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The Cacophony within Law and Macroeconomics*

By Roger Koppl**

Abstract

The emerging field of law and macroeconomics is dominated by Keynesianism, which is used to defend interventionism. Law fluctuates with economic fluctuations. I defend an alternative approach that resists fluctuations in the law and supports the rule of law. This approach emerges from old-fashioned monetary theory as exemplified by the work of F. A. Hayek and Leland Yeager. I show how the tools of complexity economics may be used to build on the foundations of such old-fashioned monetary theory. These tools are helpful in crafting criticisms of interventionist policies and in defending the vital importance of the rule of law.

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> General equilibrium theory can be a valuable vehicle for organizing thought about economic matters, even if it is not an adequate description of the character of economic life, precisely because it ignores the change, creativity, and cacophony that are natural elements of human life and the economic process.
>
> – Richard Wagner (2010, 73)

Introduction

Law and macroeconomics can do one thing only: make the idea of the price mechanism under the rule of law available to the rare political actor who can implement significant and enduring institutional change. That's it. Anything more is sound and fury.

The problem is that all change comes from within the system, which makes a common way of doing policy analysis inapplicable. Just to have a handy label, let's call this common way the "default" method of policy analysis. Default policy analysis identifies some policy that is considered "good," "optimal," "politically feasible,"

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or otherwise the thing to do. The policy expert says, "Do this." The policy analyst has done their job if they have shown that adherence to the policy will generate some good result, *ceteris paribus.* Default policy analysis ignores implementation. How is this good advice supposed to be implemented? There is a gap between the prescribed policy and the actions that will be taken by the real persons who have been given the policy prescription.

The default method of policy analysis assumes that the expert's advice will be followed without asking whether the persons who should follow this advice are willing and able to do so. The default method does not explicitly model all actors in the system. When an explicit model is missing, an implicit model will take its place. And the implicit model may be unreasonable. It may assume, for example, that the policy maker acts in a perfectly disinterested manner. James Buchanan objected to this sort of implicit theorizing when he exclaimed, "Economists should cease proffering advice as if they were employed by a benevolent despot, and they should look to the structure within which political decisions are made" (1987, 243). The theorist must model all actors in the system.

The gap between prescribed policy and actions taken is partly a matter of incentives and partly a matter of epistemics. Incentives matter because policymakers often lack the incentive to do as an expert advises. Working out, for example, the socially optimal monetary policy is useless because monetary authorities don't want the socially optimal policy. They want a policy that works for them in particular, not a policy that works for everyone in general They might even adopt some economist's preferred rule for a time. Eventually, however, the rule will be abandoned as inconvenient. (I briefly discuss the Taylor rule below.) Epistemics matter because policymakers often lack the knowledge required to do as the expert advises. Mazzucato and Li (2021, 46), for example, seek to "align corporate governance" in pharmaceuticals with the "public interest" by requiring publicly traded pharmaceuticals to put stakeholder representatives on their boards. But nobody knows who should represent each stakeholder group. Nor would such stakeholder representatives know which actions are in the public interest. The airy injunction to go forth and do good is not informative. The whole project of *designing* economic policy collapses because any policy must be implemented by persons who will, in the end, do what they damn well please and not what the expert tells them to do.

The only way around this problem of "policy endogeneity" (as we may call it) is to have *institutions* that induce people to behave appropriately. But if we take seriously the claim that all change comes from within the system, then we must recognize the problem of "institutional endogeneity," which parallels the problem of policy endogeneity in both incentives and epistemics. Who are the magic creatures that will put the designed institutions into place without error, self-seeking tweaks, or uninformed gaps? The expert advisor might design a beautiful constitution that, if followed, ensured a blissful future of *laissez-faire* abundance and democratic peace. But constitutions can be amended, abandoned, and ignored. A recurring theme in Hume's ([1778] 1983) *History* was the abject failure of the *Magna Carta* to constrain English monarchs. Devins *et al.* complain, "Constitutional design fails because any constitutional clause, mechanism, amendment, language, passage, provision, or principle becomes a tool that unknown persons will use in unknowable ways for unknowable ends" (2015). Thus, the whole project of *designing* legal and economic institutions collapses as well. We're not making progress.

The problem with the default method of policy analysis has been recognized by many scholars other than Buchanan, including rational expectations modelers. These scholars, however, have generally been better at modeling incentives than knowledge. Kydland and Prescott, for example, identify the policymaker's incentive to act in time-inconsistent ways. To prevent housing construction in flood plains, they might adopt a policy "not to build the dams and levees needed for flood protection." But if the houses go up anyway, "the government will take the necessary flood-control measures." Knowing this, people build and buy houses in the flood plain and, in the end, the dams and levees are constructed. The policy adopted at one point in time is inconsistent with the incentives that will predictably emerge at a later point in time (Kydland and Prescott 1977, 477).

My thesis is that law and macroeconomics, which is sometime called "LawMacro," can only make the idea of the price mechanism under the rule of law available to the rare political actor who can implement significant and enduring institutional change. My argument depends on both incentives and epistemics. The argument is difficult or impossible to make within the context of rational expectations. The rational expectations modeling technique has many virtues, but it is ill suited to the epistemic issues I wish to explore in this paper. It is ill suited to weigh the consequences of "the change, creativity, and cacophony that are natural elements of human life and the economic process" (Wagner 2010, 73).

I have been criticized for adopting "the nihilistic position that you can't do any social planning at all." And I do come close to such a view. But if economists, legal theorists, and other experts are to do more good than harm, they must confront what is possible. As the late Steve Horwitz never tired of reminding us, "Ought implies can."[1] It is not nihilism to model all agents in the system in an effort to avoid policy failures. Nor is it nihilism to recognize "the change, creativity, and cacophony that are natural elements of human life and the economic process" (*ibid.*).

Only rarely do events allow what I shall call a "fulcrum figure" to act on the system *as if* from without, imposing upon it changes that last and work as intended. Ludwig Erhard may be the best exemplar of such a fulcrum figure. He chose to eliminate price controls and generally liberalize what became the West German economy. And it worked; it enabled the so-called German economic miracle. The short book of Goldschmidt and Kolev (2023) gives a vivid account of this history. The emergence of such an actor cannot be planned, engineered, or reliably foreseen. Thus, again, law and macroeconomics can do one thing only: make the idea of the price mechanism under

[1] Immanuel Kant is generally credited as the original author of the principle, whose meaning is, of course, hotly disputed in philosophy (Mizrahi 2009; Kohl 2015). In invoking the principle here, I mean only to say that policies that cannot be implemented successfully are unlikely to improve things, and that we may rightly dismiss such policies as mistaken. If there is value in saying, for example, that the best monetary policy for the Federal Reserve would be to freeze the monetary base, such value is indirect. Making that claim might influence the general climate of opinion. But it will not induce the Federal Reserve to freeze the monetary base.

the rule of law available to the rare political actor who can implement significant and enduring institutional change.

My "nihilistic" argument elaborates on a comment by J. S. Mill. He said, "Ideas, unless outward circumstances conspire with them, have in general no very rapid or immediate efficacy in human affairs; and the most favourable outward circumstances may pass by, or remain inoperative, for want of ideas suitable to the conjuncture. But when the right circumstances and the right ideas meet, the effect is seldom slow in manifesting itself" (Mill [1845] 1967, 370).

1. Keynesian Law and Macroeconomics

The vision of law and macroeconomics that I have just quickly sketched differs from the Keynesian LawMacro put forward by Listokin (2017; 2019a; 2019b), Borowicz (2021; 2023) and others.[2] (See also Gelpern and Levitin 2020.) This Keynesian literature provides, unfortunately, a perfect foil for the vision of law and macroeconomics that I sketch in this paper.

Listokin (2019a, 46) rightly says, "Law and economics should really be called 'law and microeconomics.'" We need law and *macroeconomics.* Law and economics is a well-developed field of study. It has contributed important results to economic theory and policy. As Professor Wagner has reminded us, however, most of these contributions have been in microeconomics, not macroeconomics. Unsurprisingly, perhaps, there are precursors to law and macroeconomics. Salient among them is Henry Simons' classic 1936 essay on "Rules versus Authorities in Monetary Policy," which kicked of the ongoing debate on "rules vs. discretion in monetary policy." Other examples include Kelman (1993), White (2010), and Salama (2012).

In spite of such precursors, there was no field of law and macroeconomics until Listokin (2017; 2019a; 2019b), Borowicz (2021; 2023), and others created a modest literature in it as a response, in part, to the Great Recession.

In this literature an explicitly Keynesian macroeconomics justifies a time-varying legal structure. Yair Listokin has said, "Lawyers may discover here a new baseline for evaluating laws and regulations: in addition to asking whether a law is just, fair, administrable, or microeconomically efficient, we should consider that law's effects on the macroeconomic environment. A legal decision that is right when the economy is healthy may well be wrong at the zero lower bound on interest rates" (2019b, 6). He uses IS-LM analysis to argue that if a state government "preempts local zoning laws" during a liquidity trap we get "a large increase in output and reduced unemployment but no change in interest rates." He says, "The demand expansion caused by the change in zoning laws thus helps the central bank achieve its goals when its primary instruments are unavailable" (2019a, 71). He thinks a "solar power mandate" could have similar benefits in a liquidity trap. Listokin wants legal changes to kick in when the economy is stuck in a liquidity trap. "Thus, in deep recessions, law and eco-

[2] Salama (2012) flagged the need for law and macroeconomics but should not be classed with the Keynesian group around Listokin and Borowicz.

nomics should change" (Listokin 2019a, 74). In the same spirit, Borowicz argues that "as a matter of policy, the bankruptcy law protections of creditors offering to lend money to large firms in a boom should be weaker than those of creditors offering to lend to such firms in a bust" (2021).

To these writers the rule of law called for by Dicey ([1915] 1982) and Fallon Jr. (1997) is an impediment to beneficial action. They want the law to be supple, a lithe and moving creature that responds sensitively to the changing judgments of state experts, not the static, stiff, and stodgy structure created by the rule of law. This desire for law to fluctuate in response to economic fluctuations is mistaken. As Mario Rizzo has said, in a "dynamic world" we need "the certainty and simplicity of static law" (1980, 291).

Keynesian law and macroeconomics has neglected the rule of law because it has neglected the vital epistemic dimension to policy. Listokin, Borowicz, and others have not asked how their preferred policies will influence the production and distribution of knowledge in society. They neglect the epistemic dimension. Listokin does recognize that "it is hard to know whether a particular legal policy will promote or inhibit spending and employment" (2019, 76). He tosses the problem aside, however, with the breezy assurance, "The direct effects of the law on spending are a coherent empirical question that is already studied by some agencies as part of 'feasibility analysis'" (*ibid.*). Listokin's source, Masur and Posner (2015), does not support his claim. On the contrary, Masur and Posner repeat the main gripe of their 2010 paper (entitled, ahem, "Against feasibility analysis") that it is not cost benefit analysis, which they prefer. Masur and Posner report that the US government's agencies for environmental protection (EPA) and workplace safety (OSHA) have "typically" interpreted "economically feasible" to mean that "complying with the regulation would not lead to massive job loss or bankrupt the entire industry" (*ibid.*, 116, 135). This is hardly engaging "the coherent empirical question" of policy consequences, which Listokin falsely imagines to be unproblematic and largely solved. Law and economics as practiced by Keynesians such a Listokin and Borowicz ignores the "change, creativity, and cacophony" that Wagner views as "natural elements of human life and the economic process."

When we take this change, creativity, and cacophony seriously, law and macroeconomics looks very different. Epistemic problems move to the center. And, as I will argue, these epistemic problems are best handled by the rule of law. Wagner has said to me in personal conversation, "Rule-of-law principles are nowhere to be found within contemporary discussions of macro policy, where all that seems to matter is the achievement of some statistically stated objective." It is high time we chisel out the general contours of an epistemically informed law and macroeconomics, giving pride of place to the rule of law.

