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Measuring Coase's Influence

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Abstract

This paper considers Ronald Coase's legacy through citation analysis. Our goal, however, is not simply to confirm that Coase is highly cited but to examine other aspects of Coase's influence that can be revealed by citation analysis. For example, we look at the durability of his work, the highly concentrated nature of his influence, his influence in economics as opposed to law and how he has fared in economics textbooks and judicial opinions. We also compare Coase with two groups of scholars: other Nobel Prize winners in economics and highly cited law and economics scholars. We find that Coase is cited frequently in both law and economics, compared with peer scholars in both fields. Although his influence is highly concentrated, he is nevertheless among the most cited scholars in all three fields. His ideas are also widely referenced in judicial opinions and textbooks, which is further evidence of the lasting influence of his work.

1. Introduction

Citations measure a scholar's influence. That Ronald Coase is among the most influential and best-cited economists in the past 50 years is not debatable (Diamond 1989; Hoaas and Madigan 1999; Coase 1996). Two of his articles—"The Nature of the Firm" (1937) and "The Problem of Social Cost" (1960)—are among the most cited articles in both economics and law and continue to be widely cited. And the Coase theorem, first set out in "The Federal Communications Commission" (1959) and later elaborated in "The Problem of Social Cost" has become so much a part of the standard vocabulary of both economics and law that the theorem is often discussed without an accompanying citation. As Coase (1996, pp. 811–12) himself noted, "Of course, once these ideas in my article (to the extent that they come to be seen as correct) become part and parcel of legal

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thought, it will no longer be thought necessary to cite my article. And in consequence, at the stage when the influence of my article may be said to be most profound, the study of citations will cease to reveal it."

This paper considers Coase's legacy through citation analysis. Our goal, however, is not simply to confirm that Coase is highly cited but to examine other aspects of Coase's influence that can be revealed by citation analysis. For example, we look at the durability of his work, the highly concentrated nature of his influence (as evidenced by the fact that his two best-known articles account for more than 70 percent of his citations), his influence in economics as opposed to law and how he has fared in economics textbooks and judicial opinions. We also compare Coase with two groups of scholars: other Nobel Prize winners in economics and highly cited law and economics scholars.

The source for most of our analysis is data from Web of Science, the online version of the Social Sciences Citation Index (SSCI).[1] At present, the SSCI tabulates citation data from articles in more than 2,100 journals in 50 social science disciplines plus relevant items in an additional 3,300 scientific and technical journals.[2] The SSCI covers about 100 law journals (including about 30 or 40 student-edited journals) and 225 economics journals. Each year, some journals are added and others are deleted in line with the SSCI's policy of including those journals that are cited most frequently. Over time, the SSCI has expanded the number of covered journals. However, this change does not create an obvious upward bias over time in citations because when the SSCI adds a journal, it then adds citations contained in all back issues of that journal.

[1] Web of Science includes all of the following databases: the Social Sciences Citation Index (SSCI), the Science Citation Index Expanded (SCIE), the Arts and Humanities Citation Index (AHCI), and two chemistry citation indices and a conference proceedings index that were excluded from our searches. We did not exclude the SCIE or AHCI from our searches because of the potential for Coase and others to be cited in scientific or humanities publications. However, because the largest and primary database searched by Web of Science is the SSCI, we refer to this aggregate database as the SSCI throughout. For a detailed description, see the Appendix.

[2] The SSCI counts citations in two ways: computerized counts calculated by Web of Science and manual counts defined by the researcher. The computerized counts tend to be lower than the manual counts because the computerized process is more selective in counting citations. In addition, the SSCI has two ways of defining what constitutes a citation to a work: in some circumstances it simply counts citing articles, while in others it counts the total number of citations to a work, thus counting multiple citations appearing in the same article as distinct citations. For citations to post-1956 articles (the SSCI's main coverage), we collected computerized counts of the total number of citations. However, for citations to either pre-1956 articles or to books, these computerized counts are not available, so we collected manual counts of citing articles for those materials instead. Last, when citations to post-1956 articles were broken up by subject area, we collected computerized counts of citing articles. The differences between these methods are discussed in detail in the Appendix. Note that, regardless of the search method employed, the SSCI surveys only journals, so citations contained in a book are not counted, but citations to a book in a covered journal will be counted.

Table 1
Social Sciences Citation Index Citations to Coase's Publications, 1935–2008

Publication	1935–68	1969–78	1979–88	1989–98	1999–2008	All Years
"The Nature of the Firm" (1937)	15	90	424	940	1,364	2,833
"The Problem of Social Cost" (1960)	11	227	340	925	1,265	2,768
"Durability and Monopoly" (1972)		6	29	104	149	288
The Firm, the Market and the Law (1988)			4	242	263	509
Other	27	93	152	420	647	1,339
All	53	416	949	2,631	3,688	7,737
Articles published	35	20	14	20	5	94
Books published	4	0	1	2	0	7

2. Citation Analysis

2.1. Coase's Citations

The most striking feature of Table 1 is that citations to Coase's works have continued to grow at a substantial rate in each successive decade even though Coase has published very few works in the past 15 years. No doubt part but not all of this growth is due to the rapid rise in law and economics in law schools since the mid-1970s because, as we shall see, citations to Coase's articles grew as rapidly in economics journals as they did in law journals.[3] Overall, Coase received 469 citations in 1935–78, 949 citations in 1979–88, 2,631 in 1989–98 and 3,688 in 1999–2008—an annual growth rate of 6.8 percent from 1979 to 2008.[4] Equally striking, there is no sign that the trend is slowing down or turning negative. For example, citations to Coase in the last 5 years (we exclude 2009 because the data for the year are incomplete) are greater than those in any other 5-year period—for example, 389 cites per year in 2004–8, 349 per year in 1999–2003, 316 per year in 1994–98, and 210 per year in 1989–93.

