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AN OVERVIEW

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### **ABSTRACT**

Capitalism since its inception has been marked by large fluctuations. The resulting episodic unemployment has been very costly. This paper provides an overview of alternative theories. Standard models (such as DSGE) have not provided insights into the causes of the fluctuations and the shocks buffeting the economy, which contrary to what they assume, are largely endogenous; they have not provided an understanding of how and why the economy amplifies shocks and makes their effects at times so persistent or how and why there may be oscillatory behavior, rather than a smooth convergence back to some (temporary) equilibrium. Accordingly, they do not give guidance on how to make deep downturns—those that really matter—less frequent, shallower, and less costly. By contrast, there are alternative, new models, often building on older Keynesian foundations, with heterogeneous capital goods and heterogeneous agents, interacting with each other in imperfect markets and fragile networks, with endogenous innovation in an ever-evolving economy, with deep uncertainty. These theories, with endogenously driven fluctuations, provide greater insights in the causes and nature of fluctuations, and better policy guidance.

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# Growth and Fluctuations: An Overview<sup>1</sup>

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Since its inception, capitalism has been marked by large fluctuations. The resulting episodic unemployment has been the source of enormous stress and misery, and almost surely the fluctuations themselves undermine long-term growth—the riskiness of returns reduces investment; and especially in poorer countries, the fluctuations are an important impediment to the accumulation of human capital. Naturally, economists wanted to understand the sources of unemployment and fluctuations and their relation to growth. Keynes, of course, provided a theory of unemployment. Building on those foundations, New Keynesian models, and more recently, a further development, Dynamic Stochastic General Equilibrium Models, have sought to explain not just temporary unemployment but economic fluctuations. These models are central to the mainstream interpretation of economic fluctuations and are at the center of policy discourse on the ways they might be modulated.<sup>2</sup>

In this paper I provide an overview of why these models are misguided and why alternative approaches have better prospects of giving us insights not only into the sources of fluctuations, but also about what can be done to reduce their frequency, depth, and consequences.

## I. Some key mistakes of standard paradigm

Modern mathematical economics—illustrated well by Paul Samuelson (1948) in what he modestly calls the *Foundations of Economic Analysis*—attempted to model itself off of 19<sup>th</sup> century *simple physics equilibrium* models. But even after the rigorous formulation of competitive equilibrium theory by Arrow and Debreu (1954), there was never a good theory of dynamics—a good theory of how the economy gets to the equilibrium, apart from the mythical *tâtonnement* process (based on an auctioneer calling off wages and prices, but

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<sup>1</sup> Revised version of a paper presented to a Festschrift in Honor of Giovanni Dosi, on The Foundations of Complex Evolving Economies, Pisa, November 6-7, 2023. I am indebted to Giovanni Dosi and the other participants in the conference for insightful comments, to Nikhil Basavappa for research, to Andrea Gurwitt for editing, and to the Hewlett Foundation and Groundwork Collaborative for financial support. This paper is based on a long research program in which Martin Guzman and Bruce Greenwald have played a central role.

<sup>2</sup> Giovanni Dosi has been highly critical of this approach in his work, as I have in mine, making the subject of this paper particularly appropriate for this festschrift in his honor.

no trade actually occurring at those until a market-clearing equilibrium was found)—and even then, attempts to show stability in general were largely unsuccessful.<sup>3</sup>

Modern macro punted—it just assumed that the economy would find *the* equilibrium<sup>4</sup>. But that was shunting aside one of the central problems of macroeconomics: whether, when the economy is disturbed (say, out of a previous equilibrium with full employment) in a way that results in unemployment, does it quickly return to full employment? That is a question, at least in part, of dynamics of adjustment. One simply can't analyze such a question by *assuming* that the economy automatically and instantaneously returns to its long-run dynamic path. In such a world, in the absence of (nominal) wage rigidities (as in the Real Business Cycle models) there is, *by assumption*, no unemployment, not even in the short run.

