

Value-Free Economics and Engineering Education

Abstract

In a highly influential book on economic methodology originally published in 1932, *An Essay on the Nature and Significance of Economic Science*, Lionel Robbins argued forcefully that “economic analysis is *wertfrei* (value free)”. In the years following its publication, broad acceptance of Robbins’s views on this matter represented a culmination of a long-developing separation of economics from its parent discipline of moral philosophy, and an almost total exclusion of ethical evaluations from economic analysis. Economics became, in the words of Nobel laureate Amartya Sen, “self-consciously non-ethical”.

The evolution of economics as a value-free science of resource allocation has led engineering educators, among others, to view the analytical tools of economics as having no bearing on ethical evaluations. The moral science dimensions of economics have been mostly forgotten. With its institutional adherence to value-free analysis, it is not surprising therefore that economics is seldom thought of as a possible source for addressing current initiatives that aim to broaden the ethical content of engineering education. What ethical lessons, if any, could engineers take away from economics? In general, the answer to that question is “few or none”.

In this essay I argue that a return to a broader conception of economics as a moral science could improve economic literacy among engineers and actually better equip them to deal with vexing issues that often arise in their field. I review the history and nature of the value-free doctrine, offer a few examples of how ethical evaluations can be reincorporated into economic analysis, and argue that such an approach to economic pedagogy could generate benefits for both economics and engineering education.

1. Ethics, Economics, and Engineering Education

Current initiatives in engineering education, spurred by accreditation agencies, seek not only to instill a sense of ethical responsibility via traditional code-based approaches, but also to make ethical reasoning a pervasive component of engineering pedagogy.^{1, 2, 3, 4, 5} The evolving curricular approach is sometimes referred to as “ethics across the curriculum” and offers non-engineering disciplines broad opportunities to participate in the ethical education of engineers.^{6, 7} In part, this increased emphasis on ethics among American and British engineering educators may stem from a realization that technical proficiency is a minimum expectation in today’s engineering job market, and that if American and British engineering schools are to maintain a competitive advantage in the engineering labor market their graduates must be prepared to deal broadly with complex issues relating to technology and society.

In stark contrast to this trend toward *more* ethical content in engineering, modern economics, despite its 18th century roots in moral philosophy, consciously maintains a stance of ethical neutrality or even ethical blindness. Economics long ago severed ties to ethics, having adopted a stance known as value neutrality from Continental influences early in the 20th century. For engineering educators, economics has become something like mechanics – a source of pragmatic tools that can be used in the application of technology and design principles to their projects. Its heritage as a moral science has been mostly forgotten. Courses in “engineering economics” – which for many engineers are the only economics they learn – reflect this pragmatism, focusing mainly on cost behavior and capital budgeting techniques. To the extent that the social science aspects of economics can be said to have exerted any broader influence on the training of engineers, it has been through the provision of an understanding of the capitalist system in which engineers usually end up finding employment. One overarching theme is that of an historic tension between the demands of economic efficiency and the demands of technical professionalism.⁸

To this historical tension we may now need to consider another source of tension as the growing ethical sensitivities of the engineering discipline bump into the ethical blindness of economics. Engineers may sometimes feel as if they have to choose between their ethical responsibilities and the dictates of respectable economic analysis. Consider this explanation of a “degree of harm” criterion in a popular engineering ethics textbook:

“When pollutants pose a clear and pressing threat to human health, they must be reduced below any reasonable threshold of harm. *Cost should not be considered a significant factor.* Insofar as substances pose an uncertain (but possible) risk to health or when the threshold of danger cannot be determined, economic factors may be considered. If a harm is irreversible, it should be given higher priority.”⁹ (p. 219, *italics added*)

Such criteria circumscribe traditional cost-benefit analysis based on economic considerations. They narrow the applicability of economic modes of analysis in engineering work, and threaten to drive a wedge between economists who consciously strive to maintain an appearance of ethical neutrality and engineers whose professional standards require a more holistic and ethically sensitive approach.

