

*Historical roots of complex-
system reasoning in
economics*

Duncan K. Foley

New School for Social Research

External Professor, SFI

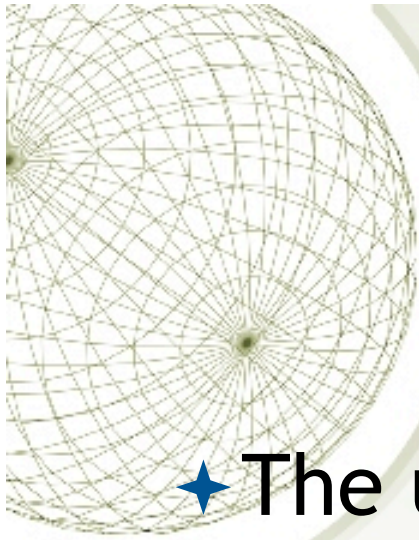
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Duncan Foley SFI CSSS Lecture 1



Some things about economics

- ★ Economics studies the production and distribution of useful goods and services
- ★ Goods or services produced as private property and distributed through exchange are *commodities*
- ★ Families, communities, tribes, also produce and distribute



Commodity production

- ★ The usefulness of a commodity to its owner is its ability to exchange for other commodities--its *exchange value*
- ★ Exchange value is expressed abstractly as money price
- ★ Money is historically inherent in commodity production



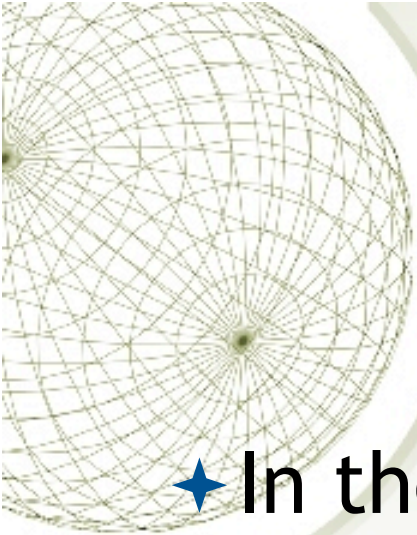
Origins of political economy

- ★ The proto-nation states of the early modern period noticed that military success arose from material resources
- ★ This led to theories of the source of the “wealth of nations”
- ★ The physiocrats of the 17th-18th centuries identified national wealth with productive land



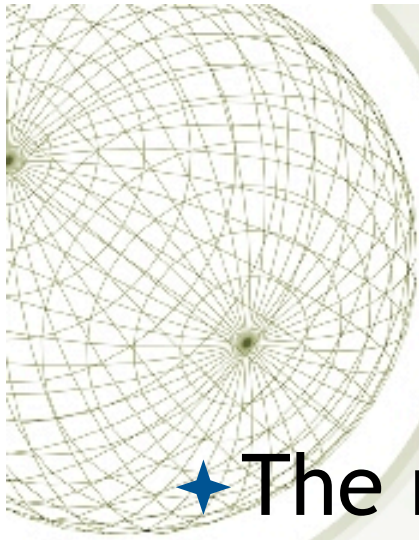
Classical political economy

- ★ The classical political economists, Adam Smith, Thomas Malthus, and David Ricardo saw the wealth of a nation as its organized productive labor
- ★ How does a commodity system organize production without central rules or control?



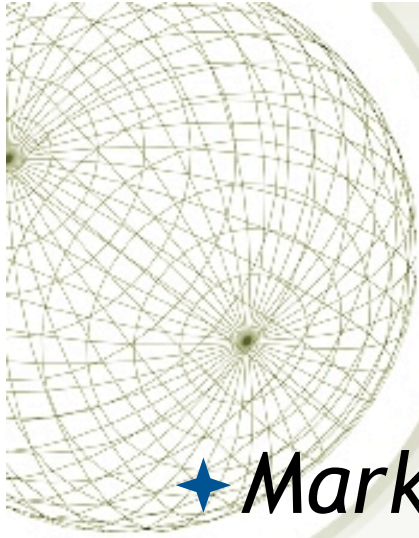
Theory of value

- ★ In the simplest case where each worker has means of production, in conditions of “perfect freedom” workers can produce any commodity
- ★ If the price of a commodity in relation to the time required to produce it is higher than average, workers will move into that line of production