### *Rational expectations*

Central to this equilibrium approach is the assumption of rational expectations—expectations (in a probabilistic sense) are always satisfied. Without that assumption, of course, the economy couldn't always be in equilibrium. There would, by definition, be “surprises” (again, in a probabilistic sense). In turn, the equilibrium assumption is *necessary* if one is to make sense of the hypothesis of rational expectations. In a sense, it's a bootstrap operation.

Whether the economy is on a rational-expectations trajectory can't in fact be confirmed (even in the absence of stochastic shocks) for a very, very long time, in the absence of futures markets extending infinitely far into the future (Hahn (1966), Shell and Stiglitz (1967)). Hahn and Shell-Stiglitz argued that, in the absence of futures markets extending infinitely far into the future, the saddle point property of economies with more than one capital good implied a fundamental instability of capitalism; if today's prices weren't set precisely correctly, and if the arbitrage equations and other behavioral hypotheses were fully satisfied, the economy would eventually explode or implode—or in other words, the arbitrage equations *couldn't* be satisfied forever. Modern R.E. macroeconomists have turned this on its head, saying that the uniqueness of the trajectory consistent with the transversality condition is what nails down *current* behavior.

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<sup>3</sup> Arrow, Block, and Hurwicz (1959), Arrow and Hurwicz (1958). As the latter point out (p.530)“... , no general assertions about the stability of the system under competition can as yet be made.” Scarf (1960) provides examples of economies exhibiting instability. Later literature, incorporating learning, show that there is no natural process by which convergence to a R.E. equilibrium can be assured. See Bray (1978, 1981, 1982), Bray and Savin (1986), Bray and Kreps (1987), Marcet and Sargent (1989), and Dosi *et al* 2020.

<sup>4</sup> Most of the models were so simplified to ensure that there was a unique equilibrium; but, of course, in general, there are multiple equilibria—and indeed, as Hirano and Stiglitz (2022a,b,c) show, even with rational expectations there can be an infinity of equilibria. See also Vines and Wills (2018).

The assumption of rational expectations is simply implausible. It would be one thing if it provided a good benchmark—a central case around which we might analyze various forms of deviations. But unfortunately, the imposition of this implausible assumption generates markedly different dynamics from those that arise in the absence of rational expectations. But what is particularly problematic is that the rational expectations assumption is combined with other, unrealistic assumptions<sup>5</sup> that lead to a particularly narrow set of feasible dynamics, suggesting that the economy is more stable than it really is and identifying a narrower set of policy instruments than may be desirable.

One might well ask, How can one have R.E. in an ever-changing economy? How could one have anticipated 9/11, the financial crisis, Trump and the deglobalization that followed, the pandemic, or October 7 and all of its consequences? These are the events that matter.

These are the events associated with deep uncertainty, where we have little basis for judging the likelihood of key relevant events and consequences—how long will the pandemic last? How many will die or be hospitalized? How deep will be the resulting economic downturn?<sup>6</sup> Even Savage was suspect about the ability to apply his theory of subjective probability to such cases, and the distinction between situations marked by deep uncertainty and those events which occur repeatedly, and for which one might define a relative frequency, has long played an important role in economics (Knight (1921)), and especially in macroeconomics (for instance in the work of Keynes). Yet modern macroeconomics has focused on shocks to the economy that occur repeatedly, and for which there is a well-defined probability distribution.

(Formally, standard economics assumes a stationary stochastic process; the real world is better described by a non-stationary stochastic process.)

The fact that there is deep uncertainty doesn't mean we can't say a lot about the economy, as exemplified by Guzman and Stiglitz' (2021a) analysis of dynamic disequilibrium models with noise. Critically, they emphasize the importance of precautionary behavior in such circumstances, evidenced so strongly in the pandemic (Guzman and Stiglitz (2021d)), Regmi and Stiglitz (2023)), and macroeconomic externalities more generally.<sup>7</sup> Similarly, Orszag *et al* (2021) provide a framework for policy in the presence of deep uncertainty.

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<sup>5</sup> Such as that the economy is described by a stationary stochastic process, with the only shocks being technology shocks, in an economy with infinitely lived identical individuals.