2. The Logical Problem of Law and Macroeconomics

There is a logical problem at the heart of law, macroeconomics, LawMacro, and, indeed, all of social science. The problem is self-reference. Recall that the theorist must model all actors in the system. But the theorist is in the system. The theorist must include themself in the model, therefore, which gives rise to the paradoxes of self-reference.[3] That's a problem.

The expert in the system is in the position of Pirandello's ([1926] 2010) character Vitangelo who tried in vain to catch himself in the mirror unawares. He wanted to see himself not as himself, but as a perfect stranger. "My supreme effort must consist in this: not to see myself *in me*, but to be seen *by me*, with my own eyes, but as if they were those of another: that other that everyone sees, and I do not." Vitangelo's futile effort had its origin in a shock to his vanity: the discovery that his nose was not quite straight. Like Bernard Mandeville ([1729] 1924; 1732), Luigi Pirandello thought one could see oneself only through the funhouse mirrors of vanity, pride, and self-deception. Adam Smith ([1759] 1982, 130–2), instead, thought that with God's help we can know how we are to others. I wish that the man in *my* breast were so impartial and unerring! I share the doubts of Mandeville and Pirandello that any human can achieve perfect and paradox-free self-transparency. But if self-transparency is not possible, the project of macroeconomics is flawed and ultimately doomed. We are being carried along by the stream, and it is an illusion to imagine that we are in charge.

The endogeneity of policy prescription is a logical point. It is also a pragmatic reality. White (2005) has shown the great influence of the Federal Reserve System on macroeconomics. It is a demander of macroeconomic models and enjoys monopsonistic power. Macroeconomics' servile dependence on the Fed puts it among the "academic 'rackets'" Roucek (1963) and Tullock (1966, 158) railed against.

Kydland and Prescott draw the connection between their idea of time-inconsistency and monetary policy but do not elaborate on it. Barro and Gordon (1983a; 1983b) do. Barro and Gordon (1983b) is the canonical model of time-consistent monetary policy. Taylor (1993; 2021) suggests that what we now call the "Taylor rule" is time-consistent without proving it. But I do not understand how the "Great Deviation" of 2002–2006 (Taylor 2011), in which US monetary policy was looser than prescribed by the Taylor rule, could have been possible if the Taylor rule were time-consistent in the sense of Kydland and Prescott. If it were, the monetary authorities in the US acted contrary to their interests during the Great Deviation.

Brian Arthur has insisted that "all systems will be gamed" (2015). He is more radical than Kydland and Prescott (1977) because he repudiates equilibrium. The economy, Arthur says, is "a web of incentives that always induce further behavior, always invite further strategies, always cause the system to change." Arthur is more optimistic than I am, however, when he says, "We need to emulate what is routine in structural engineering, or in epidemiology, or in encryption, and anticipate where the systems we study might be exploited" (*ibid.*) If Koppl *et al.* (2015) are right, some strategies of exploitation are unpredictable.

Goodhart's Law suggests one path of system exploitation. The law is, "any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes" (Goodhart 1978, 116). Expectation and reaction drive Goodhart's

[3] Levy and Peart say, "we need to put the economist in the model" because economic "experts share motivational structure with those we study" (2017, 192).

Law. The agents within the system alter their behavior when the statistical regularity is exploited for control purpose. If opera performers were paid by the decibel, their singing would be loud and off key. (The logic of this conclusion has been explored by Holmstrom and Milgrom 1991.) Goodhart's Law does not apply, therefore, to strictly mechanical systems. It is a "statistical regularity" that pressure on the brake pedal will slow a moving car. Drivers exploit this regularity "for control purposes" without "collapse" of it. Your car brakes have no *expectation* that you will apply pressure to the brake pedal. They can have no *reaction*, therefore, to your use of the brake pedal for control purposes.[4] In human systems with expectation and reaction, however, the use of some metric as a goal or performance measure may cause the system to morph in ways that defeat the putative purpose of using that metric.

The "hydraulic Keynesianism" I discuss below ran afoul of Goodhart's Law. Economic actors respond to economic policy, often in ways that defeat to putative ends of such policy. Thus, the Phillip's curve relationship between inflation and unemployment cannot be reliably exploited by the monetary authorities. The public's reaction to the *expectation* of inflation erases the link between money growth and unemployment. The "Lucas critique," also discussed below, relies on this logic of Goodhart's Law.

Goodhart's Law is illustrated by the LIBOR scandal of 2012, in which banks were fibbing about their costs of credit to hide their financial precarity (Ridley and Jones 2012; McDonald 2019). Well before the scandal, the LIBOR's administrator, the British Bankers' Association had become an interest group that was politically active in the European Community and enjoyed the sanction and support of the Bank of England (Sargent 1982). The Association was "entangled" in the sense of Wagner (2007; 2016; 2020), Podemska-Mikluch and Wagner (2010; 2017), and Smith, Wagner, and Yandle (2011). The details reveal the importance of Wagnerian entanglement to an epistemically informed law and macroeconomics.

The LIBOR is the London Interbank Offered Rate, which was an average interest rate on unsecured overnight loans between large British banks. It was created in 1969 by Manufacturers Hanover to facilitate a syndicated loan to Iran (Ridley and Jones 2012; McDonald 2019, 31–2). In a "syndicated loan," several lenders participate under the coordinating leadership of the "lead bank." The rate used in the sort of syndicated loans pioneered by Hanover was a weighted average of the rates "reference banks" gave as their "funding costs" (Ridley and Jones 2012). The formula in use as of 2012 was "broadly similar" to the original formula devised for the Iran loan by Hanover executive Minos Zombanakis (*ibid.*). Any incentive to report bogus numbers was weak. The banks stating those rates participated as lenders and thus had an incentive to report artificially high values. But, "any bank that submitted an unreasonably inflated interest rate would be ejected from the syndicate – and see a potentially valuable relationship with the borrower destroyed" (*ibid.*).

Things changed in 1986 when the LIBOR was made public. As the number of medium-sized international syndicated loans grew, there emerged a desire among partic-

4 I thank Michael Munger for help with this discussion of Goodhart's Law. I have lifted the braking example and some of my language from his helpful comments.

ipating banks for "more transparent way to fix the rate" (McDonald 2019, 34). The British Bankers' Association (BBA) then took over the function of computing LIBOR. And they began publishing it. It had been a private rate that might differ on the same day from one syndicated loan to the next. With the BBA takeover, it became a public benchmark guiding an indefinite number of independently organized loans. In this new situation, a bank feeding data into the computed LIBOR might easily be a borrower and not a lender in a loan made at a LIBOR-influenced rate. These banks now had an incentive to lowball their reported rates. Others might have the opposite incentive. And the crucial epistemic discipline provided by the lead bank in a syndicated loan disappeared. The fibbing likely began without delay. Keenan reports that, based on his personal experience as a trader, "it seems the misreporting of Libor rates may have been common practice since at least 1991" (2012). In the run-up to the 2008 financial collapse the temptation to cheat grew, and banks came to game the LIBOR with increasing frequency. The financial press published doubts about the LIBOR as early as April 2008. In what may be the first such report, Mollenkamp said, "Some banks don't want to report the high rates they're paying for short-term loans because they don't want to tip off the market that they're desperate for cash" (2008). But the scandal did not break until 2012. "Beginning in June 2012," Hou and Skeie (2014, 6) report, "LIBOR came under came under public scrutiny due to controversy over individual panel bank submissions during the height of the financial crisis." Barclays, UBS, RBS, and Rabobank all paid settlements with regulators shortly thereafter. Mollenkamp (2008) notes, "The Libor system depends on banks to tell the truth about their borrowing rates." Unfortunately, the disposition to speak truthfully is inconstant and responds to incentives.

Entangled political economy as described by Wagner (2007; 2016; 2020), Podemska-Mikluch and Wagner (2010; 2017), Smith, Wagner, and Yandle (2011), and others played an important and generally neglected role in creating the context for LIBOR fibbing. From 1986 until sometime after the scandal broke, we have seen, the LIBOR was computed by the British Bankers' Association (BBA). Though the group was founded in 1919, by 1972 it had become "a moribund institution" (House of Lords as quoted in Sargent 1982, 271) that included only about a third of British banks (*ibid.*). It was ineffectual in part because no one knew precisely what institutions should be eligible to join the BBA. Enter the Bank of England. In 1971 the Bank imposed reserve ratios on all commercial banks rather than just clearing-house banks, thus supplanting the earlier system of more direct controls on bank lending. The measure required the Bank to draw up a list of institutions that counted as commercial banks subject to the new reserve ratio requirement. Thereafter, "eligibility for membership in the BBA was established on the basis of this list" (Sargent 1982, 271). At the same time, bankers came to feel the need for improved representation in the European Community, which had the power to impose potentially obnoxious regulations on EC banks and thus on British banks. The BBA was therefore reconstituted in 1972 to represent British Banking in the European Community. As Sargent explains, the BBA became an "interest group" that was politically active in the European Community and enjoyed the sanction and support of the Bank of England. It was this entangled, formally private, semi-official, interest group that computed the LIBOR from 1986 forward. And by 1991 at the latest, the LIBOR was being gamed, as all systems are sooner or later.

Devins *et al.* (2015; 2016) argue that constitutional design is "impossible" because the results of any design measure are unpredictable. They give the helpful example of the "two-senators rule," which was meant to suppress faction but "now supports 'special interest legislation' directing a disproportionate share of federal government spending to small states" (Devins *et al.* 2016). If constitutional and, by extension, institutional design are "impossible," then we may doubt that comparative institutional analysis is possible in macroeconomics. We may compare the relative performance of two previously existing institutional regimes in their respective times and places. And it might even be possible to say, for example, that economic fluctuations would be reduced by "free banking." But such claims can only be made *ceteris paribus.* At some point, untoward events plausibly (though, perhaps, falsely) linked to "free banking" will become tools that unknown persons will use in unknowable ways for unknowable and possibly illiberal ends. Free banking may not be a stable institutional equilibrium.

Since at least the time of Mandeville ([1729] 1924), thinkers in the liberal tradition have argued that social institutions emerge unintendedly. (It doesn't matter for this article whether Mandeville was himself a liberal.) Adam Smith ([1763] 1982), Paul Rubin (1977) and others have applied this general insight to the common law. It was an emergent and unintended consequence of human action. But if institutions are endogenous, comparative institutional analysis may reflect nothing more solid than an illusion of control where no control is possible.

Public choice theory emphasizes the endogeneity of legislation (Stigler 1971; Posner 1974; Yandle 1983). The Gramm-Leach-Bliley Act of 1999, which ended the prohibition on doing both commercial and investment banking, illustrates. The act was the product of successful lobbying by Citigroup to protect the merger of Citicorp with Travels Group, which created Citigroup. The merger brought commercial and investment banking under one roof in violation of then-current law (Suellentrop 2002; Broome and Markham 2012). Gramm-Leach-Bliley was the "Citigroup Relief Act" (Broome and Markham 2012, 1). "Citigroup is not the result of that act but the cause of it" (Thomas 2002). At the time the plan to merge was announced, Travelers' chairman said, "We are hopeful that over that time the legislation will change" (Martin 1998).

Macroeconomists too often imagine themselves able to design laws, policies, and institutions in much the way engineers are dubiously imaged to design airplanes and suspension bridges. The problem is surveyed, and all the relevant facts are arrayed before the all-seeing eye of the Designer. The Designer gazes down upon the system from the outside and puts the pieces in their rightful places. This description of engineering practice is a false idealization as Nelson and Nelson (2002), Ridley (2020), and others have noted. Nor does it apply to social engineering. Laws, policies, and institutions do not originate outside the system. They bubble up within the system. And the designing economist is no less inside the system than a bank, business, or bureaucrat. When everything is endogenous how is reform possible?