It is instructive to compare Coase's citations with those to a few other Nobel Prize winners in economics. In the 1971–85 period, Coase accumulated 942 citations, Paul Samuelson had 4,956 citations, George Stigler had 3,328 citations, Gary Becker had 3,838 citations and Kenneth Arrow had 3,701 citations. By 2009, however, the gap between Coase and the other economics had substantially narrowed. In the period 1986–2008, Coase received 6,644 citations, Arrow had

[3] For a discussion on the growth of law and economics, see Landes and Posner (1993).

[4] We have incomplete data for 2009, so we exclude this year from some but not all of the analysis. We also note that citation counts before 1956 are probably unreliable because the SSCI began counting citations for all then-covered journals in 1956. The citation data available before 1956 come from back issues of journals that the SSCI has added to its coverage since 1956. No systematic effort has been made to completely cover citations before 1956.

7,742, Stigler had 7,464, Samuelson had 7,352 and Becker had 18,416.[5] It is not surprising that Becker has the greatest number of citations in the 1986–2008 period because he has produced, and continues to produce, a substantial number of new and highly cited articles since 1985. What is surprising is the sharp increase in citations to Coase's works (primarily to "The Nature of the Firm" and "The Problem of Social Cost") relative to those of the other Nobel Prize winners. In the 1986–2008 period, Coase's citations are roughly 90 percent of the average number of citations received by Samuelson, Stigler and Arrow, compared with about 25 percent in the 1971–85 period. At the outset, it is worth noting a point Coase mentions in the quotation earlier in the paper. Because Coase's ideas have become so much a part of the economics and the law and economics literature, it is no longer necessary to cite his work when discussing his ideas. However, unlike other innovators in economics whose ideas continue to influence the existing literature but whose names are rarely mentioned, Coase's central contribution will always be known as "the Coase theorem." Stigler refers to this phenomenon as "a substantial illusion in the disappearance of famous ancestors" and illustrates it with "Marshallian concepts as 'the' short run, elasticity of demand, quasi-rents, and external and internal economies, . . . Friedman's concepts of permanent and transitory incomes, and Muth's rational expectations" (Stigler and Friedland 1979, p. 11).

As a rough test of this phenomenon in the field of law and economics, we surveyed the author and subject indices in Posner's (2003) *Economic Analysis of Law*. The author index lists more than 750 names. Only about 40 names (including Coase) have references that cover two or more lines, which partly reflects Posner's judgment about the impact of these authors in the field of law and economics. When we turn to the subject index, there are roughly 2,000 entries but only 12 names. That is, only 12 people in the index are considered to be subjects.[6] Here, names are like trademarks. The name, attached to another word,

[5] These figures include citations to both articles and books, including books that collect previously published articles, such as Coase's (1988) *The Firm, the Market and the Law*. Coase has substantially fewer book citations than do the other economists, in part because he authored three books (in our data set up to 2008), compared with six for Arrow, 13 for Stigler, three for Samuelson (including his *Economics* [1948]) and 13 for Becker. If we count only citations to articles, Coase has more citations than do Stigler, Samuelson and Arrow but not Becker in the 1985–2008 period. None of Coase's books received many citations except for *The Firm, the Market and the Law* (527 citations), which is mainly a collection of previously published articles. In contrast, Samuelson's *Foundations of Economic Analysis* (1947; 2,392 citations) and his introductory economic principles text (1948; 1,870 citations), Stigler's *The Theory of Price* (1946; 906 citations), and Arrow's *Social Choice and Individual Values* (1951; 3,756 citations) are all well cited. Becker's books on discrimination (1957; 1,788 citations) and human capital (1964; 4,413 citations) are also heavily cited. Note that in calculating citations to books, we pool citations to different editions of the same book. Unlike Coase's book, all of the other books have gone through multiple editions, especially Samuelson's textbooks, which are reissued every few years.

[6] Of these 12 people, however, only nine appear in both the author index and the subject index. That is, only nine people are considered to be important both as authors and as subjects. These people are Phillip Areeda, Coase, Learned Hand, John Hicks, Robert Keeton, Merton Miller, Franco Modigliani, Jeffrey O'Connell, and Donald Turner. So, of 750 authors included in the author index, only nine (including Coase) are also considered to be subjects. It is interesting that Robert Giffen,

becomes the most economical way to describe the idea that underlies the author's contribution. Posner includes the following names in the subject index: Coase theorem, Giffen good, Hand formula, Kaldor-Hicks efficiency, Keeton-O'Connell plan (a no-fault insurance plan), Modigliani-Miller thesis, Pareto concept and Areeda-Turner test (a test for predatory pricing).

2.2. Durability and Obsolescence

Figure 1 depicts annual SSCI citations to Coase's works (both articles and books) from 1960 to 2009 and separate data for "The Problem of Social Cost" and "The Nature of the Firm." As we noted earlier, there appears to be no slowdown in Coase's citations (excluding the partial year 2009). Figure 1 also suggests a Nobel Prize effect. Coase was awarded the Nobel Prize in 1991, and his citations nearly doubled in the next 2 years. Two possible explanations for the surge in Coase's citations are that his work was in an area (law and economics) that was rapidly expanding at the time he received his Nobel Prize and, related to this, that many economists were unfamiliar with Coase's papers prior to his Nobel.[7]

We can examine the time path of Coase's citations more rigorously using regression analysis. We estimate the following equation for the period 1960–2008:

$$\ln \text{Cites} = b_0 + b_1 T + b_2 T^2 + b_3 N + u, \tag{1}$$

where ln Cites denotes the logarithm of citations, T equals time (1960 = 1, 1961 = 2, and so forth), T^2 is time squared, N is a Nobel Prize dummy variable (which equals one for the years after the Nobel Prize was awarded and zero otherwise) and u is the residual.

