Social Interaction Models and Keynes' Macroeconomics

by Duncan K. Foley*

Abstract

The central concepts of Keynes' macroeconomic theories concerning the behavior of labor markets, aggregate demand, and asset pricing can be formulated as special cases of a general social interaction model. In its simplest form this model analyzes a system of interacting identical agents, each of whom controls the level of an action, and all of whom have the same utility functions trading off the effort required by the action with the monetary incentives for it. When the incentives include an interaction term involving the action levels of the other agents, the equilibrium outcome is in general Pareto-inefficient for the interacting agents, and multiple equilibria are possible. The expectations that lie at the heart of Keynes' conception of macroeconomic equilibrium concern the behavior of other individuals rather than concrete forecasts of the concrete path of prices.

1 Introduction

The question of the relation of John Maynard Keynes' macroeconomics Keynes [1936] to Marshallian and Walrasian microeconomics has returned to center-stage with the revival of various varieties of

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"Keynesian" macroeconomics [see Foley, 2014] in the wake of the financial crisis of 2007-8 and the ensuing slump in large parts of the world economy. The purpose of this paper is to explore the relevance of "social interaction" and "social multiplier" models to understanding Keynes' analyses of labor markets in underemployment equilibrium, the theory of aggregate demand determination, and the instability of financial market valuation of financial assets.

The great theme of marginalist and neoclassical economics is that markets can spontaneously organize production and distribution in a coherent and socially efficient pattern. This claim has from its beginnings (at least in the Marshallian tradition) been accompanied by the qualification that impacts of production and distribution "external" to the market may prevent the achievement of an efficient allocation through market interactions alone. (One important line of work on this problem extends from Alfred Marshall's distinction between "pecuniary" and "technological" externalities through the work of A. C. Pigou on the correction of externalities through taxes and subsidies and the counter-analysis of Ronald Coase arguing that in principle well-defined property rights will at least permit the possibility of the correction of externalities through direct bargaining.) It makes quite a bit of difference in political economic terms whether one regards externalities as the exception that proves the rule, or the rule itself. Bowles [2004]argues that incompleteness of contracts, particularly in labor and credit markets (two of the markets most central to the theoretical debates over macroeconomics), implies the pervasiveness of externalities and the need to frame the social allocation problem from the first as a social coordination problem, with no prior presumption that market interactions will be sufficient.

Economic theorists have pointed out from time to time that uncorrected externalities, in addition to degrading the efficiency of market allocation, can have fundamental effects on the multiplicity and stability of market equilibria (again, two central issues in macroeconomics). My goal in this paper is to bring these points into sharp focus with the help of a highly simplified generic model of social interaction, which I will apply to equilibrium in labor markets, the determination of the velocity of money, and the determination of financial market prices.

The common theme in these discussions is that there are two distinct ways of understanding the concept of "expectations" in economic theory. One, which has tended to dominate macroeconomic theoretical discussion, is economic agents' expectations or forecasts of the unfolding of the future in terms of concrete outcomes like market prices and levels of income. But another, equally important, and in my view, more tractable, notion of expectations is the expectation that economic agents have of each others' behavior. These expectations (akin to the expectations that underly the analysis of "assurance games" with multiple equilibria) can explain many of the phenomena we chronically observe in the macroeconomic performance of economies that appear anomalous from the point of view of the market-clearing paradigm of marginalism.

2 The social interaction model

The simplified social interaction model I will work with here analyzes a system comprised of N identical individual economic agents. (I will comment on the issues raised by the assumption that the individuals are identical later in the discussion.) Each individual can control the level of some action variable, x. (In the various applications of the model to macroeconomic problems this variable can be viewed as the decision to quit a job rather than accept a money wage cut, or as the decision to spend money, or as the decision to hold some financial asset.) The variable z represents some appropriate statistic (such as the mean, mode, or median) describing the actions of the other members of the system. In general the utility of the individual depends on her action, which she controls, and the statistical description of the actions of the rest of the system, which she does not control.

$$u[x,z] = -\frac{1}{2}x^2 + \alpha x + \beta x z + \gamma z + \frac{\eta}{2}z^2 \tag{1}$$

The first term, $-\frac{1}{2}x^2$ represents the individual's personal effort in taking the action. The choice of a quadratic function is purely to simplify the exposition; from a theoretical point of view any concave function of x could be substituted. The second term, αx, represents the private money cost or benefit to the individual of the action. The third term, βxz, represents the interaction between the individual's money return and the actions of the rest of the system. The fourth term and fifth terms, $\gamma z + \frac{\eta}{2}z^2$, represent pure externalities from the rest of the system to the individual, the first proportional to the level of the societal action, and the second proportional to the deviation of the societal action from the individual's bliss level.

