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Nominal GDP stabilization: Chasing a mirage

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ABSTRACT

This paper argues that NGDP targeting is unlikely to produce macroeconomic stability. Contrary to the policy objective, NGDP targeting may increase macroeconomic turbulence. DSGE models that prove the effectiveness of NGDP stabilization policy rest on two assumptions. The first assumption is that macroeconomic volatility is a consequence of exogenous shocks to an otherwise stable system. The second assumption is that central banks can act upon aggregate variables. Neither of these assumptions is accurate. An economy is an ecology of interacting agents, some of whom have rivalrous plans. Macroeconomic volatility is an endogenous and intrinsic feature of such an economic system. Furthermore, central banks act upon some agents in the economic system, not on aggregate variables. The percolation of central bank actions through production networks can impede coordination efforts of economic agents during recessions, thereby increasing macroeconomic volatility.

1. Introduction

For the better part of a century, economists have explored whether macro level stability is more effectively pursued by a central bank that follows clearly articulated rules or a central bank that exercises discretion in response to events and situations (Mankiw, 1994; McCallum, 1997). In recent years, this exploration has turned towards NGDP stabilization policy. Economists have argued that NGDP stabilization policy combines the merits of rule-based and discretion-based monetary policy, while to some extent avoiding the pitfall of the two approaches. It is said that NGDP targeting stabilizes long term inflation expectations, while giving central banks enough leeway to respond to short term shocks (Koenig, 2012; Sumner, 2014). In this paper, we show that NGDP targeting is unlikely to produce macroeconomic stability. Contrary to most of the literature on NGDP targeting, we argue that NGDP stabilization may increase volatility of real output by interfering with bottom-up coordination processes.

Our view on the effects of NGDP targeting differs from those of most economists because of underlying conceptual differences. Much of the literature on NGDP targeting relies on variants of DSGE models to prove the effectiveness of NGDP stabilization policy. Undergirding DSGE models is the presumption that steady growth is an attainable state for a macro economy and that central banks can to some extent act directly upon aggregate variables. The DSGE framework treats the micro-macro relationship as additive, which produces a steady rate of growth in the absence of exogenous shocks. In contrast, we treat an economy as an ecology of inter-related plans, some of which are rivalrous. Within an ecology of plans the interactions between agents produces endogenous volatility, for some rivalrous plans must necessarily fail as others succeed. Plan failures sometimes cascade to produce macroeconomic turbulence. Macroeconomic turbulence is reflection of microeconomic coordination problems. The decline in velocity of money during recessions does not indicate an increase in the demand for money per se, but merely the postponement of spending as economic agents make new plans to create coordination. Increasing the quantity of money to accommodate the decline in velocity of money as prescribed by NGDP targeting will do little to solve microeconomic coordination problems. DSGE models present a picture of an economy where central banks can directly act upon aggregate variables. From an ecological perspective, cen-

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tral banks act upon some agents within an economic system, who in turn pass the effects of centralbank actions to other agents through production relations. The injection effects and relative price effects produced by the percolation of central bank actions through the production networks can impede bottom-up coordinative processes (Lavoie, 1983).

Any analytical framework focusses attention in particular directions while taking it away from other directions. Macro theory has given great emphasis to fine-tuning DSGE models while shying away from broad-ranging explorations into alternative paths of theoretical construction (Caballero, 2010; Collander, Howitt, Kirman, Leijonhufvud, & Mehrling, 2008). A theorist cannot be everywhere at the same time, but it does not follow that all theorists should be at the same place. In this essay, we pursue an alternative path of theoretical construction. While we accept the claim that a macro theory should rest on reasonable micro foundations, we set forth a form of spontaneous order theorizing as an alternative micro foundation (Aydinonat, 2008; De Grauwe, 2010). We develop a schema of thought in which an economy is a continually evolving ecology of plans wherein macro variables emerge out of micro-level interaction, only at no instant in time is that ecology in a *state* of equilibrium (Wagner, 2012a, 2012b). Rather it is a *process* of continual development, where at each instant some enterprises are being born and others are dying, with those births and deaths injecting turbulence into the ecology. Recognition that an economic ecology has turbulence casts a different light upon the problem of policy. In Section 2, we explain the difference in the micro-macro relation between DSGE and ecological formulations of economic systems. In Section 3, we discuss why NGDP policy is effective in stabilizing output within DSGE models. In Section 4, we discuss the emergence of endogenous macroeconomic turbulence when economic agents interact within an ecology of inter-related plans, some of which are rivalrous. In Section 5, we argue that large-scale plan failures or recessions will produce a decline in velocity of money at the aggregate level, however this does not mean that there is an increase in demand for money per se. Rather economic actors postpone spending decisions as they engage in making new plans. In Section 6, we discuss how NGDP targeting may increase macroeconomic turbulence by interfering with bottom-up coordination processes, particularly during recessions. In Section 7, we offer concluding thoughts.

2. The micro-macro relationship: additive and ecological formulations

Economists typically treat the micro and the macro levels of analysis as *effectively* independent. In the immediate post-war period when the "neoclassical synthesis" arose, the two levels were treated as truly independent. The analytical claim in those years was that macro policy could promote full employment and micro policy could promote open competition, with the two together comprising a coherent framework for economic policy. As economists grew increasingly uneasy with the absence of micro-foundations for macro theory, the DSGE model came into play. Macro theories were subsequently built on the base of general equilibrium theory. While DSGE changed the style of macro theorizing greatly, macro variables were still related directly to one another as they had been in the days of the neoclassical synthesis. What had really changed was that with DSGE the relations between macroeconomic variables were derived through the optimization problem solved by a representative agent. Macro statements could still be made without filtering those statements through the micro level because any such filtering would add no value to the explanatory enterprise, with the exception of neutrality precepts derived through the assumption of rational expectations. DSGE did not see the need to study the interactions between agents within a network of economic relations. The presumption that observations pertained to states of systemic equilibrium rendered micro and macro statements consistent without explicit articulation of connections between macro and micro levels of analysis (Weintraub, 1993) and connections within the micro-level of analysis.

The DSGE framework is *additive* in the sense that macro variables are created through aggregation over micro entities. Consider a barebones representative agent model in the early chapters of standard graduate textbooks like Stokey and Lucas's (1989) "Recursive Methods in Economic Dynamics" or Ljungqvist and Sargent's (2000) "Recusrive Macreconomic Theory". In the elementary model, a representative household faces the problem of allocating a homogeneous good between consumption and investment. The good may be thought of as corn seeds, which can be consumed or sowed to produce crops in the future. Investment transforms present good to future good using a production function. The utility function and the production function have stylized forms. The household faces the problem of making a consumption-investment decision period by period for an infinite horizon of time. The infinite-horizon introduces a recursive structure to the optimization problem, which in turn allows economists to use Bellman's equations to solve for value functions. Certain assumptions are made about functional forms to guarantee Blackwell sufficiency conditions are meet, yielding fixed point solutions to the optimization problem. Such an economy exhibits a steady state with no growth. In later chapters, the textbooks introduce stochastic productivity growth, which in steady state produces stochastic output growth. The stochasticity does not arise from the interaction between economic actors, but from extra-economic forces. DSGE models have come a long way from their early avatars. Contemporary DSGE models allow for heterogeneous expectations among a continuum of agents (Branch & McGough, 2009; Massaro, 2013) and incorporate financial market constraints (Gerali, Neri, Sessa, & Signoretti, 2010). DSGE models have largely abandoned Ricardian equivalence. In last two decades, a consensus has formed in the favor of New Keynesian DSGE models for their ability to fit data. Tovar (2010) and Christiano, Trabandt, and Walentin (2010) provide surveys of monetary policy applications of recent DSGE models.