<sup>6</sup> See Guzman and Stiglitz (2021d) for an analysis of the macroeconomics of the pandemic from our perspective, and a contrast of the insights it provides with those of the standard model. See Stiglitz (2024) and Stiglitz and Regmi (2023) for a discuss of the contrast in the analysis of the post-pandemic inflation.

<sup>7</sup> Such externalities are the macroeconomic manifestations of the “microeconomic” externalities that Greenwald and Stiglitz (1986) showed were pervasive in economies with imperfect and asymmetric information and incomplete risk markets.

To avoid the complexities that can arise even in a simple competitive model with rational expectations, much of the early work on R.E. models assumed a representative agent model (where in effect all individuals are the same)—by definition, a market economy in which there are no markets. Economics had become paradoxically a social science with no society. A single individual might be able to solve his optimal intertemporal problem of resource allocation; but that’s not the problem that economists are supposed to be analyzing—which is, whether a decentralized market economy with many agents who don’t know each other’s preferences and technologies is stable, in particular when they can only respond to price signals. None of the work in heterogeneous agent models has come close to addressing these issues; and indeed, even in simple models have raised questions about whether natural learning processes converge to a rational expectations equilibrium.<sup>8</sup>

More generally, the question of how individuals and firms form expectations is an important one. But using *better* linear estimators in a highly non-linear complex may neither lead to higher profits of the firm nor, when many firms engage in this “more rational” behavior, better performance of the economic system, either in terms of greater stability or higher values for key variables like employment or growth (Dosi *et al* (2020)). Simpler systems may perform better—less is more.

In short, to a large extent, “modern macroeconomics” assumed stability—that the economy quickly (instantaneously) converged to its long-term trajectory, in which the transversality conditions were satisfied, assuming away the very problem with which macroeconomics should be concerned. There is every reason to believe that the Hahn-Shell-Stiglitz interpretation of the consequences of the absence of futures markets extending infinitely far into the future is closer to the truth than that of the DSGE models, and this is especially the case when we recognize the heterogeneity of individuals and of capital goods, non-stationarity of the stochastic shocks hitting the economy, and that individuals have finite lives (Guzman and Stiglitz, 2021a, Hirano and Stiglitz (2022a, b,c))<sup>9</sup>.

## **II. Generating fluctuations and instability by going beyond the representative agent model**

Modern macro with representative agent was only a scaling up of a simplistic model of an individual—indeed, it was often referred to as a Robinson Crusoe economy. It was not about interactions. But interactions are at the core of economics (and any social science). With a representative agent model there are, as I’ve noted, no interactions, and

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<sup>8</sup> See reference cited in fn. 1.

<sup>9</sup> In the models of Hirano and Stiglitz, individuals live finite lives and have fully rational expectations. The economy oscillates within certain bounds, but without any regular periodicity.

accordingly, no need to coordinate; but a failure of coordination is one of key sources of macroeconomic dysfunction. (See Cooper, 1999 and Cooper and John (1988).

So-called micro foundations based on maximization of utility and profits became a religion, one not justified by evidence, with multiple paradoxes—like the dividend paradox and the executive compensation paradox. (Stiglitz (1973, 1982), Nalebuff and Stiglitz (1983a,b)). These were not small “puzzles,” but major contradictions between what the theory predicted and what was observed. It was irrational for firms to pay dividends when there were ways by which corporations could distribute profits to shareholders and pay far lower taxation, in the tens of billions of dollars. There were ways, too, of compensating executives, making them bear less risk with stronger incentives.<sup>10</sup>

Even 19<sup>th</sup> century physics went further than the simple equilibrium models. Statistical mechanics tried to describe macro phenomena from *interactions* of micro entities. Once one starts modeling interactions one gets complex systems with interesting dynamics, including fluctuations. Of course, in these complex systems, it is hard to imagine how individuals could have R.E. of the future.

### *Power*

But once one starts thinking about interactions of individuals, one has to think about power, even in a world with a large numbers of agents, necessitating going beyond the competitive model that has dominated macroeconomic thinking. (It is worth noting that in Daniel Defoe’s classic, Robinson Crusoe had a power relationship with the one person with whom he came to share the island, Friday.)