To understand this model, assume first that $\alpha = \beta = \gamma = 0$. In this case the individual will choose the action level $x = 0$, which thus represents the "satiation" or "bliss" point of the individual, the level of the action she will choose when there are no social incentives.

Second, consider the cases where $\alpha \neq 0$, but $\beta = \gamma = 0$. If $\alpha > 0$, the individual has a monetary incentive to raise the level of the action above her unconstrained bliss level. In this case x is like effort, and α is like a wage. If $\beta = \gamma = 0$ we can see that the individual maximizes utility by setting $x = \alpha$, for example, the higher is the wage, the more effort the individual will supply. If $\alpha < 0$ the individual has a monetary incentive to lower the level of the action below her unconstrained bliss level. In this case x is like the consumption of a good, and α is like a price. If $\beta = \gamma = 0$ the individual maximizes utility by setting $x = \alpha < 0$, that is by reducing her consumption of the good below her bliss point.

Third, consider the cases where $\alpha \neq 0, \beta \neq 0$. The individual maximizes utility by choosing $x[z] = \alpha + \beta z$, which is her *best response* to the system wide statistic z. When $\beta > 0$ there is a positive feedback from the actions of the rest of the system to the individual's action: the actions are *complements*. When $\beta < 0$ there is a negative feedback from the actions of the rest of the system to the individual's action: the actions are *substitutes*.

2.1 Equilibria

In this paper I will consider only equilibria where all the agents choose the same level of the action, so that $z = x$. In order to allow for some level of social intervention, assume that there is a level of *stimulus*, ζ, chosen at a system-wide level. Then an equilibrium, $x^e[\zeta]$, must satisfy:

$$x[x^e[\zeta] + \zeta] = x^e[\zeta] \tag{2}$$

It is straightforward to show that when there is an internal equilibrium, it will be:

$$x^e = \frac{\alpha + \zeta}{1 - \beta} \tag{3}$$

In some cases relevant to macroeconomic outcomes, strong complementarity of social and individual decisions can be of decisive importance. When $\beta > 1$ the equilibrium (3) is unstable. It is convenient to suppose that the individual faces bounds on her action $x_{min} \leq x \leq x_{max}$. When $\beta > 1$ there will generally be at least a stable equilibrium at $x = x_{min}$ or $x = x_{max}$ or both, and we have:

$$x^e = x_{min} \text{ if } \frac{\alpha + \zeta}{1 - \beta} \leq x_{min} \tag{4}$$

$$x^e = x_{max} \text{ if } \frac{\alpha + \zeta}{1 - \beta} \geq x_{max} \tag{5}$$

$$x^e = \frac{\alpha + \zeta}{1 - \beta} \text{ otherwise} \tag{6}$$

When $\beta < 1$ there is a *social multiplier* $\frac{1}{1-\beta}$ effect on any system-wide stimulus, ζ.

2.2 Pareto-efficient action level

A social planner who could control the level of each individual's action would choose x to maximize $u[x, x]$. It is straightforward to show that this implies a (constrained) system-Pareto-efficient action level, $x^\star$:

$$x^\star = x_{min} \text{ if } \frac{\alpha + \gamma}{1 - 2\beta} \leq x_{min} \tag{7}$$

$$x^\star = x_{max} \text{ if } \frac{\alpha + \gamma}{1 - 2\beta} \geq x_{max} \tag{8}$$

$$x^\star = \frac{\alpha + \gamma}{1 - 2\beta} \text{ otherwise} \tag{9}$$

This concept of system-Pareto-efficiency refers only to the interacting system irself, not necessarily to the whole society in which the system is embedded. For example, the system-Pareto-efficient action level of a group of oligopolistic competitors would correspond to their extraction of the maximum monopoly rent from the rest of society, which is clearly not Pareto-efficient from the point of view of the whole society.