Much of what we say in this section pertains to the foundational structure of DSGE models and therefore applies to all its variants, old and new, with and without sticky prices, with rational expectations and with learning agents. There are two principle differences between the DSGE approach and the ecological approach. The first difference is that within the DSGE approach coordination of economic plans happens outside the economic system through fixed point theorems, whereas within the ecological approach coordination is produced through the interaction between agents within an economic system (Veetil & Wagner, 2016). The second difference is that the DSGE approach postulates that the movements of macroeconomic variables occur due to shocks external to the economic system, whereas an ecological approach postulates that macroeconomic variables move because of plan miscoordinations among interacting economic agents. Within the DSGE approach is it is sensible to pose the question of how a central-planner would organize the economy. The standard procedure in solving DSGE models is to compute the central planning solution and compare that solution to the so-called "market solution" of the model. Such an exercise has no meaning within an ecological approach. As Vilfredo Pareto noted long ago, maximizing social welfare has little meaning in a polity of wolf and sheep. The happiness of the wolf is in eating the sheep and the happiness of the sheep is in not being eaten. The ecological approach encompasses rivalry among the plans of economic actors, and it is the interplay between the constellations of related rivalries that produces all kinds of interesting macroeconomic dynamics.

DSGE models allow for explicit aggregation presuming observations pertain to states of systemic equilibrium, even when such aggregation is not empirically founded (Stoker, 1993). Within the DSGE framework differences among micro entities have little work to do with regards to macro theorizing, for most differences among micro agents are cancelled through aggregation into the systemic equilibrium. Lucas (1977, p. 20), for instance, thought that the "presence of unpredictable conditions in individual markets" will not produce aggregate fluctuations because they will cancel each other. It is this feature of cancellation through aggregation that an ecological framework challenges. An ecological framework does not posit that all observations pertain to states of equilibrium. To the contrary, it posits that the passing of time is an integral feature of the economic process. As time passes, people experiment, invent, and learn things that were unknown or non-existent at earlier moments. One firm invents a new product which changes the landscape of opportunities available for competing firms and suppliers of inputs. Creation, novelty and adaptation are perennial and intrinsic features of an ecological system. Within an ecological framework, not just prices and quantities but products and production relations too are evolving economic variables (Gualdi & Mandel, 2016a). Hence the data used for comparative statics in DSGE are not available for an analysis of emergent dynamics, the ceteris paribus conditions do not hold for endogenous reasons. Within an ecological framework, the micro-macro relationship is one of interaction and not independence or cancellation. Lucas (1977, p. 20) is right that within a DSGE framework the "presence of unpredictable conditions in individual markets" cancel out in an economy with a large number of markets. However, within an ecological framework unpredictable conditions can exert influences through production networks, which may lead to cascades of creation and adaptation (Gualdi & Mandel, 2016b). It is indeed true that two adjacent rooms at different temperatures will tend towards the same temperature. But it is equally true that when the butterfly develops slippery feet, it becomes profitable for the frog to develop a sticky tongue (Kauffman & Johnsen, 1991). The ecology of economic agents is not reasonably reducible to a representative agent because interactions within the ecology does significant work. The dynamics of the evolving interaction between the butterfly and the frog will be missed if the two were treated as a representative organism or a continuum of organisms. Life lies somewhere between one and infinity (Weaver, 1948). While the passing of time decreases the temperature differences between two adjacent rooms, the passing of time produces all kinds of novelty through the interaction between the butterfly and the frog. In ecological systems time does not eliminate differences, rather it transforms old differences into new differences.

Note also the conceptual difference in the notion of "heterogeneity" in DSGE and in ecological frameworks. A heterogeneous DSGE model may posit that men have different heights. It may further derive the conclusion that in equilibrium an economy with men of different heights will produce pants of different sizes, whereas an economy with all men of the same height will produce pants of one size. A heterogeneous DSGE model may posit that men have differing risk preference. And use this heterogeneity postulate with other assumptions to derive spreads in insurance and credit markets. DSGE heterogeneity is very different from the heterogeneity between the wolf and the sheep or the heterogeneity between the frog and the butterfly. DSGE heterogeneity neither incorporates rivalrous motives as with the wolf and the sheep, nor does it lead to the generation of novelty as in the case of the interaction between the frog and the butterfly. Heterogeneity matters precisely because of differences in motives and the struggles for survival that it induces, all of which is ruled out within equilibrium notions of economic systems.

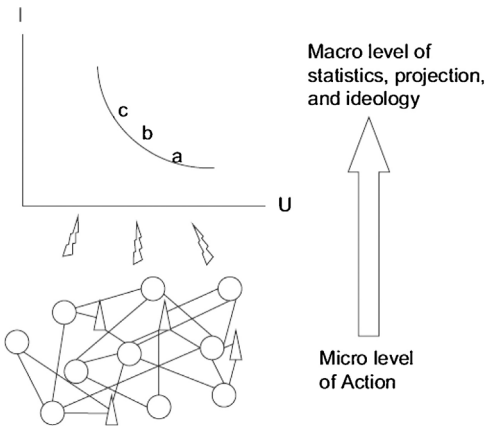

Fig. 1. Micro-origins of macro variables.

When evolution replaces equilibrium as an analytical framework, macro theory acquires a vertical direction of movement. The vertical direction goes from the ground-level of action between micro entities to the macro level of the aggregate consequences of these actions. There is a bi-directional relation between micro and macro level entities, where the macro level is generated by and influences patterns of activity at the micro level. None of this is to suggest that representative agent formulations are useless. One the contrary, such reductions can be useful for some purposes though not for others. All we intend to argue is that the reduction is not useful for understanding the consequences of macroeconomic policy. In social and economic theory, to posit an analytical scheme that is useful for all purposes is equivalent to positing the existence of a universal solvent.

Consider a parade one-mile long with 3000 people moving north at three miles per hour. The parade can be reasonably described as a social configuration in equilibrium and reduced to a point whose route can be traced on a map. The parade is an organization whose route is established by a parade marshal. Contrast the parade with a crowd of pedestrians leaving a stadium. The crowd of pedestrians is orderly in that the members of the crowd can navigate their ways to their destinations. The crowd, however, is an order and not an organization. To be sure, some of the members of the crowd will travel in groups, which might make the crowd an order of organizations. In any event, it is a system of interacting agents that cannot be reasonably reduced to a point moving along a map. Equilibrium theory does not reasonably pertain to a pedestrian crowd because that crowd cannot be reasonably reduced to a representative member. The crowd is constituted through its members but cannot be reasonably reduced to one representative member. The crowd reflects a relationship of parts-to-whole, and so belongs within the analytical domain of ecological theory.

Wagner (2012a) and Veetil and Wagner (2016) bring an ecological orientation to bear on macro level phenomena. Thinking about an ecology requires a theorist to theorize in terms of levels of phenomena, with higher levels generated through interaction among elements that reside on lower levels. Fig. 1—carried forward from Wagner (2012a) and Veetil and Wagner (2016)—presents a bi-planar model of an economy. The lower level is the ground level where all action occurs. Fig. 1 shows actors connected in network of buyer-seller relations. The incomplete graph denotes that knowledge is distributed among societal actors and not assembled in one particular node. There is no agent whose properties mirror those of the system. The upper part of Fig. 1 is organized in terms of a model of aggregate supply and demand, though it could also have been organized in terms of money supply and demand. Empirical evidence on production relations in the United States and Japan suggest that the world outside the window has intricate asymmet-

ric structures and is most certainly not formless (Atalay, Hortacsu, Roberts, & Syverson, 2011; Hisano, Watanabe, Mizuno, Ohnishi, & Sornette, 2015).

