2001

Theory, Application and the canon: The case of Mill and Jevons

Sandra J. Peart
University of Richmond, speart@richmond.edu

Recommended Citation

Peart, Sandra J. "Theory, Application and the Canon: The Case of Mill and Jevons." *Reflections on the Classical Canon in Economics: Essays in Honor of Samuel Hollander*. Ed. Evelyn L. Forget and Sandra J. Peart. London: Routledge, 2001. 356-77. Print.

19 Theory, application and the canon

The case of Mill and Jevons

Sandra Peart

> Boundary questions, it has been well said, are always perplexing.
> (*Economist* 1882: 845)

Introduction

Whatever disputes remain about the nature and content of the "canon" of economics, it is widely accepted that the boundary of economic science was narrowed throughout the nineteenth century (Winch 1972). This chapter offers a partial explanation for that narrowing in the methodological developments that occurred during the second half of the century. For reasons of practicality in the face of pronounced "multiplicity of cause," John Stuart Mill called, in his 1836 Essay *On the Definition of Political Economy; and on the Method of Investigation Proper to It,* and again in his 1843 *Logic,* for a separate and specialized science of political economy. The problem of multiple cause implied that the science should be substantially deductive in nature. Yet Mill accorded a role to induction, in the establishment of the basic causal framework, and to the process of verifying the accuracy of the theoretical analysis. Revision of the theory in the light of such verification established a key link between theory, and application.

In the 1870s this method was strenuously resisted by the British Historicists, notably John Kells Ingram and T. E. Cliffe Leslie.[1] Contemporary critics of economic method feared that the deductive method, abstracting as it did from the full array of causes that influenced economic phenomena, would lead to unjustifiable neglect of relevant causes. By contrast, Ingram and Leslie called for empirical studies, upon which they envisaged the theory of economics (and the broader sociological study they favored) could be constructed.

William Stanley Jevons's response to the critics of economic method served to narrow the canon while at the same time yielding a place for empirical studies within the discipline. He called for subdivision within economics, along both subject matter and methodological lines (Black 1972, Peart 1996). He defended the substantially deductive method outlined by Mill for economic theory, and then called for "subdivision" of the discipline as a remedy to its "chaotic" state. Historical studies would, consequently, become a specialization within the discipline alongside "empirical," "applied," and "theoretical" studies. As such, the historical and empirical study of economics would not

supplant but would instead complement the theoretical basis for the discipline. Jevons never clearly spelled out the relationships among the separate specializations of economics, yet two features of his calls for subdivision will become clear. First, the role of historical and empirical study is said to be limited to verifying the truth of the theory in widely different settings. Second, an implicit hierarchy was envisaged, in which theory, with its mathematical precision, logical consistency and universally relevant status, is granted an elevated status, above applications.

Such calls for increased subdivision served, perhaps unwittingly, to insulate theory – a theory now said to be universally applicable – from evidence, and to facilitate the development of empirical studies that were not necessarily well linked to theory. For a mechanism was furnished whereby the theory was separated from application, and while the theory was presumed invariant to time and space, variations were presumed to occur in application. Most significantly, what such variation implies for theory is never spelled out. However, if the canon as it is usually defined consists of theoretical principles that are central to the discipline, then questionable, refuted or otherwise doubtful principles can be relegated to subdivisions – to what Jevons called "applied" or "historical" economics – and do not call the canon itself into question.

Mill's case for specialization

The debate on method of the late nineteenth century was intimately linked with that on Ireland, in which Mill was an active participant.[2] The Irish question in fact constituted a catalyst for the issue of whether the axioms of political economy might be considered universally relevant, or of limited temporal and spatial applicability. Mill's proposal for widespread land reform in Ireland and his review essay, *Leslie and the Land Question*, are methodologically revealing. For his position, like that of the historicists, is that institutional and cultural differences in Ireland may render the conclusions of political economy invalid there: Mill was keenly aware of the limited relevance of conclusions developed in the context of the English institutional and cultural arrangements. It is no coincidence that while Jevons rarely objects to Mill's policy recommendations, Ireland constitutes one instance where he finds Mill's position – advocating broad land reform – questionable.[3] Jevons wrote little directly on Ireland. His objections to Mill's reform proposals appear in an 1880 *Contemporary Review* article, "Experimental Legislation and the Drink Traffic," where he argued that Mill's reform proposal was too wide-ranging. In its stead, Jevons favored peasant proprietorship on a small – and presumably voluntary – scale (Jevons 1882: 274). Here, as in his *Theory of Political Economy*, he thus moved ever so slightly towards removing economic analysis from institutional concerns.

Perhaps more than any economist of his time or since, Mill was a synthesizer. However, for reasons of practicality in the face of multiple causation, he called for specialization in the social sciences. The argument for specialization presumed that to discover how humans behave under the influence of all circumstances, one should first isolate causes and study the resulting effects separately. This is precisely the argument that Jevons was later to use. Both also

presumed that the process was generally additive, and thus that the separate effects of causes, once known, could be added to yield a total.

Mill maintained that economists faced great difficulties as a result of the "composition of causes" that characterizes the phenomena they study. Since "every attribute of the social body is influenced by innumerable causes," social phenomena, for Mill, were characterized by a pronounced multiplicity of cause:

> the phenomena of society do not depend, in essentials, on some one agency or law of human nature, with only inconsiderable modifications from others. The whole of the qualities of human nature influence those phenomena, and there is not one, the removal or any great alteration of which would not materially affect the whole aspect of society, and change more or less the sequences of social phenomena generally.
>
> (Mill [1843] 1973, vol. 8: 894)

Recognition of this problem underscores all of Mill's writing on method. Two major implications resulted from this preoccupation. First, in the face of such complexity, Mill argued strongly in favor of a deductive method modeled after physics, that compounds the effects of various causes considered separately:

> The Social Science, therefore (which, by a convenient barbarism, has been termed Sociology), is a deductive science; not, indeed, after the model of geometry, but after that of the more complex physical sciences. It infers the law of each effect from the laws of causation on which that effect depends; not, however, from the law merely of one cause, as in the geometrical method, but by considering all the causes which conjunctly influence the effect, and compounding their laws with one another. Its method, in short, is the Concrete Deductive Method: that of which astronomy furnishes the most perfect, natural philosophy a somewhat less perfect, example, and the employment of which, with the adaptations and precautions required by the subject, is beginning to regenerate physiology.
>
> (Mill [1843] 1973, vol. 8: 895)

Multiplicity of cause implied that induction was insufficient to establish causality: "the causes on which any class of phenomena depend are so imperfectly accessible to our observation that we cannot ascertain, by a proper induction, their numerical laws" (ibid., vol. 7: 620). Because possibilities for experimentation were so limited, and since theoretical specification of effects in the face of pronounced multiple cause was impossible, using the "laws of quantity" to "calculate forward to an effect," (what Jevons would call "inductive quantification"), was inappropriate in social science (ibid., vol. 7: 620–1). (For a demonstration of the difference between Jevons and Mill in this respect, see Peart 1993.) In such instances:

> specific experience affords nothing amounting to empirical laws. This is particularly the case where the object is to determine the effect of any one

> social cause among a great number acting simultaneously; the effect, for example of corn laws, or of a prohibitive commercial system generally.
>
> (Mill [1843] 1973, vol. 8: 908; cf. vol. 4: 332)[4]

Such complications meant that great caution was in order. Yet while limited experimental possibilities rendered it impossible to infer laws of causation through observation, the basic causal structure was accessible through observation and introspection (Mill [1836] 1967, vol. 4: 329; Hausman 1992).

