2007

Counterfeiting Truth: Statistical Reporting on the Basis of Trust

David M. Levy

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

Game Theory and Linguistic Meaning
Ahti-Veikko Pietarinen, editor
Current Research in the Semantics/Pragmatics Interface, Vol. 18

Chapter 3

COUNTERFEITING TRUTH: STATISTICAL REPORTING ON THE BASIS OF TRUST

David M. Levy
George Mason University

Sandra J. Peart
Baldwin-Wallace College

1 INTRODUCTION

Semantics and game theory offer modern approaches to very old problems.[1] David Lewis introduced game theoretic concepts into the study of language in his examination of conventions.[2] In this chapter we study the language of a specific sort of conventions: statistical estimators. Such estimators have the important property of being both well-defined mathematical objects and devices that form the basis of factual claims asserted and, perhaps, believed by rational agents.[3] The convention we analyze allows econometric reporting to proceed on the basis of trust.[4] In

[1]Carnap (1942, pp. v–vi): "Semantical concepts, especially the concept of truth, have been discussed by philosophers since ancient times. But a systematic development with the help of the exact instruments of modern logic has been undertaken only in recent years. ... On the basis of these preliminary analyses, Alfred Tarski (who is now in this country) laid the foundation of a systematical construction." Tarski's work is central to that of Carnap (1942, p. vi) and Quine (1940, p. 4), among others. Luschei (1962) is a full-length attempt that uses manuscript and memory to recover the contributions of Stanislaw Lesniewski.

[2]Barwise & Moss (1996, p. 4): "The philosopher David Lewis uncovered a deep source of circularity in human affairs, described in his famous study of convention (Lewis, 1969). All social institutions, from language to laws to customs about which side of the sidewalk to use, are based on conventions shared by the community in question. But what does it mean for a society to share a convention? Certainly, part of what it means is that those who accept some convention, say, C, behave in a given away. But Lewis also argues that another important part of what makes C a convention is that those who accept C also accept that C is a shared convention."

[3]Lewis (1969, p. 204): "One kind of semantics analyzes truth, analyticity, and the rest in relation to possible interpreted languages, in abstraction from any users thereof. This is the kind of semantics done by Frege, Tarski, and (most of the time) Carnap. ... The other kind of semantics analyzes truth, analyticity, and the rest, in relation to an agent or a population of agents. This is the kind of semantics done by the later Wittgenstein, Grice, Skinner, Quine, Morris, Ziff, and (sometimes) Carnap."

[4]Dewald et al. (1986) first publicly demonstrated how hard it was, even for journal editors, to obtain the data used to obtain published estimates. Without the data it is difficult to reproduce the published results. Are publishing

contrast with Lewis, we shall demonstrate that such a convention is conducive to conflict rather than co-ordination.

Long before game theory and semantics, indeed, long before economics itself, exchange conducted by means of money was linked to language. In the *Republic* (371c) Socrates talks about "money as a token for the purpose of exchange." Economists have long argued that, for money to function as a mechanism of exchange, there must be some assurance—carried by institutions and language—of its quality. Our argument is simple. Supposing money and language are interrelated the way that philosophers and economists often claim they are interrelated, if we do not take money solely on the basis of trust, why do we take claims regarding truth on the basis of trust?

There are two parts of our chapter. First, we review Adam Smith's argument that the evolution of monetary institutions is tied up in the problem of detecting deceitful metal offered in exchange. Smith points to no such comparable institution by which deceitful policy advocacy is detected and severely punished.[5] Yet his recommendation for caution in the evaluation of policy advocacy points to the caution that routinely prevailed in monetary matters before public safeguards evolved to make the metallic content of the medium of exchange transparent and to preserve its quality. Second, we turn to a different sort of deceit, in the reporting of statistical evidence. We apply Smith's insights regarding counterfeit money to the case of incentives for deceit in reporting statistical results. In the production of "truth", there is no evolved institution that compares to the Mint. We summarize our recent work regarding how another institution—competing expert witnesses—might deal with deceitful statistical arguments.