What ethical lessons, if any, might engineers take away from economics the way the discipline is usually taught today? One lesson, primarily learned in case studies of what is derisively called “disaster ethics”, is that amoral cost-benefit calculations sometime lead to disastrous or morally repugnant outcomes. In studying the Ford Pinto case, for example, engineers are often left with an unsatisfactory view of the sterile way in which economics uses market prices to place a value on human. The Ford Pinto was a subcompact car manufactured by the Ford Motor Company for

the North American market from 1971 to 1980. It became the focus of a scandal when it was alleged that the car's design allowed its fuel tank to be easily damaged and perhaps explode in the event of a rear-end collision. Ford was aware of this design flaw but allegedly refused to incur the expense of a redesign. Instead, it was argued, Ford decided it would be cheaper to pay off possible lawsuits for resulting deaths.¹⁰

Other case studies in engineering ethics deal with the implications of dumping unsafe products in developing markets. The ethical issues in such cases mirror those associated with a much-discussed World Bank Memo. In late 1991, Lawrence Summers, who was then the chief economist at the World Bank, circulated a memo that used traditional economic analysis to encourage the movement of dirty industries to less developed countries. Within economics, this memo has been used to argue that economists cannot avoid moral issues in their analyses.¹¹ In this case, the application of economic logic to the topic of optimal asset ownership is straightforward – ownership of assets should migrate to agents who value them most highly. Cases such as these, however, demonstrate that “straightforward” economic logic sometimes can lead to ethically troubling outcomes.

I would like to argue that as engineering educators seek to broaden the ethical content of their curricula an institutional adherence by economists to ethical blindness threatens to widen the divide between engineers and economists, and to marginalize economic considerations in engineering. A broader conception of economics as a moral science and a more transparent treatment of the value neutrality issue could enable economists to provide engineers with broader tools of analysis for dealing with vexing issues that often arise in their field. With these thoughts in mind, my purpose here is to consider the nature and some effects of adherence to value neutrality in economics – to review the genealogy of the ideas that inform the position, and then to consider some of the consequences of that position (or an overly strict adherence to it), with particular emphasis on current curricular discussions in engineering education.

2. Ethical Neutrality in Economics

Adam Smith, arguably the most well-known name in economics and often regarded as the intellectual father of the discipline, was not an economist as we would define the term today, but a moral philosopher. His two major works, *The Theory of Moral Sentiments* (1761) and *The Wealth of Nations* (1776), may be viewed as a lengthy study on the proper organization of society given man's nature as an ethical being. Thus from its birth, economics was part of a larger field of inquiry within moral philosophy. As late as 1938, John Maynard Keynes, one of the most influential economists of the 20th century, expressed a view that “economics is essentially a moral science.”¹² Despite such pronouncements from towering figures in the field,

however, almost from its birth economics seems to have been preoccupied with separating itself from its roots in moral philosophy, and related social sciences have lately been following this lead. As Albert Hirschman has noted, “modern social science arose to a considerable extent in the process of *emancipating* itself from traditional moral teachings.”¹³

In economics, this process of emancipation is usually thought to have begun with David Ricardo and Nassau Senior, who actively facilitated the separation of economics from ethics and narrowed the focus of the developing discipline in the early decades of the 19th century. Regarding issues related to distribution, for example, Senior was unequivocal:

“... all these are questions of great interest and difficulty, but no more form part of the Science of Political Economy, in the sense in which we use that term, than Navigation forms part of the Science of Astronomy.”¹⁴

Later in the 19th century other economists seemed consciously aware of the implications of the growing distance between economics and ethics. Almost uniformly, they opened their treatises with extended discussions about the relationship of economics to philosophy and science, often expressing a desire to establish economics on an epistemological par with the physical or natural sciences.

Despite this long history, economics, at least as it was practiced in English-speaking academic circles in the early 20th century, had not yet fully divested itself of its holdings in moral philosophy. Alfred Marshall, who epitomized the British economic tradition at the turn of the century, does not seem to have contemplated a complete severance of economics from ethics.¹⁵ At his inaugural lecture at Cambridge University in 1885, Marshall, while discussing the need for technically proficient economists, seemed equally interested in attending to their ethical sensitivities:

“It will be my most cherished ambition, my highest endeavor, to do what with my poor ability and my limited strength I may, to increase the numbers of those, whom Cambridge, the great mother of strong men, sends out into the world with *cool heads but warm hearts* ...”¹⁶ (*italics added*)

Thus, by the early 1930s, the dominant strand in British economic thought still could be characterized as one that accepted economics as a complex mixture of pure science and moral reasoning. American economic thought differed little in this respect from the British tradition.