If $\beta = 0$, but $\gamma \neq 0$, the equilibrium will be system-Pareto-efficient only if $\zeta = \gamma$. When $\beta \neq 0$ the interior equilibrium will not be system-Pareto-efficient.

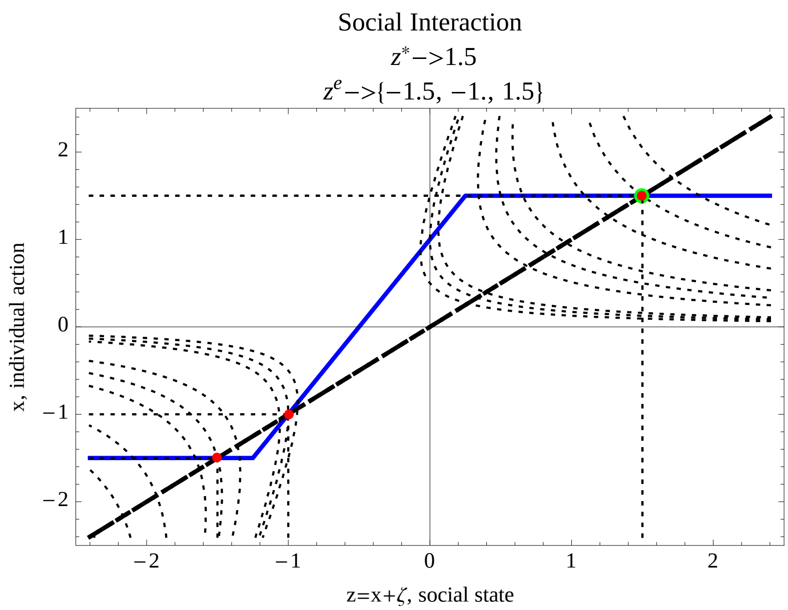

Figure 1: The social interaction model with $\alpha = 1, \beta = 2, \gamma = 0, x_{min} = -1.5, x_{max} = 1.5$. There are three equilibria (red dots), two stable and one interior one unstable. The system-Pareto-efficient action level (green dot) is $x^\star = x_{max}$.

3 Equilibrium unemployment

One fundamental feature of many real-world economies that is inconsistent with complete-contracting, complete-markets microeconomics is that money wages do not always fall when there is positive unemployment. Let us consider this from the social interaction perspective.

The individual in this case is one of a large number of wage-workers. The money price level is beyond the control of the individual worker. Each worker, however, can threaten to quit unless she receives a money wage increase. The worker's action, x, is a level of unemployment that will deter her from asking for a money wage increase. The risk of unemployment is a bad. The individual's monetary gain from risking unemployment to seek a money wage increase is the expected wage gain she anticipates if her threat works. This will be some fraction of her current wage, and constitutes her private gain from risking unemployment, $\alpha > 0$. The disutility of risking unemployment is her wage loss if the threat does not work and she quits. If the worker is operating with no social interaction with other workers she will set $x = \alpha$, and a relatively small risk of unemployment may deter her from seeking a wage increase. This scenario is illustrated in Figure 2.

If, on the other hand, other workers are willing to take larger risks of unemployment for wage gains, the individual worker may behave as if their action is complementary to hers, so that $\beta > 0$. In this scenario, the equilibrium level of unemployment necessary to deter workers from seeking wage gains will be:

$$x^e = \frac{\alpha}{1-\beta} \gg \alpha \tag{10}$$

Keynes assumed that the real wage would lie on a marginal product of labor schedule that was declining with employment. Whether this relationship holds or has its roots in technological constraints, it would explain why a rise in employment, by lowering the average wage, would also lower the social interaction equilibrium level of unemployment by depressing α. This scenario is illustrated in Figure 3.