We juxtapose these two broad topics, money and truth telling, to emphasize the common structure they share, that of an institutional framework that relies (rightly or wrongly) on trust carried by language. It is important to emphasize, in addition, that these are part of our larger enterprise. Economists model ordinary people as seeking the private good of happiness. Yet we persist in thinking of *ourselves*, qua economists, as seeking the public good of truth. And we have failed to confront the inconsistency in such a modeling procedure (Peart & Levy, 2005).

2 Adam Smith on Deceit

As economists have only recently re-acquainted themselves with language as an object of study (Rubinstein, 2000), a passage from Smith's *Lectures on Jurisprudence* that links money and language might not come readily to mind:

> The offering of a shilling, which to us appears to have so plain and a simple a meaning, is in reality offering an argument to persuade one to do so and so as it is for his interest. Men always endeavour to persuade others to be of their opinion even when the matter is of no consequence to them... (1978, 352)

If offering money is a form of persuasion wrapped up in the semantic notions of meaning and truth, then what is the semantic counterpart of counterfeiting money?

---

incentives conducive to truth seeking? This is the subject of the issue of *Social Epistemology* for which Feigenbaum & Levy (1993) served as the jumping off point.

[5] In an age in which torture was routine state policy, the penalties inflicted upon the attacks on the monetary basis of the state were noticeable for their savagery. An attack on the sovereign's monetary authority was viewed in much the same light as an attack on the physical body of the sovereign (Kelly, 1981). The juxtaposition of functions of the United States Secret Service—protecting the President and combating counterfeit currency—is a surviving instance of such an identification.

In Chapter 4 of Book I of the *Wealth of Nations* Smith gives a social evolutionary account of the economic institution of money.[6] He explains how metallic commodities came to be used as money. This, however, created a set of problems. First, there is the matter of weight:

> The use of metals in this rude state was attended with two very considerable inconveniencies; first with the trouble of weighing; and, secondly, with that of assaying them. In the precious metals, where a small difference in the quantity makes a great difference in the value, even the business of weighing, with proper exactness, requires at least very accurate weights and scales. The weighing of gold in particular is an operation of some nicety. In the coarser metals, indeed, where a small error would be of little consequence, less accuracy would, no doubt, be necessary. Yet we should find it excessively troublesome, if every time a poor man had occasion either to buy or sell a farthing's worth of goods, he was obliged to weigh the farthing. (I. iv ¶7)

Then there is problem of assaying:

> The operation of assaying is still more difficult, still more tedious, and, unless a part of the metal is fairly melted in the crucible, with proper dissolvents, any conclusion that can be drawn from it, is extremely uncertain. Before the institution of coined money, however, unless they went through this tedious and difficult operation, people must always have been liable to the grossest frauds and impositions, and instead of a pound weight of pure silver, or pure copper, might receive in exchange for their goods, an adulterated composition of the coarsest and cheapest materials, which had, however, in their outward appearance, been made to resemble those metals. (I. iv ¶7)

For each problem, a set of solutions is offered:

> To prevent such abuses, to facilitate exchanges, and thereby to encourage all sorts of industry and commerce, it has been found necessary, in all countries that have made any considerable advances towards improvement, to affix a public stamp upon certain quantities of such particular metals, as were in those countries commonly made use of to purchase goods. Hence the origin of coined money, and of those public offices called mints; institutions exactly of the same nature with those of the aulnagers and stampmasters of woollen and linen cloth. All of them are equally meant to ascertain, by means of a public stamp, the quantity and uniform goodness of those different commodities when brought to market. (I. iv ¶7)

Smith then argues that history can be explained as following an evolutionary pathway:

> The first publick stamps of this kind that were affixed to the current metals, seem in many cases to have been intended to ascertain, what it was both most difficult and most important to ascertain, the goodness or fineness of the metal, and to have resembled the sterling mark which is at present affixed to plate and bars of silver, or the Spanish mark which is sometimes affixed to ingots of gold, and which being struck only upon one side of the piece, and not covering the whole surface, ascertains the fineness, but not the weight of the metal. (I. iv ¶8)
>
> The inconveniency and difficulty of weighing those metals with exactness gave occasion to the institution of coins, of which the stamp, covering entirely both sides of the piece and sometimes the edges too, was supposed to ascertain not only the fineness, but the weight of the metal. Such coins, therefore, were received by tale as at present, without the trouble of weighing. (I. iv ¶9)

[6] F. A. Hayek's defense of evolved institutions, which develops ideas in David Hume, suggests that all evolved conventions are equally useful. This claim, and the response to it, are studied in Peart & Levy (2006). Lewis's construction shares Hayek's Humean roots (1969, p. 3), but it does not make such a claim.

The passages we omitted above, and those which follow, suggest why it took Smith twenty years to complete the *Wealth of Nations*. He has surely forgotten more about the history of coinage than these two readers will ever know. When Smith describes the state policy of debasing coinage as a type of fraud, perhaps his readers recalled the proverbial question—who guards the guardians?

The problem of deceit is critical to what might be considered as Smith's public choice view of state policy. Needless to say, a policy of state-sponsored monopolies is the systematic target of the *Wealth of Nations*. Smith explains this policy is founded upon preventing deceit. This argument appears in the conclusion of Book 1 in which the interests of the different classes of society are contrasted. We start with the workers' employers:

> His employers constitute the third order, that of those who live by profit. It is the stock that is employed for the sake of profit, which puts into motion the greater part of the useful labour of every society. The plans and projects of the employers of stock regulate and direct all the most important operations of labour, and profit is the end proposed by all those plans and projects. But the rate of profit does not, like rent and wages, rise with the prosperity, and fall with the declension of the society. On the contrary, it is naturally low in rich, and high in poor countries, and it is always highest in the countries which are going fastest to ruin. The interest of this third order, therefore, has not the same connection with the general interest of the society as that of the other two. (I. xi ¶264)

Smith appeals to a learning by doing explanation for differential competence:

> Merchants and master manufacturers are, in this order, the two classes of people who commonly employ the largest capitals, and who by their wealth draw to themselves the greatest share of the public consideration. As during their whole lives they are engaged in plans and projects, they have frequently more acuteness of understanding than the greater part of country gentlemen. As their thoughts, however, are commonly exercised rather about the interest of their own particular branch of business, than about that of the society, their judgment, even when given with the greatest candour (which it has not been upon every occasion) is much more to be depended upon with regard to the former of those two objects, than with regard to the latter. Their superiority over the country gentleman is, not so much in their knowledge of the public interest, as in their having a better knowledge of their own interest than he has of his. (I. xi ¶264)

This competence has cash value:

> It is by this superior knowledge of their own interest that they have frequently imposed upon his generosity, and persuaded him to give up both his own interest and that of the public, from a very simple but honest conviction, that their interest, and not his, was the interest of the public. The interest of the dealers, however, in any particular branch of trade or manufactures, is always in some respects different from, and even opposite to, that of the public. To widen the market and to narrow the competition, is always the interest of the dealers. To widen the market may frequently be agreeable enough to the interest of the public; but to narrow the competition must always be against it, and can serve only to enable the dealers, by raising their profits above what they naturally would be, to levy, for their own benefit, an absurd tax upon the rest of their fellow-citizens. (I. xi ¶264)

All of this motivates Smith's advice to his readers. Lacking an institution that serves as the rhetorical equivalent of the public mint, each citizen must weigh and assay arguments made by

policy makers, just as the quality of metals offered in exchange had been judged in barbarous times:[7]

> The proposal of any new law or regulation of commerce which comes from this order, ought always to be listened to with great precaution, and ought never to be adopted till after having been long and carefully examined, not only with the most scrupulous, but with the most suspicious attention. It comes from an order of men, whose interest is never exactly the same with that of the public, who have generally an interest to deceive and even to oppress the public, and who accordingly have, upon many occasions, both deceived and oppressed it. (I. xi ¶264)

The question to which we now turn is whether competition among deceivers is sufficient to solve Smith's problem of deceit in the arena of statistical reporting.