Equation (1) borrows from the human capital literature, which relates the log of earnings to experience, experience squared and other variables. The theory predicts that earnings will increase with experience at a decreasing rate (that is, the coefficient on T is positive and on T^2 is negative), but eventually the negative effects of depreciation tend to dominate, so earnings begin to fall. Citations to a scholar's work should take a similar time path. As a scholar adds to his or her stock of publications (as proxied by T), citations should increase. As scholarly output begins to decline (because of either age or death) and the earlier works depreciate, annual citations are likely to start decreasing. In terms of equation (1), the negative coefficient on T^2 will eventually dominate the positive coefficient on T.[8]

Table 2 presents the regression results for Coase's citations (and our sample

Nicholas Kaldor, and Vilfredo Pareto are considered to be subjects but not authors. Perhaps, as Coase wrote, their ideas have become so central to law and economics that while their ideas remain, they themselves have faded into the background.

[7] We thank Steven Medema for these explanations.

[8] See Landes and Posner (1993) for a detailed discussion of the application of the human capital model to citations.

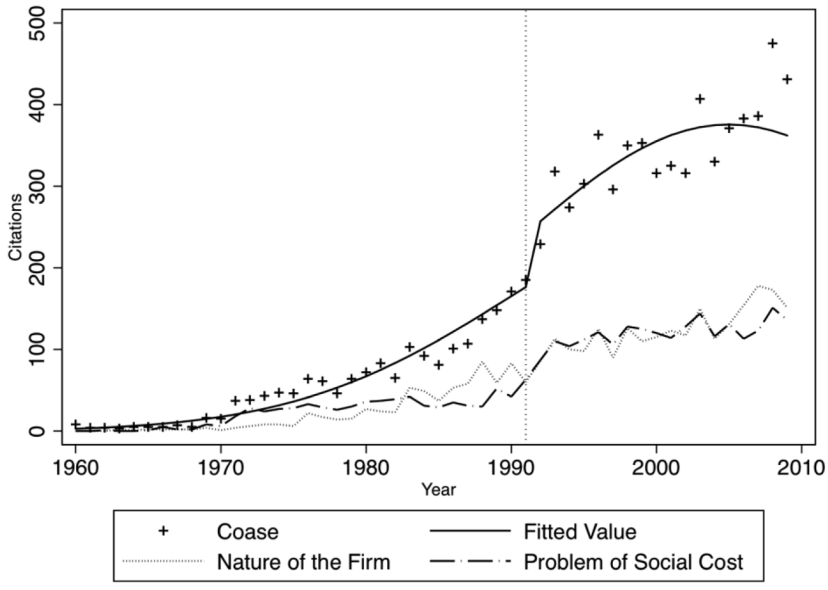

Figure 1. Citations to Coase's publications, 1960–2009

of results for other economists and law professors). All variables in the Coase regression are statistically significant (T and T^2 at the .001 level and N at the .01 level).[9] The coefficients on T and T^2 indicate that the number of Coase's citations increased initially by about 21 percent per year, and that rate has been declining by about 1 percent every 5 years. The regression predicts that citations to Coase would increase from 1960 to 2005, peak in 2005 (see the fitted-value trend line in Figure 1, which plots the predicted value of citations from the regression) and then begin declining. Contrary to the predictions of the regression model, however, Figure 1 shows that the actual values of Coase's citations continued to increase through 2008. Put differently, although the rate of increase of Coase's citations has declined in recent years, there is no evidence of an absolute decline.[10]

Turning to the Nobel Prize variable in the regression, we find a highly significant positive effect on citations equivalent to an increase of about 32 percent in the year following the award of the prize. This jump in citations is also

[9] We estimate all regressions using robust standard errors.

[10] We note an important qualification, although one not likely to apply to Coase. If a scholar continues to produce new works, the older works may depreciate but the total number of citations may continue to increase if citations to the newer works more than offset the depreciation of the older works. Similarly, the publication of new editions of works may slow their rate of depreciation by keeping them current.

Table 2

Regression Analysis of Citations to a Sample of Nobel Prize Winners and Founders of Law and Economics, 1960–2008

	Constant	T	T^2	Nobel	Death	Judge	R^2	N
Coase	.844**	.208***	−.002***	.315***			.96	49
	(3.41)	(11.25)	(7.12)	(3.61)				
Arrow	3.63***	.079**	−.0009*	.553*			.88	49
	(19.36)	(2.86)	(2.05)	(1.98)				
Becker	1.56***	.260***	−.003***	.066			.96	49
	(7.27)	(14.58)	(8.48)	(.36)				
Samuelson	4.22***	.045*	−.0007	.859**			.86	49
	(35.28)	(2.08)	(1.83)	(3.50)				
Stigler	3.19***	.150***	−.002***	−.206**	−.268***		.97	49
	(37.26)	(21.38)	(14.09)	(2.98)	(3.50)			
Calabresi	2.53***	.164***	−.003***			−.213**	.88	39
	(14.88)	(10.36)	(8.98)			(2.73)		
Manne	.926**	.162***	−.003***				.77	44
	(3.31)	(6.85)	(5.80)					
Posner	.421	.527***	−.009***			−1.131*	.91	40
	(.90)	(8.05)	(7.48)			(2.25)		

Note. The ending year in all regressions is 2008, and the starting year is the first year of continuous recorded citations. The term Judge is a dummy variable that takes the value one for Posner starting in 1981 (the year he became an appellate judge) and one for Calabresi starting in 1994 (his first year as a judge). All regressions are estimated using robust standard errors (in parentheses).