It is nevertheless true that choices will be made, and positive change is possible. The example of Germany's Ludwig Erhard is exemplary (see Goldschmidt and Kolev

2023.) It is sometimes mistakenly said that Erhard removed price controls "overnight," thereby bringing on the "German economic miracle." By his own account, however, much more was involved than removing the crushing hand of the state from the process of price formation. The institutional way had to be paved. A proper institutional environment is necessary for market prices to function well in coordinating economic activities. And the crucial institutional problem of that time and place was to establish sound money. The new Deutsche Mark was introduced 20 June of 1948 when Erhard was "director of the bizonal Office of Economic Administration" (Mendershausen 1949, 662). The removal of price controls came step by step. While the movement toward free price formation was quick, such freedom did not arrive "overnight." Mendershausen lists 20 broad categories of goods still subject to maximum or minimum prices in "Fall 1948" (*ibid.*, 664). These included "Basic foodstuff," rent, coal, "Rail rates," and "Rates for electricity, gas and water."

In various official roles beginning in 1947, Erhard acted to establish a broadly liberal economic regime in the zone that became, in 1949, the Federal Republic of Germany. After establishing "a responsible monetary and credit policy," Erhard has explained, "it was possible to remove all the restrictions characteristic of a directed economy and, above all, to restore the free formation of prices" (1958, 611). Erhard denied that he had brought on an "economic miracle." It was "the purposeful use of economic means and strict adherence to the market economy program which brought success." Erhard found a way to restore market prices to their coordinative function. He first laid the institutional foundations for the price mechanism. Only after these institutional foundations had been laid were price controls lifted.

The "institutional foundations" for the price mechanism are always a work in progress. And price controls can be enforced with greater or lesser zeal. Tolerating black markets, for example, relaxes control in some degree. Thus, it is a simplification to say that the institutional foundations must be laid down before the price mechanism can function well. But Erhard was right to recognize the enabling role of institutions such as sound money and the consequent necessity of improving institutions before more fully freeing prices.

Erhard's actions show that enduring institutional change is possible. But Erhard was a fulcrum figure acting in extraordinary times. All change comes from within the system, thwarting both institutional and policy design. Only in extraordinary circumstances such as post-war Germany is it possible for a fulcrum figure such as Erhard to act on the system *as if* from outside, beyond the system but acting on the system. As I write, Javier Milei has recently become president of Argentina. If he can become the Argentine Erhard, it was high inflation and growing poverty that put him in that position. It is generally only widespread hardship and grave institutional failure that enables the emergence of a fulcrum actor such as Erhard. Economic liberalism waxes and wanes, but the trend has been positive (Shleifer 2009; Leeson 2010). And it is the duty of scholarly economists convinced of the general benefits of liberal economic policies to have good policy proposals ready to hand should a favorable moment arise. We *can* make the idea of a price system under the rule of law available to the next Ludwig Erhard. We *cannot* do more.

3. The State of Macroeconomics

Macroeconomics was initially grounded in epistemics, but quickly turned mechanistic. Richard Wagner (2020) has called for macroeconomics to return to epistemic concerns, albeit with a more Hayekian than Keynesian theory of the production and distribution of knowledge in society. Butos and Koppl (1993) contrast Hayek's anti-rationalism with Keynes's rationalism. We should recover macroeconomics as an epistemic problem, but with an open-ended, evolutionary and subjectivist epistemics, not the rationalist epistemics of Keynes.

Wagner reports that the "first explicit distinction between micro and macro levels of economic analysis" (2020, v, 2) may have been made by Lindahl, who contrasted "*individual choice*" with "the domain of *societal interaction* among choosers" (1919). This "disjunction," Wagner says, "leads directly to the recognition that economies are complex systems of human interaction whose properties cannot be discerned simply through aggregation over the individuals who constitute a society." Lindahl's Swedish language original was not translated to English until 1939, however, by which time a Keynesian conception of macroeconomics had taken hold. In this conception, macroeconomics is essentially the study of Keynesian aggregates such as consumption, investment, and national income. Wagner laments, "ever since macroeconomics has centered on aggregation and not on human interaction along with the phenomena that emerge through interaction" (2020, v).

It is with good reason, then, that macroeconomics is generally considered to have begun in 1936 with Keynes's *General Theory* even though earlier works had, of course, considered the core macroeconomic issues of unemployment, inflation, output fluctuations, and growth. Macroeconomics was born, Mankiw tells us, "in the shadow of the Great Depression" (2006, 30). In this moment of its birth, macroeconomic theory was grounded in epistemics. Chapter 12 of the *General Theory* argues that investors cannot know the future beyond a fleeting short run. "We simply do not know" as Keynes later put it ([1937] 1973, 214). In this state of irremediable ignorance, investors cannot make "a good Benthamite calculation" (*ibid.*) of "prospective profit" (Keynes [1936] 1973, 150). Investors therefore "fall back" on the "convention" of, essentially, "assuming that the existing state of affairs will continue indefinitely, except in so far as we have specific reasons to expect a change" (*ibid.*, 152). This convention is precarious because it is "in an absolute view of things so arbitrary" (*ibid.*, 153). If the convention collapses for any reason, the economy collapses as well, falling into a crisis of confidence. And such "crises of confidence," Keynes said, "afflict the economic life of the modern world" (*ibid.*, 161). Modern capitalism is an irrational system in which the arbitrary waxing and waning of animal spirits produce business fluctuations with all their human cost.

Keynes's epistemic vision was quickly replaced by "mechanistic, determinate and mathematizable theory" of the sort his critics had "read into his book" (Shackle 1972, 224). Coddington (1976) called this bastardized Keynesianism "hydraulic Keynesianism." He may have had Phillips' (1950) analog computers in mind. These machines represented money flows with water flows. See Figures 1, which is drawn from Phillips (*ibid.*, 302). Abba Lerner later dubbed one of these machines “MONIAC,” which stood for “Monetary National Income Automatic Computer” (Bollard 2011, 5).

Figure 2 shows Phillips with one of his machines. The picture illustrates all too well the spirit of hydraulic Keynesianism. Phillips imagined himself outside the system he meant to control. He thought he was high and dry on the outside, free to determine outcomes by manipulating the system’s levers. But he was all wet. Like thee and me, Phillips was of necessity inside the system, carried along in the flow of events.

Earlier writers had compared money flows to water flows as illustrated by the original 1948 (264) edition of Paul Samuelson’s famous undergraduate textbook and Irving Fisher’s (1911, 202) textbook of an earlier generation. See Figure 3 and 4. Perhaps we should speak of “hydraulic monetarism.” The analogy of water and money was not original to Phillips. Nor was he the first to use the analogy of money flows with water flows to construct an analog computer of the macroeconomy. Dimand and Betancourt report, “Fisher not only imagined but actually built a hydraulic mechanism to simulate the determination of equilibrium prices and quantities” (2012, 186) in a general equilibrium system.

Phillips’ machines reveal how very simple the early hydraulic models were. Over time the number of equations and variables in macroeconomic models grew, but the core vision remained the same. In this hydraulic world there can be no change, creativity, or cacophony. Importantly, there is no learning in the system. Water does not learn. The hydraulic Keynesians did not bother to ask Yeager’s question: “Who does what and why and how” (1997, 29)? Asking Yeager’s question draws our attention to the necessity of putting the agent’s model in the theorist’s model. Water molecules do not model their environment, but people do as explained by Simmel (1910) with unusual clarity and Machlup ([1969] 1978) with unusual humor. “Water in a pipe does not ask what the plumber is doing, but people in a market do ask what the government is up to. Hydraulic Keynesians neglected this difference between people and water” (Koppl 2014, 45).

The “Lucas critique” objected to the assumption that the structure of the economy was independent of policy. The Keynesian “theory of economic policy,” Lucas (1976) explained, assumed that the different parameters and functions being estimated would not change when policy changed. But as I put it in the past, “the public will sooner or later catch on to the link between expansionary monetary policy and inflation rates. When they do, inflation will no longer reduce unemployment. Anticipating increases in inflation, workers may not imagine that their higher wages represent more purchasing power, suppliers may not mistake an increase in output prices for an increase in underlying demand for their goods, and so on” (Koppl 2014, 45). Lucas (1976, 20) denied that his argument was original. It could be found, he averred, in Friedman (1957), Muth (1961), “and, still earlier” in Knight (1921).

As an alternative to hydraulic Keynesianism, Lucas supported the “rational expectations” pioneered by Muth (1961) and developed by himself (Lucas 1972; 1976) and others. Expectations are modeled through a representative agent that knows and adheres to the model in which he, the representative agent, appears. The rational expectations modeling technique evades the Lucas critique by assuming that the public and the theorist have the same model of the economy. The assumption of rational expectations does not require or imply that the public makes no mistakes. Even "rational" expectations may be disappointed. Rather, the forecasting algorithms of the representative agent cannot be improved. An earthquake will cause unemployment to go up and output to go down. But the public's method of anticipating wages, inflations, and so on will require no alteration in the wake of that exogenous supply shock. This way of evading the Lucas critique assumes that all learning has already taken place. It thus leaves us with a mechanistic economy in which change, creativity and cacophony are absent.

The Lucas critique raises the problem of learning in macroeconomics. How do members of the public learn about the structure of the economy, what policies are likely to be tried soon, and so on? Presumably, the structure of the economy is a function not only of the policies of the authorities, but also of potentially mistaken lessons the public has drawn from past experience, and much else besides. All such considerations are short circuited by the assumption that everyone from Al Bundy to Albert Einstein has already learned the model in which the theorist has placed them. Some such assumption was necessary to enable Lucas's vision of theoretical economics: "One of the functions of theoretical economics is to provide fully articulated, artificial economic systems that can serve as laboratories in which policies that would be prohibitively expensive to experiment with in actual economies can be tested out at much lower cost" (1980, 696).

Lucas, writing before the complexity revolution in economics, seems to have imaged that these "artificial economic systems" would be solved analytically. But then they must be relatively simple. We have made but little progress from Phillips' watery machines. The assumption of rational expectations and the project of building tractable "fully articulated artificial economic systems" imply macroeconomic models no less mechanistic than those of the hydraulic Keynesians.

In the wake of the Lucas critique, the rational expectations modeling strategy spread and eventually become almost universal within mainstream macroeconomics. The conflict shifted to the dispute between two groups. On the one side there were the real business cycle (RBC) models of Kydland and Prescott (1982), Long and Plosser (1983) and others. On the other side were the new-Keynesian models in Mankiw and Romer (1991) and others. RCB models assume a frictionless machine and new-Keynesian models introduce frictions.

RBC models assume the "classical dichotomy," whereby real variables such as unemployment are independent of nominal variables such as inflation. For example, monetary expansion will cause prices increases, but it will not distort relative prices. And RBC models consign to irrelevance any market frictions such as price rigidity. This class of models strips money of its power to induce business cycles. Economic fluctuations are interpreted as the product of real factors such as technology shocks. Nelson and Plosser say: "stochastic variation due to real factors is an essential element of any model of macroeconomic fluctuation" (1982, 141).

New-Keynesian models reject the classical dichotomy and explicitly model one or more market frictions, especially price rigidity. For this group, "market imperfections in the economy are crucial for understanding economic fluctuations" (Mankiw and Romer 1991, 2).

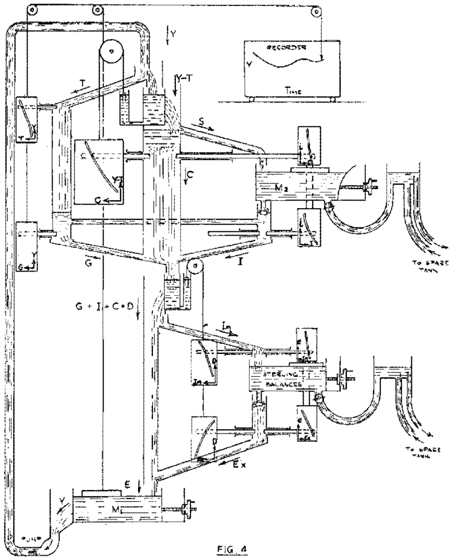


Figure 1: Diagram of one of the hydraulic machines discussed by A. W. Phillips.
Source: Phillips (1950).