The society portrayed in Fig. 1 is a pedestrian crowd and not a parade. The nodes represent commercial entities within a market economy. The triangle on the right side denotes "Big Players" like a central bank (Koppl, 2001). All action—including those of a central bank—take place at the ground level. Some entities are more influential within the societal nexus than other entities. A central bank is a particularly influential entity. Still, a central bank can operate only on the ground level like all entities in society. Central banks cannot directly act upon macroeconomic variables, which are the emergent outcomes of actions at the ground level. Suppose the Federal Reserve places an order with a brokerage house to buy or sell Treasury Bills. The brokerage house in turn establishes connections—old and new—with other entities to execute the Fed's order. These transactions generate responses, actions, alterations in old plans, and new plans. All of which generate data that can be observed at the macro level. To be sure, data never speak for themselves, but speak only after being organized according to some theoretical framework. The macro data, which emerges from the actions and interactions initiated by the Fed's order at the ground-level, when aggregated according to the DSGE framework present the illusion of the Fed acting at the macro level. But the Fed did not and cannot act on macro variables, though its actions can produce changes in macro variables. This difference between 'ground-level actions that produce macro changes' on the one hand and 'directly acting on macro variables' on the other hand is key to understanding why stabilizing nominal GDP is chasing a mirage.

3. Stabilizing nominal GDP within additive micro-macro formulations

The idea of NGDP stabilization is more than two decades old, and the theme of controlling one economic magnitude with the use of another is ancient. An explicit statement about NGDP stabilization can be found in Feldstein and Stock (1994, p. 7), who say "the relation between M2 and nominal GDP is sufficiently strong and stable to warrant a further investigation into using M2 to influence nominal GDP in a predictable way". Interestingly enough, around the same time Clark (1994) and Frankel and Chinn (1995) argued for NGDP stabilization precisely for the opposite reason. Clark (1994) and Frankel and Chinn (1995) say NGDP targeting is useful because monetary aggregate have become less reliable guides for policy, they point to the large shifts in the velocity of M1 in the 1980s. Since the financial crisis of 2008, numerous economists have revived the idea of nominal GDP stabilization as a means to control aggregate volatility. It has once again been stated that monetary aggregates under the control of the Fed are stable enough to make NGDP targeting feasible (Belongia & Ireland, 2015). Some have argued that NGDP targeting helps stabilize long term inflation expectations while giving central banks enough leeway to respond to economic shocks (Koenig, 2012; Sumner, 2014). It is said that NGDP stabilization policy splits the impact of supply shocks between inflation and real GDP growth, whereas with inflation-targeting supply shocks fall entirely on real GDP growth (Bhandari & Frankel, 2015). Others have developed auxiliary arguments about the optimality of NGDP targeting in the presence of frictions in credit markets, heterogeneous labor supply, and tax burden (Hatcher, 2016; Bullard et al., 2017).

Considering how stabilizing nominal GDP would operate in the presence of nominal shocks places the additive orientation in stark contrast to the ecological orientations toward macro phenomena. The NGDP stabilization literature draws strong inspiration from the cash balance interpretation of depression that Yeager (1956) advances. Starting from a position of systemic equilibrium, Yeager posited a sudden and universal increase in the desire to hold money balances. With this being the only change in the system, the comparative statics of the situation would lead to a new equilibrium with a lower set of prices with real activity remaining unchanged. In light of the reasonable recognition that there would never be instant societal readjustment to such shift in the demand for money, a period of economic disruption must be endured before the new economic equilibrium is established. Rather than enduring this disruption, a rule of stabilizing nominal GDP could maintain the old equilibrium without disruption. A nominal GDP stabilization policy would increase the supply of money to meet the shift in the demand for money, thereby making it unnecessary for the economy to go through a period of disruptive adjustment.

This case for stabilizing nominal GDP is deceptively simple, in this deceptive quality resides some of the central analytical issues that are hidden by the additive framework and are revealed by the ecological framework. The claim that stabilizing nominal GDP can promote real stability at the macro level is a variation of the classical theme that money is neutral in the long run. According to this neutrality proposition, the long run effect of doubling the money supply would be to double all prices, leaving relative prices unchanged. Likewise, halving the money supply would cut all prices in half, leaving relative prices unchanged. This analytical exercise could elicit the claim that the classical economists dichotomized the pricing process, wherein relative prices were determined independently of absolute prices. Patinkin (1965) explained that the classical economist did not engage in such dichotomization, but rather pursued different analytical experiments to address different questions.

What appeared to be a dichotomization of the pricing process was just an analytical technique to maintain a suitable focal point for a particular line of analysis. One line of analysis sought to explain how adjustments in relative prices operated to promote micro-level coordination in responses to changes in the relevant data. A public mourning increased the demand for black cloth, with systemic coordination promoted through changes in prices. Another line of analysis sought to explain how the general level of prices would vary with the amount of money in circulation. An influx of gold would inflate the general level of prices, but would not impair the coordinative properties of micro-level interaction in the long run. Nominal and real were analytically separated as a proposition about long-run properties of systemic interaction, and yet the ability of an increase in the supply of money to affect prices in the short run was also recognized, as noted by both Cantillon (1931) and Hume (1752). Such long-term analysis was useful to establish the proposition that an economy does not become wealthier by increasing the quantity of money in circulation.

Market monetarism and the support it gives to stabilizing nominal GDP embraces what has been wrongly described as the classical dichotomy between nominal and real values. Within the framework of the quantity theory, the equation of exchange is a macro level representation of an economy. This representation is complementary to the theory of systemic equilibrium at the micro level that the Classical economists also recognized, even though formalization of such equilibrium was not set forth until Walras (1874). Within this formalization, Walrasian equilibrium at the micro level of individual action required the balancing described by the quantity equation at the macro level. The macro level reflects the micro level equilibrium. To assert complementarity between micro and macro statements is most certainly not to assert independence between the two levels. Only by reducing a macro economy to a representative agent can a theorist avoid issues associated with the bidirectional relation between micro and macro levels.

The representative agent formalization renders NGDP targeting sensible by eliminating any notion of an economy as consisting of

interacting agents in which coordination is an emergent property of the system, not a condition imposed from outside the system. The recent work reviving NGDP targeting—cited earlier in this section—uses representative agent models to derive conclusions about the efficacy of stabilization policy. The injection or extraction of money into the representative agent is nearly identical to acting upon aggregate variables because there is essentially no distinction between macro and micro in representative agent models, after all a single agent represents the entire economy. NGDP stabilizations "works" because the central bank can directly act upon an aggregate quantity. This is in sharp contrast to the ecological view outlined in Section 2 where all action takes place at the ground-level, with macroeconomic consequences. Within an ecological setting, creative interactions between agents will produce endogenous macroeconomic volatility (as we explain in Section 4). Attempts to curb this volatility through actions of a central bank at the ground-level can further increase the volatility by disturbing coordinating properties of agent interactions (as we explain in Sections 5 and 6). The representative agent framework hides all these problems, thereby presenting an illusion of direct control over macroeconomic variables. The presumption of 'exogenous shocks rather than endogenous actions' as the motor of macroeconomic volatility on the one hand and the 'ability of central banks to directly act upon macroeconomic variables' on the other hand, together yield the efficacy of NGDP stabilization in representative agent models. Neither of these presumptions are present within an ecological model, which therefore sheds a very different light on NGDP stabilization policy.