3 What Does the Economist Want?

To model a deceitful philosopher, we need to say what he wants.[8] We represent this issue in terms of our previous work on ethics and estimation (Levy & Peart, 2006). In Figure 1, we present competing preferences over estimates where we model the trade-off between bias and statistical efficiency. We depart from the textbook treatment of the goals of statistical research and allow bias in one direction to be a desired property of an estimate. A researcher may prefer to represent the world one way rather than another. The constraint we imagine follows the simple mechanics of specification search or data mining, where one makes many estimates and picks a favorite (Leamer 1983, Denton 1985). In particular, these constraints, the replication set, result from computing a number of unbiased estimates and mapping out the frontier combination of bias and efficiency (Feigenbaum & Levy, 1996).

We consider two sorts of preferences—one for a public-spirited statistician and one for someone with both public and private wants. The public-spirited statistician is interested only in statistical efficiency, a number without a sign. Either the statistician does not care about the value of the parameter to be estimated or, perhaps he does care, but he is unwilling to give up any amount of statistical efficiency to get a more pleasing estimate. In Figure 1, this possibility is described by indifference curve JJ. For such a statistician the rational estimate is j^*. When positive bias is a good, however, indifference curves take the shape marked by II. Thus the rational estimate, one in which some statistical efficiency is traded away for some gain in bias, is i^*.

The American legal system seems an ideal case to consider such rational choice estimation in a competitive context because the motivation for non-transparencies is all-too-obvious. In this context, the problem is that contending clients hire expert econometricians to press their case before a jury.

Structural equation estimation is a natural test ground for thinking about how the theorists' motivations are affected because the identifying restrictions flow from theoretical insight. It is perhaps not a coincidence that structural equation estimation is also fertile ground to study deceitful estimation because current conventions do not require the researcher to document the consequences of different selections of instrumental variables.

[7]This interpretation of Smith might save him from the wrath of George Stigler for having failed to apply the full-information self-interested model in political discussion (Stigler, 1971).

[8]This section is a largely a summary of the work reported in Levy & Peart (2006) in which we employ the motivational claim of a sympathetic statistician who is influenced by the wants of a client.

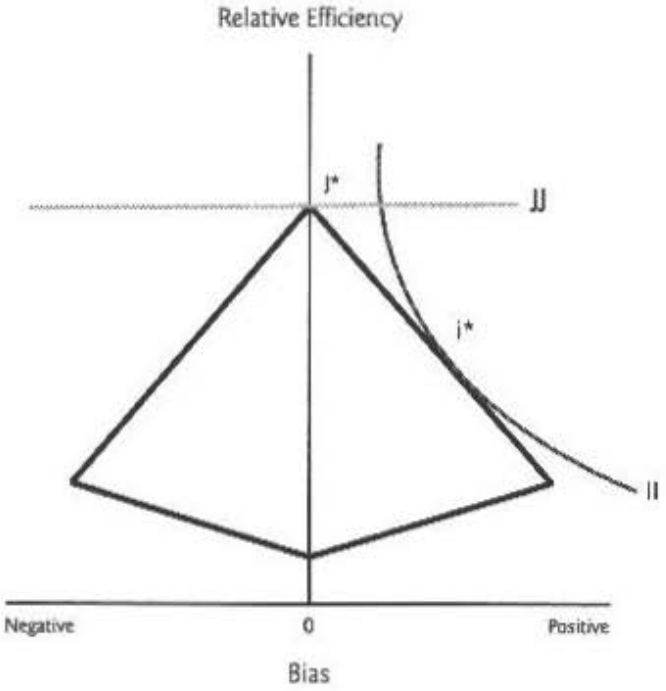

Figure 1: Competing rational estimates

This is the convention which we explore. The regression strategy need not be revealed. We need report only the equation system selected from the search.