Macroeconomic models with market power behave differently than those without<sup>11</sup>. (Stiglitz 2025; Gonzales, Montecino and Stiglitz 2024). The reason is simple: when there is market power there are rents; the present discounted value of those rents, which can be called Rent-Capital, is an alternative store of value. Lowering interest rates may, for instance, so increase the value of Rent-capital that the demand for produced capital is reduced.

### *Market power and fluctuations*

So too, by incorporating market power, we can construct simple models akin to the Goodwin model. In such a world, real wages naturally decrease with unemployment rate,

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<sup>10</sup> Stiglitz (1982) presents a list of other paradoxes, which to date have not been explained adequately, in my judgment.

<sup>11</sup> And especially different from those without a non-produced asset, such as land. See Hirano and Stiglitz (2024) for a discussion of how the introduction of land changes dynamics and the consequences of monetary and financial policy.

generating a real Phillips curve.<sup>12</sup> Assume further that investment (which at each moment of time has to equal savings) decreases with real wages, for instance, because workers consume a larger fraction of their income than capitalists. By making this assumption, we go against the representative agent model, introducing a natural, simple heterogeneity into the economy.<sup>13</sup>

Employment in such a model increases with capital stock, which increases with investment. But the increased employment leads to higher wages, which decreases investment, which over time decreases the capital stock and employment.

With a fixed coefficients production function, this model generates Volterra-Lotka equations, giving rise to a limit cycle. With more general production function, there are convergent oscillatory dynamics. But adding “shocks” may result in sustained oscillations. (Akerlof and Stiglitz (1969)).

There is a wide class of models (e.g. with credit rationing) that can generate similar results.<sup>14</sup>

### *Heterogeneity in capital*

It should thus be clear that dynamics with a representative agent living infinitely long are fundamentally different from dynamics with heterogeneous agents or even identical agents with finite lives. So too, dynamics with heterogeneous capital goods (including putty clay and vintage capital) are markedly different from dynamics with a single capital good. Even with R.E. convergence to steady state may not be monotone (Cass and Stiglitz (1969)).

That this might be the case should have been obvious—in general, the set of possible dynamics in one dimension is markedly different from the set in two, and even more so for higher dimensions.

But there are equally deep economic issues: A central problem in short-run macroeconomic stability is that individuals can allocate part of their savings to a non-produced asset, thus “breaking” Say’s Law. If the only store of value were a produced good, then increased savings would give rise to an increased demand for capital goods, and thereby an increased aggregate demand; but this is not so if savings goes into land or

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<sup>12</sup> Such relationships also occur in efficiency wage models, such as that of Shapiro and Stiglitz (1984).

<sup>13</sup> Alternatively, we could assume everyone had the same preferences, but the average savings rate depends on income, and that there is heterogeneity in income, and in particular, in wealth, with the rich deriving a larger fraction of their income from capital. See Stiglitz (2025).

<sup>14</sup> See, for example, Greenwald and Stiglitz (1993).

money. Supply doesn't create its own demand for *produced* goods, so there may be a deficiency in aggregate effective demand.

Moreover, the transversality conditions associated with intertemporal optimization need not be satisfied within overlapping generating models where individuals live finite lives. Each of the individual's transversality conditions can be satisfied, yet the aggregate behavior of the economy may not satisfy a parallel set of conditions. In particular, there may be bubbles—the reason that land is valuable is that it can be sold to others, not just because it yields rents; and the value of land may fluctuate, even in the long run.

Indeed, Hirano-Stiglitz have shown in a R.E. OLG model with land (two state variables, the price of land and the capital stock) there are an infinite number of R.E. trajectories, and that the only R.E. trajectory may entail fluctuations—booms and busts. While there are an infinite number of paths, even from any particular set of initial conditions (with a given value of land prices and capital stock), we can say a lot about the trajectories—for instance, the bounds of fluctuations—and show how those bounds change with policy and parameters.