Keynes suggested that the responsiveness of workers to relative wage changes could explain the "stickiness" of money wages and the tendency for employment to fluctuate much more over the business cycle than money or real wages. Keynes regarded this stickiness as a stabilizing feature of industrial capitalism with managed monetary policy, because large swings in money wages would lead to large swings in money prices and large changes in the burden of outstanding debts,

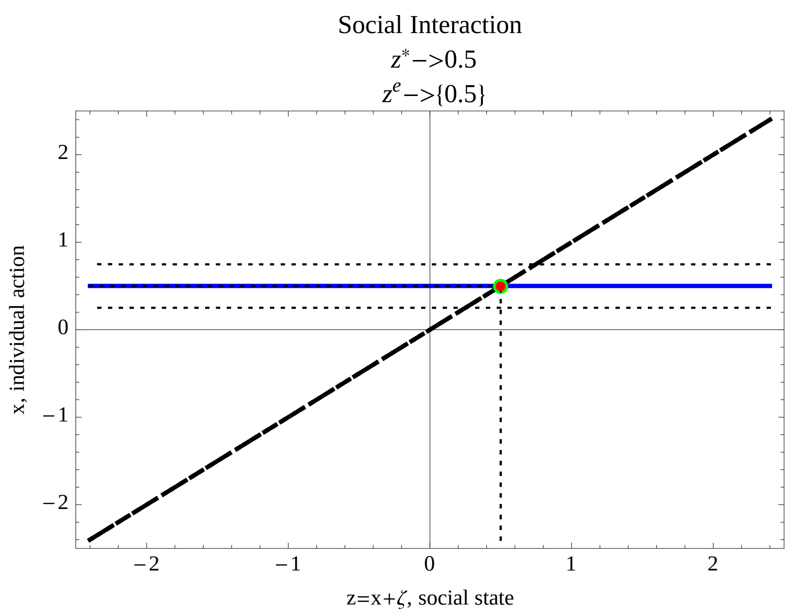

Figure 2: Unemployment risk without social interaction. The typical worker is deterred from seeking a money wage increase by a relatively small risk of unemployment.

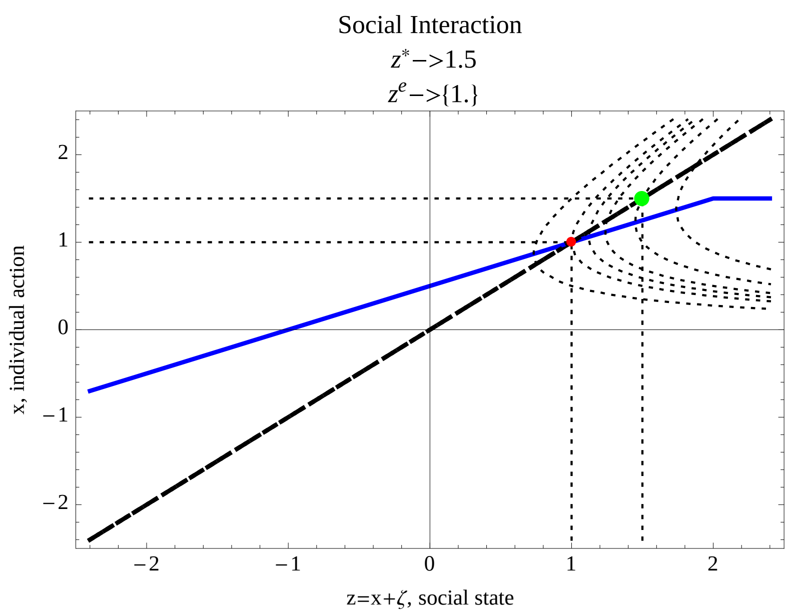

Figure 3: Unemployment risk with social interaction. The typical worker, responding positively to the choices of other workers, is deterred from seeking a money wage increase only at a relatively high unemployment rate.

complicating the already stubborn problem of stabilization of income and employment.

Models in which this type of complementarity explain unemployment have been explored by Cooper and John [1988], Diamond [1982].

4 Aggregate demand and the velocity of money

Suppose now that the individual is a spending unit in a monetary economy. The individual's action, x, is what level of liquid money balances to hold as a proportion of average spending, the inverse of the velocity of money. The individual holds money balances to reduce the effort required to manage her purchases and sales. Thus money balances are a good. If there were no cost to holding money balances, the individual would hold her satiation level, corresponding to $x = 0$ in the coordinates of the model, or $x_{max} > 0$ in terms of actual money balances. Typically individuals do face a cost of holding money balances, the nominal interest rate, so that $\alpha < 0$, and the individual holds a lower money balance in relation to her spending than her satiation level. (In this case $x_{min} = -x_{max} < 0$ represents the negative of the satiation level of money balances, corresponding to zero holding of money.)