Into this established tradition, Lionel Robbins, in a highly influential book on economic methodology originally published in 1932, *An Essay on the Nature and Significance of Economic Science*, introduced an unyielding view that ethics and economics were logically distinct, and

that if economic knowledge was to be held in the same esteem as other scientific knowledge, economists may adopt different methods but must eschew value judgments:

“... it does not seem logically possible to associate the two studies in any form but mere juxtaposition. Economics deals with ascertainable facts; ethics with valuations and obligations. The two fields of enquiry are not on the same plane of discourse.”¹⁷

In the decades following the publication of Robbins's *Essay* economics became, in the words of Nobel laureate Amartya Sen, “self-consciously non-ethical.”¹⁸ Although the movement in this direction had been going on since the early 19th century, there can be little doubt that Robbins's *Essay*, with its focus on the German concept of *Wertfreiheit* – the separation of value judgments from analysis, or the conscious pursuit of ethical neutrality – was influential on the subsequent development of economics. Even though many professional economists today have probably never read Robbins's *Essay*, they would recognize in it a general outline for an institutionally acceptable approach to economics that is heavy on deductive analysis and mimics the disinterestedness that is part of the ethos of science in general. Many years after the publication of the *Essay*, Kenneth Boulding, in his presidential address to the American Economic Association, lamented the path economics had taken as it evolved into a social science distinct from moral science and consciously introduced *Wertfreiheit* terminology with its historical baggage:

“We are strongly imbued today with the view that science should be *wertfrei* and we believe that science has achieved its triumph precisely because it has escaped the swaddling clothes of moral judgment and has only been able to take off into the vast universe of the ‘is’ by escaping from the treacherous launching pad of the ‘ought.’”¹⁹

In the wake of Robbins's *Essay* and in the name of good social science, economists seemed to adopt an extreme form of *Wertfreiheit*, moving beyond ethical neutrality towards ethical blindness, or what some have called strict value neutrality²⁰. In this version of the doctrine, Robbins's own suggestion that economists speculate “long and widely” on ethical questions²¹ seemed to have been forgotten.

This broad acceptance of an extreme form of *Wertfreiheit* in the years following publication makes it easy to look back at the *Essay* as “a rather successful attempt to eliminate from economic analysis the last vestiges of ... any reference to normative ideas.”²² In another famous methodological essay of the 20th century, Milton Friedman argued that “positive economics is in principle independent of any particular ethical position”²³, and Ronald Meek, in discussing the evolution of economics in the late 1950s and early 1960s into an engineering-like discipline, would proclaim that “the days of the intrusion of value-judgments into ‘positive’ economics are numbered.”²⁴ Such methodological pronouncements are one thing, but the theoretical

developments of the 1950s and 1960s, pursued with elegant mathematical formality, illustrate even more clearly the evolution of economics as not just a value-free science, but as an amoral science. William Letwin put it this way:

“...economic theory owes its present development to the fact that some men, in thinking of economic phenomena, forcefully suspended all judgments of theology, morality, and justice, [and] were willing to consider the economy as nothing more than an intricate mechanism, refraining for the while from asking whether the mechanism worked for good or evil.”²⁵

Ethical neutrality became ethical blindness.

Even though in modern discussions of economic methodology many economists consider strict value neutrality to be philosophically naïve,²⁶ in general this methodological approach continues to dominate mainstream economic thought. Aside from the dominant neoclassical orthodoxy, alternative genres of economic thought such as Marxism and institutionalism exert meager influence on contemporary economics. While Marx’s work and subsequent Marxian thought seem to represent an important exception to the principle of value-free methodology,²⁷ they only bear on the issues here in oblique ways. To the extent that a Marxian ethics can be derived from Marx’s own work, individual notions of duty are subsumed into an overriding social objective, a concept of ethics that grew out of the German Romantic Movement.²⁸ While this notion might bear some resemblance to the concept of a public interest, which engineers hold dear, when the public interest is discussed today it is rarely in Marxian terms. Furthermore, since Marxian theory interprets value assignment as a political process, exploration of its contemporary relevance may best be left to political scientists. In economics, subjectivist theories of value long ago replaced intrinsic theories such as Marx’s labor theory of value.

