Education and Heuristics: A Model of Market Learning

Stephen C. Miller

Department of Economics

George Mason University

ABSTRACT

Those who support increased public spending on education often cite studies that demonstrate significant returns to education (Card and Krueger 1992, 1996). This paper critiques the broad assumption that drives such claims: that education systematically increases worker productivity and thereby stimulates economic growth. The critique is twofold: First, an understanding of the subjective nature of knowledge is essential to how one views education; if knowledge is not a homogeneous input into a production function, then simply increasing spending on education will not necessarily yield net benefits in terms of worker productivity or economic growth. Second, where knowledge is understood as a flow rather than a stock (Boettke 2002), it is clear that it is learning, and not necessarily education, that generates new knowledge. An important consequence of the difference between learning and education is that without market feedback mechanisms, education can actually hinder the learning process. If a formal education system provides or reinforces inefficient heuristics, it may have more external costs than benefits.

Introduction

This paper relies on two important and related distinctions. The first is the distinction between learning and education. The second is between information and knowledge.

To describe the difference between information and knowledge, Boettke (2002) describes two basic forms of ignorance: 1) Where human beings know what they don't know, and 2) where they don't know what they don't know.[1] Acquiring information reduces the first form of ignorance, but only new knowledge can decrease the latter. Information is defined in this framework as *existing data* that can simply be obtained through search. Knowledge, by contrast, results from a cognitive learning process.

While learning can be a part of education, education can take place without generating new knowledge – education is often just the sharing of information; likewise, learning often takes place outside of the institution of formal education. State capital names, spelling rules, and multiplication tables are examples of information that is typically spread through education. Knowledge of how to cook a meal or edit a digital photograph are examples of knowledge gained through reflection, experimentation, and experience. For the purposes of this paper, these activities are defined as "learning." The word, "education" is used rather narrowly as a substitute for "formal schooling." The question, "What is the capital of Missouri?" has many incorrect answers, but exactly one

[1] Boettke mentions a third cognitive state, one of willful ignorance, where what people know isn't so. This is similar to Caplan's (2001, 2002) notion of *rational irrationality*.

correct answer. But the question, “How do you bake a cake?” has multiple correct and incorrect answers.

The first section of the paper focuses on the heterogeneity of knowledge, using the distinction between information and knowledge, where *information* refers to a stock (i.e. facts to be known) and *knowledge* refers to a flow, ever-changing as it passes from individual to individual. The implication of this distinction is that while the stock of information is important to participants in an economy, knowledge (as defined here) is even more important to their decision-making, as the knowledge available changes rapidly and varies with specific circumstances. The argument, then, is that formal education can improve the stock of information available, but it does not typically provide the knowledge that is most relevant in the coordination of the market.

The second section of the paper offers a slight twist on the analysis in the first section, in that it suggests that formal education actually does influence knowledge indirectly, where it provides heuristics that shape knowledge. Heuristics, or mental shortcuts that reduce the costs of understanding new information, affect the evolution of new knowledge. In the market, heuristics are adopted through a natural selection process of sorts; heuristics that are more consistently useful will defeat and replace heuristics that are prone to frequent failure. When education is treated as a public good, and is separated from market forces, "bad" heuristics are more likely to survive than they otherwise would in a competitive market.

The third section analyzes the internal and external costs and benefits of education, and compares them with the costs and benefits of of learning as a more

subjective and spontaneous process. Most of the empirically demonstrated returns to education are private and internal benefits, and the claim that civic returns are positive is examined within the framework of two important concepts in public choice, namely rational ignorance and rational irrationality.

Knowledge as a Heterogeneous Good

Boettke (2002) presents the Austrian distinction between information and knowledge as being a crucial and perhaps defining feature of the Austrian economists' approach to economic inquiry. The Austrian approach, Boettke explains, is to treat information as a stock and knowledge as a flow. Knowledge for Boettke can be thought of as specific and localized knowledge, and information can be treated as a synonym for "common" knowledge. Specific knowledge, treated as a flow, changes as discovery occurs, as market participants act, and as they learn. Put in different terms, it evolves. The new knowledge is determined both by the interaction and how it existed prior to its evolution.