* $P < .05$.

** $P < .01$.

*** $P < .001$.

observable in Figure 1, where the vertical line denotes the year after Coase received the Nobel Prize.[11]

2.3. Comparing Coase with Other Nobel Prize Winners

Figure 2 presents data on annual citations for Coase plus four other Nobel Prize winners—three received the prize before Coase (Samuelson in 1970, Arrow in 1972 and Stigler in 1982) and one (Becker in 1992) the year after Coase. Becker is the clear citation leader among the group, although this is probably not a fair comparison because (as we noted earlier) Becker has continued to publish a large number of articles and books in recent years that add to his citation count (which may also draw attention to his earlier works and increase their citations), whereas Coase, Samuelson (who died in 2009) and Stigler (who died in 1991) have produced only a few works in the last 15 years or so. (Arrow is somewhere in between, since he continues to write and publish, but his number of publications per year has declined more steeply in recent years than is the

[11] Since the Nobel Prize in economics is announced in October, our dummy Nobel Prize variable takes the value one in the year following the Nobel Prize.

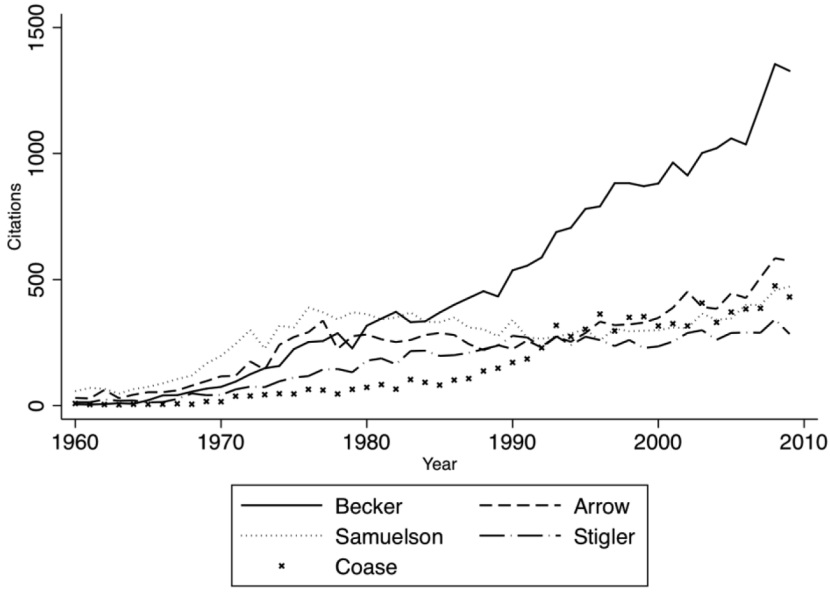

Figure 2. Total citations (articles and books) to works by Nobel Prize–winning economists, 1960–2009.

case for Becker.)[12] The Becker effect is readily observable in Figure 2, where the gap between Becker and the other economists has widened considerably in the last years. As is shown in Figure 2, although citations to the economists have all increased, Coase's citations have increased more rapidly than have those of the other economists (excluding Becker) since the mid-1970s.

Turning to the results of regressions for the other economists in Table 2, we see that the coefficients on T and T^2 are statistically significant (except for T^2 in the Samuelson regression) and in the predicted direction. The other findings include the following:

1. The model predicts a peak citation year of 2005 for Coase, 2004 for Arrow, 2001 for Becker, 1992 for Samuelson and 2002 for Stigler, yet the actual number of citations is greater in 2008 for all economists than it had been in any prior

[12] Becker remains an active member of the University of Chicago Department of Economics and continues to have dissertation students who are likely to cite his works in their publications. This continuing work with students probably contributes to the total of Becker's citations and distinguishes him from Arrow and the other Nobel winners.

year.[13] Stigler has had two peaks. The first occurred in 1990, the year before his death. Mysteriously, his citations fell by 27 percent from 1990 to 1992 (see the regression coefficient on this variable in Table 2). Then his citations began increasing again, and by 2002 the number was slightly greater than it had been in 1991.

2. The rate of increase in citations (the regression coefficient on T) is significantly lower for Arrow and Samuelson than that for Becker, Coase and Stigler. One possible explanation is that Arrow's and Samuelson's work focused on more traditional and highly technical aspects of economic theory. This content led to more immediate acceptance of their work and a substantial number of citations early in their careers. This period was followed by a continued growth in citations that was roughly in step with the overall growth in the economics profession. In contrast, the impact on the profession of Becker, Coase and even Stigler was less immediate. Stigler reinvented the largely dormant field of industrial organization, and his best-known paper on the economics of information was not published until he was 50 years old; Becker applied economics to a wide variety of subjects outside the traditional purview of economics, starting with his book on discrimination in 1957; and Coase had a major impact (after the age of 50) on the modern field of law and economics, which has always been centered at law schools, rather than economics departments. In other words, the work of all three was centered on unconventional topics, which means that it took longer for their contributions to be recognized and cited in mainstream economics articles.[14]

3. Although the Nobel Prize had a statistically significant positive impact on citations for Coase, Arrow, and Samuelson, this is not the case for Becker and Stigler. Moreover, the data in Table 2 indicate a statistically significant negative effect of the Nobel Prize on Stigler's citations. We have no explanation for this finding.