#### *What is the source of economic fluctuations*

The economy obviously fluctuates. It doesn't converge smoothly to a steady state equilibrium. So what's the source of the fluctuations? If we look at recent economic downturns, it is clear. It is, for the most part, internal dynamics (as in some of the models already described). The 2008 economic crisis, the most important in three quarters of a century, was caused by excessive risk-taking (predatory lending and ill-conceived securitization) on the part of America's under-regulated banks.<sup>15</sup> The US 1992 economic downturn was a result, too, of the earlier crisis in the Savings and Loan Associations, the predictable and predicted outcome of a misguided and mismanaged financial sector deregulation begun under President Reagan. (Stiglitz, 1992, 2003). The euro crisis was a result, again, at least in part, of bad lending—the belief that a loan to Greece was virtually as safe as a loan to Germany because they both were part of the Euro. (Stiglitz, 2016). There was no “technology” shock that gave rise to the Great Depression.

By contrast, the standard theory has assumed that the source of the perturbations to the economy are exogenous shocks. But to explain much of the empirical evidence, the only exogenous shocks that work are those to the *aggregate production function*. Random sectoral shocks will typically offset each other.<sup>16</sup> And what are the negative shocks? What

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<sup>15</sup> For an overview, see Stiglitz (2010).

<sup>16</sup> In a network economy, shocks to individual firms can be amplified; but with a few exceptions there will be bounds, with firms turning to suppliers other than those with whom they normally deal in the event of a large

does it mean to have a reduction in productivity? Collective amnesia about how to produce? As we look more particularly at recent fluctuations in the economy, the only real exogenous shock has been the pandemic—and it was a shock not just to the *aggregate production function*. It affected demand and it had large sectoral effects, which could not be well understood within an aggregative model.

In short, the standard model wasn't up to the task of understanding any of the recent major fluctuations in the economy—let alone helping us design appropriate policy responses.

### *Innovation and structural transformations*

While fluctuations in the *level* of technology seem inherently implausible<sup>17</sup> it is not implausible that there might be fluctuations in the rate of growth of technology<sup>18</sup>—but even these are likely to be at least partially endogenous. The pace of innovation is, at least in part, the result of learning by doing, which depends on the level of investment and production, and explicit investments in R & D.<sup>19</sup> In particular, one can construct models of innovation where internal dynamics lead to fluctuations in rates of growth—with sometimes negative growth not caused by “production amnesia” but by a Keynesian insufficiency of demand. That was the important contribution of Dosi's Schumpeter plus Keynes model (Dosi, Fagiolo, and Roventini (2010)).

Of course, once one attempts to incorporate endogenous technology, one is led quickly to models in which imperfect competition are central. (Stiglitz and Greenwald, 2014). Imperfect competition gives rise to “rent-capital,” as we noted earlier, which can become an essential feature in understanding economic fluctuations. Rent-capital is another form of non-productive capital, a non-produced asset into which savings may go. Moreover, fluctuations in *expectations* of future profits (induced, for instance, by new information about possibly competitive innovations) can be a source of fluctuations as well as an amplifier, as the change in wealth can directly affect demand for consumption and indirectly affect demand through investment, affecting both the willingness and ability to invest, with a firm's ability to invest being affected by its ability to borrow.

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shock. This may not be the case, of course, when the set of possible suppliers is limited or the capacity of alternative suppliers is limited.

<sup>17</sup> Outside of small undiversified economies, such as those where weather or the terms of trade may play an important role.

<sup>18</sup> Though even big advances, such as computerization and electricity, diffuse slowly through the economy.

<sup>19</sup> See Arrow (1962), Stiglitz (1975, 1987a, 1987b), Dasgupta and Stiglitz (1980a, b), Stiglitz and Greenwald (2014), and the large literature cited there. There can be multiple equilibria, with expectations of a high output next period generating larger investments in learning (higher levels of production) this period, and the greater productivity next period generating higher output. See Stiglitz (1994a).

Historically, large changes in technology have been associated with booms and busts, as irrational exuberance may lead to excessive investment; when things don't pan out, the boom becomes a bust. (Kindleberger, 1978). This is the story of the bursting of the tech bubble in the late 1990's. And there are often financial scams associated with such technological innovations—perhaps even more so with financial innovations. This is the story of the 2008 crisis. The S&L crisis induced the 1991-2 downturn, was associated with exuberance (excessive lending) and fraud. Fraud played a role, too, in the 2008 financial crisis.