Information is the equilibrium notion of knowledge. Facts are out there to be traded in the market. In a standard neoclassical equilibrium framework, information is costly to obtain, and is sought after to a point where the marginal benefits of a search for information equal the marginal costs of the search. *How* information is found isn't seen as particularly important to individuals acting within a market. Information is two-dimensional; you either have more of it or less of it.

This characterization of the equilibrium-oriented view of information is not necessarily a criticism. To the extent that economists working within this framework understand that they are simplifying the notion of information to make analysis possible, it is a useful step. Information is certainly easier understood as a costly good that is demanded and supplied in the marketplace. But the problem with equilibrium analysis is when it distracts from the evolving market process that economists wish to explain. If the point is merely to explain the basic incentives surrounding information and ignorance, an equilibrium framework clarifies the point. But if an economist wishes to examine the incentives in more detail, to explain why actors are informed or ignorant in a particular way, then it is necessary to step away from a static equilibrium framework. To explain the dynamics of a market, equilibrium must be a dynamic notion. If economics is the study of individuals' means to a given end, then the series of actions taken toward that end is what matters. Simply proving logically that they will reach those ends is not enough.

A better notion of equilibrium is potentially found in game theory, where an equilibrium is a combination of strategies that players adopt. The strategies can actually be quite complex, relying on a system of "if, then" procedures, where how one acts depends on the specific actions of other players, and is limited by one's own knowledge (usually assumed to be incomplete in some way) and expectations. Equilibrium in such a sense is a description of *action* within an institutional framework. Certain kinds of games may not have a stable equilibrium, and where an equilibrium exists there is a recognition of the action necessary to reach it. Equilibrium is not seen as a static point that is reached

in terms of human exchange and interaction. It is possibly static where information is concerned, as in many game theory models the players' information is assumed to be fixed, but even then a more complicated set of models can be used to show how players actually learn and change strategies as more knowledge flows to them. So in the sense that game theory is static, it leaves room for, and in some case focuses on, how equilibria can themselves change as knowledge flows through the system.

So what is the role of education in a more dynamic equilibrium analysis? Clearly *learning* has a role, but note that within the context of game theory the most relevant learning seems to be very specific. Learning occurs within a game, and is the result of interaction with other players while the game is played. Learning is a changing of, perhaps an evolution of expectations. So in what sense does education, particularly formal education, help expectations evolve in a more efficient or more productive direction?

There's no clear answer. It would seem to be the case that education really only affects expectations where it is specifically relevant to the game being played. And it also would be feasible that education will alter expectations in a number of ways, some of which may actually hinder players by slowing down or misdirecting the evolution of their expectations. Imagine if a formal education led a player to believe, for example, that people in general are narrowly self-interested. Such a belief would tend to hinder a player making offers in an ultimatum game if in fact the other player considers notions of fairness or equity rather than pure material self-interest. In fact, it can be imagined how such a belief doesn't just change an initial strategy, but can also slow down the learning

process; a player may change expectations more slowly where those expectations contradict prior beliefs. Fortunately, the incentives, i.e. the payoff structure of a game, should eventually push players in the right direction, but there are net losses – and if the game is a one-shot game or limited-turn game the player's change in expectations may come too late to yield benefits at all.

Within a single-equilibrium "information market" framework, this point is lost. Education is an increase in the stock of information, which can only improve coordination and allow markets to equilibrate more quickly. Education is only inefficient where the marginal costs of providing it exceed the marginal benefits. But there is no equilibrium level of output for education, because education is itself an extremely heterogeneous good, its heterogeneity is very relevant to the question of how much education is demanded. Within an equilibrium framework, it may be advantageous to simply deal with the demand and supply of relevant information, rather than all information. But relevance is a problematic concept, unless one considers knowledge as something distinct from information. As the cost of education falls, one would expect not only more consumption of relevant information, but also more consumption of less relevant information. Information can't neatly be divided into separate categories of relevant and irrelevant, as some information may be relevant or important enough to seek out at relatively high costs, but other information, while somehow relevant to individuals' ends, is only worth seeking out at relatively low costs.