Second, and perhaps more importantly given the theme of this chapter, the complexity of economic phenomena rendered it impossible to specify all the causal factors at work in all cases. Consequently, Mill urged that scientists select the main (or "general") causes in action, and reason based on those selections. This formed the methodological basis for limited specialization within social science:

> By reasoning from that one law of human nature, and from the principal outward circumstances (whether universal or confined to particular states of society) which operate upon the human mind through that law, we may be enabled to explain and predict this portion of the phenomena of society, so far as they depend on that class of circumstances only. . . . A department of science may thus be constructed which has received the name of Political Economy.
>
> (Mill [1843] 1973, vol. 8: 901)

The outcome of such a procedure is "hypothetical," correct only to the extent that no additional causes interfere with it:

> All the general propositions which can be framed by the deductive science, are therefore, in the strictest sense of the word, hypothetical. They are grounded on some suppositious set of circumstances, and declare how some given cause would operate in those circumstances, supposing that no others were combined with them. If the set of circumstances supposed have been copied from those of any existing society, the conclusions will be true of that society, provided, and in as far as, the effect of those circumstances shall not be modified by others which have not been taken into account.
>
> (Mill [1843] 1973, vol. 8: 900)[5]

In his 1836 *Essay*, Mill's language was somewhat stronger in pointing to the hypothetical character of economic reasoning: political economy, he writes there,

> does not treat of the whole of man's nature as modified by the social state, nor of the whole conduct of man in society. It is concerned with him solely as a being who desires to possess wealth, and who is capable of judging of the comparative efficacy of means for obtaining that end. It predicts only such of the phenomena of the social state as take place in consequence of

> the pursuit of wealth. It makes entire abstraction of every other human passion or motive; except those which may be regarded as perpetually antagonizing principles to the desire of wealth, namely, aversion to labour, and desire of the present enjoyment of costly indulgences.
>
> (Mill [1836] 1967, vol. 4: 321)

Thus, in this context Mill argued that one abstracts from the multitude of desires and motivations that prompt a being to act in a social context, and reasons based on the premise that economic actions are mainly influenced by self-interest.[6]

Recognition of the inadequate causal basis of analysis necessarily meant that such reasoning was based on an explicitly-recognized incomplete set of causes: economists' deductive conclusions were derived from a set of causes that abstracted from, (or held constant), additional causes known to affect the phenomena in question. The resulting reasoning would therefore provide an adequate representation of reality only if all of the general causes influencing the phenomena have been taken into account by the theorist (ibid.: 329; see Hausman 1992). Even in these circumstances, however, partial or disturbing causes were bound also to influence the phenomena on occasion, so that the conclusions of the theory were never borne out completely by observation. As a consequence of this recognition, Mill insisted on an additional methodological step, of verification. The deductive conclusions of political economy, he urged, were to be checked constantly against specific experience. The importance of combining the a priori method with verification increased as the "composition of causes" became more pronounced; "[a]t every step," Mill urged scientists

> to assure ourselves that no other law of nature has superseded, or intermingled its operation with, those which are the premises of the reasoning; and how can this be done by merely looking at the words? We must not only be constantly thinking of the phenomena themselves, but we must be constantly studying them; making ourselves acquainted with the peculiarities of every case to which we attempt to apply our general principles.
>
> (Mill [1843] 1973, vol. 7: 710)

Verification was the means to assessing the effects of "partial" or "disturbing" causes, which, once determined, might be added to or subtracted from the effects of general causes (Mill [1836] 1967, vol. 4: 330). Disturbing causes (which "have their laws, as the causes which are thereby disturbed have theirs") might be "brought within the pale of the abstract science if it were worthwhile" (ibid.: 331), "inserting among its hypotheses a fresh and still more complex combination of circumstances, and so adding *pro hâc vice* a supplementary chapter or appendix, or at least a supplementary theory, to the abstract science" (ibid.). However the role of verification was not limited to this; it might also reveal

> errors in thought, still more serious than what can with any propriety be termed a disturbing cause. It often reveals to us that the basis itself of our

> whole argument is insufficient; that the data, from which we had reasoned, comprise only a part, and not always the most important part, of the circumstances by which the result is really determined.
>
> (Mill [1836] 1967, vol. 4: 332)

Two types of revisions of the theory thus result from the process of verification. A set of general causes, A, B, and C is used to predict the outcome E. E* is observed, leading the scientist to revise the causal framework by adding D to the model. Alternatively, the procedure of verification might reveal that the axioms have been inferred from an incomplete set of circumstances. In this instance observation of E* leads the scientist to revise A, B and C to A*, B* and C* (Peart 1993). Mill never clarified, however, how one is to distinguish between these two problems.

A key consequence of the recognized inadequacy of the reasoning was the limited predictive capacity of the science:

> Sociology, considered as a system of deductions *a priori*, can not be a science of positive predictions, but only of tendencies. We may be able to conclude, from the laws of human nature applied to the circumstances of a given state of society, that a particular cause will operate in a certain manner unless counteracted; but we can never be assured to what extent or amount it will so operate, or affirm with certainty that it will not be counteracted; because we can seldom know, even approximately, all the agencies which may co-exist with it, and still less calculate the collective result of so many combined elements.
>
> (Mill [1843] 1973, vol. 8: 898)[7]

The conclusions of political economy were consequently of limited relevance, either because they were true only to the extent that additional causes did not interfere with those specified in the reasoning, or because additional causes whose effects were presumed constant had in fact varied.[8]

The significance of Mill's emphasis on verification for the theory–practice distinction (and the nature and flexibility of the canon of economics), is that it provides a loosely-defined but nonetheless significant mechanism whereby the basic causal structure can be modified, as a result of close empirical scrutiny, in order better to describe "real world" phenomena. One telling instance of such modification involves the basic self-interest motivation.[9] Here Mill altered the theoretical model in order to incorporate the influence of "custom." The analysis entails an attempt to account theoretically for observations of contemporary market structures. It is a matter of circumstance how custom is to be classified; in some instances the influence of custom is so strong and pervasive that it must be treated as the general cause, relegating to competition the role of disturbance:

> hitherto it is only in the great centres of business that retail transactions have been chiefly, or even much, determined, by competition. Elsewhere it rather acts, when it acts at all, as an occasional disturbing influence; the

> habitual regulator is custom, modified from time to time by notions existing in the minds of purchasers and sellers, of some kind of equity or justice.
>
> (Mill [1836] 1967, vol. 4: 243)

Methodological challenges

In the latter half of the century, and especially during the 1870s, several attacks on the nature and scope of Economics were mounted by, among others, J. K. Ingram, and Cliffe Leslie.[10] These attacks focused first and foremost on the relative roles of induction and deduction in economics, and on the legitimacy of studying economic phenomena separately from social phenomena.[11] So successful were they that in 1876 Sir Francis Galton attempted to have economics removed from Section F of the British Association for the Advancement of Science, and the following year the Adam Smith Centennial Dinner of the Political Economy Club broke into an acrimonious discussion of the nature of economics. Following the dinner, the *Pall Mall Gazette* reported that "the natural philosophers have been frightened out of their wits by the ladies who flock to the Section of 'Economic Science and Statistics' and who insist on reading papers and starting discussions which are not only not scientific but which savour of the singular antipathy to science for its own sake common to all the feminine movements of the day" (Jevons 1972–81, vol. 4: 272–3).