Another alternative genre of economic thought is American institutionalism. In both its old and new incarnations, however, institutionalism does not offer a significantly different perspective on the value neutrality issue.²⁹ Where value neutrality is concerned, institutionalism, particularly in its new incarnation, exhibits similarities to orthodox neoclassical economics. The principal difference between institutionalism and orthodox neoclassicism is that the former argues for a value-free science founded on historical and inductive analysis, while the latter favors intuitive and deductive analysis. Thus both tend to eschew ethical evaluations. At present, therefore, if economists are to wrestle with ethical considerations at all, it would seem that such considerations must be tackled within the mainstream of economic thought.

Within the existing neoclassical orthodoxy that dominates classroom economics, alternative views on the subject of ethical evaluations are generally voiced at the margins of the discipline. At the other end of a philosophical spectrum from strict value neutrality, for example, is a strict non-neutrality view that is usually associated with Gunnar Myrdal’s agnosticism concerning the “existence of a body of scientific knowledge acquired independently of all

valuations.”³⁰ In general, this line of reasoning argues that value-free analysis is not possible in the social sciences because the researcher and model builder always approaches his or her project with valuations, hidden or not. For some, this issue is unavoidable, because humans are unavoidably driven by ideology, and the pretense of disinterest is just that – a pretense. As one historian of economic thought put it, “... the very decision to be ethically neutral may be related to one’s ideology.”³¹ The best one can hope for, according to this view, is that social scientists are meticulously explicit in setting forth their biases, in the manner of moral philosophers, who often initially set out their “ethical perspective” before proceeding to their actual arguments.

3. Integrating Ethics and Economics as Part of a Broader Pedagogical Approach

In introductory courses, new students of economics quickly encounter one manifestation of the institutional adherence to strict value neutrality – a brief discussion of the distinction between positive and normative economics. Textbook writers and instructors at introductory levels usually define good positive economics as analysis that is free of value judgments, while describing good normative economics as policy-related work that either implicitly or explicitly rests upon underlying value judgments or ethical perspectives. Economists often frown upon the introduction of normative analyses into the economics classroom, preferring to leave such issues to other disciplines. For example, in a recent op-ed piece on fairness debates involving the U.S. tax code, Greg Mankiw writes “Fairness is not an economic concept. If you want to talk fairness, you have to leave the department of economics and head over to philosophy.”³² Comments such as Mankiw’s are testament to Robbins’ polemical success and to the pervasiveness of an ethos of economic science that has been heavily influenced by the value-free approach Robbins espoused in his *Essay*.

In general, this approach enables economics instructors to maintain the premise that its modes of analyses are scientifically credible, a stance that engineering and science students often find quite amusing. One reason for this response is that for many years professional economists have attempted to have it both ways – to wear two hats and simply announce when their pronouncements were value free and thus had scientific validity, or when they were making normative claims or offering ethical evaluations. In practice, knowledgeable listeners suspect that positive economics often comes with normative baggage attached. Within economics, there is an increasing awareness that such a clean division is untenable, that ethical considerations cannot be so easily cordoned off or contained like a hazardous substance.³³ Unfortunately, introductory economics texts do not present matters this way. Instead they tend to offer “settled views” on many matters where there are genuine philosophical differences. Such an approach to economic pedagogy misses important opportunities to participate in the sharpening of students’ ethical sensitivities. While more philosophical debates within economics may arise in graduate seminars and sometimes in well-taught upper-level undergraduate courses, most engineering

students never find themselves in such venues and thus are likely to emerge from the economics courses they manage to take with a relatively unsophisticated level of economic literacy.