2.4. Coase and Other Founders of Law and Economics

At the inaugural meeting of the American Law and Economics Association in 1990, Coase, Guido Calabresi, Henry Manne and Posner were honored as "founders of law and economics." Figure 3 shows Coase's citations alongside

[13] As we noted earlier, the increase over time in citations is not the result of greater journal coverage, because when the SSCI adds a journal to its database, it adds all previous issues of that journal. Citations to books, however, would increase with an increase in the number of covered journals. We add that book citations declined after 1980 for Arrow, Samuelson and Stigler but increased slightly for Coase and substantially for Becker.

[14] In Diamond's (1989, p. 11) ranking of the most-cited economics articles published in core journals, he finds that Coase is "the citation superstar of the list." However, he continues, "for most of his career [Coase] taught in the law and economics program at the University of Chicago Law School. Coase's work is unusual because it contains almost no mathematics or sophisticated statistical analysis. This may explain why economists seldom mention Coase as a candidate for the Nobel Prize when they speculate on future winners," despite his very high citation counts.

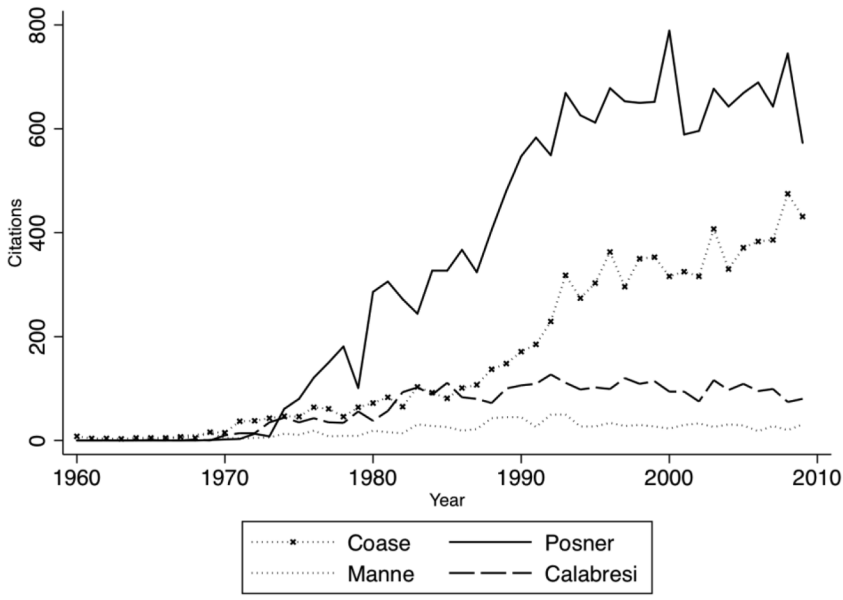

Figure 3. Total citations (articles and books) to works by founders of law and economics, 1965–2009.

those of the other founders.[15] Not surprisingly, Posner is the overall citation winner. Unlike the others in the sample, he continues to produce scholarship at an undiminished rate, and his citations exceed those for any of the economists in our sample. But in terms of durability, Coase is the clear winner: the number of citations to his work continues to increase throughout the entire 1965–2008 period. In contrast, citations to Posner peak in 2000, although they stay at a very high level after that date; citations to Calabresi and Manne peak much earlier, in 1992.

Table 2 also contains regression estimates for Posner, Manne and Calabresi. In all regressions, the coefficients on T and T^2 are statistically significant and in the predicted direction. We can use the coefficients to calculate the predicted peak citation period for each individual—that is, the year in which the negative effect of depreciation just offsets the positive effects of new works or greater impact for existing works. The predicted peaks are 1998 for Calabresi and Posner and 1997 for Manne. We also find that the appointments of Posner (1981) and Calabresi (1994) as federal court of appeals judges had a negative and statistically significant effect on their citations. This outcome is understandable for Calabresi but not for Posner. At the time of Calabresi's appointment to the appellate court

[15] Landes and Posner (1993) also examined the influence of the founders on law.

in 1994, he had been dean of the Yale Law School for 9 years, and the rate of his academic publications had significantly slowed. The result for Posner remains a mystery since his academic and related output did not slow after his appointment as a judge in 1982 (although one might argue that Posner's pathbreaking work occurred prior to 1982, when he helped create the field of law and economics).[16]

3. Further Empirical Results

3.1. The Superstar Phenomenon

In assessing Coase's influence, one is struck by the fact that two early works, "The Nature of the Firm" and "The Problem of Social Cost," account for 86 percent of the total citations to Coase's articles.[17] In comparison, the top two articles account for between 13 percent (Samuelson) and 36 percent (Stigler) for the other Nobel Prize winners (see Table 3). Posner is at the opposite pole from Coase. His top two articles account for less than 12 percent of his article citations (and if one adds his books, the top two articles account for less than 5 percent of his total citations). Calabresi and Manne are closer to Coase in the relative influence of their top two articles. However, it is not entirely clear that they should be included in Table 3 because their aggregate citations are so much lower than those of the other scholars.

One reason that Coase's 1937 and 1960 articles (and older articles in general) receive more citations is that they have more years to accumulate citations than do more recent articles. Even if depreciation is substantial, the worst that can happen to an old article is that it will no longer be cited and its total citations will remain flat. Until that point is reached, the older the article, the more citations it will receive. To test this hypothesis, we estimate the following regression for 39 top-cited articles (the five highest for Arrow, Stigler, Becker, Samuelson, Posner, Calabresi and Manne and the four highest for Coase):

$$\ln \text{Cites}_i = b_0 + b_1 \text{Age}_i + b_j \text{IND}_j + u, \tag{2}$$

where ln Cites is the logarithm of total citations for article i, Age_i is the age of the article (2009 minus the date of publication),[18] IND_j is a set of dummy variables for each of the scholars in the sample and u is the residual. As expected, the regression coefficient of Age is positive (.034) and statistically significant (a t-ratio of 2.87), indicating that the number of citations increases about 3.4 percent

[16] Posner has averaged six and nine publications per year from 1969 to 1980 and from 1981 to 2008, respectively, a statistically significant difference.