Ingram's Presidential Address to Section F (Economic Science and Statistics) of the British Association at the 1878 Dublin meeting consisted of "an exhaustive argument in vindication of the right of Political Economy and Statistics to citizenship in the commonwealth of science" (*The Times*, August 17 1878, p. 10). Relying squarely on the authority of Comte (whose influence on Ingram is very strong), Mill and Spencer, Ingram defended the scientific status of the study of "economic facts." But the question that followed was in what sense economics was scientific. Ingram strongly objected to the method advocated by Mill, which attempted to specify a limited set of causal factors and study them in depth:

> the pretension of the economist to isolate the special phenomena they study, the economic phenomena of society, from all the rest – its material aspect from its intellectual, moral, and political aspects, and to constitute an independent science, dealing with the former alone, to the exclusion of the latter.
>
> (Ingram 1878: 608)

In opposition to that procedure, Ingram urged that the mutual relationship between economics and "the general body of human knowledge" constituted "the most radical and vital" question of economic studies, one on which the future of political economy depended (ibid.).[12]

Ingram reiterated these arguments in his popular textbook, *History of Political Economy*: "Economics must be constantly regarded as forming only one

department of the larger science of Sociology, in vital connection with its other departments, and with the moral synthesis which is the crown of the whole intellectual system" (Ingram [1888] 1967: 296). Social phenomena, he argued there, were not independent one from another as was commonly presumed, but were instead mutually determining. As a result, isolated consideration of one set of causes necessarily neglected key determining influences; most importantly, also, such procedures neglected the "high moral issues" to which, Ingram contended, political economy is "subservient" (ibid.: 297).

Ingram allowed that, for Mill, the method of political economy entailed a key role for verification. Yet Mill is said to "halt" between the correct method of the scientific study of sociological phenomena – the method revealed to him by Comte – *a posteriori*, and the deductive method of "his youth" (Ingram [1888] 1967: 150). Ingram was consequently critical of Mill's reliance on abstraction: Mill's hypothetical "economic man" comes in for particularly harsh criticism as an unrealistic and thus unscientific construct (ibid.: 151–2). Cairnes receives harsh criticism as well; his logical method of political economy is said to constitute "a retrogression in methodology" because, unlike Mill, Cairnes concludes that verification is unnecessary in political economy (ibid.: 150–1). Ingram attributes the "larger and more philosophical spirit in which Mill dealt with social subjects" to the influence of Comte (ibid.: 146).

In a series of articles written in the 1870s, the Irish political economist, Cliffe Leslie similarly challenged the claim to distinctness by political economy, and argued in favor of developing a historical method:

> The truth is, that the whole economy of every nation, as regards the occupations and pursuits of both sexes, the nature, amount, distribution and consumption of wealth, is the result of a long evolution in which there has been both continuity and change, and of which the economical side is only a particular aspect or phase. And the laws of which it is the result must be sought in history and the general laws of society and social evolution.
>
> (Leslie 1876: 227)[15]

Little had been accomplished, however, in the discovery of such laws of evolution, and Leslie warned that such important work would soon be taken over by sociologists, if political economists continued their neglect (ibid.: 241). He blamed political economists – and particularly the formalization of economic theory – for such lack of progress: "The bane of political economy has been the haste of its students to possess themselves of a complete and symmetrical system, solving all the problems before it with mathematical certainty and exactness" (ibid.: 241).

Leslie's criticism focused on what he regarded as overly abstract methods used by political economists. He allowed that Mill possessed some historical sensibilities, but argued that Mill's training in the Ricardian school and methods caused him to neglect or suppress such sensibilities (ibid.: 221). Consequently, Millian-style analysis overly simplified the causal structure underlying economic phenomena:

> The real defect of the treatment by economists of these other principles is, that it is superficial and unphilosophical; that no attempt has been made even to enumerate them adequately, much less to measure their relative force in different states of society; and that they are employed simply to prop up rude generalizations for which the authority of 'laws' is claimed. They serve, along with other conditions, to give some sort of support to saving clauses, – such as 'allowing for differences in the nature of different employments,' 'caeteris paribus,' 'in the absence of disturbing causes,' 'making allowance for friction' – by which the 'law' that wages and profits tend to equality eludes scrutiny. Had the actual operation of the motives in question been investigated, it would have been seen to vary widely in different states of society, and under different conditions.
>
> (Leslie 1876: 226)

In opposition to Mill (and, as we will see later, to Jevons) Leslie tended to focus on just those causes the economists downplayed:

> Had Mr. Mill looked to actual life, he must have at once perceived that among the strongest desires confounded in the abstract 'desire for wealth,' are desires for the present enjoyment of luxuries; and that the aversion to labour itself has been one of the principal causes of inventions and improvements which abridge it.
>
> (Leslie 1876: 225)

In fairness to both Leslie and Mill, however, one might note that Leslie's criticisms were generally aimed not so much at Mill as at the simplistic and narrow so-called "followers" of classical economists' methods. In particular, politicians who based poorly designed policy measures loosely on arguments of classical economists, come in for harsh criticism.

Like Ingram, Leslie was also critical of calls for the development of a separate science of political economy. He allowed that the science might select a "special class of social phenomena for special investigation," but he insisted that it must nonetheless "investigate all the forces and laws by which they are governed" (Leslie 1879a: 404).

Leslie also objected to any claim that the maximization axiom was universally relevant:

> Mr. Jevons, though favourably disposed by philosophical culture and tastes towards historical investigation in economics, has urged on behalf of deduction from the acquisitive principle, that even the lower animals act from a similar motive.
>
> (Leslie 1879a: 389)

While the limited capacity of the human mind rendered the pragmatic separate study of economic phenomena a necessary evil, Leslie cautioned against paying insufficient attention to "all the causes" affecting such phenomena. Thus, he argued,

> it is legitimate to make economic phenomena, the division of labour, the nature, amount, and distribution of national riches, the subject of particular examination; provided that all the causes affecting them be taken into account. To isolate a single force, even if a real force and not a mere abstraction, and to call deductions from it alone the laws of wealth, can lead only to error, and is radically unscientific
>
> (Leslie 1879a: 404)

The problem was all the more serious because economists "more often still have jumped to the laws without heed to the phenomena" (ibid.: 378).

In contrast to the substantially deductive method of political economists, Leslie urged that a combination of methods be used in economics.[13] Specifically, he advocated the "formal incorporation of economic science with statistics," a combination which would tend to correct the tendency of one-sided reliance on theory on the part of economists, and on facts, on the part of statisticians (Leslie 1873a: 377; cf. 378).