How can education provide the most relevant information possible? It cannot always do so. Education is limited to providing more easily obtained and easily

communicable information. It cannot provide specific information about how actors will form strategies within a market. It can convey tendencies, and provide heuristics for individuals to use in their own decision-making, but the quality of such information will vary. Education can convey information, but not knowledge. Formal education provides general information that may or may not be useful for individuals trying to develop means to an end. The more general the information, the less of a marginal effect it has. Teaching basic algebra to high school students may have a slight overall effect on the engineering field, but a much greater marginal effect comes from the post-graduate schooling of engineers, and perhaps an even greater marginal effect comes from what actual engineers learn on-the-job as they deal with specific problems. There's no doubt that general education provides a foundation for specific learning, but simply increasing the size and scope of general education may or may not increase the critical learning at the margin. What's critical for decision-makers in markets is the knowledge they possess, and how to obtain more of the relevant knowledge they need to improve their own welfare. While public education can improve the stock of information available, it does not typically provide the knowledge that is most relevant in the coordination of the market. Why not? Because knowledge is not easy to articulate. It is often learned through experience, and typically grows through experience.

Heuristics, Information, and Knowledge

It might be worthwhile to focus on one example to explain the distinction between information and knowledge. An auto mechanic must possess information to perform his job and earn a living. The mechanic must know various specifications for valve clearances, torque specifications, ignition timing, etc. But a successful mechanic must also acquire knowledge that cannot be easily shared with others, and is best learned by repeated tasks and repeated processes of problem-solving. A shop manual for a particular model of vehicle will provide nearly all of the information required to disassemble and reassemble an automobile to every last small bolt. But a non-mechanic can make only limited use of such information, whereas an experienced mechanic can actually use the information to tear down and rebuild a complex modern car. Furthermore, even if an experienced mechanic were watching over a non-mechanic's shoulder, answering all of his questions and offering information as it was needed, the result would likely be a much slower and more problematic project than if the mechanic had worked alone.

The mechanic has knowledge that has been acquired through repeatedly performing tasks and repeated exposure to similar problems. But he has also built up a set of heuristics, or mental shortcuts, to be used in his work. He develops habits that are not always efficient in certain situations, but are "meta-efficient," in that they allow him, on average, to maximize his productive output. The mechanic may decide, whenever working on large trucks of a certain make, to separate the cab from the frame before performing any engine work, because most of the time it is a time-saving step -- even if

there is a unique exception or two to that rule. The rule, i.e. the heuristic, is itself efficient.

It is now appropriate to review the earlier claim that education provides only information and not knowledge. Using the idea of heuristics, this is not entirely true. For the mechanic, many of his heuristic devices can be learned through formal education. The heuristics are not themselves knowledge in the same way that developing a "feel" for mechanical work is knowledge, or in the same way that practicing an activity makes it easier, but heuristics clearly affect how knowledge is acquired.

Many mechanics do seek out formal education in the form of intensive manufacturer seminars, short automotive repair courses, etc. Much of what they learn are heuristics that have proven to be useful for other mechanics, such as the practice of separating the cab from the frame of a large-body truck to perform engine work. Often, they are learning a *better* heuristic than the one they previously might have relied on, such as lifting the hood of a truck to access the engine.

Heuristics push decision-makers in a particular direction by telling them what to do in certain situations. As it can be seen from the example of an auto mechanic, heuristics are themselves a way for individuals to economize; carefully examining and weighing different methods of working is costly and time-consuming. Heuristics are a lower-cost alternative, though less perfect in an epistemological sense. For a heuristic to be adopted, it need only provide better results than the next best heuristic.