Consider a demand and supply system (D & S) of the following structure:[9]

$$\text{Quantity} = \beta_1 + \beta_2\ \text{Price} + \beta_3\ \text{Income} + \eta \qquad (D)$$

$$\text{Price} = \alpha_1 + \alpha_2\ \text{Quantity} + \alpha_3\ \text{Cost} + \alpha_4\ \text{Weather} + \alpha_5\ \text{Politics} + \epsilon \qquad (S)$$

We suppose that the statistician has preferences over the estimated value of β_2. A researcher is required by convention to report only D, mentioning S casually. Thus, one can choose whether to include one, two or three exogenous variables from S. The rational choice estimate is the result of computing all possible combinations which identify a system and then picking. As above, we suppose the client and the sympathetic expert wants both bias and statistical efficiency. We measure the efficiency of estimator i by the minimum mean square error [MSE*] of the estimates considered relative to the MSE of estimator i; thus, MSE^*/MSE_i.

A simulation is provided to give some idea of the ease with which biased estimates can be generated by such a selection procedure. There are several technical details. First, what is the distribution of the exogenous variables? If they are omitted not only do they change the error distribution but also the degree of over-identification, which changes dramatically the property of 2SLS estimates (Phillips, 1983). In the case considered, all exogenous variables are assumed to be a standard normal. Thus, omitting an exogenous variable in search of a pleasing outcome will not change the normality of the resulting errors.

[9]The alphas are all 1; β_1 is 10; β_2 is -1; β_3 is 3.

We consider two types of search. First, there is an unconstrained search for the maximum (minimum) value of the estimates of β_2. In the Tables below this is called "Max" and "Min." Second, there is a search which is constrained by the desire to have at least two exogenous variables in the supply curve. These are called "C-Max" and "C-Min." This will suggest how much the researcher might be willing to give up in efficiency to get bias. 100,000 experiments for N=25, 100, 400, 1600 are performed in *Shazam 8.0* (White, 1997).

All of the simultaneous estimates are replicable "two-stage least squares" estimates or "inefficient two-stage least squares" although only 2SLS and OLS are non-deceitful. The divergence between the "rational choice" estimate and the transparent 2SLS estimate can be thought of as transparency bias. Such bias persists through the case of N=1600.[10]

Table 1: Normal Exogenous Variables
100,000 Replications

	N=25		N=100		N=400		N=1600	
	Bias	Efficiency	Bias	Efficiency	Bias	Efficiency	Bias	Efficiency
OLS	0.40	0.35	0.40	0.08	0.40	0.02	0.40	0.02
2SLS	0.03	1.00	0.01	1.00	0.00	1.00	0.00	1.00
C-Min	-0.21	0.27	-0.09	0.48	-0.04	0.54	-0.02	0.54
C-Max	0.17	0.58	0.08	0.66	0.04	0.63	0.02	0.63
Min	-1.74	0.00	-0.22	0.14	-0.09	0.21	-0.04	0.21
Max	1.87	0.00	0.16	0.32	0.08	0.30	0.04	0.30

While the bias declines in absolute value as N increases, the reduction in bias from increasing N by a factor of four can be held in check by moving from the C-Max (C-Min) to Max (Min). This suggests that the problem of convergence will depend upon how the possible models increase as N increases. The simulation considered only exogenous variables which were truly included in the structure. We leave the problem of identifying the system by employing random numbers for future research. The problem of "pseudo-identification" raises theoretical questions that emerged at the dawn of simultaneous equation estimation and seem to have re-appeared in a new guise.[11]

The literature on the economics of expert witnesses has supposed that the jury decision will be made on the basis of an average of such biased estimates. This average is what the jury believes to be true. The conclusion of Froeb & Kobayashi (1996) for the case of biased experts before a jury, is that the average of their estimates will be unbiased.[12] And, it will be obvious

[10]Judging from 10,000 experiments the bias persists through N=6400. If the bias were measured in terms of the median of the estimates instead of the mean, it too would persist. The experiments were repeated with all exogenous variables following a uniform distribution between 0 and 1. Since it is not surprising that the amount of the bias is acutely sensitive to the distribution of the omitted exogenous variables, these results are not reported.