Perhaps sensing the difficulties and shortcomings of a singular adherence to strict value neutrality, Robbins himself in 1981 called for a revival of the term “political economy” to cover “that part of our sphere of interest which essentially involves judgments of value.”³⁴ It is useful to remember that neither Weber nor Robbins, in arguing for “ethically neutral” or “value free” social science, required that social scientists take a vow of abstinence from making policy pronouncements. Properly understood the *Wertfreiheit* doctrine requires only that economists be clear about the basis of their pronouncements and not attempt to give them “scientific” validation.³⁵ Weber himself put it this way:

“...it can never be the task of an empirical science to provide binding norms and ideals from which directives for immediate practical activity can be derived ... What is the implication of this proposition? It is certainly not that value-judgments are to be withdrawn from scientific discussion in general simply because in the last analysis they rest on certain ideals and are therefore “subjective” in origin.”³⁶

Similarly, in distinguishing between pure scientific analysis and postulates about “different judgments of value”, Robbins concludes:

“Our methodological axioms involve no prohibition of outside interests! All that is contended is that there is no logical connection between the two types of generalization, and that there is nothing to be gained by invoking the sanctions of one to reinforce the conclusions of the other.”³⁷

As an alternative to a bifurcation of the discipline into economic science and political economy, Albert Hirschman envisioned a different transformation:

“Down the road, it is then possible to visualize a kind of social science that would be very different from the one most of us have been practicing: a moral social science where moral considerations are not repressed or kept apart, but are systematically commingled with analytic argument, without guilt feelings over any lack of integration; where the transition from preaching to proving and back again is performed frequently and with ease; and where moral considerations need no longer be smuggled in surreptitiously, nor expressed unconsciously, but are displayed openly and disarmingly.”³⁸

While economics is unlikely to undergo such a broad transformation, I would argue that a less radical solution, one that pays homage to the discipline’s roots in moral philosophy, could help improve the economic education of engineers and scientists, and enable economists who teach in engineering environments to participate in the ethical training of engineers. There is a danger, of

course, that a careless blurring of distinctions between positive and normative issues could lead economics into what Geoffrey Hodgson has called a “normative morass.”³⁹ I think that danger can be avoided by maintaining a careful distinction between ethical evaluations and ethical judgments.⁴⁰ In what follows, I offer a few examples of topics that easily admit moral philosophic discussion into issues of basic economic analysis.

Social rates of discount. In evaluating large-scale public projects, cost-benefit analysis unavoidably involves discounting monetary values over very long time horizons, with significant (and unavoidable) issues surrounding assumptions about the preferences of future generations. In contemporary economic discussions of discount rates for publicly financed large-scale projects with long time horizons it is often suggested that the appropriate rate of discount is a weighted average of before-tax and after-tax interest rates where the weightings are the proportions of funds coming from displaced private investment and displaced private consumption.^{41, 42} Proponents of social rates of discount argue, however, that opportunity costs revealed in market rates of return may not provide adequate representations of intergenerational tradeoffs, and that the appropriate rate of discount is somewhere below this market-determined rate, perhaps even close to zero. As long ago as 1928, Frank Ramsey argued more broadly that the use of a social rate of discount greater than zero was “ethically indefensible.”⁴³ Such rates significantly increase the importance of benefits and costs in the distant future. These arguments usually revolve around issues of market imperfections or missing markets – claims that distortions in current credit markets make interest rates misleading indicators or that future generations are inadequately represented in today’s markets. In any event, the economist’s claim to have a rule for determination of an “appropriate” rate cannot entirely insulate the analysis from ethical issues. Not addressing such issues at the introductory level threatens to leave the student of economics inadequately prepared to deal with real-world issues.