In a monetary economy spending inevitably does involve a social interaction. When the individual decides to spend, she consults the balance of marginal benefits and costs to herself of the spending decision. But spending in a monetary economy, as Keynes points out, has a positive externality, in that it reduces the liquidity constraints of everyone else in the economy. Thus we would expect $\beta > 0$. As a result the equilibrium ratio of money balances to spending will be too high, that is, closer to satiation than would be system-Pareto-efficient. Everyone would be better off at a higher velocity of money, or equivalently, a lower ratio of money balances to the rate of spending, as Figure 4 shows.

In this scenario the social multiplier provides a role for system-wide intervention. An injection of spending at the system level can move the equilibrium ratio of money holding to spending closer to the system-Pareto-efficient level, as Figure 5 shows.

Thus the social interaction model provides a parsimonious and rigorous foundation for Keynes' theory of aggregate demand and the

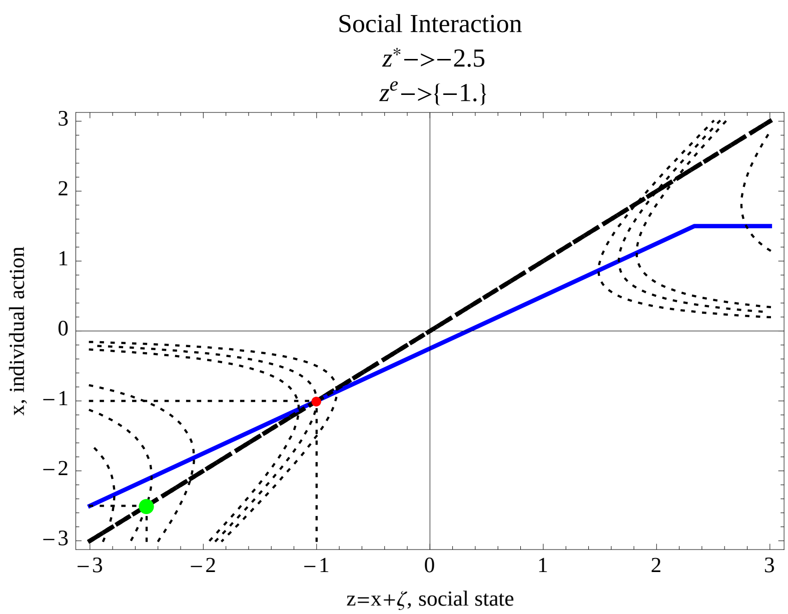

Figure 4: The equilibrium level of the ratio of money balances to spending will be too high (the velocity of money will be too low) because in equilibrium the individual does not take into account the impact of her spending on relaxing the liquidity constraint of the other spenders.

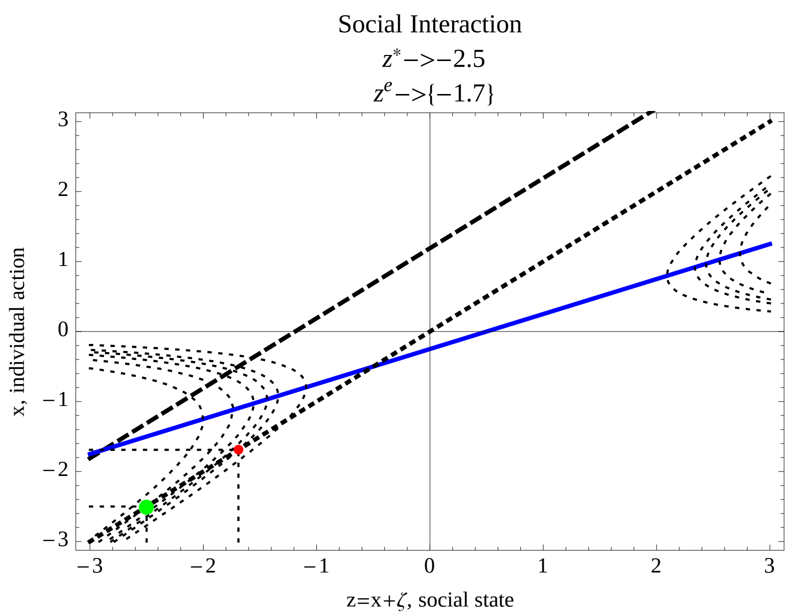

Figure 5: If there is a system-wide injection of spending, the equilibrium ratio of money balances to spending will fall by more than the stimulus, due to the social multiplier.

multiplier.