The Great Depression and the Great Recession are associated, too, with structural transformations, the former the move from an agrarian economy to a manufacturing one, the latter from a manufacturing economy to a service- and knowledge-based economy. The impediments to the shifting of resources that we noted earlier can lead to deep and long downturns—far longer than can be explained by simple, random shocks of the kind normally envisaged in the standard model. Even the models emphasizing financial accelerators, where the shock gets amplified through effects on balance sheets, which take time to restore, cannot explain the decade-long Great Depression or the slow recovery from the Great Recession. (See Delli Gatti *et al* 2012).

Note that *all* of the big shocks giving rise to the large and long economic fluctuations of the last century have been endogenous, and thus cannot be well understood within a model that simply assumes exogenous shocks, and the way the economy seems to have responded to the shocks, or more broadly generated fluctuations, typically cannot be explained within a framework that assumes rational expectations. Indeed, there is no way that one could have rational expectations about the large technology and financial innovations and the structural transformations that have been central to the important fluctuations over the past century.

And because there is no basis for rational expectations, individuals will have different views of the future, and this itself can give rise to fluctuations: They can engage in bets with each other (direct bets, in derivatives markets, but more commonly indirect bets, by taking different positions on financial and real assets). With each believing that they are likely to win the bets, aggregate demand will be amplified; but eventually truth will win out—one or the other will turn out to be correct. *Perceived* aggregate wealth will decline, and with it so too will aggregate demand. Thus, there can be further amplification of large idiosyncratic random shocks of any kind (endogenous or exogenous), through this mechanism—something that simply couldn't occur if everyone had the same beliefs. It is evident, however, that the standard theory is simply wrong in assuming that they do have the same beliefs. (Guzman and Stiglitz (2016, 2021b, 2021c).

### III. Alternative theories of Economic Fluctuations

I've already mentioned several theories of economic fluctuations. There is, in fact, no single explanation of the economy's fluctuations. If one looks at the fluctuations experienced by the US economy, several have distinctive "stories," with few falling within the ambit of the standard DSGE models, but several others are of a kind where the insights of recently constructed models emphasizing how credit and equity constraints ("financial frictions") can amplify shocks and lead to their persistence, and others noting the source of shocks being associated with technological changes and structural transformations.

Theories of fluctuations have to address two questions: (a) the source of shocks; and (b) how the shocks are translated into significant fluctuations in economic aggregates, like unemployment and GDP. We note that while most of the standard models have the economy quickly reaching a steady state of equilibrium, the alternative models generate slow and sometimes oscillatory convergence—or even no convergence. In the latter models, one does not even need external shocks to sustain fluctuations.

In simple agrarian economies, weather "shocks" can give rise to fluctuations—these are the kinds of fluctuations best described by the DSGE models, except that there is little evidence that in the 19<sup>th</sup> century (when the agricultural sector dominated) market participants' behavior could be well described by rational expectations, and imperfections in capital markets were critical. While such shocks remain important in an economy where the agricultural sector is critical, like Argentina, they are not an important source of fluctuations.

In the 20<sup>th</sup> century, inventory cycles were important. Of course, such cycles, well described by multiplier-accelerator models (Samuelson (1939)) shouldn't have existed if individuals had rational expectations and there were no financial frictions. With R.E. and no financial frictions it is hard to get any mechanical fluctuation. Individuals and firms, knowing that there is such a regularity, would take actions to smooth the economy. But, of course, the world is not characterized either by R.E. or perfect capital markets. With the decline in the share of manufactured goods in the economy and changes in inventory management systems, inventory cycles have become less important.

The "mechanical models" of Samuelson, Goodwin (1967), Kaldor (1940) and Akerlof and Stiglitz provide insights into why there might be oscillations in economic activity. Financial constraints can give rise to an accelerator much as investment can in a fixed coefficients model. Thus, the Greenwald and Stiglitz (1993) model and further developments<sup>20</sup> have

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<sup>20</sup> See, e.g. Greenwald and Stiglitz 1988a, 1988b, 2003a; Delli Gatti *et al* 2006, 2009.

shown how capital constraints<sup>21</sup> can give rise to dynamics similar to those explored by Goodwin, Kaldor, and Akerlof/Stiglitz and advanced our understanding of *amplification*, of why small shocks may be amplified to have large macroeconomic consequences, and of *persistence*, of why the effects of a temporary shock may be long lasting, of why there can be large hysteresis effects.