4. Endogenous turbulence within an ecology of plans

An ecological framework entails "creative dynamics" which is different from "out-of-equilibrium dynamics" (Katzner, 1998). Out-of-equilibrium dynamics involves the traversal of a system from one equilibrium to another equilibrium (Veetil, 2016). The traversal maybe slow or fast, successful or unsuccessful. Nonetheless, out-of-equilibrium dynamics necessitates a meaningful definition of equilibrium as plausible starting and ending points of the dynamics. Creative dynamics involves the continual generation of novelty through the purposeful behavior of agents within the system. There is no meaningful sense in which one can define an equilibrium where the agents are at rest with regards to each other. One man's adventure wrecks another man's peace. Rivalry is an intrinsic aspect of social life, much like in the ecological life of non-human organisms. We all wish to play in a concert, but far too many of us want to be the first violin. These basic human inclinations manifest in the discovery of new markets, the creation of new productions, and the establishment of new ways of doing things (Schumpeter, 1939). But they also manifest in death of firms, the extinction of products, and macroeconomic turbulence.

Economists for many years believed in the dictum that small changes at the micro level cancel out to produce little or no change at the macro level. In Lucas's (1977, p. 20) words the cancelling of small changes in a large system is "the most important reason why one cannot seek an explanation of the general movements we call business cycle in the mere presence, per se, of unpredictability of conditions in individual markets". This percept lead economists to seek explanations for macroeconomic changes in exogenous shocks. As argued in Section 2, such canceling out does not happen in ecological systems. The variations in plans of microeconomic agents produce further changes in the plans of other agents through cooperative and competitive relations. Some micro changes have small macro effects. Other micro changes cascade through production relations to produce large effects (Bak, Chen, Scheinkman, & Woodford, 1993). While the ground-level economy is in perennial flux, the macro economy exhibits periods of calmness and turbulence. The qualitative features of micro and macro dynamics are quite distinct. Macro calmness does not mean micro fixity. For instance, Axtell (1999) presents an ecological model of firm formation. In Axtell's model, workers choose to work in a firm, move to a different firm, or create a new firm. The micro economy is in perpetual flux as firms are taking birth and dying, growing and shrinking, with the passing of time. Yet, macro level attributes like the size distribution of firms displays some stability. Similarly, Gualdi and Mandel (2016b) present a model in which firms innovate on a production network, and these microeconomic interactions produces periods of calmness and turbulence at the macro level. The idea of emergence solves the paradox that "you can never step in the same river twice" yet the same river flows for centuries. Macro level properties can exhibit a modicum of stability despite perennial micro flux. Ecological models—unlike representative agent models—do not require micro level variables to have the same properties as macro level variables. Macro level variables are derivatives of actions that happen at the ground level, though the macro variables in turn influence ground level actions. There is a bi-directional and vertical relation between mind and society, intermediated by human action (Wagner, 2010).

As to when and why perennial micro flux produces macroeconomic turbulence remains an open question. In recent years, macroeconomists have increasingly come to view buyer-seller relations between firms as the link between micro flux and macro volatility (Carvalho, 2014). Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi (2012) presents a model in which micro changes produce sizable macro volatility due to the production relations between firms. While the turn of macroeconomics towards networks constitutes progress in recognizing empirical reality, it continues to invoke equilibrium notions using variants of representative agent models. One limitation of using equilibrium notions is that in recent network models negative micro changes produce negative macro changes and positive micro changes produce positive macro changes. The recent macro models use networks to amplify the micro shocks, whereas they might have cancelled out in the absence of production relations. From an ecological point of view, the relation between micro and macro is not one of negative to negative or positive to positive. The invention of a new product may produce cascades of plan failure large enough to register a decline in a macro variable. Similarly, the failure of some firm may open new opportunities for other firms, which may manifest in an increase in a macro variable. In an ecological model, there can be aggregate volatility without negative technological shocks. One of the principle features of the ecological approach is that economic dynamics emerge from economic decisions and interactions not exogeneous technological shocks.

Endogenous macro dynamics emerge from creative interactions with an ecology of evolving plans. And the dynamics of macro level variables can be very different from the dynamics of ground level micro interactions. This difference between macro and micro dynamics is important in understanding the "nature" of recessions which NGDP stabilization policy attempts to cure. Within the representative-agent framework, recessions are periods of inactivity. The additive approach to micro-macro relationship associates the decline of aggregate indicators with a lull in ground level activity. After all there is no distinction between the macro and the micro levels in representative agent models. Yet from an ecological perspective recessions can be periods of vigorous activity rather than inactivity. Recessions are periods of relatively large-scale miscoordination. Businesses have inventories that consumers do not want to buy, workers have skills that entrepreneurs do not want to hire, and entrepreneurs have projects that banks do not want to fund. Such macroeconomic phenomena as unemployment, underused factories, and un-loaned loanable funds are reflections

of miscoordination at the micro-level. What do economic actors do when they find themselves in such a world? During recessions there are significant gains to be made from creating coordination. Entrepreneurs can make profits by hiring workers at low wages, if they develop projects that are consistent with the skills of workers and the demands of consumers. Economic actors have an incentive to dovetail their plans. They substitute coordination activities for production activities. They spend less time producing goods and services, and more time determining what to produce, how to produce, and for whom to produce. Workers look for employers who want their skills, and may even retrain themselves to learn new skills. Consumers substitute one product for another, even develop new tastes. And entrepreneurs come up with new projects that banks may be willing to fund.

All this involves novelty and change. The economic system goes through a process of creating a new constellation of plans that is more coordinated than previous plans. This process of coordination is costly. The cost of coordination includes intended and unintended costs. Intended costs are costs incurred by economic actors with the intention of dovetailing their plans to those of others, such as the cost of job search by workers. Unintended costs are costs that occur due to the failure of some planned adjustments. Individual economic actors go about adjusting their plans locally, some new plans work and others fail. Some plans appear to be a good local fit but turn out to be a poor fit within a larger picture. Much like the pieces of a puzzle, the plans of two actors must not only fit with each other's, but they must fit together within the larger picture of the economy. Consider the following example. An entrepreneur learns that consumers are looking for cheaper clothing. He succeeds in securing a loan to build a factory to produce cheap cotton shirts. Some workers hear about this opportunity and invest in training themselves to secure a job at the factory. The workers' actions are intended to dovetail their skills to those that the entrepreneur wishes to hire. However, the dovetailing of the plans of the entrepreneur and the workers says little about whether the two together fit within the global picture. If the entrepreneur's plans fail, so will the workers'. The entrepreneur's plans may fail because of the closure of the cotton mill from which he intended to source cotton. The cotton mill closed because of competition from synthetic fibers, which has arisen in response to changes in consumer demand because of the recession. Plan failures during recessions due to endogenous reasons are the unintended costs of coordination. Plan failures are more likely during recessions because they are periods of vigorous mutual adjustments, change, and novelty.

The failure of plans, however, is not an economic waste. Consider a job interview that fails to match an employee and an employer. The worker does not get the job but he learns about the skills that potential employers want. Similarly, the employer learns about skills that workers have. They also gain information about what each is willing to accept and willing to pay. All this is reflected in relative prices when plans succeed and trades happen. The price at which trade happens is not always—or even predominantly—discovered at the moment at which trade happens. Prices are discovered through a process of interactions during which no trade may have happened. Failure sows the seeds for success. The information accumulated during failed attempts to trade is brought to light when trade finally happens. It is costly to create coordination during recessions when many economic actors are together making new plans, while taking stock of what is left of old plans that did not materialize.