Many experimental observations of “irrational” economic behavior are instances of a heuristic failing when it conflicts with another heuristic. Examples of how heuristics

can fail are often found in the literature of behavioral economics, where habits like loss-aversion are labeled as "irrational." A survey-based example given by McNeill, et al. (1982) is that of physicians who preferred a surgical procedure with a 90% survivability rate over one with a 10% mortality rate, even though the risks are statistically identical. The "irrationality," though, can be plausibly explained in terms of competing heuristics, where 90% survivability meets the threshold of a "good chance," and 10% mortality meets the threshold of a "bad risk." In the survey risk aversion wins out. The heuristic of avoiding risks that are, for example, in the double-digits percentage-wise, fails when offered against a positive outcome that sounds likely (such as 90%).

Undoubtedly, education provides students with certain sets of heuristics over others. If education provides better heuristics and alerts students to where they can fail, then there's reason to believe that education will improve individual decision-making, and ultimately people's well-being. But education of that sort is a likely outcome of market interaction, such as the seminars and courses that mechanics take to improve their abilities. Presumably educators who provide the best heuristics will be in high demand. One can imagine that the education or training they provide is worth investing in, which is possibly what can be seen in the current growth of task-specific education, such as for mechanics, nursing, etc.

With public education, it is plausible that first-best heuristics are being provided, and the expense of public education is justified by the positive externalities that come from the proliferation of efficient heuristics. But it is equally plausible that the poor incentive structure and bureaucratic nature of many educational institutions leads them to

promote inefficient or outdated heuristics that will not improve decision-making, and may in fact reduce the well-being of those who adopt them. Of course markets can respond to this problem, but overcoming an inferior heuristic and replacing it with a better one is costly. Furthermore, inefficient heuristics are only rejected where there is market feedback. If an educational institution is bureaucratic and lacking some feedback or incentive-oriented structure, then bad heuristics will tend to persist as generations of students will adopt them only to discard them later in life when they prove to be ineffective.

Of the two plausible scenarios, one where the public educational institutions are efficient and the one where they are not, the second is more consistent with an economic theory of incentives. Public school teachers do not likely have a strong incentive to promote better heuristics if the productivity of their past students is not directly connected to their compensation or job security. In a way, public education puts principals at the mercy of their agents. The agent (educator) decides what the principal (student) gets in terms of an education, and the principal is forced by truancy laws and taxes to pay the agent, regardless of the agent's performance.

An example of education providing "bad" heuristics may be found in a survey of public opinion on toxicology given by Kraus, et al. in 1992 and published in *Risk Analysis*. Elementary and high-school texts often focus on the risks of exposure to toxic chemicals through pollution, smoking, poor diet, etc. For example, the survey described in the article shows that non-toxicologists are likely to believe that *any* exposure to known carcinogens, no matter how small, can cause cancer, whereas toxicologists are

very unlikely to agree with such a statement. A possible explanation of the discrepancy is that lower-level education creates and/or enforces a heuristic of extreme risk-aversion, where the terms "carcinogen" or "chemical" raise warning signs that are synonymous with grave danger. But trained toxicologists, on the other hand, have abandoned that heuristic for one that emphasizes dose over exposure.

Another, perhaps more controversial example of the persistence of inefficient heuristics concerns people's beliefs about economics. Caplan (2002) uses the term "systematically biased beliefs" to describe commonly used heuristics related to economic policy positions. Using data from the Survey of Americans and Economists on the Economy (SAEE), Caplan shows a systematic belief difference that exists between professional economists and the general public. The difference itself might be interpreted as bias on the part of economists; but Caplan tests the leading alleged sources of economists' bias, for example the claims that they have a "right-wing" bias on a political spectrum and that economists are biased as a group based on income. In testing these potential sources of bias, Caplan finds no significant correlative effect of those factors on economic beliefs, though he does find positive correlation between "thinking like an economist" and factors such as gender, education, and job security (see Caplan 2001). Given those results, Caplan makes a qualified rejection of claims concerning economist bias, and instead proceeds with the assumption that what separates economists from the general public is their education in their field of expertise.

The heuristics adopted through education may have significant effects, especially where it affects the risks that people take in their own lives. One may be afraid to take a

job in a restaurant where smoking is allowed, for example, if that person believes that *any* exposure to cigarette smoke can be fatal.