In a telling indictment of the state of political economy late in the decade, the Oxford professor Bonamy Price questioned the limited achievements of the discipline as well as its very scientific nature (Price 1879: 182).[14] Price objected to the treatment of political economy as an exact science, a treatment encouraged by Ricardo (though Price suggested that Ricardo did not actually regard economics as an exact science) and, to some extent, J. S. Mill (ibid.: 198). In the case of Mill, however, Price argued that

> His whole temper and disposition rendered him incapable of being restrained by bounds inapplicable to the subject, even when they had been prescribed by himself. Consequently, throughout his whole work, he boldly deserts, whenever it suits him, the endeavour to write scientifically; and the best parts of his work are when he does so
>
> (Price 1879: 198)[15]

It is, in fact, this attention to detail as well as the fuzzy boundary to the subject matter that Price admired in Mill, and the lack of which he objected to in Jevons (ibid.: 200–1).

Jevons's response to the challenge

Jevons's defense of economics in the face of such challenges was spelled out in an 1876 lecture delivered at University College, "The Future of Political Economy," as well as the 1879 'Preface' and 'Introduction' to his *Theory of Political Economy*. Having recognized in the lecture that "the state of the science" was "almost chaotic" (Jevons [1905] 1965: 191), his response to the critics was two-sided. First, Jevons called for further subdivision within the discipline, now in fact proceeding a step beyond Mill, advocating a permanent separation of economic from sociological studies, and subdivided "historical," "empirical," "theoretical," and "concrete," or applied, studies within economics. For the theoretical study of economics, Jevons's methodological

recommendation was very much in line with that of Mill. Where he differed from Mill was in his insistence on further specialization within the discipline.

In addition, and somewhat paradoxically, Jevons also favored the use of statistical methods in economics, and he conducted some pioneering statistical studies himself. Not surprisingly, this won him some support from the dissenters above, most notably Cliffe Leslie. Leslie remained troubled, however, by Jevons's inattention to the full potential array of causal factors influencing the specific phenomena under investigation.

In his 1876 lecture, Jevons recognized the "absolutely essential" nature of the type of historically based empirical study advocated by Leslie (Jevons [1905] 1965: 196). Yet he held fast, in opposition to Leslie and other Historicists, to the argument that historical studies would neither "destroy" nor "replace" "abstract theory." He opposed the historicists' argument outlined earlier concerning the limited relevance of the conclusions of political economy, arguing instead that the laws of political economy – including the "most fundamental" law "that human wants are limited in extent" – "are so simple in their foundation that they would apply, more or less completely, to all human beings of whom we have any knowledge" (ibid.: 196). Jevons concluded, "They seem to be in a very rudimentary state among the Eskimo. . . . Nevertheless we can trace in [the] transaction of the borrowed boat the simple principles which are at the basis of economy" (ibid.: 196), and he speculated that "I should not despair of tracing the action of the postulates of political economy among some of the more intelligent classes of animals. Dogs certainly have strong though perhaps limited ideas of property" (ibid.: 197).

As a consequence of his conviction that "the first principles of political economy are so widely true and applicable that they may be considered universally true as regards human nature," Jevons argued that the role of historical political economy would necessarily be limited to "exhibiting" and "verifying" the "long-continued action of its laws in most widely different states of society" (ibid.: 197).[16] In sharp contrast with the historicists, then, Jevons carved a specialization within economics (theory) in which individual – rather than social – phenomena were placed squarely at the centre of the analysis.[17]

However, Jevons allowed that Leslie's calls for historical studies of economic phenomena should not go unheeded. He called for subdivision within the discipline, and argued that historical studies should constitute one of the subdivisions within the discipline. "The fact is," Jevons maintained, "it will no longer be possible to treat political economy as if it were a single undivided and indivisible science."[18] He enumerated several ways in which such subdivision should occur – along both the lines of subject matter, as well as methods. Thus, he argued first:

> There is, firstly, the old distinction of the laws of the science, according as they treat of the production, exchange, distribution, or consumption of wealth. In this respect economy may be regarded as an aggregate of two or more different sciences, there being, in fact, little connection between the principles which should guide us in production and those which apply in distribution or consumption.
>
> (Jevons [1905] 1965: 197–8)

In addition, a division should occur according to whether the subject matter were theoretical, or applied.[19] Here, Jevons insisted again on the "generality" of the theoretical laws, while allowing that variation might occur in the "concrete" applications:

> Passing now to a second aspect, political economy will naturally be divided according as it is abstract or concrete. The theory of the science consists of those general laws which are so simple in nature, and so deeply grounded in the constitution of man and the outer world, that they remain the same throughout all those ages which are within our consideration. But though the laws are the same they may receive widely different applications in the concrete. The primary laws of motion are the same, whether they be applied to solids, liquids, or gases, though the phenomena obeying those laws are apparently so different. Just as there is a general science of mechanics, so we must have a general science or theory of economy.
>
> (Jevons [1905] 1965: 198)

But Jevons went farther. He called next for subdivisions of "concrete political economy" along the lines of newly constituted subject matter:

> Concrete political economy, however, can hardly be called one science, but already consists of many extensive branches of inquiry. Currency, banking, the relations of labour and capital, those of landlord and tenant, pauperism, taxation, and finance, are some of the principal portions of applied political economy, all involving the same ultimate laws manifested in most different circumstances. In a subject of such appalling extent and complexity as currency, for instance, we depend upon the laws of supply and demand, of consumption and production of commodities as applied to the precious metals or other materials of money. In the science of banking and the money market we have a very difficult application of the same laws to capital in general. This separation of the concrete branches of the science is, however, sufficiently obvious and recognised, and I need not dwell further on it. The general conclusion, then, to which I come is that political economy must for the future be looked upon as an aggregate of sciences.
>
> (Jevons [1905] 1965: 200; cf. 206)[20]

In the future, and in contrast with Mill, Jevons envisaged the growth but not the synthesis of such sciences (ibid.: 206). As Steedman has argued in a different context, the theory/practice distinction does not in and of itself imply preeminence of the logical core over application (Steedman 1998: 17). It does seem, however, that in Jevons's mind there was a presumed hierarchy, theory, with its generality and logical consistency, being regarded as superior to "application."