Corporate governance and the public interest. The dominant theoretical views underlying economic considerations related to corporate governance – agency theory and shareholder value maximization – were developed in the 1970s under the auspices of value free positive science.^{44,}⁴⁵ and generally dismiss the notion of a public interest as irrelevant to private decision making.^{46,}⁴⁷ (ch. VIII) After dominating management education for a generation, such views recently have been criticized as being myopic⁴⁸ and ideologically based.⁴⁹ Engineers, however, have never abandoned the notion of a public interest or their obligation to serve it. Thus, in the area of corporate governance there exists potential for the concept of public interest to drive a wedge between engineers and economists. When economists use the term public interest, it is usually within the context of the need to ameliorate market failures to improve economic efficiency. Engineers on the other hand seem to view the concept as a sort of collective preference ordering over a broader set of objectives. In an earlier era, engineers and economists shared this latter view. For example, six years before Robbins offered his sharp demarcation of economics from

ethics, John Maynard Keynes, who always remained a complicated mixture of deductive scientist and moral philosopher, expressed this older view of a public interest when he said “our problem is to work out a social organization which shall be as efficient as possible without offending our notions of a satisfactory way of life.”⁵⁰ Of course, one cannot enter into discussions about the meaning of “satisfactory” without allowing for some relaxation of the strict value neutrality view. One could operationalize sentiments such as Keynes’s by introducing notions other than efficiency as additional constraints. As a pedagogical strategy, such an approach might offer opportunities to discuss whether single-minded attention to efficiency may itself be regarded as a value judgment.

Environmental Economics and Sustainability. In his wonderfully ambiguous discussion of the subject, Nobel laureate Robert Solow points out that sustainability is essentially about intergenerational distributional equity.⁵¹ This perspective clearly introduces ethical considerations into the discussion. A fundamental issue in this area, and one which has broad applicability to engineers, is the assignment of value to human lives or environmental assets. Economists maintain that valuation is subjectively based upon well-ordered preferences, while deep ecologists reintroduce the age-old notion of intrinsic value. Whether economists accord intrinsic values equal status to preference-based valuations or reject them as intractable, they unavoidably make a value judgment. In reality,

“There is no reason to reject the idea of intrinsic values because the idea of measuring preferences is adopted. What is being assessed are two different things; the value of preference of people for or against environmental change (economic values) and the value that intrinsically resides ‘in’ environmental assets (intrinsic values) ... Once it is accepted that both forms of value exist, the issue becomes one of which values should inform and guide the process of making public choices.”⁵²

In this area, perhaps more than in others, economists need to acknowledge the existence of other perspectives and accept that those other perspectives might place limits on their own analysis. As Kenneth Arrow once said, “Looking at policy issues from the point of any one system is likely to lead to unsatisfactory conclusions somewhere.”⁵³

In each of these areas and others economics actually has rich histories of debate over methods and moral implications. Ignoring those histories impoverishes the economics curriculum and leaves students with a myopic view of economic analysis. At its worst, this approach creates an impression that economic science is little more than a justification for free markets. Pushing these issues to the background contributes to missed opportunities to use economic analysis to sharpen students’ ethical sensitivities and moral reasoning skills. Some economists and moral philosophers see the relationship between economics and ethics as a two-way street. In this alternative view, economics can be made more relevant through the inclusion of concepts from

ethics, but at the same time ethical analysis can be made more formal and rigorous through the application of economic methods.^{54, 55, 56}

4. Summary

As it stands, the ethos of economic science, strongly imbued with a sense of value neutrality, continues to exercise broad influence. While the debate over the relationship of economics to ethics continues in some corners of the discipline, in general mainstream professional economists assiduously avoid any trappings of value-influenced analysis. The view taken here has been that a return to a broader conception of economics as a moral science could allow economists to participate more fully in the ethical training of engineers and might contribute to an improvement in economic literacy in general.

The benefits of such an approach could flow in both directions. In prognosticating on the future of microeconomic theory, Beth Allen saw “vast potential for economists to learn from engineers.”⁵⁷ Her primary interest was in the possibility of interdisciplinary knowledge transfer – she speculated that economists could enhance their theories of production by studying the ways in which engineers deal with problems of technology selection and design. More than this, it may be fruitful to consider if economists can learn anything from the ways in which engineers wrestle with ethical issues in an attempt to pursue a unified approach to their design problems. It also is possible that there is potential for engineers to learn more from economists if economists will venture more freely into areas of ethical discourse. In this way, both fields could be enriched.