As already mentioned, though, inefficient heuristics will eventually be abandoned within markets, as individuals will tend not to hold costly beliefs (Caplan 2001). But a significant problem with systematic bias may arise in democratic frameworks, where individuals as voters can hold beliefs with high external costs and very low private marginal costs. For example, a belief that foreign exchange hurts economic growth is not costly for an individual voter to hold, as the effect of his or her belief on policy outcomes is near zero, even if the cost of the belief when many voters share it is potentially very high.

Costs and Benefits, Internal and External

There is certainly evidence that education has significant returns in terms of private incomes (Card and Krueger 1992,1996). But as a justification for *public* education, those returns are irrelevant.

Why? The returns are irrelevant because any justification for public funding of education should rely on external benefits, not private benefits. There's no reason to assume that a market for education will be inefficient simply because private returns are high. If private returns are high, then presumably the amount of education provided in a private market will also be high. An argument for public funding or a subsidy to increase *internalized* benefits contradicts basic Pigovian externality theory. The common argument is generally that goods with external benefits and goods with external costs

should be subsidized and taxed, respectively.

It might be helpful in comparing the concepts of education and learning, to consider their costs and benefits, both internal and external.

Figure 1 shows the internal and external costs of public education. The internal costs are low, because with public education tuition is paid by the state, external costs are high, because third parties pay a significant part of the cost. External costs are also arguably high where poor learning heuristics persist *because* of public education curricula.[2] The internal benefits are high; for the sake of argument, the Card-Krueger point on high returns is conceded. The external benefits are low, precisely because the Card-Krueger work shows that most of the benefits are internalized.

In Figure 2, private learning has a different set of internal and external costs and benefits, where internal costs are high (tuition in task-specific schools is an internal cost, and the time spent learning skills and acquiring specific knowledge has a high opportunity cost). The external costs of private learning are low, if anything, because the costs are borne by the individual seeking education. Furthermore, it's not clear how one person's learning can harm another, unless the learning were focused on the end of harming others. The internal benefits of private learning are high; new knowledge and new skills that lead to profit or productivity gains are internalized. Finally, private learning has high external benefits because the creation of new knowledge is what allows for further specialization and gains from trade in the marketplace.

External costs and benefits are highly debatable, and what really matters is

evidence of their importance. So far, the claims of external benefits to education fall into one of three categories: the first is based on the Card-Krueger type claims of large significant returns to education. As has been pointed out, those returns are by definition internal benefits. The second claim echoes Dewey's (1916) line of argument that in democracies, more educated electorates will make better decisions at the polls, leading to better outcomes. Recent work (Dee 2004) supports this line of reasoning by giving evidence of higher civic participation among more-educated citizens. The problem with this line of reasoning, though, is that does not consider the possibility of systematic bias among voters, and the potential for systematic bias to actually be perpetuated by education, where feedback may be insufficient to allow efficient heuristics to triumph over inefficient ones.

The third type of evidence shows a correlation between economic growth and education levels, but does not show the causal connection. Since education has high private returns, it may be that societies with high enough incomes develop a longer time horizon, prompting more investment in education, whether public or private. If that is the case, then the reasons for public education versus private alternatives fade away; private returns would presumably provide enough incentive for private investment in learning.

[2] Lott (1999) argues that public education may have external costs in the form of indoctrination.

Conclusion

While a standard information-market framework lends itself to an analysis of education as simply growth in a stock of information, a non-equilibrium, coordination framework will treat education as part of a larger process of inquiry and decision-making. Education is part of the flow of knowledge through an economic system, and how education is supplied is as important as how much is supplied. Incentives influence how knowledge evolves through heuristics, and knowledge can evolve in inefficient ways where educators are not accountable to their customers. The effect is similar to the effects of monetary manipulation, where the principal-agent problem is intensified by the legal protection of agents from the consequences of consumer choice. The effects can be significant when public education promotes ineffective heuristics over effective ones.

Figure 1: Public Education

	Costs	Benefits
Internal	Low	High
External	High	Low

Figure 2: Private Learning

	Costs	Benefits
Internal	High	High
External	Low	High

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