Jevons's *Theory of Political Economy* contained his other major strong plea for subdivision. In this context he alluded to the "remarkable discussion [that] has been lately going on in the reviews and journals concerning the logical method

of the science, touching even the question whether there exists any such science at all" (Jevons [1871] 1911: xv). He recognized "a spirit of very active criticism," especially in Leslie's *Hermathena* article, which attempted to "to dissipate altogether the deductive science of Ricardo" (ibid.: xvi).[21] Again he urged that the "present chaotic state of Economics arises from the confusing together of several branches of knowledge" (ibid.: xvi–vii), a problem to be remedied by subdivision:

> Subdivision is the remedy. We must distinguish the empirical element from the abstract theory, from the applied theory, and from the more detailed art of finance and administration. Thus will arise various sciences, such as commercial statistics, the mathematical theory of economics, systematic and descriptive economics, economic sociology, and fiscal science. There may even be a kind of cross subdivision of the sciences; that is to say, there will be division into branches as regards the subject, and division according to the manner of treating the branch of the subject. The manner may be theoretical, empirical, historical, or practical; the subject may be capital and labour, currency, banking, taxation, land tenure, etc. – not to speak of the more fundamental division of the science as it treats of consumption, production, exchange, and distribution of wealth. In fact, the whole subject is so extensive, intricate, and diverse, that it is absurd to suppose it can be treated in any single book or in any single manner. It is no more one science than statistics, dynamics, the theory of heat, optics, magnetoelectricity, telegraphy, navigation, and photographic chemistry are one science.
>
> (Jevons [1871] 1911: xvii)

Jevons reiterated the case for the universal status of theory:

> But as all the physical sciences have their basis more or less obviously in the general principles of mechanics, so all branches and divisions of economic science must be pervaded by certain general principles. It is to the investigation of such principles – to the tracing out of the mechanics of self-interest and utility – that this essay has been devoted".
>
> (Jevons [1871] 1911: xvii–xviii)

The theory of political economy, the "logical method" propounded here by Jevons – in opposition to the calls for increased inductive content put forth by Leslie and others – was that advocated by Mill (as well as Cairnes):

> [Mill] considers that we may start from some obvious psychological law, as for instance, that a greater gain is preferred to a smaller one, and we may then reason downwards, and predict the phenomena which will be produced in society by such a law. The causes in action in any community are, indeed, so complicated that we shall seldom be able to discover the undisturbed effects of any one law, but, so far as we can analyse the statistical phenomena observed, we obtain a verification of our reasoning.
>
> (Jevons [1871] 1911: 16–17)

In contrast with Mill, Jevons called this the "Complete Method," as "implying that it combines observation, deduction, and induction in the most complete and perfect way . . . induction itself in its essential form":

> Possessing certain facts of observation, we frame an hypothesis as to the laws governing those facts; we reason from the hypothesis deductively to the results to be expected; and we then examine these results in connection with the facts in question; coincidence confirms the whole reasoning; conflict obliges us either to seek for disturbing causes, or else to abandon our hypothesis.
>
> (Jevons [1871] 1911: 17–18)

While Jevons concurred with Leslie and Ingram "so far as to allow that historical investigation is of great importance in Social Science," he reiterated his argument that "instead of converting our present science of economics into an historical science, utterly destroying it in the process," he would "perfect and develop" theoretical economics, while "at the same time" erecting "a new branch of social science on an historical foundation" (ibid.: 20).[22]

Jevons's own career very much followed the prescription for subdivision. While he refrained from complementing his theoretical treatment with empirical methods in the *Theory*, he called there for the collection of improved economic data on consumption (Jevons [1871] 1911: 10–11). Further, while alluding to the difficulties involved, he called for complementary statistical endeavors in order to invest theory with the "reality and life of fact" (ibid.: 22; cf. 1905: 195). He was, and remains, well known as an applied, as well as a theoretical, economist.[23]

Most importantly, perhaps, Jevons contributed significant empirical studies throughout his career, contributions that were well known and granted at least qualified approbation by Leslie, Ingram, and other economists of his day. In fact, in correspondence with Jevons, Léon Walras remarked that he knew Jevons's reputation as an applied statistician rather than a theorist (May 23 1874; Jevons 1972–81, vol. 4: 45). Jevons's work on the value of gold attracted wide attention in the 1860s and well into this century; as a consequence Irving Fisher concluded that Jevons was the "father of index numbers" (Fisher 1922: 459). Keynes praised Jevons's ability in this regard to "survey his material with the prying eyes and fertile, controlled imagination of the natural scientist" (Keynes 1951: 268). Jevons's attempts to decompose time series into secular and cyclical components also earned him high praise (Mitchell 1928: 384) and the title "founder of econometric method" (Robertson 1951: 247).[24]

In Jevons's "reconstruction" of political economy, he made one important additional step, one that Mill would never sanction and which greatly troubled Leslie. In such applications as the gold studies, Jevons argued that causes other than the gold influx "balanced" in the drawing of a mean, and thus could be neglected at least in 'large enough' samples (Peart 1995). Though he was very much in favor of such empirical studies, Leslie – true to his concerns outlined earlier – criticized the method of averages used by Jevons in the gold studies. In a paper that argued strongly in favor of uniting economics and statistics,

Leslie presented a general criticism of the assumption that, in application, one might ignore omitted causes, or presume they "balance":

> And we have in this matter an illustration of the defective character of that kind of statistical inquiry which confines itself to the collection of a multitude of instances of facts, without reference to causes. It must be allowed that the principles laid down by the illustrious Quetelet rather tend to foster the error to which we advert. He assumed that by enlarging the number of instances, we eliminate chance and arrive at general and stable laws of conditions. But a great number of instances does not give us their law, or justify us in any positive conclusion respecting the future. New conditions, for example, have been acting on prices during the last two years, and mere tables of prices for the last twenty or ten years, confound years in which those causes were in operation with years in which they were not.
>
> (Leslie 1873a: 381)

Thus, Leslie was critical of what he took as Jevons's inadequate attention to the full array of causal factors influencing price data. In opposition to Jevons he stressed that the gold discoveries were not the only cause of the measured price alteration: the method of averages, he contended,

> does not show the real movement of prices or the real depreciation of money; the tables omit some of the chief elements of the cost of living; the prices compared are wholesale prices, while the purchasing power of an income depends on retail prices; and, by ascribing the whole rise of prices to the new gold, this method conceals the material fact that the gold is only one of a plurality of causes lately tending to raise them
>
> (Leslie 1873b: 349)

Leslie questioned Jevons's assumption that "the new gold [constitutes] the sole cause of the rise in prices arrived at, on the ground that the 'average must, in all reasonable probability, represent some single influence acting on all commodities,'" and argued, in opposition to Jevons, "But why not a plurality of influences?" (ibid.: 353). Leslie's own investigation focused on this very "plurality of causes," and how their influences differed across different prices: "The actual situation of matters in England is, then, that a number of causes, of which the new gold is only one, have raised the cost of living" (ibid.: 355).

Conclusions: implications of the calls for subdivision

These were complex disputes, complicated by Irish policy issues, views on Ricardian distribution theory, and gray areas where the major contributors shared common ground. Neither Mill nor Jevons entirely opposed the historically-based treatment of economic phenomena propounded by Ingram and Leslie. The Historicists' sharpest criticisms were often directed at naïve or narrow economic analysis relied upon by politicians who proclaimed economic theory widely transferable (to Ireland, in particular). Still, the foregoing

suggests that economics moved, with Jevons pushing it, a step away from Mill and perhaps two away from the Historicists by the end of the 1870s. Subdivision, with economic theory placed in a position superior to application and few clearly spelled out connections among specialties, reversed the scientific order envisaged by J. K. Ingram and Cliffe Leslie.