[17] That percentage dips to 72 (see Table 1) if citations to Coase's books are included. The most heavily cited book, however, is *The Firm, the Market and the Law* (1988), which mainly reprints articles published earlier, including "The Nature of the Firm" (1937) and "The Problem of Social Cost" (1960).

[18] For articles published before 1960, we set Age equal to 2009 minus 1960 since very few citations were recorded before 1960. That change, however, does not change the regression coefficient on Age.

Table 3
Citations to First, Second and Third Most-Cited Articles, 1960–2009

	First	Second	Third	Total
Coase	3,079	2,909	310	6,954
	(44.2)	(41.8)	(4.4)	
Arrow	1,191	1,042	598	8,497
	(14.0)	(12.3)	(7.0)	
Stigler	1,633	1,514	764	8,680
	(18.8)	(17.4)	(8.8)	
Samuelson	758	467	334	9,792
	(7.7)	(4.8)	(3.4)	
Becker	1,775	1,746	1,060	12,838
	(13.8)	(13.6)	(8.3)	
Posner	476	391	296	7,320
	(6.5)	(5.3)	(4.0)	
Calabresi	802	119	114	1,529
	(52.5)	(7.8)	(7.5)	
Manne	507	57	42	676
	(75.1)	(8.4)	(62.1)	

Note. Robust standard errors are in parentheses.

per year. With respect to the dummy individual variables (the omitted variable was Manne), all the coefficients are positive and statistically significant except for those for Samuelson (a *t*-ratio of 1.94) and Calabresi.

3.2. Influence on Legal Scholarship

Table 4 separates citations to our Nobel Prize winners and the founders by whether the citing journal is an economics journal or a law journal.[19] It is no surprise that the fraction of citations in economics journals is substantially greater for economists than it is for lawyers. Among the economists, Samuelson and Arrow have the greatest fraction of economics journal citations, which, no doubt, reflects the highly formal nature of their work. Coase has the smallest fraction of economics journal cites of all economists, because of his impact on legal scholarship. Notice that Manne has roughly the same fraction of citations in economics journals as in law journals. This similarity is explained because more than 80 percent of Manne's citations are to his single pathbreaking article on insider trading, which has an equal appeal to economists and legal academics.

[19] We divided citations into those to law journals and those to economics journals by restricting our citing articles to articles classified by the SSCI as belonging to either law or economics, business, finance, and/or management. Thus, the citations in Table 4 count a citing article only once. For example, a legal article with two citations to a Coase article will count as one citing article, but in our total citation counts in other tables this will count as two citations. Like citations to books and pre-1956 articles, the number of citations in law or economics are counts of citing articles instead of total citations. However, unlike citations to books and pre-1956 articles, computerized counts are used. In addition, the SSCI can classify an article as belonging to multiple subject areas; for example, articles in the *Journal of Law and Economics* are classified as belonging to law and to economics. So these citations by subject area can (and do) double count some articles that are considered to belong to both subject areas. See the Appendix for a more detailed explanation of these differences.

Table 4
Citations in Law and Economics Journals, 1960–2009

	Total	Law	Economics
Coase	6,213	.28	.72
Arrow	5,152	.05	.95
Becker	7,635	.13	.86
Samuelson	6,936	.03	.97
Stigler	6,666	.16	.84
Calabresi	2,835	.90	.10
Manne	926	.49	.51
Posner	14,305	.80	.20

Note. Totals shown are the sums of citing articles in law and economics journals.

Although Coase's contribution in academic law is greater than that of the other economists (see Table 4), Figure 4 indicates that Coase's influence in economics has been growing relative to that in law over the past 2 decades. For example, the fraction of economics journal citations (economics citations/[economics plus law citations]) increased from an average of .64 in the 1991–2000 period to .74 in the 2001–9 period. Conversely, the fraction of citations in law journals fell from .36 to .26 during this period. Moreover, the increase was even more pronounced in the last 5 years (.80 in the 2005–9 period).[20] One possible reason for the shift is the increasing attention in the economics literature to Coase's (1937) "The Nature of the Firm." But this does not appear to be the case (see Figure 1), since citations to both "The Nature of the Firm" and "The Problem of Social Cost" (1960) have increased at about the same rate over the past 25 years. Another possible reason for the increase is the growth in economics scholarship relative to that in legal scholarship. This also is not the case, however, because the relative number of economics and law journals surveyed by SSCI has been roughly constant over the past 25 years. The most likely explanation for the growth in citations to "The Nature of the Firm" and "The Problem of Social Cost" in the economics literature is that these articles have become the foundations of the new institutional economics that focuses on organization theory and the role of property rights.

No doubt Coase will be greatly pleased by his increasing influence in economics literature relative to that in law. It is no secret that Coase was never a big fan of using economics to analyze legal rules and doctrines. Coase's interest in law was in understanding how the legal system impacts the economic system. Consider Coase's own words on the subject in a letter he sent to William Landes in October 1981:

Now that I'm giving up the editorship (although you have been doing the bulk of the work for some time) I thought I should send you (and Dennis [Carlton]) my very best

[20] The difference between .64 and .74 is significant at the .01 level, and the difference between .65 (the fraction of economics citations in the 1991–2004 period) and .80 is significant at the .001 level.

