Title of entry: Imitation

Synonyms: Emulation, copying

Definition: Imitation in economics and the social sciences is the process by which individuals adopt the strategies and practices of others. Typically we imagine that it is success that is imitated rather than failure.

Introduction:

Imitation plays a key role in the economic study of competition, innovation, and evolution: the imitation of good ideas serves as a crucial way in which those ideas spread throughout a population. A key theme in the literature is that imitation improves economies and tends to foster efficiency. Imitation, however, bootstraps off of innovation: without new ideas to imitate stagnation is likely to result.

Main Text:

There are three broad strands of literature in economics studying imitation. The first is the role of imitation in competitive economies. The second is the role of imitation in pushing the process of innovation and growth. The third is the role of imitation in determining long-run outcomes in evolutionary economies. In all three cases imitation serves a positive role in advancing economic progress.

1. Competition

Competitive equilibrium requires that firms maximize their profits. In a long oral tradition firms were thought to do so by dynamically imitating the policies of rival firms rather than statically “optimizing.” On the one hand firms innovate – try new pricing and production policies, combine inputs in new ways and with new production processes. On the other hand they adopt practices of other firms which seem to be successful.

Some of the earliest work in economics on imitation is the examination of how stochastic imitation combined with a degree of innovation can

lead to competitive equilibrium – in effect verifying the earlier oral tradition. The classical paper is that of Winter (1971) who studied a Markov model of evolution in an economy with gross substitutes and shows that indeed convergence to competitive equilibrium is obtained. An element of innovation – the innovating remnant in the title – is needed to make sure that eventually good production plans are discovered. Once discovered they are then spread by imitation leading to competitive equilibrium and an efficient production plan and allocation.

Winter's paper is very advanced for its time, using as it does a stochastic Markov model similar to those that only became widespread twenty or so years later. It provides a much more compelling account of convergence to competitive equilibrium than the deterministic tatonnement and non-tatonnement models of price adjustment that were widely used at the time.

The early literature on imitation, innovation and competition is well reviewed in the Nelson and Winter (1977) survey which also reviews some of the empirical literature at that time on the importance of imitation. It covers also their own work simulating the process of innovation and imitation.

2. Schumpeterian Competition

Schumpeter (1942) focused not on static competitive equilibrium but rather on dynamic competition resulting in the generation of new ideas. In this account imitation is destructive of the profit of existing ideas: this on the one hand makes it less desirable to generate new ideas as profit will be lost to imitators, but on the other hand makes it essential in order to gain a short term monopoly by generating new ideas. In this account imitation forces firms to run faster to stay ahead.

This idea first appears in the literature on patent races such as Fudenberg et al (1983). There firms engage in a contest to see who can get the monopoly thereby shutting out the competitors. Such models can lead to "excess" innovation.

This Schumpeterian idea is picked up on and plays a key role in some modern theories of innovation, most notably in Grossman and Helpman (1991) and in Aghion and Howitt (1992). Although different in details both of these theories focus on imperfect competition and quality ladders. That is production may be carried out with different

technologies organized on a ladder with lower cost more productive technologies higher on the ladder. Firms move up the ladder either by innovating and discovering a new step or by imitating another firm higher up on the ladder. In the simplest version an innovating firm keeps its place on the top of the ladder for some fixed number of periods after which imitators enter the rung and drive profits to zero. On the one hand the presence of imitators takes some of the profit out of innovating, on the other hand it provides incentive to innovate as only innovation can provide short term monopoly profit.

These models with their simple imperfect competition point to intellectual property – patents – as a key incentive to innovate. Boldrin and Levine (2003) observing that empirically patents seem to have little to do with innovation (see Boldrin and Levine 2008 for a review of the evidence) contest this point of view. They observe that the presence of imitators – of copiers even – does not drive profit to zero as a matter of theory. Imitators must pay for a product to imitate and imitation takes time. Moreover, innovators have a number of methods of generating profits such as the complementary sales of expertise and services – the driving force in open source software – with which to profit from their ideas. Hence imperfect competition in general and patents in particular are by no means necessary to generate innovation and growth – it is the movement up the ladder that is key.

This connection between imitation and growth is further reinforced when we recognize that R&D not only is needed in order to innovate but in order to imitate. For example Griffith, Redding, and Van Reenen (2004) show that R&D is essential in order to imitate existing ideas. This perhaps is not surprising: one who is not actively doing research in an area is unlikely to quickly appreciate the breakthrough of others working in the area. A biochemical formula will mean little to someone who is not a biochemist; we are likely to get better service for our software from the creators than from people who simply copied the code verbatim, and so forth.