It would, of course, be unwise to attribute the development of the economics canon following Jevons's death in 1882, to his contributions to these methodological debates. And it would be simplistic to suggest that Jevons alone is responsible for narrowing the economics canon late in the century, or that the methodology debates occurred without reference to policy issues which were in fact of great significance, especially to Mill, Ingram and Leslie. The Irish question formed a backdrop to these methodological debates throughout the decade, and issues of whether the axioms of political economy were universally relevant or whether economic behavior could be studied in abstraction from the institutional (and, as they often put it) "moral" aspects of the economy, were often framed in terms of the Irish question (Koot 1975).

Certainly also, as outlined earlier, Jevons's own example was by no means narrow.[25] In addition, although there is enough evidence to suggest that Jevons influenced these debates and helped to silence the critics of economics, it would be foolhardy not to recognize two later contributions: by J. M. Keynes, and by Alfred Marshall. But it would be equally foolhardy to neglect, as many have, Jevons's influence on the debate and to conclude that it was Keynes and Marshall alone who caused the demise of Historicism in England.

Whatever the effect of Jevons's methodological recommendations, there is no evidence that he made them strategically, in order to counter the Historicists' influence. Instead, it is much more likely that Jevons called for subdivision because he genuinely believed this was the fruitful methodological approach for the future of his discipline.

It does bear noting, however, that Jevons made something of a virtue of disconnectedness. To some, Jevons's position on the methodology of economics appears rather unfinished. Unlike Mill's *Logic*, there is no section in his 1874 *Principles of Science* on the methodology of social science. Jevons never related the methodological recommendations in the 1876 lecture or the 1879 edition of his *Theory* to his *Principles of Science*. Some have surmised that he might have eventually tried to relate apparently disconnected portions of his work (see the *Guardian*, September 1 1886: 'Review of *Letters and Journal*', p. 1282; Jevons Archive 6/50/20). Others, like Keynes (1951), have concluded that Jevons's best work was finished at the time of his death.

Even beyond the Historicists' concerns, then, there is evidence that Jevons's contemporaries were troubled by his calls for separation of theory and practice, and the resulting disconnected nature of Jevons's work. J. E. Cairnes, for instance, found Jevons's inattention to practice troubling. His distrust of the theory-practice distinction explains, in part, why Cairnes objected to the formalization of economic theory in Jevons:

> When mathematics are carried further than this ["very limited application"] in the moral or social sciences, and used for conducting processes of reasoning, without constant reference to the concrete meaning of the

> terms for which the mathematical symbols are employed, I own I regard the practice with profound distrust.
>
> (Cairnes 1872: 76)

Contemporary summaries of Jevons's achievements also focused on his calls for the separation of theory and practice. Philip Wicksteed's (very favorable) review of the posthumously published *Letters and Journal* suggested that one of Jevons's major achievements lay in his having provided social scientists with the means to separate the historical from the theoretical "with vice-like firmness":

> It would be idle to attempt any exposition here of the precise nature of Jevons's discoveries; but his disciples may claim that he has given them an instrument by which they can hold down any problem of pure economics with vice-like firmness, and submit it to a precise and delicate treatment hitherto undreamed of, that he has provided them with a reagent by which they can *precipitate* the assumptions that pervade, in solution, the works of all the economists, and can separate the theoretical from the historical element in their researches, that he has at last revealed the true nature of "exchange-value" and its relation to "value in use," thereby putting an end to the age-long controversy between England and France and bringing the theory of "supply and demand" out of the clouds, that he has laid the foundations of the true theory of interest, thereby at once confuting the logic and the methods and justifying the aspirations of Mr. Ruskin and the Socialists, and, in a word, that he has made one part of economics actually amenable to the methods of the exact sciences, and has put it beyond the reach of eloquence or ingenuity to make the other parts *appear* to be (as they are not amenable to those methods).
>
> (Wicksteed 1886: 646)

Jevons's calls for subdivision of the discipline provided the means by which the method of Mill could be preserved in the realm of theory, and with the added assertion of universal relevance for the axioms of political economy – extending even to animals! – theory became somewhat more insulated from practice. In contrast with the Historicists, Jevons placed the individual at the heart of economic analysis, and he seems to have elevated universally relevant and logically precise theory to a status above application. Second, Jevons's calls for subdivision allowed for the encouragement of empirical studies as a branch of economic studies, thus garnering at least limited support from the Historicists such as Leslie and Ingram. Within such specialized empirical studies he argued that omitted causes could be presumed to balance, thereby further directing attention away from the process of abstraction underlying the analysis. To this practice, Mill and Leslie both strenuously objected. Finally, as the discipline became more subdivided – and the theory became increasingly regarded as universally applicable – the canon became more narrow, more rigidly defined, and more unassailable.

Notes

A preliminary version of this paper was presented at the Canon Session of the 1999 HES meeting, Greensboro, N.C. I am grateful to David Levy for organizing that session and to Evelyn Forget for encouraging me to write the paper. Jeff Lipkes, Laura Valladādao de Mattos, and Larry Moss provided helpful comments. I am also grateful to Dr Peter McNiven and Dr Peter Noeckles for their assistance and permission to cite material from the Jevons Archives.

1 A leading proponent of the historical school, the Irish political economist Thomas Edward Cliffe Leslie (1825–1882), was Professor of Political Economy and Jurisprudence in Queen's College, Belfast, from 1853 until his death. A second major proponent whose work proved to be of significant popular appeal was John Kells Ingram. Ingram's ([1888] 1967) *History of Political Economy* went through numerous printings and was translated into nine languages.

2 Mill's method has, of course, been widely and carefully studied (see Blaug 1980, DeMarchi 1986, Hausman 1992, Hirsch 1992, Hutchison 1978, Peart 1995). Many investigations have focused on the relative roles of deduction and induction in Mill, with some analysts arguing that his method was "overly" deductive, confident, and irresponsible (Hutchison 1978). It is not my purpose here to repeat this well-known ground. For a recent detailed demonstration of the importance of experience in Mill's method, including several case studies of Mill's practice, see Hollander and Peart 1999.

On Ireland see "What Is To Be Done With Ireland?" (1848) and "England and Ireland"(1869), (in Mill 1982, vol. 6: 496–503, 505–32). See also Mill's sympathetic review of Leslie's essays, "Leslie on the Land Question" (1870); (Mill 1967, vol. 5: 669–702). In "England and Ireland," Mill advocates wide-ranging land tenure reform transforming tenancy to fixed rents (Mill 1982, vol. 6: 527).

3 On the substantial identity between Mill and Jevons on policy issues, see Peart 1990.

4 Jevons also used the example of the corn laws to make the same argument; cf. *Theory of Political Economy* (Jevons [1871] 1911: 18–19).

5 I agree with Hausman that in some passages Mill writes as though he considers economic reasoning to be an abstraction (and thus hypothetical), while he also on occasion refers to economic laws as qualified by *ceteris paribus* conditions (Hausman 1992: 33–53; see DeMarchi 1986).