Labor theory of value

- ★ The movement of labor will prevent the ratio of the price of a commodity to the labor time required to produce it from moving very far from average
- ★ This labor theory of value explains both the decentralized allocation of labor as a resource and the dynamics of commodity prices



Market and natural price

- ★ *Market prices* in this theory will fluctuate or “gravitate” around *natural prices* proportional to required labor times
- ★ The fluctuating allocation of labor and prices of commodities constitute a self-organizing complex system



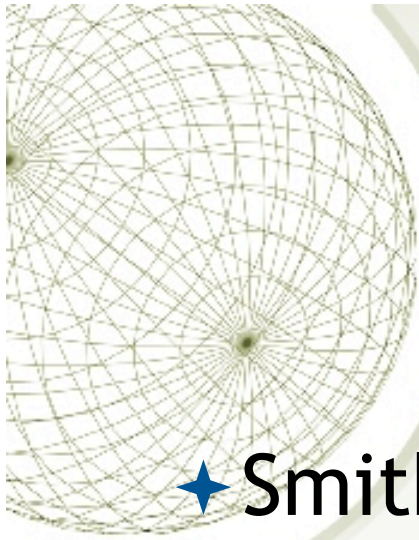
Capital and the rate of profit

- ★ When workers do not own the means of production they become *capital*
- ★ The owners will shift capital (carrying workers along) into lines of production with a higher profit rate
- ★ Actual commodity profit rates will fluctuate around an *average rate of profit*



The invisible hand

- ★ Smith makes the extraordinary claim that this type of self-organized complex system is superior to centralized top-down systems in creating wealth
- ★ The *unintended consequence* of each worker and capitalist's pursuit of self-interest is social progress



The division of labor

- ★ Smith argues that commodity production can sustain a wider *division of labor* than other forms of production
- ★ Because of the inherent productive advantages of the division of labor the spread of the commodity form increases social wealth
- ★ A virtuous spiral ensues



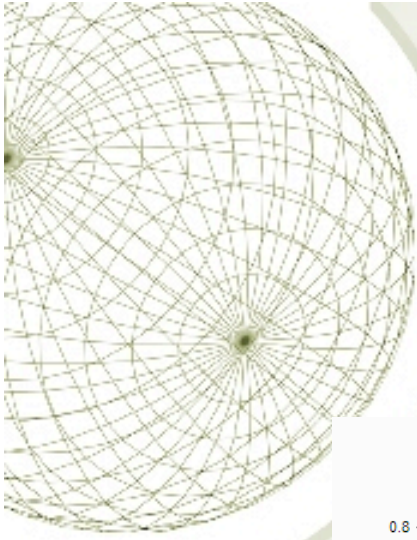
Money

- ★ Commodity circulation requires a counter-circulation of money
- ★ Money is either a particular money-commodity (gold, for example) or its representative as a token or credible promise to pay
- ★ Government can regulate money but does not control or create it