5 Asset market bubbles

The social interaction model can also provide insight into the phenomenon of asset market pricing anomalies.

In this context, suppose the action x is the degree of overvaluation of an asset that will lead the individual to sell it, or the degree of undervaluation that would lead the individual to buy. In this setting there is no private incentive for the individual to deviate from her fundamental valuation of the asset given her information, and $\alpha = 0$. In the absence of social interaction pressures ($\beta = 0$), the individual would choose $x = 0$, and the market value of the asset would correspond to her fundamental valuation.

When $\beta > 0$, however, the individual sees a return in conforming to the valuation of the market. If this social interaction effect is strong ($\beta > 1$), the fundamental equilibrium becomes unstable and in general two new stable equilibria appear at which the asset is as much over- or under-valued as the individual's common sense or her banker's patience will permit, that is at x_{max} or x_{min}, as illustrated in Figure 6.

The unstable social interaction underlying the asset bubble ("average opinion trying to guess what average opinion is", in Keynes' words) also sets the stage for dramatic movements of prices. For example, if some system-wide attempt is made to control the bubble by manipulating a stimulus (for example, by raising or lowering interest rates) the unstable equilibrium may approach and annihilate one of the stable equilibria in what mathematicians call the *cusp catastrophe*. Figure illustrates this possibility in the asset market bubble case.

This type of non-linear dynamics can also explain why the superficially appealing notion of "rational expectations" has limited relevance to the concrete unfolding of historical events in the real world. Even if an observer has seen cusp catastrophes in asset markets, it is very difficult to predict whether one will actually occur given limited information on the exact location of the stimulus, not to speak of the exact value of the best-response parameters such as β, x_{min} and x_{max}.

The consequences of informational interactions in asset markets are the focus of the literature stemming from Grossman and Stiglitz [1980].

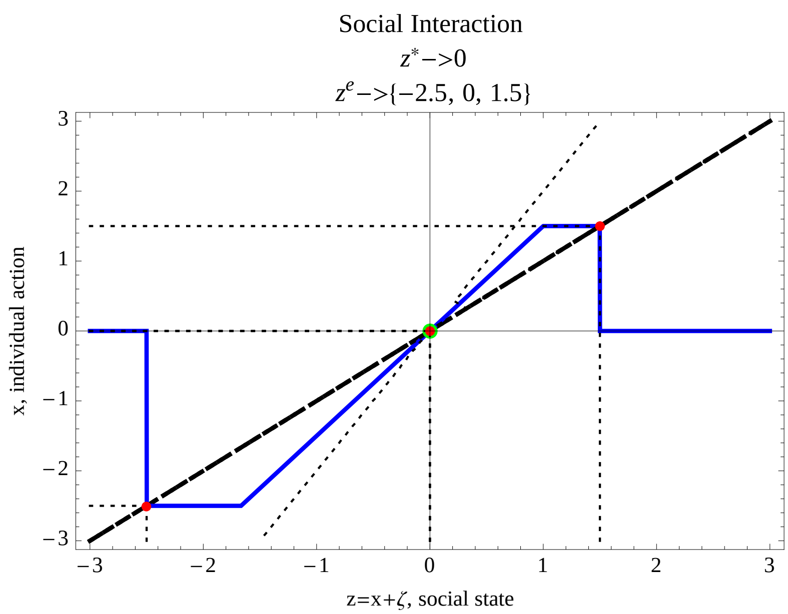

Figure 6: When $\beta > 1$ social interaction can make a fundamental asset price equilibrium unstable, bifurcating into two stable equilibria at the limiting values of the individual behavior. In this illustration a negative externality proportional to z^2 is assumed, representing the social costs to the individual of the mis-pricing of the asset. As a result the system-Pareto-efficient equilibrium remains at the fundamental $x = 0$.