Both groups now typically use dynamic stochastic general equilibrium (DSGE) models. Kydland and Prescott (1982) and Long and Plosser (1983) were especially important in inaugurating this family of macroeconomic models. Rotemberg and Woodford include "impediments to the free adjustment of prices" (1997, 299) in what may be the first new-Keynesian DSGE model. (Calvo 1983, upon which they build, probably should not count as DSGE.)

Macroeconomics today is dominated by DSGE models. As Koppl (2014, 50) has explained, "DSGE models are dynamic because they describe the behavior of an imaginary economy over time. They are stochastic because some of the key variables of the model such as productivity and labor supply are subject to random shocks. Finally, they are general equilibrium models because all markets are considered at once." Importantly, DSGE models are no less mechanistic than the hydraulic Keynesianism of earlier years.

The situation in growth theory is not substantially better than in macroeconomics more narrowly construed. Modern growth theory in economics is dominated by single-sector models. In such models, economic growth is represented as increases in a scalar value, as shown below:

$$Y_t = A_t K_t^{\beta} L_t^{(1-\beta)} \tag{1}$$

In this equation, Y_t represents the overall output of the economy, which is typically equated with GDP. A_t is the "level of technology." K_t and L_t represent the quantity of capital and labor, respectively. And β is a weighting factor between zero and one. Output in any period is a simple function of the quantities of the total of all types of labor

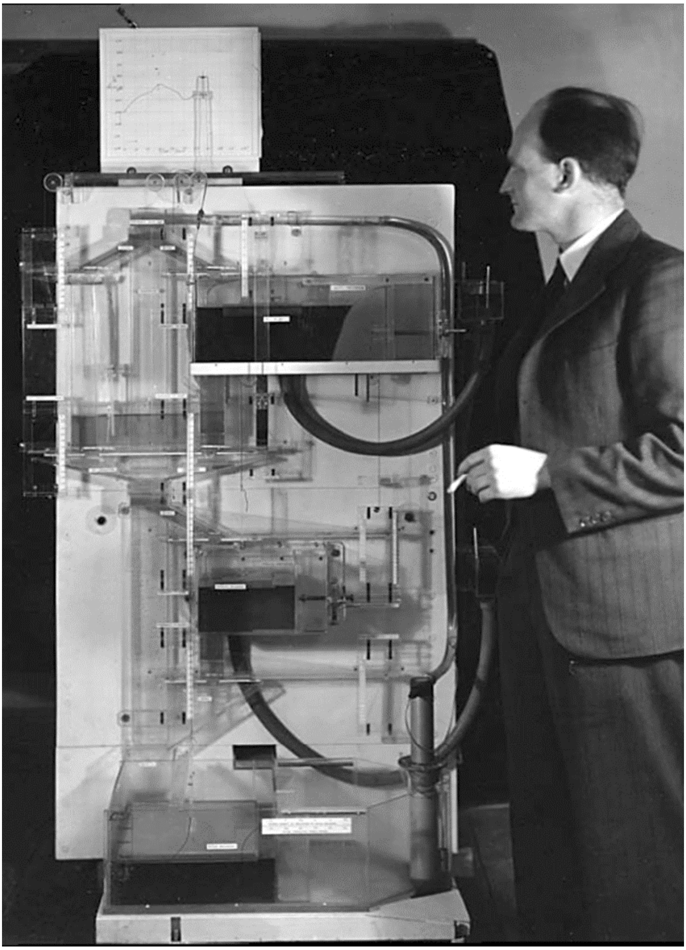


Figure 2: A photograph of A. W. Phillips with one of his hydraulic machines.
Source: Flickr/Public Domain.

added up, somehow, by an unspecified process and the total of all types of capital added up by an equally unspecified process, all multiplied by a scalar value that is supposed to represent the "level" of technology. Solow (1956) is an earlier pioneering example of the sort of growth theory we are describing. Romer's transformative 1990 article endogenized technological change. Jones (2019) provides a lucid and helpful discussion. This sort of highly aggregative model has its strengths. Solow showed powerfully, for example, that there is more to economic growth than capital accumulation and population growth. Like any model or model class, however, standard growth theory has its limits. It omits emergence and ramifying cambiodiversity. It omits change, creativity, and cacophony. We need a more evolutionary macroeco-

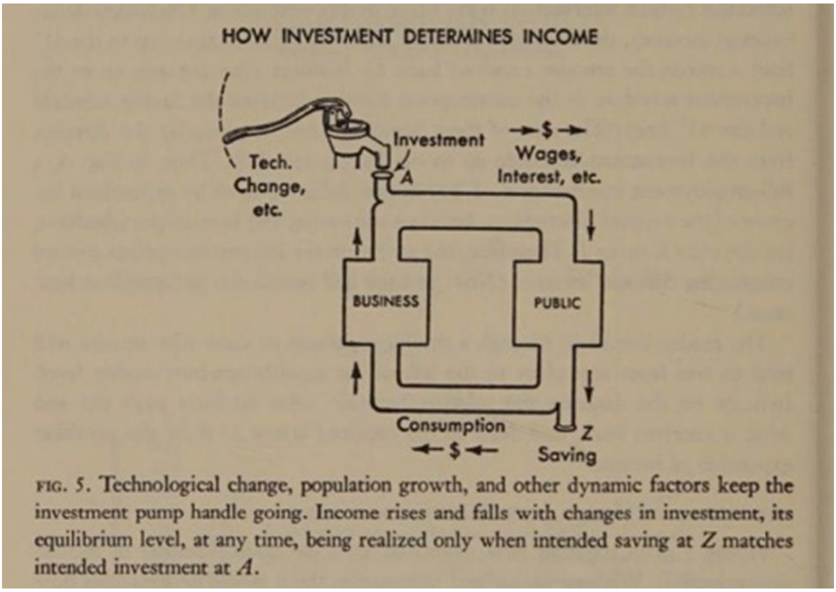
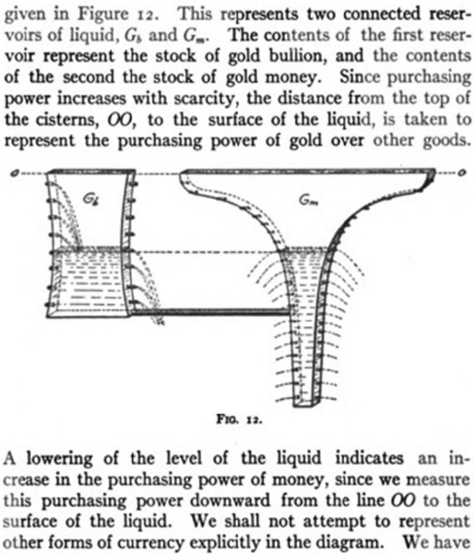


Figure 3: A diagram from the first edition of Paul Samuelson's famous textbook.
Source: Samuelson (1948).


given in Figure 12. This represents two connected reservoirs of liquid, G_b and G_m. The contents of the first reservoir represent the stock of gold bullion, and the contents of the second the stock of gold money. Since purchasing power increases with scarcity, the distance from the top of the cisterns, *OO*, to the surface of the liquid, is taken to represent the purchasing power of gold over other goods.

A lowering of the level of the liquid indicates an increase in the purchasing power of money, since we measure this purchasing power downward from the line *OO* to the surface of the liquid. We shall not attempt to represent other forms of currency explicitly in the diagram. We have

Figure 4: A diagram and some text from Irving Fisher's textbook.
Source: Fisher (1911).

nomics in which learning may occur. We need a macroeconomics with change, creativity, and cacophony.

4. The Past of Change, Creativity, and Cacophony in Macroeconomics

Wagner (2012) and Wagner and Devereaux (2020) have contrasted DSGE with a macroeconomics that is "open-ended and evolutionary" (OEE). Open-ended systems evolve and the agents within them must learn. Thus, a macroeconomics of change, creativity, and cacophony is an evolutionary and epistemic macroeconomics. A central question for an evolutionary and epistemic macroeconomics is, to paraphrase Yeager (1997, 29), "Who learns what and why and how?" Comparative institutional analysis for an evolutionary and epistemic macroeconomics is what Boettke calls "epistemic institutionalism" (2018). The evolutionary and epistemic macroeconomist compares institutions for their epistemic properties rather than efficiency or productivity. Bad epistemic properties generally correspond to inefficiency and low productivity. Thus, evolutionary and epistemic macroeconomics does not repudiate traditional macroeconomic concerns such as inflation and unemployment. Rather, it addresses them through an evolutionary and epistemic lens. As in Keynes ([1936] 1973; [1937] 1973), expectations become a central macroeconomic issue.

The evolutionary and epistemic macroeconomics I sketch in the next section is meant to be the sort of open-ended and evolutionary theory Wagner and Devereaux call for. Importantly, it builds on earlier work. It falls within the broad tradition of monetary theory exemplified by Hayek ([1933] 1975; 1934; [1935] 1967) and Yeager (1986). Before "macroeconomics" there was "monetary theory," which included the quantity theory of money in all its variants and monetary theories of the trade cycle. Hayek's theory of the trade cycle preceded Keynes's *General Theory.* Yeager's "monetary disequilibrium theory" came later, but it revived and revised an older tradition. I believe old-fashioned monetary theory in the tradition of Hayek and Yeager contains valuable analyses that we should retain.

Today, for example, "cost push" theories of inflation are back, especially in the popular press. (See, for example, Degiannakis *et al.* 2018.) Advocates of the theory do not always give a clear statement of it. Sometimes, at least, the idea is that an increase in a factor price such as wages will induce further increases downstream, which induce yet further increases yet further downstream, and so on. Sooner or later the induced price increases will percolate up to consumer goods, which will then drive wages up further, reinitiating the cycle. Asking Yeager's question ("Who does what and why and how?") helps draw our attention to the notion of "real cash balances," which he emphasized in both his writing and his lectures. The imagined cycle implies that the purchasing power of money holdings are shrinking. Real cash balances are falling. Economic actors such as people and businesses will try to shore up their real cash balances by increasing the supplies of what they sell and decreasing the demands for what they buy. These increases in supply and decreases in demand will bring the imagined price inflation to an end and, indeed, restore prices to about their earlier levels. Thus, if observed inflation is ongoing, then real cash balances must not be shrinking; the inflation must be fueled by money growth. As Fritz Machlup (1960) explained, there can be no cost-push without demand-pull. This bit of old-fashioned monetary theory illustrates the general proposition that we want to preserve and maintain the old-fashioned monetary theory of figures such as Hayek, Machlup, and Yeager.

I was a student of Yeager, and I hope that I may be considered both "Hayekian" and "Yeagerian." To honor and appreciate this broad tradition of thought, however, we must stand on the shoulders of its giants just as Newton stood on the shoulders of Galileo. (See Merton 1965 on the idiom, which well preceded Newton.) Wooden insistence on past doctrines is the death of thought. As Mises said, "as long as the human mind does not stop thinking, striving, and inquiring, there is no such thing as 'finality' and 'definitiveness'" ([1933] 1981, 151–2). Recent developments in Austrian business cycle theory illustrate the value and necessity of constantly updating our theories.

The Austrian theory of the trade cycle has been dogged by difficulties in capital theory. The theory requires sectoral distortions. The trade cycle is bad in part because resources are moved from some sectors and away from others during the boom only to be restored to their earlier sectoral distribution in the bust. A monetary theory of the trade cycle is not "Austrian" if it does not include this sloshing of resources back and forth over the course of the cycle. But it is precisely this sloshing that has created perplexity over the theory. The sloshing is induced by low interest rates driving investment into "earlier stages of production." And perplexity follows when we try in vain to understand what "earlier stages of production" might mean. Only recently have Austrians found a way out thanks to Lewin and Cachanosky (2014; 2021) as I will now explain.