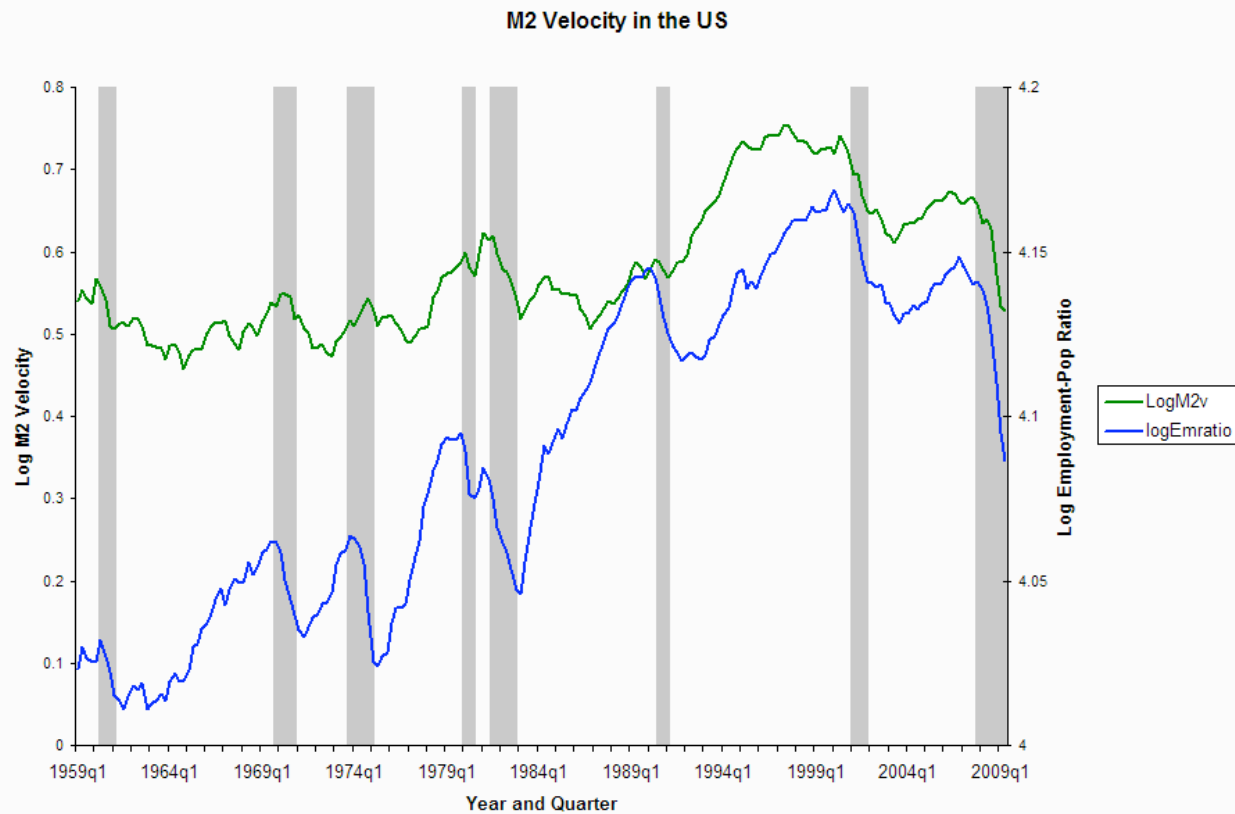


Velocity of money and credit

- ★ The value of commodity exchange per unit time that can be sustained by a given quantity of money depends on how many transactions on average the money mediates, its *velocity*
- ★ *Credit transactions* can raise the average velocity of money and sustain a larger commodity circulation



U.S. Velocity of Money



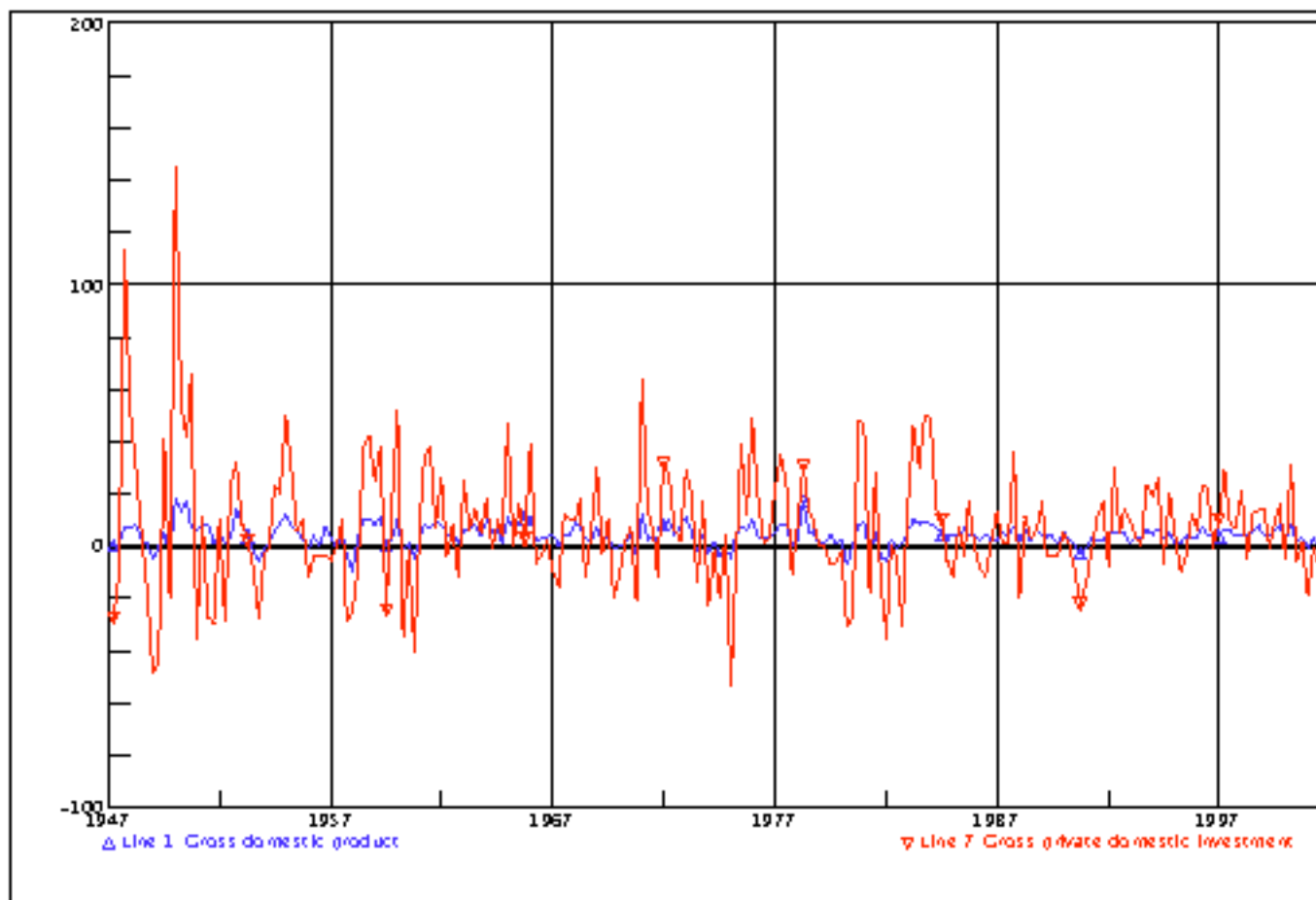
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The vision of self-regulation