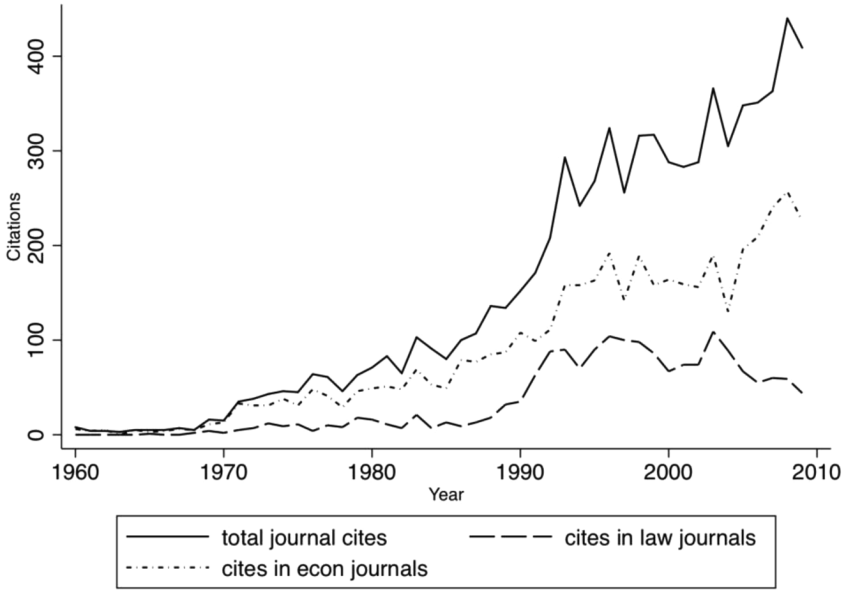

Figure 4. Citations to works by Coase in economics and law journals, 1960–2009

wishes. Editorship of the *Journal of Law and Economics* has always been dear to my heart. I would not have come to Chicago were it not for the *Journal*. I saw it playing an important role in changing the views of economists and in establishing and developing certain types of study. But, of course, my interest has always been in the economics profession—and it was the views of economists not lawyers that I wanted to change. When I said at the California meeting that I was uninterested in legal education, I did not mean that I was uninterested in law but simply that the education of lawyers did not interest me. What I wanted to do in the *Journal* was to make economists see that the legal system had a great influence on the working of the economic system. And in this I feel I succeeded.

3.3. Coase's Influence on the Law

Has Coase's work influenced the development of the law, as opposed to academic law or law and economics? A very rough proxy for measuring this influence is to count citations to his work in judicial opinions. We say "very rough" because citations will substantially understate Coase's influence on the law, for the very reason that Coase identified in his remarks on citations. As a central contributor to the law and economics movement, Coase has helped create a climate in which economic analysis has become more and more commonplace in law and no longer requires an explicit citation in judicial opinions. Federal judges (and even some state court judges) appointed since the 1980s are increasingly receptive to economic reasoning, partly because many of them had a

Table 5
Citations in Judicial Opinions in Federal Court

	Total Federal Court Citations	Supreme Court	Court of Appeals	Easterbrook and Posner	Other Law and Economics Judges
Coase	51	4	47	20	6
Arrow	4	1	3	1	0
Becker	20	2	18	13	4
Samuelson	39	8	31	0	6
Stigler	48	8	40	24	3

Note. The other law and economics judges are Douglas Ginsburg (D.C. Circuit), Stephen Williams (D.C. Circuit), Guido Calabresi (Second Circuit), Ralph Winter (Second Circuit), Diane Wood (Seventh Circuit) and Alex Kozinski (Ninth Circuit).

heavy dose of economics (and the Coase theorem) in law school and in continuing education programs for judges.[21] Other judges such as Posner and Frank Easterbrook were academic practitioners of the economic analysis of law before they became judges and regularly use economics in deciding cases and writing opinions. As a result, Coase's influence on the practice of law could be substantial, and yet direct citations to his work in judicial opinions could be negligible. Subject to this important qualification, we look at judicial citations to our sample of five Nobel Prize–winning economists.[22]

Table 5 presents the citation data. Coase and Stigler are cited the most, followed by Samuelson, Becker, and Arrow. It is not clear, however, whether Samuelson's judicial citations should even be counted since all are to his introductory economics textbook and not to his more original work. In any case, it is pretty clear from the data in Table 5 that the number of judicial citations to the five economists is paltry.

An interesting but not surprising result is that Posner's and Easterbrook's opinions account for more than 51 percent of the total citations to the economists (excluding Samuelson). If we add the opinions of six other judges who are well-known practitioners of the economic analysis of law, we are up to 63 percent. For Coase alone, Posner and Easterbrook account for almost 40 percent of his citations. If we include the opinions of six other law and economics judges, we are up to nearly 51 percent.

Another reason we are hesitant to conclude from the citation data that Coase has only a minor influence on the practice of law is that Posner and Easterbrook are among the top five most influential judges on the court of appeals, as measured by citations to their opinions from court of appeals judges outside the Seventh Circuit (see Landes, Lessig and Solimine 1998). This authority implies

[21] Two examples of recent programs are those run by the Law and Economics Center at George Mason University School of Law and the Searle Center on Law, Regulation and Economic Growth at the Northwestern University School of Law.

[22] Another implication of law students' extensive exposure to economic analysis of law is that lawyers today are probably more comfortable making arguments that stem from the economic analysis of law in their briefs than they were in the past. Thus judges are more comfortable with these arguments because of both training and necessity.

that Coase's influence is understated and not easily quantifiable because it shows up in judicial citations to Posner's and Easterbrook's opinions (and the other well-cited law and economics judges) but not as citations to Coase. In short, Coase, and also Becker and Stigler, have probably had a substantially greater (but indirect) influence on the law than is shown by citations to their works in judicial opinions.