In the Austrian story, money growth may create credit expansion, depending on details that include, importantly, the institutional context. In many real-world cases, expansionary monetary policy suppresses interest rates "artificially." A boom results because the recently reduced interest rates discourage saving while encouraging investment. Investment without saving is unsustainable, and the boom will be followed by a bust at some point. The "turning point" may be brought on by either "real" or "monetary" factors (Koppl 2014, 33–6). In either event, the adjustment process of the bust is made more difficult by sectoral shifts brought on by the low interest rates of the boom. Sloshing is costly and difficult. In earlier expositions of the theory, these sectors are arrayed in a linear order of higher and lower. Hayek ([1935] 1967) spoke of output passing through "successive stages" (*ibid.*, 40) with some "earlier" and others "later" (*ibid.*, 53). The disproportionate expansion is said to occur in the earlier stages of production. Kaldor (1942, 359) illustrates the perplexity many economists of the time felt when grappling with "Austrian" capital theory and Hayek's "stages of production." Hayek's cycle theory was very impressive at first, Kaldor says. The capital theoretic apparatus of "production periods" and Jevonsian triangles that create the potential for "distorted price margins" made the "prevailing" Anglo-American theories look "facile and superficial" by comparison. "On second thoughts," however, "the theory was by no means so intellectually satisfying as it appeared at first." Because early expositions of the theory were "merely intended as rudimentary," they had "gaps." But "when one attempted to fill these gaps, they became larger, instead of smaller, and new and unsuspected gaps appeared." In the end, "one was driven to the conclusion" that the theory must be "wrong." Hayek's *Prices and*

Production called forth "a remarkable crop of critics … in the pages of English and American journals the number of which could rarely have been equalled in the economic controversies of the past." It was, in other words, a mess.

Lewin and Cachanosky (2021) show how a tool of financial analysis could have made the whole business of "stages of production" unnecessary, which might well have made the theory more palatable to Hayek's fellow economists. The low interest rates characterizing an Austrian boom give greater stimulus to the more interest-sensitive sectors. Thus, the boom creates a distortion. And we may reasonably expect that the distortion cannot be set right painlessly. In the US, much of the painful adjustment process of the Great Recession was concentrated in the housing sector, which is interest sensitive. (The intrinsically important point that policies and practices relating to housing and not money *exacerbated* the problem is inessential to the current discussion.) In finance theory, "duration" formulas such as "Macaulay's duration" measure such interest sensitivity. Lewin and Cachanosky (2014; 2021) have developed the connections between different notions of "duration" and both Austrian capital theory and Austrian cycle theory. They report that Macaulay (1938) proposed his measure of duration in 1938 and that Hicks (1939) independently proposed his equivalent measure of "average period" a year later. My own exposition of the Austrian business cycle theory (Koppl 2014) uses, in effect, duration without formulas by speaking of "interest-sensitive sectors" rather than "stages of production." I agree with the assessment of Lewin and Cachanosky that "much of the controversy surrounding capital theory and the business cycle might have been avoided if duration had been incorporated into the discussion" (2021, *x*).

I endorse the sort of monetary theory exemplified by Hayek and Yeager. I hope to have convinced the reader, however, that such theory *always* needs updating and critical reevaluation. It is in Newton's shoulder-standing spirit that I discuss some analytical approaches to macroeconomic change, creativity, and cacophony that were unavailable to earlier theorists in the tradition represented by Hayek and Yeager. We have new tools with which to rethink old lessons, and we should use them.

5. Some Possible Futures for Change, Creativity, and Cacophony in Macroeconomics

If epistemics is central to an open-ended and evolutionary macroeconomics, we need a theory of learning. The issue is not individual learning as studied in psychology, but the processes of knowledge production and distribution in society. What policies and institutions tend to produce relatively prescient expectations? What policies and institutions tend to produce discovery and innovation? What policies and institutions tend to produce relatively high levels of mutual adjustment and coordination of actions? What policies and institutions tend to produce good epistemic outcomes? The economist's answers to these questions should generally be robust to individual psychology. Israel Kirzner's (1973) theory of entrepreneurship, for example, depends on the empirical psychological assumption that people tend to notice opportunities. The theory is robust, however, to psychological theories of learning and alertness. Most or all such theories fit Kirzner's theory of entrepreneurship. It is enough that the psychological theory generates *some* capacity for alertness and learning. We can try to imagine a world in which humans were entirely devoid of Kirznerian alertness. But in such a world technological change would be impossible. Since there has been and continues to be technological change, we may infer that at least some humans have Kirznerian alertness in at least some degree. No more detailed psychological theory is required as underpinning for Kirzner's theory.

In company with Milton ([1644] 1949), Mill ([1859] 1869), Hayek (1944), and others, I (Koppl 2005; 2018) have argued for the epistemic value of multiple voices and multiple perspectives. Such "viewpoint diversity" (as it is now often called) creates cacophony. Many different voices clammer for attention in a rough and tumble scramble for revenues and resources. It is Hayek's "end of truth" when the cacophony is silenced. "If all the sources of current information are effectively under one single control, it is no longer a question of merely persuading the people of this or that. The skillful propogandist then has the power to mold their minds in any direction he chooses, and even the most intelligent and independent people cannot entirely escape that influence if they are long isolated from all other sources of information" (Hayek 1944, 154). It is the "interaction of individuals, possessing different knowledge and different views," Hayek explained, that "constitutes the life of thought" (*ibid.*, 165). Thus, contestation is a central criterion of institutional goodness in macroeconomics and beyond.

Contestation and learning imply change, creativity, and evolution, which are ill suited to the broadly "Newtonian" model of scientific explanation, which is also the default mode of argumentation in macroeconomics. The word "Newtonian" is, of course, contested. But it does not matter for my purposes whether Newton was a "Newtonian." What matters is only the characterization of "Newtonian" given presently, which is a foil for the evolutionary perspective I prefer. From now on, therefore, I will drop the scare quotes around "Newtonian."

Lucas's (1976, 21) description of the "theory of economic policy" exemplifies the standard Newtonian pattern of scientific reasoning. The Lucas critique did not challenge this "theory of economic policy," only certain practices of hydraulic Keynesians such as the spurious modularity of assuming "forms for consumption, investment, price and wage setting functions separately." The theory of economic policy, Lucas explains, starts with a description of the economy "in a time period t" given by "a vector y_t of state variables, a vector x_t of exogenous forcing variables, and a vector ε_t" of iid errors. A difference equation describes the "motion of the economy." One or more of the "forcing variables" are viewed as policy variables to be freely manipulated in an only vaguely specified manner. Lucas says, "A *policy* is viewed as a specification of present and future values of some components of $\{x_t\}$." This elliptical phrasing is important. Lucas does not tell us who will do the "specification" of policy. He imagines that a policy so defined *can* be specified … somehow. Embarrassment follows, however, if we ask Yeager's question: Who does what and why and how? Wagner's entangled political economy requires us to ask Yeager's question not only of nominally private markets but of policymaking as well. Wagner admonishes us to endogenize policymaking. With Lucas, instead, policy is exogenous.

Like most of modern social science, Lucas implicitly invites each of us imagine themself adjusting the policy levers. You are outside the system looking down on it. What "policy" do you choose? This way of thinking relieves us of the necessity of modeling ourselves. And it short circuits any consideration of Wagnerian entanglement. Each reader and each theorist is transformed by elliptical phrasing into a godlike and omnipotent creature that can unilaterally choose a "policy." As we have seen, Kydland and Prescott (1977) raised doubts about this framing. But the policymaker is still a unitary actor playing against, but not entangled with, "rational economic agents." The adoption of Nash equilibrium as a solution concept tames the potential chaos of such games and returns us safely to the Newtonian model of science. The list of state variables is fixed and known. In other words, the phase space is fixed and known. The list of "forcing variables" is fixed and known. Given the assumed stasis in the phase space, the system's laws of motion are rendered fixed and known by the assumptions of rational expectations and Nash equilibrium. Input the initial conditions, pick the desired levels of the forcing variables, turn the crank, and out comes the future trajectory of the system up to an error term. Pick a new set of forcing variables and turn the crank again. Out comes an alternative future trajectory. Pick the "policy" that generates the trajectory you prefer.

Even within this Newtonian framework, there arises the problem of multiple equilibria (Farmer 1991). This problem has been handled in the same way as the problems arising with the representative agent revealed by Kirman (1992) and the problems of aggregating demand curves revealed by Sonnenschein (1972; 1973), Mantel (1974), and Debreu (1974). All these problems have been handled within standard macroeconomics by ignoring them. Much ink has been spilled on these problems, of course. But as the discussion of macroprudential policy given below illustrates, the problems are generally just assumed away by the time we get to policy prescription.

As Longo, Montévil, and Kauffman (2012) have shown, the logic of evolution is inconsistent with the traditional Newtonian model of explanation in science. The core difficulty is that the phase space – "a representation of the set of all possible actions, strategies, or states" – evolves in unpredictable ways that generate unprestatble outcomes (Felin *et al.* 2014). Evolutionary systems are "creative" because they produce structures that cannot be imagined ahead of time. My co-authors and I have developed their argument within the context of economics (Felin *et al.* 2014; Koppl *et al.* 2015). Unlistability is the key to the argument of Longo, Montévil, and Kauffman (2012).

In the evolutionary systems of biology and the social sciences, the agents within the evolving system have "affordances." The objects about them "afford" them opportunities to eat, cool down, or achieve some other result that, in humans at least, we call "ends" or "purposes." The system's phase space must include these affordances. But it is impossible to list all possible future affordances of the system. Kauffman has repeatedly used the example of a screwdriver.

Kauffman challenges the reader to list all the uses of a screwdriver. (See, for example, Kauffman 2008, 175, 187–8.) This challenge is meant to invoke the unshakeable intuition that no such list can be given. The number of uses for a screwdriver is neither finite nor infinite, but indefinite. With this example, Kauffman has independently discovered the listing problem, which is well known to Austrian economists through the writing of Shackle (1959, 291; 1972, 20 ff.), Langlois (1982, 30–1), O'Driscoll and Rizzo (1985, 66, 132), and others. Devereaux *et al.* (2021) attempt a mathematical proof that implies unlistability. If their proof is valid, the agents within a system cannot infer a correct and complete model of the system. They draw out the further inference that the affordances of a system are unlistable from within the system. Their proof was inspired by, but distinct from, Hayek's (1952) attempted proof that the mind cannot fully know itself. As far as I can tell, it is an important and new result, but it has distinct affinities with Wolpert (2008) and with da Costa and Doria (2017), upon which they build.

If we are to have an open-ended and evolutionary macroeconomics, if we are to have change, creativity, and cacophony in macroeconomics, we must model "the economy as an evolving complex system" (Anderson, Arrow, and Pines 1988; Arthur, Durlauf and Lane 1997; Blume and Durlauf 2005). The key analytical features of such an economy are unprestatable innovation and ramifying change. If the system is open-ended there is no list, and certainly no "known" or "given" list, of possibilities for the system. (In the spirit of Yeager, one must ask Known to *whom?* Given to *whom?*) Nor, if Devereaux *et al.* (2021) are right, can we coherently image that such a list would be available to any agents existing in the system, including the putatively "observing" theorist. But then change will sometimes mean innovation, new things not previously present or even possible. Such new things expand the set of possibles in the system and push the set in new and unexpected directions. They ramify the set of possibles. Thus, again, an open-ended and evolutionary macroeconomics must exhibit unprestatable innovation and ramifying change.

The role of innovator is assigned to the "entrepreneur" in economic theory (Kirzner 1973). The entrepreneur is no more and no less a flesh and blood person than the "laborer" or "capitalist." The labels "laborer," "capitalist," and "entrepreneur" identify functional roles and not disjoint sets of persons. The very existence of entrepreneurs is inconsistent with the Newtonian explanatory framework of standard macroeconomics because entrepreneurial innovations expand the phase space.

Entrepreneurial innovations respect Kauffman's (2000, 142–4) theory of the adjacent possible. As Koppl *et al.* explain, the theory develops "in stark logic the humble insight that evolution happens one step at a time. Amoebae do not give birth to elephants. The way must be prepared. The modern elephant could exist only after evolution had produced mammals and, indeed, the order Proboscidea. At each step some things are possible, others are not. The things possible at any moment are one step away. The *possible* things are *adjacent*" (2023).