- ★ This abstract theory creates a vision of a *self-regulating* commodity system
- ★ Once government has secured the *rules of the game*, property rights and monetary system, the system is supposed to take care of itself
- ★ This is not how things actually work out



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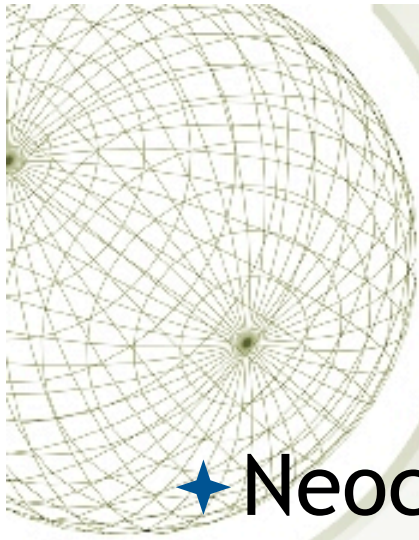
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Neoclassical economics

- ★ Neoclassical economics elaborates the classical view in several respects
- ★ The maximization of profit or utility requires the equalization of marginal cost and marginal revenue or marginal utility and price
- ★ *Attained equilibrium* takes the place of gravitation



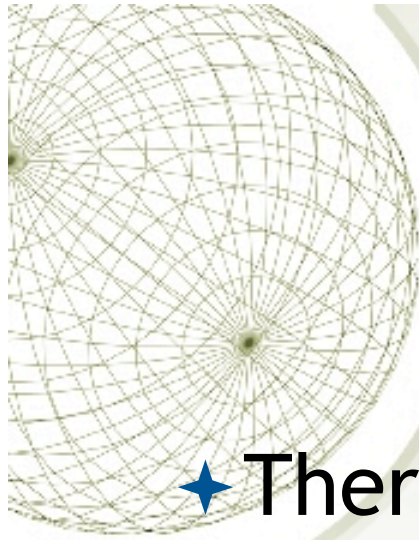
Equilibrium vs complexity

- ★ Neoclassical theory replaces the complex, adaptive system of commodity production with attained equilibrium
- ★ This is a (somewhat distorted) version of thermodynamic equilibrium
- ★ In particular the neoclassical view is *path-independent or ergodic*



