain or reverse the massive rise in unemployment, the past two decades have shown that consensus economic theory is today equally at sea over growth, inflation, and financial crises. A marked improvement in the way we manage the economy is desperately needed, and there are two changes required to make this possible. We must scrap current consensus theory and accept that we live in an economy for which at least three conditions must be met for steady growth to be accompanied by low and stable levels of unemployment and inflation. Today we only have two adjustments—those to interest rates and budget deficits—to control all three, and the economy is thus unmanageable without a third policy tool. In my previous article,[20] I showed that this third instrument

could be provided by tax policy. This differs from monetary policy as it leaves the budget deficit unchanged but switches the burden of tax from depressing investment to reducing consumption.

When Keynes pointed out that cutting interest rates sometimes failed to stimulate demand, he called these conditions a liquidity trap, and it has been assumed in the neoclassical synthesis that such traps are short-term cyclical ones and that, once the necessary medicine of fiscal stimulus had been applied, the economy would speedily recover and the rise in the budget deficit would be reversed. The twenty-first century has shown this to be a myth. For more than two decades, we experienced rising deficits and falling interest rates. This structural liquidity trap has also been called secular stagnation.[21] While these two phrases are descriptions of the same phenomenon, they have different policy implications. The term secular stagnation carries with it the implication that it cannot be cured by boosting investment, as any short-term increase in capital spending will be offset by a compensating fall in the future. This assumption is consistent with current consensus theory and implies that the real rate of interest has some natural or neutral level.

In other words, consensus theory assumes the existence of an animal—the natural rate of interest—for which there is no evidence. In reality, the rate of interest is determined by political decisions, including those about the level of corporation tax and the budget deficit. For the real rate of interest to be natural in the accepted meaning of the word, it would have to be the natural consequence of the way people behave; it would have to be endogenous, not the result of their conscious political decisions and thus exogenous. Since it is exogenous, it is possible to escape from a structural liquidity trap by stimulating more business investment through tax policy.

There are widespread hopes that current developments in technology, notably through artificial intelligence, will boost investment and thus bring secular stagnation to an end without the need for tax policy. I hope that these expectations will prove justified, but we would be unwise to rely on them, particularly as there are today three major forces which encourage developed economies to have structural liquidity traps. The first is the bonus culture which, as I have explained both in an earlier article for *American Affairs*[22] and elsewhere,[23] has changed the incentives for corporate managers so that they require higher prospective returns on the equity needed to finance net investment. I expect the impact of this to ease over time, but it appears to remain a current hindrance to corporate investment. The second problem is the rise in buybacks compared to dividends as the preferred way to distribute cash

to shareholders. Those who receive dividends treat them as a certain contribution to their income, but treat any capital gains, which over time is the offsetting benefit from buybacks, as an uncertain benefit: the rise in buybacks therefore tends to enhance household savings. The third problem is China, which is now large enough to have an important impact on other developed economies. One way to understand China's "natural" trade surplus is that the rule of law there is insecure. The rich therefore wish to export wealth even if the return on it is lower than in China. The government seeks to prevent this by controlling the direct export of capital, but these regulations can be easily circumvented by pricing exports too low and imports too high, with the margins producing profits in the hands of friendly agents overseas. To this problem is added the current reluctance to stimulate domestic demand.[24] This structural excess of intended net savings in the private sector can be offset either by more investment or less savings and more consumption. In the run-up to the Greek euro crisis, Mediterranean countries chose more consumption, and it ended tragically. We face the same choice and will suffer unless we choose investment.

Changing Assumptions, Changing Methodology

Descriptions of a system do not allow us to understand it. For this we must extract a model by deciding which information is irrelevant and what can be ignored. The postwar development of the consensus model suffered from some unfortunate accidents. The first was that there were no data then available that could be used to check the validity of any model, and the one chosen was thus inescapably aprioristic. The second was that the choices turned out to be bad ones, and another was that they were accepted with such strength that the objections made to the emerging model were ignored. This century, the resulting errors in economic theory and management have proved very harmful, and we must replace the current consensus theory with the alternative that is available and provide the additional policy tools needed for successful economic management, if we are to avoid perpetuating the resulting grief.

Changing methodology is far more difficult than persuading scientists to adjust an assumption, as this requires an understanding of epistemology, which is the philosophy of knowledge, and scientists are often advised to simply get on with their job, stop worrying about what it is, and leave philosophy to the experts. "For a working scientist 'doing philosophy' is not part of the job description," as one review of a book

on physics recently put it.[25] Ignorance of epistemology has been noted by several distinguished physicists[26] as the cause of so much bad science, but the faults of economics dwarf those of physics.

Even the most notable revolutions in science usually involve only the adjustment of the previous paradigm rather than requiring its wholesale scrapping. Newton's laws remain in place and have been supplemented rather than thrown out by the introduction of relativity and quantum mechanics. Nonetheless, the arrival of relativity was a profound shock. We seem to crave certainty, and nature appeared to provide a feeling of security, as Alexander Pope observed when he wrote, "Nature and nature's laws lay hid in night, God said, 'Let Newton be!' and all was light."[27] As J. C. Squire's riposte underlined, however, Einstein's adjustment was profoundly unsettling: "It did not last. The devil howling, 'Ho, let Einstein be,' restored the status quo."[28]

The shock involved in replacing the current economic consensus model with one which falls on the right side of Karl Popper's demarcation between science and nonscience will be much worse, as it does not leave the assumptions of current economic theory undisturbed but requires them to be completely discarded. Economists, having first built the consensus model on assumptions which were at the time necessarily untestable, have refused to discard them when data became available that showed them to be invalid. The problem is not the absence of an alternative to replace consensus theory; it is that of persuading economists to accept change. This is never easy, but it is exceptionally difficult in this instance—precisely because the methodology which has been used to create the current model is unscientific. ⁂

NOTES

I would like to acknowledge my thanks to William White for his help and corrections—any errors of course remain mine.