Figure 5 is meant to help one visualize the logic of the adjacent possible. (I cribbed both the device of encircling the adjacent possible and the term "remote possible" from Eskildsen 2020.) The possibilities of a system are represented as nodes in a graph. The possibilities that have been actualized are black nodes. The possibilities that have not been actualized are green and yellow nodes. At any one moment, you can move from an actualized node to any adjacent node. You can go one step, but not two or more. Each of the green nodes can be reached in one step from an actualized node. These green nodes are Kauffman's "adjacent possible," which is circled in Figure 5. The yellow nodes are the remote possible. If at least some of the green nodes are actualized this period, then at least some of this period's remote possible will form part of next period's adjacent possible. If node A is actualized this period, for example, the top two nodes in this period's remote possible will enter next period's adjacent possible. If nothing in this period's adjacent possible is actualized this period, then the remote possible will be just as remote next period as it is this period.

The node labeled E1 in Figure 5 is occupied by Entrepreneur #1, who can see possibilities A, B, and C. The node labeled E2 is occupied by Entrepreneur #2, who can see possibilities C, D, and E. Presumably, entrepreneur #1 knows that entrepreneur #2 sees opportunities in the adjacent possible that they, entrepreneur #1, cannot see and vice versa. In that case, each entrepreneur will experience "radical" uncertainty not because they do not know what their rival *will* do next period, but because they do not know what their rival *can* do next period. If entrepreneur #1 were to falsely imagine that the only possibility for entrepreneur #2 was to remain in node E2 or

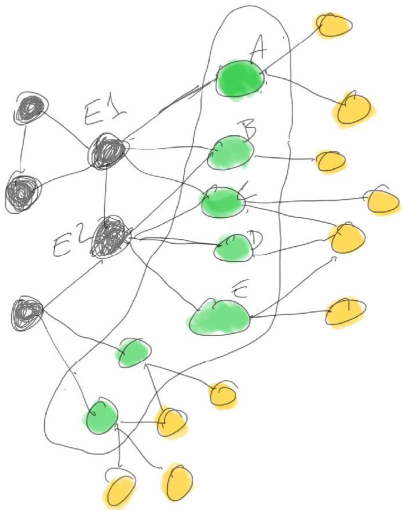


Figure 5: The Adjacent Possible.
Source: Illustration by the author.
The black nodes, which are toward the left, represent realized possibilities. The green nodes, which are circled, represent the adjacent possible. The yellow nodes, which are to the right of the green nodes, represent remote possibilities. The node labeled E1 is occupied by Entrepreneur #1, who can see possibilities A, B, and C. The node labeled E2 is occupied by Entrepreneur #2, who can see possibilities C, D, and E.

move to node C, then they might formulate a subjective probability for each possibility and make "a good Benthamite calculation" (Keynes [1937] 1973, 214) of "prospective profit" (Keynes [1936] 1973, 150). Such a Bayesian calculation will be put to ruin, however, if entrepreneur #2 moves to node D or E. This prospective failure of any Bayesian calculation of prospective profit is an "objective" sense of "radical uncertainty."

The invention of the airplane illustrates the logic of the adjacent possible. It was probably impossible to produce powered heavier than air flight before the arrival of elements such as small, reliable internal combustion engines. But by about 1900 we had all the elements, including the light gas engines, gliders, propellors, and bicycle wheels. And this fact was widely recognized. Many teams were competing to be the first to put them together successfully and produce powered heavier than air flight. The priority of the Wright brothers owed much to their brilliance and hard work, but it owed much to chance as well.

The history of art also illustrates the logic of the adjacent possible. Vasari ([1550/1568] 1846) credits Giotto's (supposed) teacher, Cimabue, with putting an end to painting in the style of the "Greeks" who produced works such as Figure 6, "with glazed eyes, outstretched hands, standing on tiptoe" ("*con occhi spiritati e mani aperte in punta di piedi*" (*ibid.*, 213). Everything changed "when, as God willed it, there was born in the city of Florence in the year 1240, to give first light to the art of painting, Giovanni, surnamed Cimabue" ("*quando, come Dio volle, nacque nella città di Fiorenza l' anno 1240, per dar i primi lumi all'arte della pittura, Giovanni cognominato Cimabue*" (*ibid.*, 219). First light! If the revolution began with Cimabue, then Figure 7 is an example of the Greek style Vasari excoriated. Figure 8 shows an early crucifix by the revolutionary Cimabue. Without the legends in the figures, most readers would be unsure which of these paintings was in the old style and which in the new. The artist of the earlier work was Guinta Pisano, who had influenced Cimabue. And he had himself contributed to the move away from the earlier more rigid "Greek" style of Figure 6. (Vasari's history was Medici propaganda. Presumably, he chose to begin with Cimabue because earlier artists who were moving away from the rigid forms of the "Greeks" were Pisan and not Florentine.) The long road from Vasari's hated "Greeks" to Guinta Pisano to Cimabue, to Giotto, to the dramatic images of Matthias Grünewald to Pablo Picasso's very unByzantine crucifixion of 1930 was trod one step at a time. Neither Pablo Picasso nor Matthias Grünewald could exist in 13th-century Tuscany.

Combination is the central evolutionary mechanism of both Western art and modern technology.

The combinatorial nature of the evolution of technology has long been recognized (Smith [1776] 1982; Schumpeter [1911] 1934; Ogburn 1922; Kauffman 1988; 2008; 2016; 2019; Weitzman 1998; Arthur and Polak 2006; Arthur 2007; 2009; Muthukrishna and Henrich 2016). As Koppl *et al.* (2023) note, combination explains the "arrival of the fittest" (Schurman 1887, 78). Figure 10 illustrates the combinatorial nature of the evolution of the technosphere. Rails and locomotive had been in use to carry coal out of mines. Horse-drawn carriages had been used to carry people from one city to another. Railroads initially combined the existing technology for carrying coal with the existing technology for carrying people.

Innovation by combination follows a simple pattern. 1) Existing goods are combined to produce a new good. The Wright brothers combined a glider, a light gas engine, bicycle wheels, and a propeller. 2) This new good may be a radical departure from the past. Powered flight was a radical departure from gliders and air balloons. 3) But the new good's components already existed. Each of the things the Wright brothers combined existed before they set to work. Modern gliders, for example, had been pioneered by George Cayley around 1849 and brought to a high level of functionality by Otto Lilienthal and others well before Kittyhawk (Gibbs-Smith 1953, 5). The innovator's innovation consisted in combining these pre-existing components together to create something new.

Such combinations follow one another over time. Each new good enables the creation of still newer goods that use it as a component. The process is cumulative. In this sense, we may call it "evolutionary." Following Brian Arthur, we may speak of "combinatorial evolution" (2009). The combinatorial evolution of technology is simply the accumulation of technological innovations over time, with each innovation following the pattern just described.

Arthur gives "three fundamental principles" for the "combinatorial evolution" of technology: 1) "technologies, all technologies, are combinations," 2) "each component of a technology is itself in miniature a technology," and 3) "all technologies harness and exploit some effect or phenomenon, usually several" (*ibid.*). Koppl *et al.* (2023) alter this theory slightly to include "modifications to an existing good."

Arthur's third principle is fundamental. It explains how novelty enters the system. The "effect" or "phenomenon" that a new combination may "harness" is a cause-effect relationship. It may have previously been unknown and uncontrollable. But it can in some degree be controlled or influenced within the context of the new combination. The "lowly hammer," Arthur explains, "depends on the phenomenon of transmission of momentum" and oil refining depends on the fact that different "components or fractions of vaporized crude oil condense at different temperatures" (2009, 46). A magisterial passage Carl Menger's *Principles* points in the same direction.

> The quantities of consumption goods at human disposal are limited only by the extent of human knowledge of the causal connections between things, and by the extent of human control over these things. Increasing understanding of the causal connections between things and human welfare, and increasing control of the less proximate conditions responsible for human welfare, have led mankind, therefore, from a state of barbarism and the deepest misery to its present stage of civilization and well-being, and have changed vast regions inhabited by a few miserable, excessively poor, men into densely populated civilized countries. Nothing is more certain than that the degree of economic progress of mankind will still, in future epochs, be commensurate with the degree of progress of human knowledge (1871, 74).

The history of Tuscan art as described by Vasari ([1550/1568] 1846) is also a combinatorial evolution as I have noted elsewhere (Koppl 2018, 127). Step by step, Tuscan painters learned how to represent the human body realistically, how to foreshorten figures, how to represent a naked figure shivering with cold ("*uno ignudo che trema del freddo* [own emphasis]" (Vasari ([1550/1568] 1846, 16), perspective, how to give figures grandeur and majesty ("*grandezza e maestà* [own emphasis]" (*ibid.*, 22)), and so on.

Figure 6: The “San Damiano Cross,” painted by an unknown Umbrian artist in the 12th century. *Source:* Wikimedia Commons.

Muthukrishna and Henrich (2016) say, “the three main sources of innovation are serendipity, recombination and incremental improvement.” I agree, except that I view serendipity as a source of recombination and incremental improvement rather

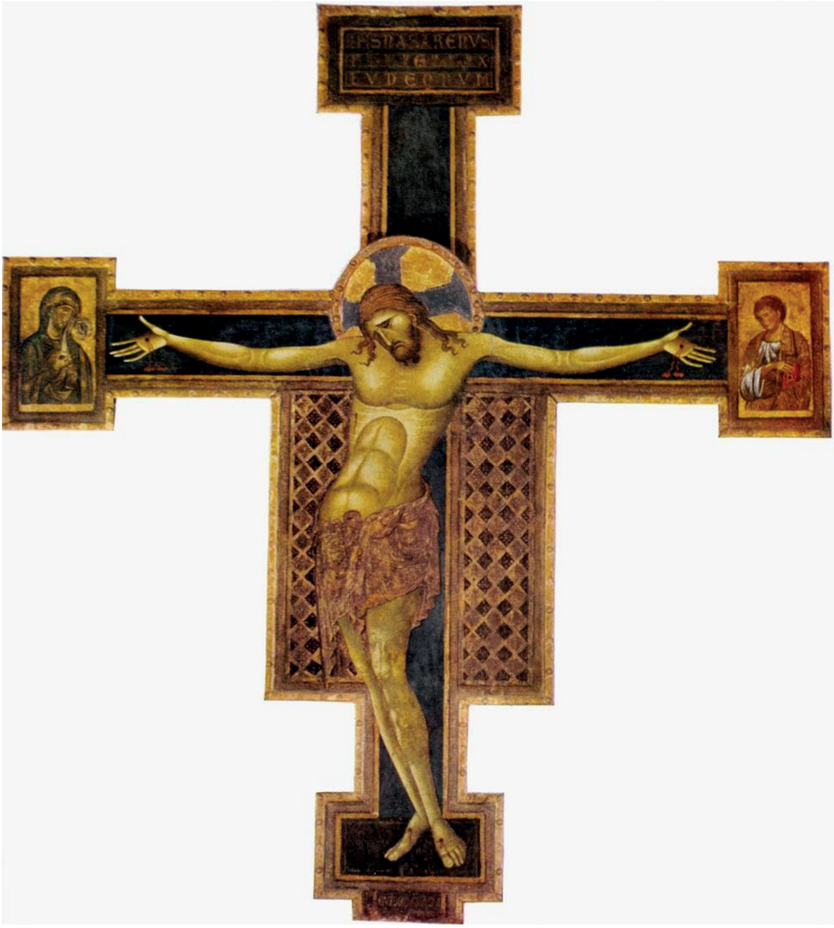


Figure 7: Crucifix painted by Giunta Pisano in the year 1250.
Source: Wikimedia Commons.

than a distinct thing. Like Muthukrishna and Henrich, I will view recombination and incremental improvement as mechanisms of cultural evolution in general.

Koppl *et al.* (2018), Cazzolla Gatti (2020) Koppl *et al.* (2023) and others model combinatorial evolution with a remarkably simple equation. They call it the "TAP equation," where "TAP" stands for "theory of the adjacent possible." Let M_t denote the number of distinct types of goods in the economy at time t. M_t is the degree of cambiodiversity. Assume fixed probabilities of combining n goods to produce a new value-enhancing good. This assumption leads to the simple combinatorial model given in equation (2) below.