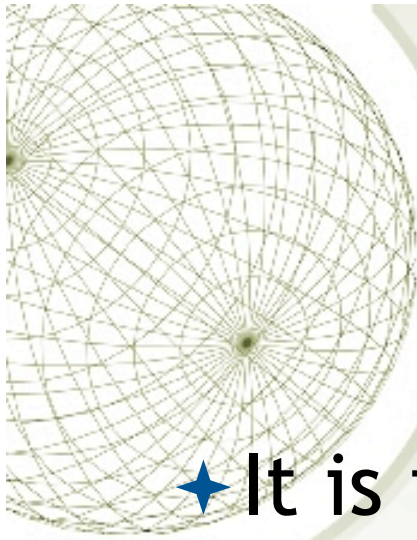
Hayek and the Austrian view

- ★ Friedrich Hayek, who is an important complexity theorist in his own right, emphasizes the *informational* aspect of commodity production
- ★ Each worker or entrepreneur has only a sliver of the knowledge required for a coherent social allocation; the market forces them to reveal information



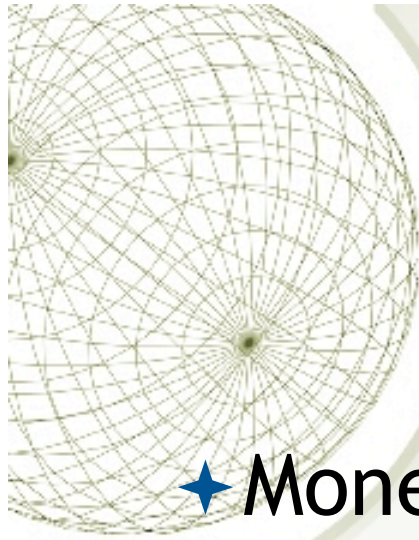
Pitfalls of econophysics 1

- ★ There are many aspects of economic interactions that look like the types of systems physicists excel at analyzing
- ★ Economic systems have a mixture of positive and negative feedback, complex dynamics and statistical self-organization



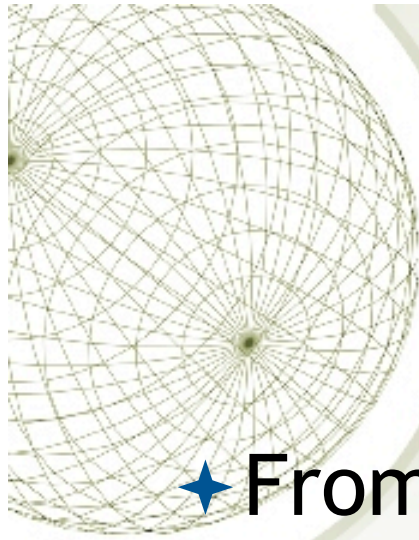
Pitfalls of econophysics 2

- ★ It is tempting to apply the powerful analytical methods of physics to economic institutions and dynamics
- ★ Physicists have an advantage conceptually in some aspects of economics
- ★ Price is similar to thermodynamic phenomena like pressure



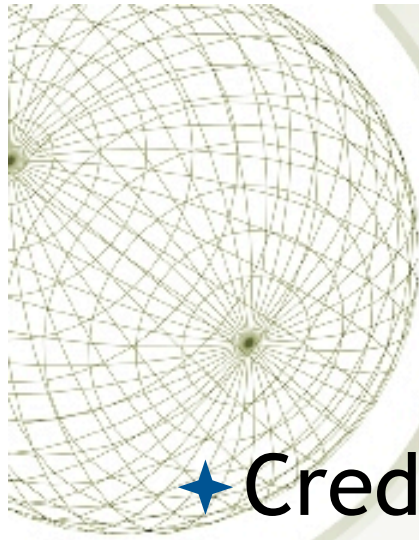
Pitfalls of econophysics 3

- ★ Monetary and financial institutions, however, are subtle, not widely understood technically, and difficult to grasp
- ★ For example, in any transaction money is conserved: what someone pays someone else gets