REFERENCES

-
- ¹ LINCOURT, J. and JOHNSON, R. (2004). Ethics training: a genuine dilemma for engineering educators. *Science and Engineering Ethics*, **10**, 353 – 358.
 - ² BIRD, S. J. (2003). Integrating ethics education at all levels – ethics as a core competency. In *Emerging Technologies and Ethical Issues in Engineering*. Washington, D.C.: National Academy of Engineering.
 - ³ UFF, J. (2002). Engineering ethics: some current issues. *Ingenia Online*, **13**, 47 – 52.
 - ⁴ HERKERT, J. R. (2007). Continuing and emerging issues in engineering ethics education.” National Academy of Engineering Website, <http://www.nae.edu>.
 - ⁵ ----- (2000). *Social, Ethical, and Policy Implications of Engineering*. New York: Wiley/IEEE.

-
- ⁶ RUDNICKA, E. (2005). Ethics in an operations management course. *Science and Engineering Ethics*, **11**, 645 – 654.
- ⁷ KLINE, R. R. (2001). Using history and sociology to teach engineering ethics. *IEEE Technology and Society Magazine* (Winter), 13 – 20.
- ⁸ LAYTON, E. (1969). Science, business, and the American engineer. In Perrucci, R. and Gerstl, J. E. (eds.), *The Engineers and the Social System*. New York: Wiley.
- ⁹ WADSWORTH, C. E., PRITCHARD, M. S., and RABINS, M. J. (2000). *Engineering Ethics: Concepts and Cases*. Belmont, CA: Wadsworth.
- ¹⁰ BAURA, G. D. (2006). *Engineering Ethics, An Industrial Perspective*. Burlington, MA: Elsevier.
- ¹¹ HAUSMAN, D. M. and McPHERSON, M. S. (1996). *Op. cit.*
- ¹² KEYNES, J. M. (1938). “Letter to Roy Harrod”, 1 November 1938. In D. Moggridge (ed.), *The Collected Writings of John Maynard Keynes*, Vol. XIV. London: Macmillan (1973).
- ¹³ HIRSCHMAN, A. O. (1981). Morality and the social sciences, a durable tension. In *Essays in Trespassing, Economics to Politics and Beyond*. Cambridge: Cambridge University Press.
- ¹⁴ SENIOR, N. (1836). *An Outline of the Science of Political Economy*. London: Bradford & Dickens (1938 reprint).
- ¹⁵ COATS, A. W. (1990). Marshall and ethics. In R. McWilliams Tullberg (ed.), *Alfred Marshall in Retrospect*, Brookfield, VT: Edward Elgar.
- ¹⁶ MARSHALL, A. (1885). The Present Position of Economics. In A. C. Pigou (ed.), *Memorials of Alfred Marshall*. London: Macmillan & Co., 1925.
- ¹⁷ ROBBINS, L. (1935). *Essay on the Nature and Significance of Economic Science*, 2nd ed., rev. London: Macmillan & Co.
- ¹⁸ SEN, A. (1987). *On Ethics & Economics*. Malden, MA: Blackwell.
- ¹⁹ BOULDING, K. E. (1969). Economics as a moral science. *American Economic Review*, **59**, 1 –12.
- ²⁰ MONGIN, P. (2006). Value Judgments and Value Neutrality in Economics. *Economica* **73**, 257 – 286.
- ²¹ ROBBINS, L. (1935). *Op. cit.*
- ²² PRIBRAM, K. (1983). *A History of Economic Reasoning*. Baltimore and London: The Johns Hopkins University Press.
- ²³ FRIEDMAN, M. (1953). The methodology of positive economics. In D. M. Hausman, (ed.), *The Philosophy of Economics: An Anthology*, 2nd ed. Cambridge: Cambridge University Press (1994).
- ²⁴ MEEK, R. L. (1964). Value-judgments in economics. *The British Journal for the Philosophy of Science*, **15**, 89-96.
- ²⁵ LETWIN, W. (1963). *The Origins of Scientific Economics*. London: Methuen.