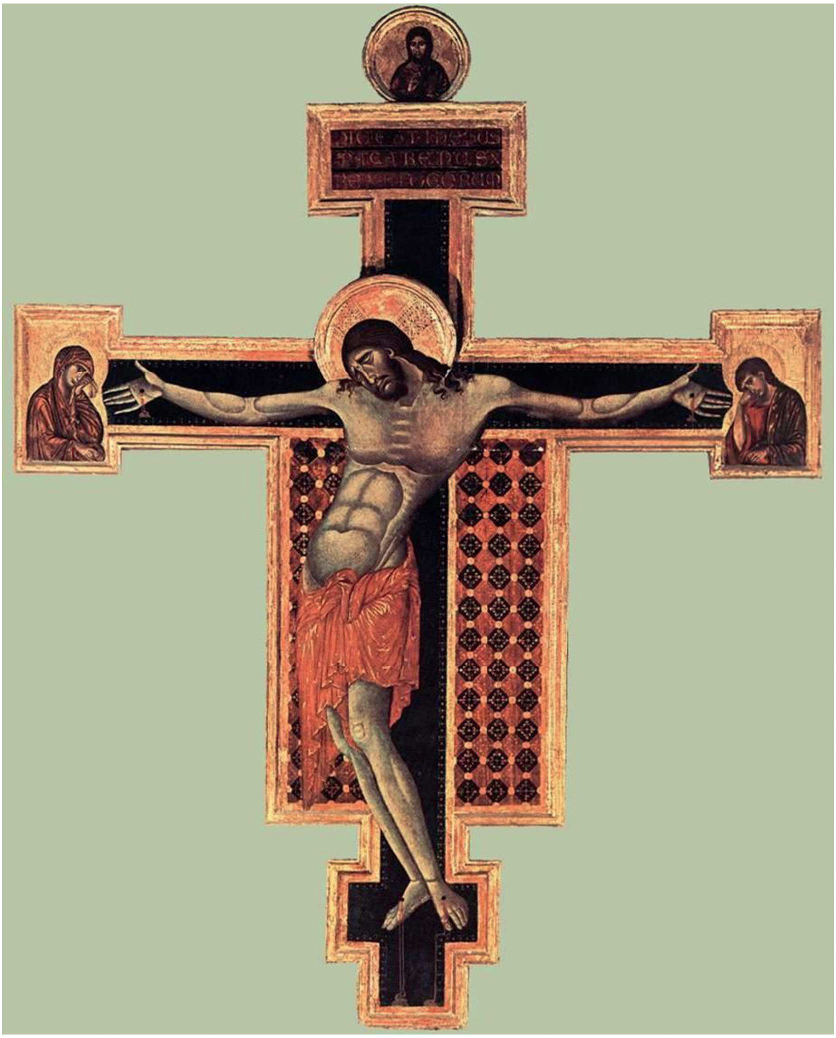


Figure 8: Crucifix painted by Cimabue in the years 1268 – 1271.
Source: Wikimedia Commons.

$$M_{t+1} - M_t = P\left(\sum_{i=1}^{M_t} \alpha_i M_t i\right) \tag{2}$$

where $0 < P\alpha_i < 1$ for $i = 1,\ 2,\ \ldots, M_t$ and $\alpha_{i+1} \leq \alpha_i$ for $i = 1,\ 2,\ \ldots, M_t - 1$. (In practice, we set $\alpha_i = 0$ for $i > 4$.) P is the probability that if $M_t i = \frac{M_t!}{i!(M_t - i)!}$ goods are combined they will result in a new good. For simplicity, we take equation (2) to describe the net increase in cambiodiversity rather than separately modeling additions

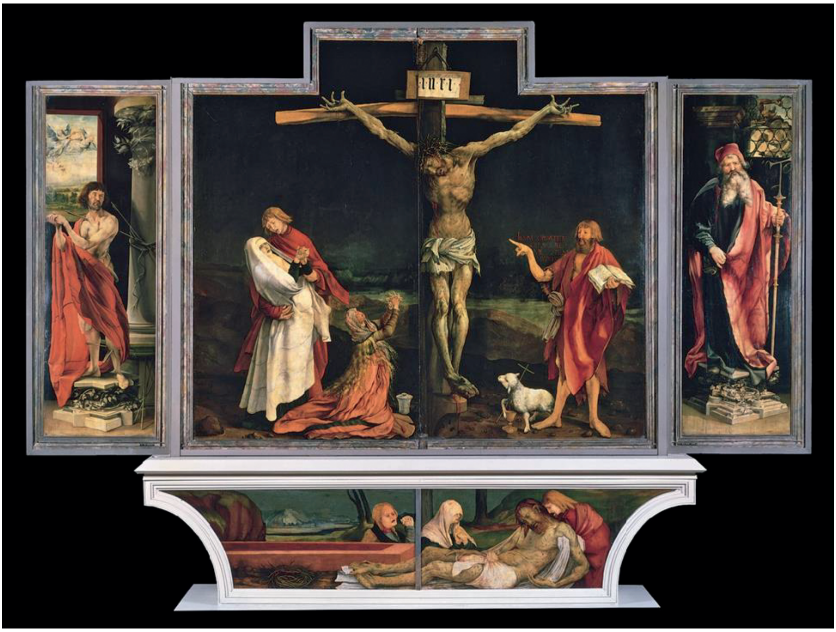


Figure 9: Image of the crucifix painted by Matthias Grünewald for the Isenheim Altarpiece, dated 1512 – 1516.
Source: Wikimedia Commons.

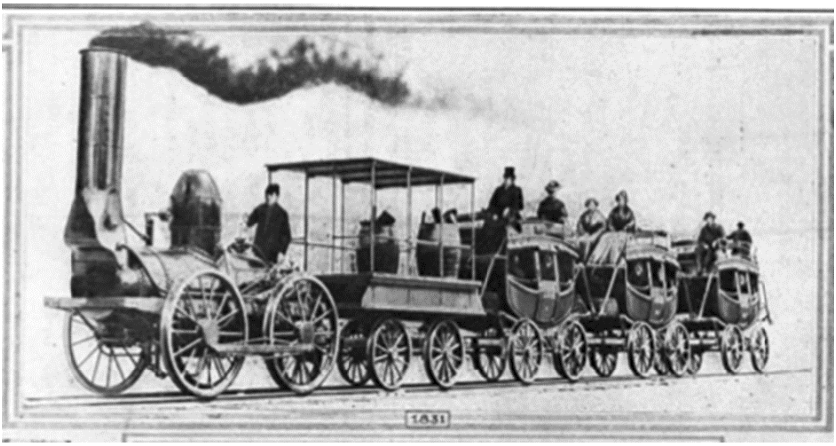


Figure 10: The image shows the DeWitt Clinton Locomotive of 1831 pulling coaches on the Mohawk & Hudson Railroad. It was published in the *Scientific American* in 1920.
Source: Unattributed (1920).

and subtractions to the variety of goods under production. Steel *et al.* (2020) work out some of the analytics of the TAP equation. For other applications of the TAP equation, see Kauffman and Roli (2022), Cortês *et al.* (2022a; 2022b).

The TAP equation explains the hockey-stick of economic growth. Figure 11 shows the hockey stick of economic growth. Figure 12 shows the characteristic behavior or the TAP equation. Abigail Devereaux (2023) has fitted the TAP equation to the hockey stick of economic growth using a simplified growth theory model in which the state-of-knowledge variable, A_t, from equation (1) above is replaced by the cambio-diversity measure, M_t, from equation (2) above. She obtains a tight fit with only four free parameters.

Valverde (2023) shows that the TAP equation also fits the "descent distribution" in US patent data from 1835 to 2010. If your patent uses my patented technology, your patent is the child of my patent. If your patent has a child, it is the grandchild of my patent. A patent may have children, grandchildren, great-grandchildren, and so on. We may ask how many descendants each patent has. Steel *et al.* (2020) show that the distribution of dependents should follow a "power law" whereby a log-log plot of number of descendants vs. number of patents with that many descendants will be linear. Valverde (2023) showed that it does. Figure 13 shows Valverde's fit.

The TAP equation can play a role in the sort of open-ended evolutionary macroeconomics Wagner has called for in part because it gives us a combinatorial growth theory. Combinatorial growth models like Devereaux (2023) have advantages over present-day growth models. TAP-based combinatorial growth theory is less mechanistic than standard models. It exhibits ramifying change and respects the logic of the adjacent possible. It also produces the hockey stick of economic growth. As far as I know, the only more standard model to do so is Jones (2001). His model, however, is highly parameterized. It gets a good fit to the hockey stick only by loading up the model with a swarm of dials that can be independently twiddled up or twiddled down to produce the final fitted pattern of economic growth.

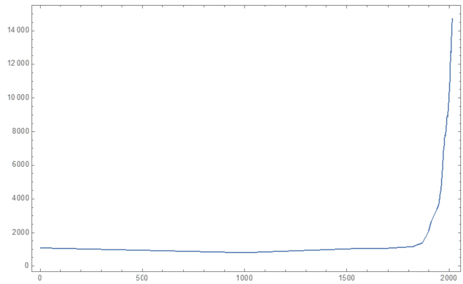


Figure 11: The hockey stick of economic growth. The horizontal axis shows the year. The vertical axis shows global GDP per capita in 1990 Geary-Khamis dollars.
Source: Koppl et al. (2023).

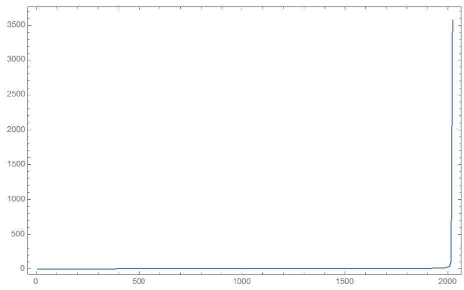


Figure 12: The characteristic behavior of the TAP equation. The horizontal axis shows time (scaled from 0 to 2015). The vertical axis shows M_t.
Source: Koppl et al. (2023).

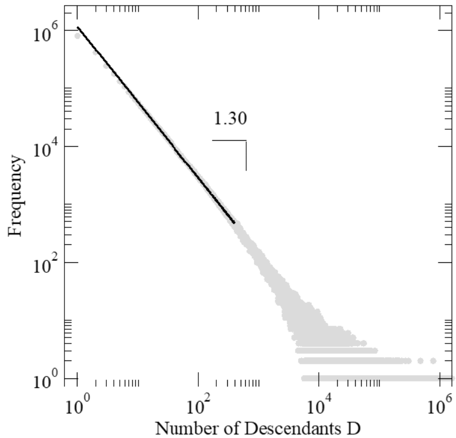


Figure 13: The TAP descent distribution.
Source: Koppl et al. (2023).

Hordijk, Kauffman, and Koppl find that the "autocatalytic production networks" created by TAP are "generally resilient to random removals of product transformations, but that the removal of certain linchpin transformations can induce a significant collapse in RAF size" (2023). They note the similarity of this result to that of Albert, Jeong, and Barabasi (2000). The economy is generally resilient to the removal production processes. But the elimination of some processes will cause economic activity to collapse to significantly lower levels.

Devereaux (2021) has explored whether the TAP process is robust to intervention. She adds a death term to the TAP equation, which she interprets as a product of intervention. "Suppose at every time interval, a percentage of combinations already in the system 'dies'—essentially, is banned by some controller." If the commodity death rate is low enough, the combinatorial explosion happens anyway and cambiodiversity (eventually) soars. A sufficiently large death rate will cause the system to crash and the number of goods to shrink. A 100 % death rate is big enough to crash the system. The transition point lies somewhere between a zero percent death rate and a one hundred percent death rate. Her simulations reveal that the transition point is a "repellor." If a system should for any reason arrive at a "repellor," it will immediately move away from it. Devereaux says, "The transition point for 10 % deaths per period is somewhere between $M_0 = 151.73329841$ and $M_0 = 151.73329842$." This is a small difference. "Even with a 10^{-8} precision, the slightest error causes the curve to explode or collapse. That is, the transition point is a repellor, not an attractor."