6 > Not that any political economist was ever so absurd as to suppose that mankind are really thus constituted, but because this is the mode in which science must necessarily proceed. When an effect depends upon a concurrence of causes, those causes must be studied one at a time, and their laws separately investigated, if we wish, through the causes, to obtain the power of either predicting or controlling the effect; since the law of the effect is compounded of the laws of all the causes which determine it.
>
> (Mill [1836] 1967, vol. 4: 322)

7 A tendency is "a power acting with a certain intensity in that direction" (Mill [1836] 1967, vol. 4: 337).

8 In his *Essay*, Mill seems to imply that the issue is abstraction, instead of *ceteris paribus*:

> The conclusions of Political Economy, consequently, like those of geometry, are only true, as the common phrase is, *in the abstract*; that is, they are only true under certain suppositions, in which none but general causes – causes common to the *whole class* of cases under consideration – are taken into account.
>
> (Mill [1836] 1967, vol. 4: 326)

9 For additional evidence of Mill's modifications to theory based on experiential evidence, see Hollander and Peart 1999.

10 For an overview of the historical school, see Hutchison 1953. A detailed review of

Leslie's ideas is contained in Koot 1975. The prominent economic historian, J. E. T. Rogers, is also considered an important influence in the historical school. Since his writings are predominantly non-methodological, and since Jevons's responses are directed at the work of Ingram and Leslie, I confine my attention to them. Walter Bagehot (1826–1877), conservative editor of the *Economist* and author of *Lombard Street*, also figured in debates about the generality of the axioms of political economy. He took the Millian position that the conclusions of political economy were of limited relevance, applicable only to countries with institutional structures similar to those of England at the time (Bagehot 1876). He was, however, well disposed towards Jevons, and wrote a March 10 1866 testimonial in favor of Jevons for the Cobden Professorship at Owens College, praising Jevons's "equal knowledge" of "abstract theory" and "statistics" (*Papers and Correspondence of William Stanley Jevons;* Jevons 1972–81, vol. 3: 114).

It would be a mistake not to recognize much admiration for Jevons – and for Mill – among these dissenters, as revealed by their correspondence as well as published remarks. Leslie considered himself a follower of Mill and theirs is a correspondence that reflects much warmth. See Mill's review of Leslie's essays on Ireland, referred to in note 2. See the letter from Ingram to Jevons dated January 21 1881 (Jevons 1972–81, vol. 5: 124–5), in which Ingram acknowledged with great pleasure Jevons's recognition of his BAAS Address in the second edition of the *Theory*. See also Leslie's warm letter to Jevons of 28 August 1878, alluding to the Address by Ingram (Jevons 1972–81, vol. 4: 272–3).

11 Though some common ground is necessary given the intermixture of the issues in the original debates, this investigation confines itself to the theory/practice debates. For a detailed examination of the separation of economics from social phenomena, see Peart 1999.

12 Ingram's Address received wide press. A detailed summary appeared in *The Times* (August 17, p. 10). A leader on the Address appeared in the *Pall Mall Gazette* (August 22 1878). See Leslie's August 28 letter to Jevons, (Jevons 1972–81, vol. 5: 2–3).

13 The significance of such a combination had been revealed in the study of economic fluctuations:

> A theory of decennial recurrence of commercial crises, for example, was based on the occurrence of crises in 1837, 1847, and 1857. Had the causes of commercial crises been examined, it would have been discovered that they are extremely various and uncertain in their occurrence; that a war, a bad harvest, a drain of the precious metals, anything, in short, which produces a panic, may cause a crisis; and as there is no decennial periodicity in the causes, there can be none in the effects.
>
> (Leslie 1873a: 377)

14 Bonamy Price (1807–1888) succeeded Thorold Rogers as Drummand Professor of Political Economy at Oxford in 1868, a position he held until his death. Price acknowledged but downplayed the significance of achievements by J. E. Cairnes as well as Jevons: "they have remoulded, rather than added to, our economical knowledge, and remoulded it in a way rather tentative than final or satisfactory" (Price 1879: 183).

15 > No one, whether agreeing or not, can fail to feel the force, the energy, the extent of knowledge, which distinguish his chapters on peasant proprietors, on co-operation, on the future of the labouring classes. But from these perfectly natural and practical disquisitions he is perpetually being recalled by the artificial sense that he is writing a scientific work. He elaborates the simplest propositions, and puts them in technical form. Sometimes, after a series of complex and cumbrous reasonings, he emerges on a conclusion perfectly naïve in its simplicity.
>
> (Price 1879: 198)

16 Jevons's comment about first principles is, however, a statement about the average: he allowed that individuals make mistakes, but he believed that such mistakes cancel out over time or over a wide group of consumers. See Peart 1996 and, for the similarity with Menger in this respect, Peart 1998.

"M. de Laveleye and Professor Leslie may succeed in constituting a new science, but they will not utterly revolutionise and destroy the old one in the way they seem to suppose" (Jevons [1905] 1965: 197). The Belgian political economist Emile Louis Victor de Laveleye (1822–1892) was a supporter of the historical school and Professor of Political Economy at Liège, from 1864–92.

17 Maas 1998 maintains that Jevons's abacus helped him conceive of economic man as similar to a machine.

18 In support of his calls for subdivision, Jevons invoked the division of labor principle.

19 > [T]he theory of economy . . . will naturally be one science, remaining the same throughout its applications, though it may be broken up into several parts, the theories of utility, of exchange, of labour, of interest, etc. partly corresponding to the old division of the science into the laws of consumption, exchange, distribution, production, and so forth
>
> (Jevons [1905] 1965: 200)

Jevons insisted, of course, that this "general science" or "theory" of economics, was mathematical. See Schabas 1990.

20 "[T]he political economist is expected to teach all parts of his equally extensive and growing science, and is lucky if he escape having to profess also the mental, metaphysical, and moral sciences generally" (Jevons [1905] 1965: 201).

21 He alluded also in this context to Ingram's BAAS Address, as well as – to a "lesser extent" – the work of Thornton. It is important to bear in mind the theoretical debates that occurred throughout this time, and which are linked to the methodological disputes as well: Ricardian wage and distribution theory was being attacked throughout the decade by Historicists (see Leslie 1879b: 160), and, though along other lines, by Jevons as well.

22 Jevons makes a similar argument in the Lecture:

> Now I am far from thinking that the historical treatment of our science is false or useless. On the contrary, I consider it to be indispensable. The present economical state of society cannot possibly be explained by theory alone. We must take into account the long past out of which we are constantly emerging. Whether we call it sociology or not, we must have some scientific treatment of the principles of evolution as manifested in every branch of social existence. . . . every law, custom, or social fact is the product of the past, historical or forgotten.
>
> (Jevons [1905]1965: 195)

23 See the obituary notice in the Royal Society, signed R. H.:

> Problems in applied economics had for Jevons a peculiar attractiveness, because of their bearing on the material welfare of the community. His devotion to abstract studies did not destroy his interest in the progress of society, or in questions touching the practical life of men. While busied with researches on abstract principles, he always kept a window open to the outer world.
>
> (*Proceedings of the Royal Society* 1883: vii–viii)

24 Not surprisingly, Jevons's calls for the use of statistical studies found support in the Manchester Statistical Society, where, in 1871, then President and influential Manchester banker John Mills recognized Jevons's remarkable gold studies, "a beautiful typical illustration of the use of hypothesis in this class of enquiries, [that] may suffice to show the mode in which theoretical Political Economy and Statistics co-operate and render a reciprocal service" (Mills 1871: 8)

25 The obituary in *Nature* points to Jevons's caution in this regard:

> He was too far-seeing and too judicious to overlook the enormous gulf that separates abstract economics from the domain of practice, and he was under no delusion as to the practicability of applying exact methods to phenomena so immensely complex as those of society
>
> (*Nature* 1882: 420).