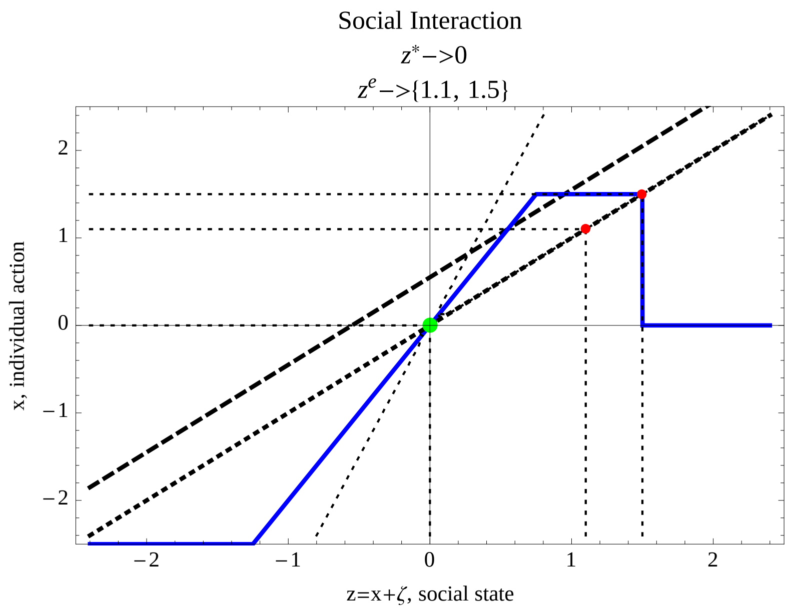

Figure 7: If system-wide stimulus or restraint impinges on an unstable asset market, the unstable equilibrium may approach and annhihilate the stable equilibrium, forcing the system suddenly to the remaining unstable equilibrium. In this figure, stimulus manipulation is driving the unstable equilibrium toward the upper stable equilibrium.

6 Two notions of "expectations"

Human beings are social (or in the usual translation of Aristotle, "political") animals. We have evolved to operate in complex natural environments, and have exquisite sensitivity to signals from the natural environment. We have also evolved to be attentive and reactive to other human beings when they are present either physically or virtually as information.

Marginalist economics and its intellectual descendants in various forms of neoclassical economics focus primary attention on how the existence of markets can effectively isolate individuals from direct interaction. The concept of market equilibrium presents equilibrium prices as information signals to the individual in the place of direct interactions with other similar individuals. This device works fairly well as long as we are trying to explain individual behavior in isolation. But it runs afoul of the fallacy of composition when economists try to apply it directly to understanding aggregate economic outcomes. Leakages of information between individuals not completely mediated by market prices that are possible to ignore at the level of explaining individual behavior cumulate to become dominant determinants of aggregate outcomes, as the examples presented here illustrate.

The analytical limitations inherent in the assumption that all the individuals are identical in this simple social interaction model are not so restrictive as they might first appear. The assumption that the individuals in a social interaction are all identical dramatizes the central insight of social interaction logic, which is that even when the behavior of others is completely predictable (since they will in equilibrium behave exactly like the individual actor herself) the limited ability of the individual actor to influence others' behavior has a decisive impact on the aggregate outcome and hence on the actual behavior of the individual. It is possible to generalize this model in several ways to be more "realistic" about the heterogeneity of agents and behavior. The most parsimonious generalization is to allow actions to be heterogeneous without assuming differences in the underlying preferences or constraints of the individuals, for example, through models of endogenous heterogeneous behavior such as the rational inattention model [Sims, 2006]. If there are inescapable differences in underlying preferences or constraints, the main complication is in understanding how information about the behavior of heterogeneous agents is communicated to and processed by each individual.

From the point of view of the individual actor engaged in market transactions such as the sale of labor-power, decisions to spend money, or willingness to hold over- or under-valued financial assets, it would be comforting to have credible knowledge of the concrete unfolding of future prices. (In Stravinsky's chamber opera *The Soldier's Tale* one of the enticements the devil offers the soldier to give up his violin is a book reporting stock market prices a year in the future.) This kind of knowledge is rare in human life, and we therefore are tempted to substitute expectations of a different kind for them, namely, expectations of how other people very much like ourselves will behave. With this maneuver, however, we invite the devil into the market in the form of the fallacy of composition and the social interaction problem.

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