[11]We have benefitted from a conversation with Arthur Goldberger about the concerns of the Cowles Commission on pseudo-identification of structural equation estimates and with Adolf Buse on the modern discussion of weak-identification.

[12]In this, they are followed by Posner who contends that this property of a competitive procedure makes the idea of a court-appointed expert witness unwarranted: "The use of a court-appointed expert is problematic when (for example, in the damages phase of the case) the expert witness's bottom line is a number. For then, in the case of opposing witnesses, the trier of fact can 'split the difference,' after weighting each witness's estimate by its plausibility" (Posner, 1999, p. 1539).

from the tables above that, roughly speaking, the policy determined by the average of Min and Max or by the average of C-Min and C-Max will be unbiased.

However, this policy will have a higher variance than a policy determined by both using 2SLS. Thus, we create the familiar prisoner's dilemma in statistical context. While it is in the interest of each statistician considered separately to engage in selective under-reporting of results, it is in the interest of the statisticians considered as a group not to under-report. This is shown by the result that the diagonal element is roughly unbiased but the cell where both statisticians engage in "bias seeking" behavior has lower statistical efficiency than when they restrain themselves.

As an illustration of the point, a simulation of a quarter million replications was conducted to generate the statistician's dilemma using the case of normal exogenous variables with N=400. Here bias is computed in terms of deviation from the 2SLS estimate so as to represent the transparency bias. The efficiency is now the mean square error relative to the minimum where bias is measured in terms of deviation from the mean 2SLS estimate.

Table 2: Econometrician's Dilemma
Normal Exogenous Variables, N=400
250,000 Replications

	2SLS		C-Min		Min	
	Bias	Efficiency	Bias	Efficiency	Bias	Efficiency
2SLS	0.00	1.00	-0.02	0.81	-0.05	0.50
C-Max	0.02	0.88	0.00	0.97	-0.03	0.73
Max	0.04	0.64	0.02	0.92	-0.01	0.86

The optimistic conclusion of Froeb & Kobayashi (1996), followed by Posner (1999), depends upon their exclusive focus on the problem of bias. But if variance is also an issue, because one worries about the efficiency of the process, then their optimism about the unrestricted competitive process of expert witness seems more complicated than they suggest. A rule which constrains experts to report only 2SLS results would have a smaller variance than the competitive process modeled above.

4 Conclusion

Even under the idealized conditions described above, competition generates the obvious problem of a prisoners' dilemma. This results from a convention which, contrary to those modeled in Lewis (1969), forms the basis of conflict rather than co-ordination. The result suggests that it should be possible to propose a pareto superior convention. We offer one such, a computationally-intensive version of final-offer arbitration, in Levy & Peart (2006).

For the larger project at hand, game theory and semantics, we have presented a tiny model of an enormous problem. How does the ordinary person deal with advice, carried in language and reporting conventions, from motivated experts? Warts and all, competition provides one answer. Yet the harder problems emerge when the incentives of experts are so asymmetric that there is no viable competition at a level of statistical detail. Our study of the eugenic episode in statistics and economics (Peart & Levy, 2005) finds very little competitive opposition to this ghastly "scientific" development.

One promising approach to deal with the rational choice of statistical deceit comes out of biomedical research, in which clinical trials are quite literally matters of life and death (Berger et al., 2006). The authors suggest that experts, who are sympathetic to patients being victimized by the advice flowing from ill-designed clinical statistical procedures, might follow the thought experiment of John Rawls. So, medical experts would imagine themselves behind a veil of ignorance in which their private rational choice considerations are set aside.