In standard competitive models there are buffers, like price adjustments and inventories, that help an economy absorb shocks. A range of rigidities undercuts these buffering mechanisms. But while standard models have focused on *nominal wage and price rigidities*, there are also financial and real rigidities, including the difficulties of reallocating resources, and these are, perhaps, more important.<sup>22</sup> And while the standard explanations of wage and price rigidities (based, for instance, on staggered contracts and menu costs) are far from convincing, there are alternative explanations, based on risk, uncertainty and incomplete contracts, coordination failure, and market power, that give a better explanation of sluggish adjustment—adjustments, for instance, to shocks in the demand for labor that are too slow to restore full employment.<sup>23</sup> Moreover, in 'Keynesian' worlds with the endemic possibility of insufficient aggregate demand, 'rigidities'—both nominal and real—might well have a stabilizing effect on the economy (Dosi *et al* 2017); lowering wages (and prices) may reduce aggregate demand, as in the Fisher-Greenwald-Stiglitz model, where the adverse effects of price declines on firm balance sheets leads to reduced investment (Fisher, 1933, Greenwald and Stiglitz 1993).

Our analyses of imperfections in financial markets have provided insights into the amplification and persistence of shocks. Earlier, we discussed the varied nature of the important shocks the economy has experienced over the past century—with the pandemic being perhaps the only one that rightly fits into the category of “exogenous” and large. (Wars, too, have given rise to variability in economic activity, both as they start and as they end; while these are exogenous to the economy, they are clearly a result of human action, and some claim that economic factors are a large driver.) While we cannot predict well when such shocks will occur, we have considerable understanding of their origins and

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<sup>21</sup> See also Stiglitz and Weiss (1981, 1992) and Greenwald, Stiglitz, and Weiss (1984) exploring the role of credit rationing. There is a large subsequent literature on the role of financial frictions on economic fluctuations, but mostly set in the R.E. framework with exogenous shocks that we have already criticized; still, the incorporation of capital market imperfections was an important step forward in this literature. See, e.g. Bernanke *et al* 1989, 1999.

<sup>22</sup> These real rigidities can take multiple forms. Efficiency wage models (Shapiro and Stiglitz (1984)) give rise to real wage rigidities. Mobility costs and imperfections of capital markets (themselves explicable by imperfections and asymmetries of information) give rise to rigidities in the reallocation of labor and capital. (Della Gatti *et al* (2012)). Imperfections of capital markets can result in inventories being procyclical rather than countercyclical.

<sup>23</sup> See, for instance, Greenwald and Stiglitz (1989, 2003b) and Stiglitz (1984, 1999, 2013).

consequences. The economy has, for instance, experienced several negative shocks when the Federal Reserve mistakenly becomes worried about inflation and excessively tightens monetary policy, or when the government becomes excessively optimistic about the financial sector being able to regulate itself, and engages in deregulation.

All of this is important. We need to identify the “forces” at play if we are to devise policies to reduce the frequency and amplitude of fluctuations and their adverse welfare consequences.

It is perhaps a comment on modern macroeconomics that, while for fifty years after Keynes and the Great Depression there were few deep downturns and economic crises, since the advent of modern macroeconomics, and especially after its teachings were absorbed by policy makers, they have become more frequent and more severe even in advanced countries, where allegedly “improvements” and “reforms” in markets and policy were *supposed* to improve the performance of the economy, epitomized by the Global Financial Crisis of 2008 and the subsequent euro crisis.

In my interpretation, the reasons are simple. We thought the economy could self-regulate so we took off the guardrails, and financial deregulation led to financial excesses that generated many of the crises we’ve experienced. Moreover, because we thought, in the era of neoliberalism and the Great Moderation, that large fluctuations were a thing of the past, we didn’t pay attention to how policies, such as weakening unemployment insurance systems and pension plans (with fewer defined benefit programs), were undermining automatic stabilizers. The growing inequality also meant more individuals had little to no cash reserves, so reductions in income translated into commensurate reductions in consumption.