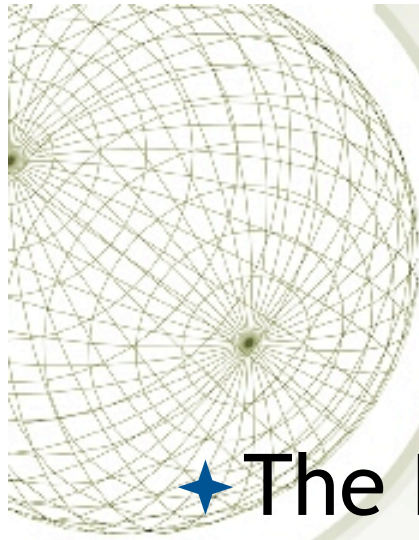
Pitfalls of econophysics 4

- ★ From this simple observation it is tempting to conclude that money is conserved over the whole economy
- ★ The development of sophisticated credit transactions, however, creates money substitutes that are not conserved



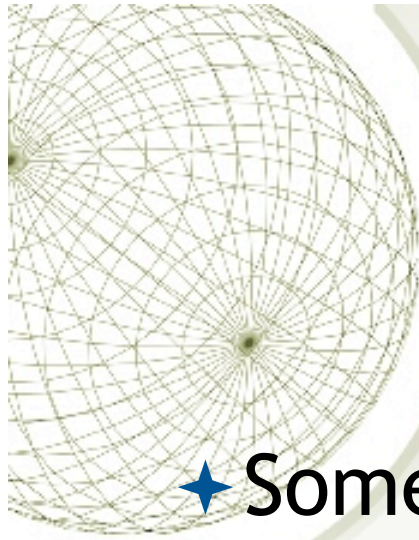
Pitfalls of econophysics 5

- ★ Credit transactions affect both sides of the balance sheet: the credit is an asset and a liability
- ★ In highly developed capitalist economies credit fluctuations can be quantitative huge on a short time scale
- ★ Foreign exchange transactions exceeded \$3 trillion a day in 2007



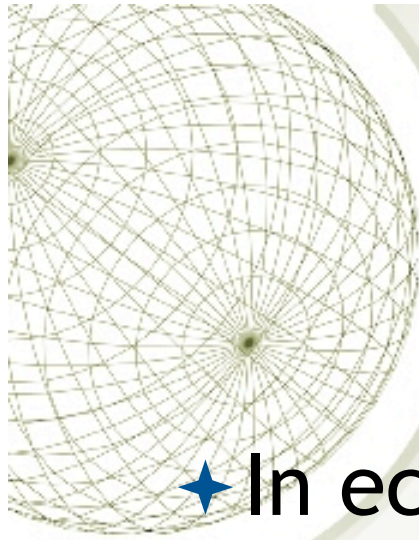
Pitfalls of econophysics 6

- ★ The New York clearing houses clear \$300 million payments a day, less than 5% settled in cash
- ★ In a virtual sense each transaction is balanced in money terms, but rapid changes in the volume of outstanding credit make the abstract assumption of conservation of money irrelevant



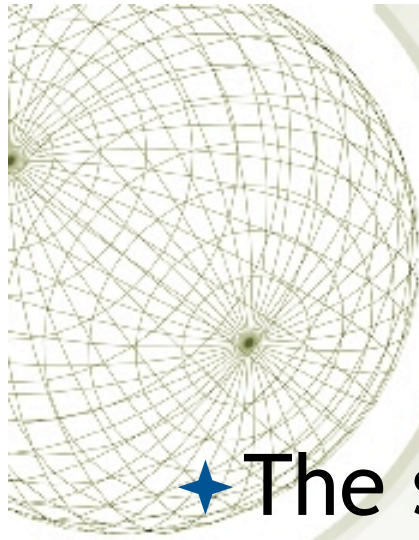
Pitfalls of econophysics 7

- ★ Some dynamic assumptions that are compelling in physical systems are quite off the mark for economies
- ★ In physical systems, for example, it is plausible to assume symmetry in the interchange of energy among molecules



Pitfalls of econophysics 8

- ★ In economic systems, however, there is very little symmetry in money payments
- ★ Because of the division of labor most households specialize in the sale of specialized labor services to a small group of buyers



Pitfalls of econophysics 9

- ★ The same division of labor dictates that household spending is directed to a wide range of goods and services providers
- ★ Similar asymmetries are pervasive in firm transactions; suppliers are rarely customers



Pitfalls of econophysics 10

- ★ The application of powerful physical analytical methods to economic and financial problems requires a thorough understanding of the economic institutions
- ★ This often has the creative effect of spurring the development of new methods adapted to economics