-
- ²⁶ DAVIS, J. B. (2005). Robbins, Textbooks, and the Extreme Value Neutrality View. *History of Political Economy* **37**, 191 – 196.
- ²⁷ WILDE, L. (1998). *Ethical Marxism and its Radical Critics*. New York: St. Martin's.
- ²⁸ KAMENKA, EUGENE (1969). *Marxism and Ethics*. New York: Macmillan.
- ²⁹ RUTHERFORD, M. (1999). *Institutions in Economics – The Old and the New Institutionalism*. Cambridge, U.K.: Cambridge University Press.
- ³⁰ MYRDAL, G. (1969). *Objectivity in Social Research*. Middletown, CT: Wesleyan University Press.
- ³¹ MALONEY, J. (1985). *Marshall, Orthodoxy and the Professionalization of Economics*. Cambridge: Cambridge University Press.
- ³² MANKIW, N. G. (2007) Fair taxes? Depends what you mean by 'fair'. *New York Times*, 15 July.
- ³³ MONGIN, P. (2006). *Op. cit.*
- ³⁴ ROBBINS, L. (1981). Economics and Political Economy. *American Economic Review* **71**, 1 – 10.
- ³⁵ BLAUG, M. (1992). *The Methodology of Economics, or How Economists Explain*. Cambridge: Cambridge University Press.
- ³⁶ WEBER, M. (1949). *The Methodology of the Social Sciences*, translated and edited by Edward A. Shils and H. A. Finch. Glencoe, IL: The Free Press.
- ³⁷ ROBBINS, L. (1935). *Op. cit.*
- ³⁸ HIRSCHMAN, A. O. (1981). *Op. cit.*
- ³⁹ HODGSON, G. M. (1999). *Evolution and Institutions, On Evolutionary Economics and the Evolution of Economics*. Northhampton, MA: Elgar.
- ⁴⁰ MONGIN, P. (2006). *Op. cit.*
- ⁴¹ ROSEN, H. S. (2001). *Public Finance*. Homewood, IL: McGraw-Hill / Irwin.
- ⁴² JOHANSSON, P. (1991). *An Introduction to Modern Welfare Economics*. Cambridge, U.K.: Cambridge University Press.
- ⁴³ RAMSEY, F. (1928). A mathematical theory of saving. *Economic Journal*, **38**, 543 – 559.
- ⁴⁴ DEES, J. G. (1992). Principals, agents, and ethics. In *Ethics and Agency Theory, An Introduction*, N. E. Bowie and R. E. Freeman (eds). New York: Oxford University Press.
- ⁴⁵ JENSEN, M. C. (1983). Organization theory and methodology. *The Accounting Review*, **58**, 319 – 339.
- ⁴⁶ JENSEN, M. C. and MECKLING, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics* **3**: 305 – 360.
- ⁴⁷ FRIEDMAN, M. (1982). *Capitalism and Freedom*. Chicago: University of Chicago Press.
- ⁴⁸ DEES, J. G. (1992). *Op. cit.*

-
- ⁴⁹ GHOSHAL, S. (2005). Bad management theories are destroying good management practices. *Academy of Management Learning & Education*, **4**, 75 – 91.
- ⁵⁰ KEYNES, J. M. (1926). The End of Laissez Faire. *Essays in Persuasion*, Volume 9 of *The Collected Writings of John Maynard Keynes*. Cambridge: St. Martin's Press (1972).
- ⁵¹ SOLOW, R. (2005). Sustainability: An Economist's Perspective." In R. Stavins (ed.), *Economics of the Environment*, 5th ed., 503 – 513.
- ⁵² PEARCE, D. W. (1993). *Economic Values and the Natural World*. Cambridge, MA: The MIT Press.
- ⁵³ ARROW, K. (19). Invaluable Goods. *Journal of Economic Literature* **35**: 757 – 765.
- ⁵⁴ SEN, A. (1982). *Op. cit.*
- ⁵⁵ HAUSMAN, D. M. and McPHERSON, M. S. (1996). *Economic Analysis and Moral Philosophy*. Cambridge, U.K.: Cambridge University Press.
- ⁵⁶ VICKERS, D. (1997). *Economics and Ethics, An Introduction to Theory, Institutions, and Policy*. Westport, CT: Praeger.
- ⁵⁷ ALLEN, B. (2000). The future of microeconomic theory. *The Journal of Economic Perspectives*, **14**, 143 – 150.