All this is to say that from an ecological perspective action never ceases at the ground-level, though one kind of action may be substituted for another kind of action. A decline in one or more macro variables merely indicates a change in ground-level actions, it does not indicate a decline in ground-level actions. It is the confounding of the micro and macro, the absence of the distinction between the plane of actions and the plane of macro variables, which produces the illusion that recessions are periods of inactivity. While recessions involve vigorous ground-level activity, the activity is qualitatively different from production activities. In Section 5, we argue that planning, waiting, and coordination activities during recessions will appear as a decline in the volatility of money on the plane of macro variables.

5. The velocity of money within an ecology of plans

The velocity of money is of paramount importance in macroeconomic theory (Gordon, 1984; Lounsbury, 1931; Thornton, 1983). The role of monetary policy, and its ability to influence real output, depends on the answer to the question of why velocity of money behaves the way it does (De Long, 2000). In fact, Keynes's (1923) famous phrase "in the long run we are all dead" appears in the midst of the following passage about the velocity of money.

> Now 'in the long run' this [the rigid quantity theory] is probably true. . .. But this long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is long past the ocean is flat again.

The above passage from Keynes highlights two fundamental differences between the ecological view and the DSGE view of economic systems. The first is the reference to the "storm", which suggests macroeconomic turbulence is brought about by exogenous shocks as in DSGE models. The second is the caricature of an economy as an "ocean", in which the molecules of water do not exhibit purposeful behavior, and without the exogenous storm the economy is a rather flat ocean. There is no sense in which the molecules of the oceans form plans or purposefully interact to produce storms. From an ecological point of view, much of the turbulence in an economic system is a consequence of actions and interactions of purposefully behaving economic actors. The storm emerges from within. As explained in Section 4, economic actions and interactions within an ecology of plans produces occasional miscoordinations. Some miscoordinations will be small, limited to industries or sectors. Other miscoordinations will be large, engulfing entire economies. The plan miscoordinations at the ground-level will be projected onto the plane of macro variables. Plan miscoordinations will appear as a decline in aggregate variables like output and velocity of money. This however does not mean that the problems lie at the macro plane, nor does it mean that solutions can be found by attempting to change macro variables. A decline in macro variables like the velocity of money does not mean a decline in plans and actions at the ground-level, though it may indicate change in the qualitative nature of plans and actions at the ground-level. While spending is the prime variable in much macroeconomic theorizing, spending is a derivative and not a primitive variable. The plans of different economic agents and the inter-relations between these plans are the primitive variables of an economic system. Spending derives from the commercial plans that people form and execute. Within DSGE models this distinction is perhaps not terribly significant because the macro and the micro are essentially one and the same in an economy of a representative agent. But within an ecological system all that of importance resides in the nexus of relations between the commercial plans of people.

Consider the scenario in which the actions and interactions within an ecology of plans produces a large scale miscoordination, a recession. What do economic agent do in such circumstances? How do their actions and interactions change macroeconomic variables? And how does NGDP stabilization policy influence the ground-

level actions of economic agents? In so far as a recession is a period of large scale miscoordination, as discussed in Section 4, economic agents begin forming new plans. Men—unlike molecules of water—do not merely respond to external force in deterministic ways. Men are men in so far as they get up and get going, though some may lead and others follow. While there might be numerous particular reasons why some agents might increase their money balances, a good number of these will reflect efforts to pursue new economic plans. Some people may accumulate money balances prior to undertaking new entrepreneurial projects, while at the same time concluding that the foregone expected interest earnings were not worth the risk or trouble that would be involved in buying short-term financial instruments. This accumulation, however, does not denote a reduced desire to spend per se but rather denotes that some span of time is necessary to assemble an entrepreneurial plan. This entrepreneur and his money balances appear to be idle when examined from the outside. Yet neither he nor his money balances are idle, but rather are involved in putting together an enterprise that will soon spring into action.

During periods of large scale miscoordination agents may also "take time" to form new plans. Entrepreneurs may wait to see what other entrepreneurs do. And the waiting periods will tend to be heterogeneous, depending on a variety of factors from personalities of the entrepreneurs to the inter-relations between their plans to those of others. Some macro theories view staggered contracting as a source of price rigidities and economic fluctuations. Yet there is no option to staggered contracting in any but the simplest of economic environments. Actually, the staggered quality of decision making operates to reduce the costs of bringing about economic coordination. Suppose, to the contrary, that all agents make economic decisions simultaneously. Doing this requires each agent to guess correctly the decisions of the other agents to render their plans consistent with each other's. By making decisions in sequential and staggered fashion, economic actors can learn about the plans of others before making their own plans, economizing on coordination costs in the process.

A simple way to illustrate this is the number-coordination problem. Imagine a population of N agents, each of whom must choose either 0 or 1. The agents succeed if all agents choose the same number. If N = 2 and agents choose simultaneously, the probability of success is 0.5. However, if N = 10, the probability of success is less than 0.002. As N grows, it becomes more and more costly to play simultaneously. They would do better if they staggered their decisions, so that one agent knew what another has chosen before making her own choice. Economic coordination problems during recessions are vastly more complex than the number-coordination problem. What the number-coordination problem highlights, however, is that the only plausible way to solve large-scale coordination problems entails a continual parade of staggered decisions that passes information around the system. Sometimes the fastest way to solve a coordination problem is to take time.

"Taking time" at the ground-level of actions projects a decline in the velocity of money onto the plane of macro variables. Some agents postpone their consumption and investment decisions as they wait for others to make their decisions. These agents do not spend their money, which shows up as a decline in the velocity of money at the macro level. Like in the number-coordination problem, the staggering of decisions allows economic agents to learn about each other's plans before making their own. The decline in the velocity of money, however, hides all that is of importance from an economic point of view. Some agents take the lead in implementing new plans by spending the money that those plans require. Some agents wait for days before implementing their plans, others wait for weeks, and still others wait for months. How long each actor decides to wait before executing new plans depends on a variety of factors, including their risk preference, the degree of miscoordination around them, and the sensitivity of their position in the nexus-of-economic relations. Risk-preference is the simplest of the determinants of the variations in the decline in velocity of money. Implementing new plans always entails risk; however, the general riskiness of economic activities is elevated during recessions. This is because many economic actors reformulate their plans during recessions; therefore, mutually consistent expectations are less likely to prevail than under less turbulent conditions. Other things equal, how long an economic actor waits will depend negatively on his appetite for risk. A second determinant of how long economic actors wait is the degree of miscoordination in their proximity. By proximity we mean "plan proximity" not "geographical proximity". Plan proximity is a measure of the nature and degree to which the plans of one economic agent are related to those of other agents. If the plans of those to whom an agent sells his goods and those from whom he buys inputs have failed during the recession, he may take longer to reformulate his own plans. In contrast, economic actors whose input sellers and output buyers are largely unaffected by the recession have less of a reason to reduce spending and reconfigure their plans. Yet another determinant of the waiting periods of economic actors is their positions within the global ecology of plans. In the number-coordination problem, the plans of all agents are equally sensitive to the plans of all other agents. All agents are in a symmetric position with regards to the decisions of everyone else. This is not true of economic actors. The nexus-of-economic interaction is complex and asymmetric. The sensitivity of the success of one's plans to the plans of others will vary across economic agents. Some positions in the economic ecology will be sensitive to small changes in far away regions, while other positions will be robust. Those who live in robust positions will tend to wait less and therefore lead economic recovery. Those who live in sensitive positions will tend to wait it out. There will be a decline in spending across the economy during recessions; however, that decline will vary among economic actors. The decline in velocity of money at the aggregate level is merely a reflection of different waiting and consequently spending decisions made by economic actors. The movements in monetary aggregates during recessions reflects the disaggregate decisions of economic actors.