This connection is also relevant in the literature on user innovation. Von Hippel (2005), for example, makes the point that it is users of products and imitators who often improve those products. Here imitators also improve upon the original. One of the fascinating things is the “not invented here” syndrome so that producers of products often attribute to themselves improvements that originated either with users or imitators.

Empirically theories of user innovation and competition such as Boldrin and Levine (2002) better match the data than Schumpeterian models. We see this in empirical work of Irwin and Klenow (1994) for example. Their study of memory chips is particulary useful as the quality ladder is clearly defined moving as it does by factors of four. The key fact is that production of a particular quality does not jump up instantaneously but ramps up gradually – long after imitation has taken place – and that a new quality is only introduced when the stock of the old one is fairly large. Each old vintage is phased out gradually as the new one is introduced. The price data shows that the price of each vintage of chip falls roughly exponentially over the product cycle – meaning that the incentive to introduce the next generation chip keeps increasing. Evidence suggests this is the usual pattern in most industries. It makes the point: why introduce a new product if the old one is still doing so well? Rather innovation waits until the market is relatively satiated and there is reason to introduce a new product.

3. Evolution

In the original work on evolutionary game theory in Kandori, Mailath and Rob (1993) and Young (1993) innovation was central and imitation not present. One conclusion from this literature is that evolution selects not for efficiency but trades off efficiency against a measure of the risk from coordination failure. The subsequent literature shows that when imitation is present along with innovation there is a stronger tendency towards efficiency – reinforcing the conclusions of Winter about competition and Boldrin and Levine about growth.

The contrast between models used by economists to study learning and biologists to study evolution highlights the role of imitation. Traditionally learning models in economics have focused on best response dynamics in which players attempt to do the best they can relative to how other people in the population are playing. This is rather different than biological models of evolution in which the number of offspring a population can produce is greater in a larger population all else equal. However, when imitation is introduced into economic models, dynamics more similar to biological models results.

Consider first how biological models work. Central to biological models of evolution is the replicator dynamic. This asserts that ideas (or organisms) reproduce not only based on how much utility or fitness they provide, but also on their current level of success as measured by their population. In biology this reflects the fact that a larger

population will have more offspring than a smaller population all else equal.

What happens when imitation is introduced into the economic setting of ideas rather than organisms? Schlag showed how imitation in an economic setting can lead to a dynamic more like the replicator dynamic of biology than the best response dynamic of traditional economic theory. If players they acquire information through imitation then the chances of meeting a player playing a better strategy depend on how many of those other players there are. This means that more popular strategies are more likely to spread all else equal.

One of the peculiar and unattractive features of the replicator dynamic is that it can get stuck – if everyone is doing the same thing, no matter how stupid, then the system cannot move. If there is only imitation this makes perfectly good sense: if the population is homogeneous there is nobody to imitate. Hence we need some degree of innovation. Imitation alone is never enough – and this is characteristic of all types of economic models.

It is natural to combine the random innovation model of Kandori, Mailath and Rob (1993) and Young (1993) with a model of imitation. This program is carried out in Levine and Pesendorfer (2007) who model a process in which imitation more common than innovation, but in which innovation is present as well. They show in this case that stochastic stability is determined by the outcome of pairwise contests. This favors relatively efficient outcomes – for example if strategies can identify themselves to each other.

This tendency towards efficiency can be found in other strands of the economics literature. Ellison and Fudenberg (1993, 1995) study how rules of thumb for imitation evolve and find also that there is a tendency towards efficient outcomes.

A particularly clean example of how imitation and evolution lead to efficiency can be found in Ely (2002). Ely studies a model in which there are different locations. Innovation takes place at different locations and imitation has the form of moving to a particular location and adopting the social convention there. Naturally people move to successful locations and unsuccessful – inefficient – locations gradually lose population to the successful – efficient locations. In the long run the outcome is fully efficient.

Conclusion

Economists have studied a broad range of models where imitation plays a crucial role in spreading ideas. In dynamic theories of competition imitation plays a key role in establishing competitiveness and efficiency. In the theory of growth and development imitation may drive down profits from existing ideas, but by doing so creates incentives to create new ideas. In evolutionary game theory imitation spreads good ideas pushing towards more efficient outcomes. In all cases it is the combination of imitation and innovation that results in good economic outcomes.

Cross-References

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