Devereaux's repellor result suggests the extreme difficulty of intervening successfully in a market economy. The interventions, the "regulations," may be useless. If, however, they are strong enough to "bite" on the system, the consequence will be sudden catastrophic collapse. The regulatory state's medicine is never therapeutic, but always only either otiose or poisonous. I think Devereaux would be quick to point out that her repellor result is an exercise in blackboard economics. The real world may introduce complexities, frictions, and inertia. But it raises the alarming prospect that a small increase in the restrictions imposed by the regulatory state might produce a sudden large drop in economic coordination and the level of economic activity.

An earlier result by Velupillai resonates with Devereaux's repellor result. Velupillai showed that "an effective theory of economic policy is impossible" for an economy that can be modeled as "a dynamical system capable of computation universality" (2007, 273, 280). Paraphrasing Rosser (1939, 56), Velupillai essentially showed that you cannot program a digital computing machine that can solving the problems a regulator is charged with solving with no human intervention beyond inserting the question and (later) reading the answer. In other words, Velupillai showed that no computer program can be written that will output reliable predictions of the consequences of different policy interventions. (In this paper I ignore hypercomputation. No hypercomputer has yet been built, and hypercomputers may be impossible. See Koppl 2017, 6–7). Velupillai links his important result to Hayek's "lifelong skepticism on the scope for policy in economies that emerge and form spontaneous orders" (2007, 288). Velupillai's result gives rigorous expression to the intuition that a machine such as a digital computer cannot be made to simulate the future behavior of non-mechanistic processes such as economic evolution. No computer fed data current to the year 1240 could have predicted the innovations of Cimabue and Giotto let alone the later products of Picasso's artistic genius.

Chaitin, da Costa, and Doria (2012) includes a helpful discussion of Rice's (1953) theorem and its destructive implications for projects of command and control. While originally a result in pure mathematics, the theorem shows that for any nontrivial property of a computer program, being a virus for example, we have no general way to ensure that a computer program does or does not have that property. Ultimately, we can only run it and see. But the attempt by administrative bodies to "regulate" the economy amounts to an attempt to reprogram the economy. Rice's theorem shows, as a matter of strict logic, that you cannot reliably predict the consequences of such reprogramming. We cannot know whether the regulatory program will help or be the macroeconomic equivalent of a computer virus. (See also da Costa and Doria 2005; 2014).

In previous work, I used the tools of computability theory to address the traditional macroeconomic issue of rules vs. discretion in monetary policy. I analyze three models that essentially just add a computability constraint to Barro and Gordon (1983b). "Rational expectations are possible in these models when policy is rule-governed and impossible when it is discretionary" (Koppl 2017). I take this result to bolster the case for rules over discretion in monetary policy.

The complexity theory result of Devereaux (2021) and computability results such as Velupillai (2007) matter for macroeconomics in part because of the rise of macroprudential regulation of today's commanding heights of industry, namely, financial markets. Macroprudential financial regulation has been touted as "recogniz[ing] the importance of general equilibrium effects, and seeks to safeguard the financial system as a whole" (Hanson, Kashyap, and Stein 2011, 3). It is, we are told, "an effort to control the social costs associated with excessive balance sheet shrinkage on the part of multiple financial institutions hit with a common shock" (*ibid.*, 5). A leading example is countercyclical capital requirements, "with banks being asked to maintain higher ratios of capital to assets in good times than in bad times" (*ibid.*, 7). Hanson, Kahyap, and Stein (2011, 5, 7–8) define "market failure" as a state in which private actors "deviate from what a social planner would have them do." Time-varying capital requirements are "intuitively appealing" in part because they "emerge as an optimal scheme in a model where the social planner maximized a welfare function that weights both" the risk of bank failures and the need for credit during recessions. Thus, current mainstream thinking on financial regulation and macroeconomic policy is analytically oblivious to any concern that policy is endogenous. This policy recommendation is striking for its hydraulic naivety.

Forbes recognizes that actually existing policy falls short of the ideal propounded by economic experts. The regulatory mandate for a "countercyclical buffer (CCyB)" has "widespread academic and policy support and a well-defined framework." And "many countries have a framework in place to use the CCyB" (2019). But the regulatory mandates have generally been "soft." No country has varied the required buffer "as aggressively as suggested by basic calculations [of Hanson, Kashyap, and Stein 2011] on its optimal use" (Forbes 2019, 473). Forbes recommends "designing institutions to support the optimal use of macroeconomic policy." The "macroprudential authority should be independent and somewhat insulated from the political cycle, while at the same time maintaining a high degree of transparency and accountability" (*ibid.*, 474). Forbes does not suggest a real-world process that would implement such a marvelous design, nor how to get both independence and accountability.

Devereaux's repellor result raises the prospect that macroprudential regulation will be either otiose or poisonous. If the policy is too "soft" to matter, then the behavior of the system will be close to what it would have been without any macroprudential regulation. If it is not too soft, however, it may choke off credit flows altogether, producing a crisis far worse than the 2008 financial crisis to which the very existence of macroprudential policy was a response. If this possibility is realized, the tragedy will recapitulate the story told in Friedman and Schwartz (1963). The Federal Reserve System was created to prevent another catastrophe like the Panic of 1907. It came into being on 23 December 1913. Black Thursday was 24 October 1929. Thus, within 16 years of its creation, the Fed had precipitated a still greater crisis.

The computability results of Velupillai (2007) and others call into question the very idea of "regulating" financial markets. If the consequences of regulations cannot be predicted, then some version of *laissez faire* may be the better path.

Frontline thinking on macroprudential policy is all too good a foil for the sort of macroeconomics I have been discussing. Frontline thinking in macroeconomics fully conforms to the Newtonian paradigm. It is oblivious to entanglement. It is oblivious to computability problems. It views policy as exogenous. It neglects open-ended and creative evolution and the continual arrival of novelty. It exudes the hubris of an unselfconscious pretense of knowledge. Furthermore, I think that macroprudential policy must be destroyed. *Macro delenda est.*

The prospective field of law and macroeconomics needs policy prescriptions if it is to count as "macroeconomics." But I have called into question the very possibility of coherent and reliable policy. We might seem to be stuck in the cul-de-sac of ineffectual criticism of whomsoever might promulgate policy. But there is, I think, a way out. We can take the "constitutional turn," which is "the ancient prescription of David Hume and Adam Smith for stable and secure property rights, for good systems of justice and for the 'rule of law'" (Koppl 2014, 17). The rule of law is key. A research program in law and macroeconomics should include analyses of the consequences of compromising or abrogating the rule of law and the comparative institutional consequences of greater adherence to it.

The gist of the rule of law, Hayek explained, is "that government in all its actions is bound by rules fixed and announced beforehand—rules which make it possible to foresee with fair certainty how the authority will use its coercive powers in given circumstances and to plan one's individual affairs on the basis of this knowledge" (1944, 72). Koppl (2014, 119–25) discusses the rule of law drawing especially on Fallon Jr. (1997), whose sources include Hayek (1944) and Dicey ([1915] 1982).

Some work on macroeconomics and the rule of law has been done. Theory of "regime uncertainty" of Higgs's (1997) and the related theory of Big Players (Butos and Koppl 1993; Koppl and Yeager 1996; Koppl 2002) apply only to the extent that the rule of law has been compromised. In both theories the central insight is that deviations from the rule of law create uncertainty. Such uncertainty suppresses investment, degrades expectations, and creates a more volatile economy. "Keynesian policies tend to create a Keynesian economy" (Koppl 2014, 104). Higgs (1997) and Koppl (2014) link regime uncertainty to the state of confidence. (Koppl 2014 includes a thus far neglected theory of the state of confidence.) At about the time of the 2008 financial crisis, White justly complained, "The approach of Federal Reserve and Treasury officials during this crisis, unfortunately, has been to consider every possible remedy but applying the rule of law" (2010). More recently, Boettke, Salter, and Smith (2021) have developed at some length "the relevance of the rule of law to monetary institutions and policy" (*ibid.*, p. xii).

These sources on macroeconomics and the rule of law are a beginning. But, of course, more work needs be done. A central task is to work out what can be done. As I have tried to emphasize, macroeconomists are inside the system and not above the system. Therefore, policy, including the prescription to have the rule of law, is endogenous. There is no lever for "us" to pull and then out pops the rule of law or rule-bound monetary policy. And yet the rule of law has somehow emerged in various times and places. Following Cazzolla Gatti *et al.* (2020), I believe the Industrial Revolution was the root cause of the global increase in liberty since about 1800.

> The TAP process of technological change tends to give power to those enriched by it. For most of human history, only a small portion of the population was enriched by the process of technological change. Thus, too much of history has been a dismal tale of back and forth change in who was oppressing whom. After about 1800, the TAP process began to enrich the masses… . This "Great Enrichment" (McCloskey 2016) allowed "liberal" institutions such as democracy to spread… . First, technological progress. Then wealth. Then democracy. This crude pattern is a good approximation for the global spread of democracy, which came mostly after the Industrial Revolution, not before (Cazzolla Gatti *et al.* 2020).

If wealth is the key, then the influence of policy experts and political actors may be small in ordinary times. In such times, the most we may hope for is to be midwife to some incremental improvements. But times are not always ordinary. As we have seen with Ludwig Erhard, relatively large positive change is sometimes possible in extraordinary times. In such moments, the fulcrum figure cannot act beneficially without good ideas. I hope to have provided a few good ideas in this essay.

6. Closing Remarks

In making the "nihilistic" argument of this paper, I have merely elaborated on the comment by J. S. Mill quoted earlier: "Ideas, unless outward circumstances conspire with them, have in general no very rapid or immediate efficacy in human affairs; and the most favourable outward circumstances may pass by, or remain inoperative, for want of ideas suitable to the conjuncture. But when the right circumstances and the right ideas meet, the effect is seldom slow in manifesting itself" (Mill [1845] 1967, 370). Ideas and circumstances must meet. LawMacro can preserve and cultivate the idea of the price mechanism under the rule of law for use when "favourable outward circumstances" arise. It is not enough to *preserve* the idea of the price mechanism under the rule of law. We must *cultivate* it as well. To cultivate the idea, we must move it forward, develop it in new and unexpected directions, engage *today's* intellectual foes, and generally slay the dragons afoot now and not the long-dead dragons already slain by our intellectual forebears. I believe the tools of analysis I reviewed above help to "cultivate" in this sense the macroeconomic theories of Hayek, Yeager, and other "mainline" (Boettke 2012, xvi) economists.

As we have seen, the Keynesian law and macroeconomics of Listokin and others calls for a time-varying legal structure. The complexity-theoretic tools I have reviewed are useful aids to epistemic critiques of such policies. I believe they are helpful in producing epistemic analyses of policy in general. They bolster the "Austrian" view that "knowledge problems" tend to frustrate the stated goals of interventionist policies. Using the TAP equation to model Brian Arthur's "combinatorial evolution" has led Koppl *et al.* (2023) to a new explanation of the Industrial Revolution and, more generally, a different and, I believe, better theory of economic growth. This new model of "combinatorial growth" may prove helpful in sorting out the growth implications of alternative institutions and policy regimes, including those of Keynesian law and macroeconomics. Devins *et al.* (2015; 2016) are "against design." The tools I have been reviewing tend to support their skepticism of constitutional design and, by extension all forms of institutional and policy design. The implications of such skepticism are not nihilistic, however. They reinforce the central value of the rule of law, which was esteemed in the old-fashioned monetary theory of Hayek, Yeager, and others. The rule of law is never fully realized. It is always aspirational. Therefore, we must always fight to preserve and defend some approximation to it. The sort of law and macroeconomics I have described in this essay is worth developing because, I believe, it provides helpful tools in the ongoing fight. I invite other scholars to join me in this important effort.

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