The above analysis of the decline in the velocity of money due to agent interactions, planning, and waiting stands in sharp contrast to Yeager's mental experiment of a universal increase in the demand for money which is reflected in a decrease in the velocity of money. Yeager and others have argued that the price level is unlikely to adjust instantaneously to accommodate the increase in demand for money. NGDP stabilization is proposed as a policy to increase the quantity of money to meet the increase in demand for money (or decline in velocity of money) so that output does not stutter. The motivation in Yeager (1956) was to advance a monetary policy remedy for depression over the fiscal policy remedy that in the 1950s received far stronger support among economists. From an ecological point of view, the decline in velocity of money at the macro level reflects non-uniform changes in spending patterns at the micro level. The non-uniform changes in spending patterns mirror non-uniform waiting, planning, and decision-making at the ground level. The measured changes in the velocity of money at the aggregate level do not emerge from an increase in the demand for money per se. In fact, the increase in aggregate demand for money during recessions is an artifact of theorizing as if macro variables act upon each other, as if there were such entities as aggregate-demand and aggregate-supply. Large scale miscoordinations and the following period of mutual adjustments plans necessarily involves a temporary decline in spending. But the root problem is the micro-coordination within an evolving ecology of plans. The measured decline in velocity of money or increase in demand for money is a derivate of the state of affairs at the ground-level. Money is not a substitute for plans. Injecting money into the economy will

do little to help economic actors form new mutually consistent plans, which may involve developing new products, find new markets, and forming new economic organizations. Within a dynamic ecology of interacting plans, recessions can serve a valuable social function and most certainly does not denote a pure social loss. When men are lost as to where to go, they pause to explore future directions of travel. A macro measure of distance travelled will show a decline in activity. At the ground level, these men are acting, perhaps more vigorously than they were while traveling. The lost travelers are sketching possible future paths, evaluating dangers, measuring stocks of food, tending to the weak and injured. They are formulating plans for the future while taking stock of the present. Men are not inert molecules of water. To associate recessions with a pure social loss is to commit Keynes's fallacy of caricaturing the economy as a flat ocean in the absence of external storms.

Our view of the decline in velocity of money during recessions differs fundamentally from all variants—including the "new" and the "neo"—of monetarist, Keynesian, and perhaps some "free-banking" positions (Nunes & Cole, 2013). Some have argued that money is held primarily for transactions purposes. The decline in inflation and interest rate during recessions lowers the opportunity cost of holding money, resulting in an increase in the quantity demanded of money and a concomitant decline in velocity of money (Baumol, 1952; Tobin, 1956). Others have argued that money demand depends on permanent income. And since recessions imply a decline of income below its permanent level, quantity demanded of money increases as a proportion of income, thereby producing a decline in velocity of money (Friedman & Schwartz, 1965; Tatom, 1983). Some economists of the "free banking" school have argued that the decline in the velocity of money during recessions is a consequence of the central bank's inability to supply the right quantity of liquidity at the right places, and that a free-banking system will not experience periodic declines in the velocity of money because of its flexibility in catering to heterogeneous changes in the demand for money (Salter, 2013; Selgin, 1987).

There is a grain of truth in each of these positions. It is reasonable to believe that a decline in opportunity cost of holding money during recessions will increase the quantity of money held. We agree with the free-banking school's observation that central banks are unlikely to have the information necessary to cater to heterogeneous changes in the demand for money, especially in a dynamic economy. What distinguishes our analysis from those of others is that the plans of economic actors rather than spending comprises the primitive variable of an ecological framework. Macro and micro spending patterns reflect the dynamics of ecology of plans of different agents. This means that we do not see the decline in the velocity of money as a problem per se, but as a reflection of deep and inter-related micro plan problems. Economic agents may hold more money during recessions due to changes in opportunity cost of holding money or changes in the ratio of transient to permanent income. But more fundamentally, we believe economic agents hold money because of the "waiting" to form new plans and the "staggered" quality of decision-making during recessions. The problems solved through waiting and staggering of decision making cannot be solved by injecting more money into the economy. Similarly, while the free-banking school concords with us in the observation that changes in demand for money are heterogeneous at the micro level, we are skeptical of the claim that a free-banking system will produce relatively stable velocity of money. It is not that we doubt the ability of competitive banking to supply credit and liquidity to heterogeneous demands. As to how a free-banking system will do compared to a central banking system is a complex and open question. We disagree with the claim that a free-banking system will produce a stable velocity of money because we believe macroeconomic turbulence is an endogenous property of an economic system. Plan failures of different sizes, nature, and qualities emerges due to twin forces of the desire of human beings for change and the interdependent relations between the plans of different human beings. These plans failures will be reflected in monetary aggregate variables like the velocity of money. It is not that nominal economy is constantly in a flux, cursed to live in the realm of Becoming, while the real economy is serene and firmly ensconced in the realm of Being. Rather, the nominal and real aggregate variables dance to the tunes of the evolving ecology of plans of economic actors. The decline in the velocity of money during recessions is a consequence—not a cause—of problems at the ground-level. In Section 6, we argue that NGDP stabilization policy has perilous consequences for the re-coordination process during recessions.

6. The mirage of NGDP stabilization policy

In Section 4, we argued that macroeconomic turbulence is an ordinary working property of an economic system with millions purposefully behaving and interrelated agents. In Section 5, we argued that the macroeconomic turbulence will at times reflect in decline in the aggregate velocity of money. In this section, we argue that attempts to compensate for the decline in velocity of money through an increase in the quantity of money can potentially increase the micro-level problems and cause further disturbances. Proponents of NGDP stabilization point to such abrupt downturns in the growth of nominal GDP as occurred in 2008 as something that could be eliminated by having the Fed stabilize nominal GDP. We do not doubt that a sufficient monetary expansion could offset any decline in nominal GDP, provided only that V remains positive. To conclude that nominal stabilization implies real stabilization, however, is possible only if monetary change is always neutral. To the contrary, there is strong reason to think that monetary change is never neutral provided only that there are more projects for which entrepreneurs are seeking support than there is a supply of credit able to offer that support (Bilo & Wagner, 2015). Credit processes are involved in selecting among entrepreneurial projects. Once it is recognized that people learn through their activities, the selection among entrepreneurial projects will change the pattern of knowledge that operates within a society. When people learn through doing, interaction within the ecology of enterprises continually changes the structure of knowledge in society. Entrepreneurship is not neutral, nor is the credit process through which entrepreneurial projects are selected. Nominal GDP stabilization can impede rather than facilitate entrepreneurially-generated evolution.

Within a comparative static framework, suppose the initial monetary equilibrium is disturbed by virtue of a subset of people increasing their money balances as prelude to undertaking new entrepreneurial projects. From the perspective of the central bank, velocity has declined. Stabilizing NGDP would call for the Fed to increase its asset holdings sufficiently to stabilize NGDP at its perceived trend level. When this action is viewed in terms of aggregate statistics, nothing more would seem to be involved than increasing aggregate spending from what it would otherwise have been. This view from the level of aggregate statistics, however, is incomplete and inadequate because it ignores the ground-level of human action. The increase in the aggregate money supply will not mirror the particular pattern of increased demand for money that has been aggregated to mean a decline in velocity. Open market operations to increase the supply of money can select different entrepreneurial projects than were in the process of being selected by those entrepreneurs who were accumulating money balances. The increase in demand for money observed at the macro level has a structure to it at the ground-level of action, yet macro theory pretty much treats depression as a formless entity. As explained in Section 5, the observed increase in demand for money and decline in velocity of money reflects postponement of spending decisions

and formation of new plans at the micro-level. The postponement of spending and waiting by different agents are conditional on similar decisions by other agents, who are all related through buyer-seller relations. The treatment of observed increase in demand for money as formless is reminiscent of Keynes's (1936, p. 379) claim that the expansionary policy he was advocating would act on the volume of employment but not on the type of employment. In advancing this assertion, Keynes was stating the neoclassical synthesis where money is universally and perpetually neutral before that synthesis had even been articulated. This assertion denies any interaction among parts as the process through which the whole is constituted.