> In the context of the research design, the "veil of ignorance" idea would require that researchers agree to construe as optimal only those design methods that all research would willingly assent antecedentially (i.e., before they had looked at a particular set of data.) (Berger et al., 2006)

Our suggestion of statistical arbitration might be one method that passes the deep test proposed by Rawls. If an expert will not pre-commit to a procedure, his clients might well have a good reason to ask why not.

REFERENCES

Barwise, J. and L. Moss (1996). *Vicious Circles: On the Mathematics of Non-Wellfounded Phenomena*. CSLI Publications, Stanford.

Berger, V. W., J. R. Matthews and E. N. Grosch (2006). On improving research methodology in medical studies. *National Cancer Institute Working Paper*.

Carnap, R. (1942). *Introduction to Semantics*. Harvard University Press, Cambridge, Mass.

Denton, F. (1985). Data mining as an industry. *Review of Economics and Statistics*, **57**, 124-127.

Dewald, W. G., J. G. Thursby and R. G. Anderson (1986). Replication in empirical economics: *The Journal of Money, Credit and Banking* Project. *American Economic Review*, **76**, 587-603.

Feigenbaum, S. and D. M. Levy (1993). The market for (ir)reproducible econometrics. *Social Epistemology*, **7**, 215-232.

Feigenbaum, S. and D. M. Levy (1996). The technological obsolescence of scientific fraud. *Rationality and Society*, **8**, 261-276.

Froeb, L. M. and B. H. Kobayashi (1996). Naive, biased, yet Bayesian: can juries interpret selectively produced evidence? *The Journal of Law, Economics and Organization*, **12**, 257-276.

Kelly, G. A. (1981). From Lèse-Majesté to Lèse-Nation: treason in eighteenth-century France. *Journal of the History of Ideas*, **42**, 269-286.

Leamer, E. E. (1983). Let's take the con out of econometrics. *American Economic Review*, **73**, 31-43.

Levy, D. M. and S. J. Peart (2006). Inducing greater transparency: towards the establishment of ethical rules for econometrics. *Eastern Economic Journal*. Forthcoming.

Lewis, D. (1969). *Convention: A Philosophical Study*. Harvard University Press, Cambridge, Mass.

Luschei, E. C. (1962). *The Logical Systems of Lesniewski*. North-Holland, Amsterdam.

Peart, S. J. and D. M. Levy (2005). *The "Vanity of the Philosopher": From Equality to Hierarchy in Post-Classical Economics*. University of Michigan, Ann Arbor.

Peart, S. J. and D. M. Levy (2006). Discussion, construction and evolution: Mill, Buchanan and Hayek on the constitutional order. *Allied Social Sciences Association*, Boston.

Phillips, P. C. B. (1983). Exact small sample theory in the simultaneous equations models. In: *Handbook of Econometrics* (Z. Griliches and M. D. Intriligator, eds.). North-Holland, Amsterdam.

Plato (1937). *The Republic* (P. Shorey, trans.). Loeb Classical Library, Cambridge, Mass.

Quine, W. van O. (1940). *Mathematical Logic* (Revised edition 1951). Harvard University Press, Cambridge, Mass.

Posner, R. A. (1999). An economic approach to legal evidence. *Stanford Law Review*, **51**, 1477-1546.

Rubinstein, A. (2000). *Economics and Language*. Cambridge University Press, Cambridge.

Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations* (E. Cannan, ed., 1904). Methuen and Co., London. http://www.econlib.org/library/Smith/smWN.html

Smith, A. (1978). *Lectures on Jurisprudence* (R. L. Meek, D. D. Raphael and P. G. Stein, eds.). Clarendon Press, Oxford.

Stigler, G. J. (1971). Smith's travels on the ship of state. *The Economist as Preacher, and Other Essays* (G. J. Stigler, 1982). University of Chicago Press, Chicago.

White, K. J. (1997). *Shazam: Econometrics Computer Program (8.0)*. McGraw-Hill, New York.