1 Andrew Smithers, "Monetary Policy, Tax Policy, and Investment," *American Affairs* 7, no. 2 (Summer 2023): 33–49.

2 James Thomas Flexner, *Washington: The Indispensable Man* (Boston, Mass.: Little Brown and Company, 1974).

3 Paul Krugman, "How Did Economists Get It So Wrong?," *New York Times*, September 2, 2009).

4 "A theory is no longer testable when rejection is used not to discard the theory but to select the data moments under which the core model is to be judged." Ricardo Caballero, "Macroeconomics after the Crisis," *Journal of Economic Perspectives* 24, no. 4 (2010): 85–102.

[5] Nicholas Kaldor, "Marginal Productivity and the MacroEconomic Theories of Distribution: Comment on Samuelson and Modigliani," *Review of Economic Studies* 33, no. 4 (1966).
[6] Robin Marris, *The Economic Theory of "Managerial Capitalism"* (New York: Macmillan, 1964).
[7] Hyman P. Minsky, *Stabilizing an Unstable Economy* (New York: McGraw-Hill, 2008).
[8] Milton Friedman, "A Monetary and Fiscal Framework for Economic Stability," *American Economic Review* 38 (1948): 245–64.
[9] See for example figures 16 and 17 in Andrew Smithers, *The Economics of The Stock Market* (Oxford: Oxford University Press, 2022). Note also that, for the economy as a whole, equity provides all capital. There is no net debt as liabilities of the borrowers match the assets of the lenders. The entire produced capital stock is the value of its past savings, which equals past investment minus depreciation (or capital consumption). Business, however, is partly financed by debt, which it borrows from the household sector. In recent years companies have been using about two-thirds equity to one-third debt.
[10] George A. Akerlof, "What They Were Thinking Then: The Consequences for Macroeconomics during the Past 60 Years," *Journal of Economic Perspectives* 33, no. 4 (171–86).
[11] It took me several years before I felt I had given enough thought and built up enough confidence to attempt to produce such a model, which I have at last done briefly in a paper called "Improving Economic Policy," which was published in the journal *World Economics*; Andrew Smithers, "Improving Economic Policy," *World Economics* 24, no. 2 (April–June 2023).
[12] By measuring returns in log percentages, the comparison between trend and return can be used, as I do in this chart, to demonstrate the high probability of mean reversion, which is all that can be done as mean reversion can no more be proved. This has the advantage of being simpler to demonstrate than, for example, by using the algebra required for ADF tests.
[13] See chapter 15 of Smithers, *The Economics of The Stock Market*, for the detailed calculation.
[14] This is shown by R^2 for q of 0.8 and for CAPE of 0.52.
[15] The data series used in the tangible investment, but the lack of connection is also shown if intangible investment is included, as shown in Smithers, *The Economics of the Stock Market*, table 15.
[16] Ciaran Driver, "Macroeconomics with Firms and Stock Markets," *Contributions to Political Economy* 42, no. 1 (July 2023): 1–11.
[17] Robert Hall, "'E-capital': The Link Between the Stock Market and the Labour Market in the 1960s," Brookings papers on Economic Activity, 2000.
[18] Andrew Smithers and Stephen Wright, "Stock Markets and Central Bankers: The Economic Consequences of Alan Greenspan," *World Economics* 3, no. 1 (2002).
[19] Olivier Blanchard, "Public Debt and Low Interest Rates," *American Economic Review* 109, no. 4 (April 2019): 1197–1229.
[20] Smithers, "Monetary Policy, Tax Policy, and Investment.".

[21] Lawrence Summers, "The Age of Secular Stagnation: What It Is and What to Do about It," *Foreign Affairs*, February 15, 2016.
[22] Andrew Smithers, "Investment, Productivity, and the Bonus Culture," American Affairs 4, no. 2 (Summer 2020): 18–31.
[23] Andrew Smithers, *Productivity and the Bonus Culture* (Oxford: Oxford University Press, 2019).
[24] Robin Harding, "China's Demand Dilemma Could Spell Trouble for the World," *Financial Times*, September 5, 2023.
[25] Jennan T. Ishmael, "The Big Questions," *Times Literary Supplement*, July 14, 2023. Ishmael is William H. Miller III Professor of Philosophy at Johns Hopkins University; the cited essay is a review of Sabien Hossenfelder's *Existential Physics*. In an unpublished letter to rebut this common and totally mistaken view I wrote that "Karl Popper took the diametrically opposite view. When my father wrote to congratulate him on his FRS, he replied (July 5, 1976) "I am very happy about this election because recognition from scientists is, in my field, the only one that matters. I won't forget that you were among the first working scientists in this country to recognise the practical value of my ideas, and I shall always be grateful to you."
[26] Examples include David Deutsch, *The Fabric of Reality* (New York: Penguin, 1997); Sabine Hossenfelder, *Lost in Math* (New York: Basic Books, 2018); and Chiara Marletto, *The Science of Can and Can't* (New York: Viking, 2021).
[27] Alexander Pope, *Epitaph for Newton*, which was turned down for Newton's memorial in Westminster Abbey.
[28] J. C. Squire, *Epigrams* (1916).