Once the ecological character of the micro–macro relationship is recognized, a significant question pertaining to opportunity cost arises. The recession that reflects the effort of some people to accumulate money balances while forming plans for subsequent entrepreneurial projects will necessarily lower the volume of transactions. This lowering will have a structural pattern that is related to the objects for which those entrepreneurs reduce their spending. In this instance, NGDP stabilization will redirect the supply of credit from forward-looking entrepreneurial projects to supporting previously developed projects that were candidates for being replaced by the new projects. NGDP stabilization, in other words, will impede creative evolution within the ecology of plans of a society. Lavoie (1983) recognized this problem in his paper "Economic Calculation and Monetary Stability". Lavoie argues that a rule of fixed rate growth of money supply is not sufficient to solve problems associated with inflation because inflation necessarily diverts resources from one use to another. Such diversions are problematic because they will tend to produce readjustments in so far as the diversions are inconsistent with the plans that economic agents would have formed in the absence of inflation. Lavoie's view of the economic system is very different from that of the DSGE view. Lavoie (1983, p. 164) sees an economy as a "complex network of production relations". Assumptions about monetary neutrality do not hold in such a system. When a Big Player like a central bank injects money with the buying of Treasury Bills from some banks, the money percolates to other banks, and ultimately to firms and households. The percolation of the new money produces a whole sequence of price changes. The time sequence of prices depends on the points of money injection, the network of production relations, and the creative decisions firms on how to use new money. What is important to note is that the neutrality postulates derived with the "rational expectations" assumption, as in Lucas (1976), does not hold in a production-network economy. This is not because economic agents fall prey to money-illusion. Money is not neutral even when demand functions are homogeneous of degree zero: demand does not change if all input and output prices change in the same proportion. Money is not neutral because the percolation of new money through an economy happens through buyer-seller interactions among firms (Veetil & White 2017, pp. 33–35). Firms cannot predict the time sequence of price changes of their inputs and output in response to the new money without unrealistic knowledge and unrealistic computation capacity (Hayek, 1989). Firms need to know the initial points of injection, the network of relations among all firms in the economy, and the way in which each firm will respond to new money through creative actions. Firms must then be able to use this incredible knowledge to compute the time sequence of changes in the prices of their inputs and outputs. In a network economy most—if not all—inflation is *surprise* inflation. Economic agents do and must make decisions based on nominal prices.

Much of what economic actors do during recessions may appear problematic when looked at from the outside; however, matters appear differently when one looks from inside the minds of economic actors. Economists sitting at far-away bureaus may see fear and irrationality in the eyes of the farmer who reduces spending during a recession. For the economist, the farmer is a trouble-marker because from an accounting point of view her decision to spend less leads to a fall in GDP. In so far as the economist is tasked with the job of maintaining a stable growth rate—as many are—the farmer is making the economist's job more difficult. In reality, it is the economist who makes the farmer's job more difficult. National income accounting data do not highlight the actions of economic entities. Counting is not creating. What economists call the "real" economy is a statistical feature created ex-post through national income accounting. Economic actors operate within a network of production relations in which they buy some inputs and sell some outputs. These decisions are made based on money prices of inputs and outputs, among other factors. Economic actors may incorporate their projections of changes in price-level or overall economic conditions in their decision making, however the influence of macro level variables on microeconomic decisions in no way implies that the day-to-day nominal variables encountered by economic actors are merely a veil.

7. Concluding thoughts

When market monetarists propose targeting of nominal GDP as a policy rule, they do so precisely with the DSGE type of model in mind, rather than that of an ecological emergence. The Classical economists searched without success to locate an invariant standard of value. Labor commanded a good deal of attention in this respect, though it was hardly invariant across time and place. Gold likewise seemed to have some such features, but it too failed any test of invariance. An invariant standard of value is possibly a mirage, as a species of a universal and absolute standard of justice. For the crooked timber of humanity (Berlin, 1991), however, many standards might be articulated but none will command universal assent. The best that can be hoped for is a reasonable degree of invariance, most of the time and under most circumstances. Life in the societal ecology will never resemble the perpetual stability of general equilibrium, for births and deaths, both of people and of enterprises, is an enduring feature of societies, as is creativity. Those births and deaths, and also creativity, will translate into societal turbulence. Mostly that turbulence will be modest, but at some times and in some places it seems to become distinctly immodest.

Nominal stabilization is not a recipe for eliminating turbulence within societies. There is no such recipe, for the ingredients necessary to develop such a recipe are inconsistent with human nature and its perpetual effort to create new techniques and new enterprises in an environment where everyone is also fallible and mortal. Yet people have shown creative and resilient ability to deal with turbulence, provided only that political power and policy does not interfere with deployment of those abilities (Wagner, 2012b). Seeking to stabilize nominal GDP is to chase a mirage. A superior direction at which to aim a concern with turbulence is at the ways in which political activity might retard the reasonable efforts of people to calm turbulence relative to the ways in which it might strengthen such efforts. To move in that analytical direction, however, requires recognition of something like the micro-macro form of systemic interaction that we have sketched here. It also requires recognition that money is far more than the veil that obscures the real economy. To the contrary, money is an emergent product of social evolution that provides the language for economic calculation and commercial planning.

References

Acemoglu, D., Carvalho, V. M., Ozdaglar, A., & Tahbaz-Salehi, A. (2012). The network origins of aggregate fluctuations. *Econometrica*, *80*(5), 1977–2016.
Atalay, E., Hortacsu, A., Roberts, J., & Syverson, C. (2011). Network structure of production. *Proceedings of the National Academy of Sciences*, *108*(13), 5199–5202.
Aydinonat, N. E. (2008). *The invisible hand in economics*. London: Routledge.

Axtell, R. L. (1999). *The emergence of firms in a population of agents*. Brookings Institution Discussion Paper.

Baumol, W. J. (1952). The transactions demand for cash: An inventory theoretic approach. *Quarterly Journal of Economics*, *66*, 545–556.

Bak, P., Chen, K., Scheinkman, J., & Woodford, M. (1993). Aggregate fluctuations from independent sectoral shocks: Self-organized criticality in a model of production and inventory dynamics. *Ricerche Economiche*, *47*(1), 3–30.

Belongia, M. T., & Ireland, P. N. (2015). A "working" solution to the question of nominal GDP targeting. *Macroeconomic Dynamics*, *19*(03), 508–534.

Berlin, I. (1991). *The crooked timber of humanity: Chapters in the history of ideas*. New York: Knopf.

Bilo, S., & Wagner, R. E. (2015). Neutral money: Historical fact or analytical artifact? *Review of Austrian Economics*, *28*(2), 139–150.

Bhandari, P., & Frankel, J. A. (2015). *Nominal GDP targeting for developing countries*. National Bureau of Economic Research Working Paper 20898.

Branch, W. A., & McGough, B. (2009). A new Keynesian model with heterogeneous expectations. *Journal of Economic Dynamics and Control*, *33*(5), 1036–1051.

Bullard, J., Kaplan, R., Lockhart, D., Williams, J.C., (2017). International Monetary Stability and Policy.

Caballero, R. J. (2010). Macroeconomics after the crisis: Time to deal with the pretense-of-knowledge syndrome. *The Journal of Economic Perspectives*, *24*(4), 85–102.

Cantillon, R. (1931). *An essay on the nature of commerce in general*. London: Macmillan [1775].