More broadly, the key problem of the economy is: it’s complex. And perhaps the key insight is that complex systems, with multiple state variables, can have complex dynamics far different from the simple dynamics generated by the standard over-simplified models.

We’ve come to accept that climate is complex, and <sup>24</sup>can only be understood with “big models.” But still, some of the key determinants can be explained simply. We can explain how the melting of the tundra or the polar ice cap drives and/or amplifies the effects of global warming.

So too in economics. There is a role for simple models to help understand some parts of what is going on. In this paper, we have shown how, even with assumptions of competition, R.E., a representative agent in each generation, and a single capital good, there can be

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<sup>24</sup> See, for instance, the extensive discussions of the corn-hog and similar cycles (Ezekiel (1938)).

fluctuations. In the Hirano-Stiglitz model, there can be self-fulfilling optimistic and pessimistic expectations: animal spirits can give rise to booms and busts *even with rational expectations*. It is instructive to see how such a simple model can still generate fluctuations. Still, we have to bear in mind the insight noted earlier that as one increases the dimensionality and complexity of the system, there can be marked changes in the set of possible dynamics that can arise.

### *Towards an evolutionary macroeconomics*

If we were to start economics from the beginning now, I suspect we would turn to evolutionary biology not 19<sup>th</sup> century physics as our paradigm. While there may be equilibrating forces, the world is always changing, and understanding how societies respond and create those changes is essential to understanding economic fluctuations. Consider, for instance, how we are to understand the most important recent downturn, the Great Recession. It was *not* driven by a “technology shock” of the kind that is central to the standard DSGE equilibrium analyses. Rather, underlying that crisis was a series of changes in beliefs: about how risk could be better managed (misunderstandings, as it turned out, based on the kind of overly simplistic models that I have been criticizing) that gave rise to structured finance and securitization; about how to motivate people through (as it turned out, poorly designed) incentive schemes; and it was beliefs, too, in the efficiency and stability of markets—beliefs that had been shattered by the Great Depression, but somehow got restored by neoliberals in the latter part of the twentieth century.

These were “new ideas,” “reforms” and “advances” in the economic system. But these same ideas tainted how we responded to the crisis, which, combined with how we responded to and created globalization—with its consequent deindustrialization in advanced countries, in turn has helped generate the political dysfunction in the US and some other advanced countries. As we sit here today, we can’t be sure where all this will lead us. But we can be sure that it will not always be smooth going and that there will be economic fluctuations.

While we cannot describe precisely how matters will unfold, we can describe the processes of evolution, the critical determinants of change (and societal rigidities). We can describe patterns, even likelihoods, but we will have to recognize that we can’t really predict the next mutation.

The currently fashionable models of economic fluctuations have been a distraction—they have not provided us insights into the causes of the fluctuations and the shocks buffeting the economy, which contrary to what they assume, are largely endogenous; they have not provided us an understanding of how and why the economy amplifies shocks and makes

their effects at times so persistent or how and why there may be oscillatory behavior, rather than a smooth convergence back to some (temporary) equilibrium. As a result, the standard models do not give us guidance on how to make the kinds of downturns that really matter less frequent, shallower, and less costly.

In this paper, we've reviewed the major questions which should be at the top of the research agenda, and some of the major strands of work that are beginning to provide insights into the answers to those questions, giving a better understanding of economic fluctuations than the standard model. These alternatives, often building on older Keynesian foundations, with heterogenous capital goods and heterogeneous agents, interacting with each other in imperfect markets and often fragile networks with deep uncertainty, some with endogenous innovation in an ever-evolving economy. These theories, with endogenously driven fluctuations, provide greater insights in the causes and nature of fluctuations, and better policy guidance.<sup>25</sup>

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<sup>25</sup> At the Festschrift, I noted that Giovanni Dosi has led the way in developing evolutionary models, incorporating critical insights from Keynesian economics, and in doing so has opened up new frontiers in economics.

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