References

Bagehot, W. (1876) "The Postulates of English Political Economy," *Fortnightly Review* 21 o.s. (15 n.s.)(1): 215–42.

Black, R. D. C. (1972) "W. S. Jevons and the Foundation of Modern Economics," *History of Political Economy* 4(2): 364–78.

Blaug, M. (1980) *The Methodology of Economics or How Economists Explain*, Cambridge: Cambridge University Press.

Cairnes, J. E. (1872) "New Theories of Political Economy," *Fortnightly Review*, 17 o.s. (11 n.s.)(1): 71–6.

DeMarchi, N. (1986) "Mill's Unrevised Philosophy of Economics: A Comment on Hausman," *Philosophy of Science* 53: 89–100.

Economist (1882) "Review of *The State in Relation to Labour*," 40 (July 8); 845.

Fisher, I. (1922) *The Making of Index Numbers*, Boston: Houghton Mifflin.

Guardian (1886) "*Review of Letters and Journal*," (September 1): 1281–2; Jevons Archive 6/50/20.

Hausman, D. (1992) *The Separate and Inexact Science of Economics*, Cambridge: Cambridge University Press.

Hirsch, A. (1992) "John Stuart Mill on Verification and the Business of Science," *History of Political Economy* 24(2): 843–66.

Hollander, S. and Peart, S. (1999) "John Stuart Mill's Method in Principle and in Practice: A Review of the Evidence," *Journal of the History of Economic Thought* 21(4): 369–98.

Hutchison, T. W. (1953) *Review of Economic Doctrines, 1870–1929*, Oxford: Clarendon.

—— (1978) *On Revolutions and Progress in Economic Knowledge*, Cambridge: Cambridge University Press.

Ingram, J. K. (1878) "Address of the President of Section F of the British Association," *Journal of the Royal Statistical Society* 41 (August): 602–29.

—— [1888] (1967) *History of Political Economy*, New York: A. M. Kelley.

Jevons, W. S. [1871] (1911) *Theory of Political Economy*, 4th edn, ed. H. S. Jevons, London: Macmillan.

—— [1882] (1965) *Methods of Social Reform*, London: A. M. Kelley.

—— [1905] (1965) *The Principles of Economics and Other Papers*, ed.H. Higgs, London: Macmillan.

—— (1972–81) *Papers and Correspondence of William Stanley Jevons*, 7 vols, ed. R. D. Collison Black, London: Macmillan.

Keynes, J. M. (1951) *Essays in Biography*, London: Hart-Davis.

Koot, G. M. (1975) "T. E. Cliffe Leslie, Irish Social Reform, and the Origins of the English Historical School of Economics," *History of Political Economy* 7(3): 312–36.

Leslie, T. E. C. (1873a) "Economic Science and Statistics," *Athenaeum* (September 27) (reprinted in *Essays in Political and Moral Philosophy* (1879), Dublin: Hodges, Foster, and Figgis).

—— (1873b) "Prices in England in 1873," *Fortnightly Review* (June) (reprinted in *Essays in Political and Moral Philosophy* (1879), Dublin: Hodges, Foster, and Figgis: 349–55).

—— (1876) "On the Philosophical Method of Political Economy," *Hermathena* iv

(reprinted in *Essays in Political and Moral Philosophy* (1879), Dublin: Hodges, Foster, and Figgis: 216–42).

—— (1879a) "Political Economy and Sociology," *Fortnightly Review* (February 1) (reprinted in *Essays in Political and Moral Philosophy* (1879), Dublin: Hodges, Foster, and Figgis: 383–411).

—— (1879b) "Untitled Review of the Second Edition of *Theory of Political Economy*," *The Academy* 377 n.s. (July 26) (reprinted in *Papers and Correspondence of William Stanley Jevons* ed. R. D. Collison Black, London: Macmillan, vol. 7: 157–62).

Maas, H. (1998) "Mechanical Rationality: Jevons and the Making of Economic Man," *Research Memoranda in History and Methodology of Economics*, Centre for the Philosophy of Natural and Social Science 98(4).

Mill, J. S. [1836] (1967) "On the Definition of Political Economy; and on the Method of Investigation Proper to It," in vol. 4 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

—— [1843] (1973) *A System of Logic: Ratiocinative and Inductive*, in vols 7–8 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

—— [1848] (1965(*Principles of Political Economy*, in vols 2–3 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

—— [1848] (1982) "What is To Be Done With Ireland?,' in vol. 6 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

—— [1869] (1982) "England and Ireland," in vol. 6 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

—— [1870] (1967) "Leslie and the Land Question," in vol. 5 of *The Collected Works of John Stuart Mill*, ed. J. R. Robson, Toronto: University of Toronto Press.

Mills, J. (1871) "On the Scope and Method of Statistical Enquiry, and on some Questions of the Day," Manchester Statistical Society Inaugural Address, read Nov. 15, *Transactions of the Society* 1871–2.

Mitchell, W. C. (1928) *Business Cycles: The Problem and Its Setting*, New York: NBER.

Nature (1882) "Obituary," August 31, 420–1.

Peart, S. (1990) "W. S. Jevons's Applications of Utilitarian Theory to Economic Policy," *Utilitas* 2(2): 281–306.

—— (1993) "W. S. Jevons's Methodology of Economics: Some Implications of the Procedures for 'Inductive Quantification'," *History of Political Economy* 25(3): 435–60.

—— (1995) "'Disturbing Causes,' 'Noxious Errors,' and the Theory–Practice Distinction in the Economics of J. S. Mill and W. S. Jevons," *Canadian Journal of Economics* 28(4b):1194–211.

—— (1996) *The Economics of William Stanley Jevons*, London: Routledge.

—— (1998) "Jevons and Menger Re-homogenized: Jaffé After 20 Years," *American Journal of Economics and Sociology* 57(3): 307–26.

—— (1999) "Sociology, Economics and the Demise of the Historicist School in Nineteenth Century England," manuscript.

Price, B. (1879) "Is Political Economy a Science?," *Quarterly Review* 147 (January): 182–202.

Robertson, R. (1951) "Jevons and his Precursors," *Econometrica* 19: 229–49.

Royal Society Proceedings (1883) "Obituary," signed R. H.

Schabas, M. (1990) *A World Ruled by Number: William Stanley Jevons and the Rise of Mathematical Economics*, Princeton: Princeton University Press.

Steedman, I. (1998) "Comments in British HET *Newsletter*," 61 (Winter): 17.

The Times (1878) "The British Association," August 17: 10.

Wicksteed, P. H. (1886) "Review of *Letters and Journal*," in *The Inquirer*, October 2: 645–7; Jevons Archive 6/50/22.

Winch, D. (1972) "Marginalism and the Boundaries of Economic Science," *History of Political Economy* 4(2): 325–43.