Carvalho, V. M. (2014). From micro to macro via production networks. *The Journal of Economic Perspectives*, *28*(4), 23–47.

Christiano, L. J., Trabandt, M., & Walentin, K. (2010). *DSGE Models for Monetary Policy Analysis*. National Bureau of Economic Research Working Paper 16074.

Clark, T. E. (1994). Nominal GDP targeting rules: Can they stabilize the economy? *Economic Review-Federal Reserve Bank of Kansas City*, *79*(3), 11–25.

Collander, D., Howitt, P., Kirman, A., Leijonhufvud, A., & Mehrling, P. (2008). Beyond DSGE models: Toward an empirically based macroeconomics. *The American Economic Review*, *98*(2), 236–240.

De Grauwe, P. (2010). Top–down versus bottom–up macroeconomics. *CESifo Economic Studies*, *56*, 465–497.

De Long, J. B. (2000). The triumph of monetarism? *The Journal of Economic Perspectives*, *14*(1), 83–94.

Feldstein, Martin, & Stock, James H. (1994). The use of a monetary aggregate to target nominal GDP. In *In Monetary policy*. pp. 7–69. The University of Chicago Press.

Frankel, J., & Chinn, M. (1995). The stabilizing properties of a nominal GNP rule. *Journal of Money Credit and Banking*, *27*(2), 318–334.

Friedman, M., & Schwartz, A. J. (1965). Money and business cycles. In *The state of monetary economics*. pp. 32–78. New York: Columbia University Press.

Gualdi, S., & Mandel, A. (2016). On the emergence of scale-free production networks. *Journal of Economic Dynamics and Control*, *73*, 61–77.

Gualdi, S., & Mandel, A. (2016) Endogenous growth in production networks. *Centre d'Economie de la Sorbonne Working Paper* 2016-54.

Gerali, A., Neri, S., Sessa, L., & Signoretti, F. M. (2010). Credit and banking in a DSGE model of the euro area. *Journal of Money Credit and Banking*, *42*(1), 107–141.

Gordon, R. J. (1984). The 1981–82 velocity decline: A structural shift in income or money demand? In *The proceedings of the conference on monetary targeting and velocity* (pp. 67–99).

Hatcher, M. (2016). *Nominal GDP targeting and the tax burden*. University of Southampton Discussion Papers in Economics and Econometrics 1604.

Hayek, F. A. (1989). The pretense of knowledge. *The American Economic Review*, *79*(6), 3–7.

Hisano, R., Watanabe, T., Mizuno, T., Ohnishi, T., & Sornette, D. (2015). Role of the interfirm buyer-seller network in aggregate fluctuation and the effect of link renewal. *arXiv preprint arXiv:1506.00236*.

Hume, D. (1752). *Political discourses*. Edinburgh: Kincaid and Donaldson.

Katzner, D. (1998). *Time, ignorance, and uncertainty in economic models*. Ann Arbor: University of Michigan Press.

Kauffman, S. A., & Johnsen, S. (1991). Coevolution to the edge of chaos: Coupled fitness landscapes, poised states, and coevolutionary avalanches. *Journal of Theoretical Biology*, *149*(4), 467–505.

Keynes, J. M. (1923). *A tract on monetary reform*. London: Macmillan.

Keynes, J. M. (1936). *The general theory of employment, interest, and money*. New York: Harcourt Brace.

Koenig, Evan F. (2012). All in the family: the close connection between nominal-GDP targeting and the Taylor Rule. Staff Papers Mar.

Koppl, R. (2001). *Big players and the economic theory of expectations*. New York: Palgrave Macmillan.

Lavoie, D. C. (1983). Economic calculation and monetary stability. *Cato Journal*, *3*(1), 163–170.

Lounsbury, R. H. (1931). Velocity concepts and prices. *The Quarterly Journal of Economics*, *46*(1), 34–67.

Ljungqvist, L., & Sargent, T. J. (2000). *Recursive macroeconomic theory*. Cambridge: MIT Press.

Lucas, E. Robert. (1977). *Understanding business cycles*. pp. 7–29. *In Carnegie-Rochester conference series on public policy* (vol. 5) North-Holland.

Lucas, E. Robert. (1976). *Econometric policy evaluation: A critique*. pp. 19–46. *Carnegie-Rochester conference series on public policy* (vol. 1) North-Holland.

Mankiw, G. N. (1994). *Monetary policy*. Chicago: University of Chicago Press.

Massaro, D. (2013). Heterogeneous expectations in monetary DSGE models. *Journal of Economic Dynamics and Control*, *37*(3), 680–692.

McCallum, B. T. (1997). *Issues in the design of monetary policy rules*. National Bureau of Economic Research Working Paper 6016.

Nunes, M., & Cole, B. M. (2013). *Market monetarism: Roadmap to economic prosperity*. Colorado Springs: CreateSpace Independent Publishing Platform.

Patinkin, D. (1965). *Money, interest, and prices* (2nd ed.). New York: Harper & Row.

Salter, A. W. (2013). Not all NGDP is created equal: A critique of market monetarism. *The Journal of Private Enterprise*, *29*(1), 41–52.

Schumpeter, J. A. (1939). *Business cycles*. New York: McGraw-Hill.

Selgin, G. A. (1987). The stability and efficiency of money supply under free banking. *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, 435–456.

Stoker, T. M. (1993). Empirical approaches to the problem of aggregation over individuals. *Journal of Economic Literature*, *31*(4), 1827–1874.

Sumner, S. B. (2014). Nominal gdp targeting: A simple rule to improve fed performance. *Cato Journal*, *34*, 315.

Stokey, N., & Lucas, R. (1989). *Recursive methods in economic dynamics*. Boston: Harvard University Press.

Tatom, J. A. (1983). Was the 1982 velocity decline unusual? *Federal Reserve Bank of St. Louis Review*, *64*(7), 5–15.

Thornton, D. L. (1983). Why does velocity matter? *Federal Reserve Bank of St. Louis Review*, *64*(10), 5–13.

Tobin, J. (1956). The interest elasticity of the transactions demand for cash. *Review of Economics and Statistics*, *38*(3), 241–247.

Tovar, C. E. (2010). DSGE models and central banks. *Economics: The Open-Access Open-Assessment E-Journal*, *3*.

Veetil, V. P. (2016). Out-of-equilibrium dynamics with heterogeneous capital goods. *New Mathematics and Natural Computation*, *12*(2), 157–173.

Veetil, V. P., & Wagner, R. E. (2016). Treating macro theory as systems theory: How might it matter? *Advances in Austrian Economics*, *19*, 119–143.

Veetil, V. P., & White, L. H. (2017). Towards a new Austrian macroeconomics. 2017. *The Review of Austrian Economics*, *30*(1), 19–38.

Wagner, R. E. (2010). *Mind, society, and human action*. New York: Routledge.

Wagner, R. E. (2012a). A macro economy as an ecology of plans. *Journal of Economic Behavior and Organization*, *82*(2–3), 433–444.

Wagner, R. E. (2012b). Viennese kaleidics: Why it's liberty more than policy that calms turbulence. *Review of Austrian Economics*, *25*(4), 283–297.

Walras, L. (1874). *Elements of pure economics*. Homewood, IL: Richard D. Irwin [1954].

Weaver, W. (1948). Science and complexity. *American Scientist*, *36*, 536–544.

Weintraub, E. R. (1993). *General equilibrium analysis: Studies in appraisal*. Ann Arbor: University of Michigan Press.

Yeager, L. B. (1956). A cash-balance interpretation of depression. *Southern Economic Journal*, *22*(4), 438–447.