4. Concluding Remarks

In assessing Coase's legacy, one is struck by the fact that two works, "The Nature of the Firm" and "The Problem of Social Cost," published 74 and 51 years ago, respectively, account for 72 percent of Coase's total citations.[23] This is truly an example of a durable good—here, intangible property—with a very long life that appears to appreciate rather than depreciate in value. What lesson this has for the intellectual history of law and economics is unclear. Still, it does suggest a trade-off between quantity and quality. And in Coase's case, quality wins.

Appendix

Using Web of Science

Web of Science is the online version of the SSCI. It also searches the Arts and Humanities Citation Index (AHCI), the Science Citation Index Expanded (SCIE), two chemistry databases, and a conference proceedings index. Because the authors of interest in this paper could be cited in the AHCI or the SCIE, we did not exclude these supplementary databases from our searches. However, for simplicity's sake, we refer to this aggregate database as the SSCI throughout. The SSCI has two search functions: the basic search and the cited reference search. These two search functions survey different types of material and return different results.

A1. Basic Search

The basic search allows you to search for articles with the fields topic, title, author, publication name, year published, and several others. The search surveys the SSCI's main database, that is, articles published in covered journals from 1956 (the first year the SSCI was compiled) to the present. It also covers select articles published before 1956, because when the SSCI adds a journal to its coverage, it adds all past issues of that journal. So if a journal was founded before 1956 and was added to the SSCI after 1956, its pre-1956 articles would also be added to the database and subsequently tracked, and their references

[23] This percentage would be higher if one includes citations to the two articles that were reproduced in his book *The Firm, the Market and the Law* (Coase 1988). If we counted all citations to the book as citations to the two articles, Coase's two articles would account for 79 percent of his total citations.

would be added to the SSCI's citation counts. The articles cited, however, are not added to the SSCI. Since coverage of pre-1956 articles found using the basic search is patchy at best, we exclude pre-1956 citation counts from our results.

Once a basic search has been performed, a series of articles that best match the search criteria appear on the screen. Selecting Create Citation Report will return the citations by year (in covered articles) to all articles found in your search. Each citation is counted; that is, if one article cites an article(s) of interest twice, that will count as two citations. Citations appearing in books, or in pre-1956 articles, are not included in these totals.

At this point, you can review the articles returned by your search and manually exclude false positives. For example, a basic search for author = "Becker, G*" will return a large number of articles that were not written by Gary S. Becker. Selecting Create Citation Report will allow you to check all articles credited to "G Becker" individually and exclude those that are not by Gary S. Becker. The citations by year will revise themselves accordingly.

In order to separate citation counts into citations in the subject area classifications law or economics, select View Citing Articles and restrict the resulting articles by subject area. Subject area classifications are performed by the SSCI and are not mutually exclusive; that is, an article can be classified as belonging to multiple subject areas. For example, an article published in the *Journal of Law and Economics* is classified by the SSCI as being both in law and in economics. In addition, the number of citing articles per year, as opposed to the number of citations, is being counted. An article that cites your article(s) of interest more than once will be counted as one citing article.

A2. Cited Reference Search

A cited reference search allows us to obtain citing articles by year (1956–present) for pre-1956 articles, post-1956 articles and books. Searching for an article (by cited author,[24] cited work or cited year) leads to a screen that prompts users to "select cited references." Below this invitation is a series of truncated, inhomogeneous, partially incorrect citations; we must select the ones that are, in fact, references to our desired work. For example, all of the following are references to Coase's 1937 article "The Nature of the Firm":

COASE	ECONOMICA	1937	4	
COASE	ECONOMICA	1937	5	386
COASE	ECONOMICS NEW SERIES	1937	4	386
COASE	NATURE FIRM	1937		
COASE	READINGS PRICE THEOR	1953		

(The article was reprinted in the American Economic Association's *Readings in Price Theory* [1952], which explains the last truncated reference.) In general, we

[24] Unlike the general search, the cited reference search classifies works by first author only, so if a book or article has multiple authors, the bulk of the citations to that work will be found only by searching for the first author. Searching for a second or third author will probably turn up a few scattered hits but will miss the vast majority of references to the desired work.

consider a citation to be correct if it has two or more correct fields, Author excepted. However, determining which references to include is a judgment call on the part of the researcher.

This stage of the cited reference search dramatically limits its usefulness. If we wished to conduct a cited reference search for an author (in order to obtain citations by year of an author's entire output), we would have hundreds of thousands of potential citations to comb through in order to select which references are correct: an impossible task.[25] The cited reference search is, thus, practical only for compiling citation counts for a specific article or book; it cannot be used to conduct wide-ranging searches. In addition, because of the large discretionary role of the researcher, counts obtained from the cited reference search are much less reproducible than are counts obtained from the general search, which will return the same results every time. Thus, the cited reference search should be used only to obtain citation counts for pre-1956 articles and books, which are not covered by the general search.

A cited reference search also returns many more citing articles than does a general search. In a general search, the computer performs this selection step; that is, it goes through potential citations to an article (say, "The Nature of the Firm"), selects which ones to count, and returns the articles that incorporate those citations. However, because a researcher generally has more information than does the computer about the article and author, the researcher can correctly identify more citations to "The Nature of the Firm" than can the computer. For example, if I know that Coase wrote only two articles in 1960 and the other one was published in the *London Times,* I can count all citations to a 1960 article by Coase in the *Journal of Law and Economics* as citations to "The Problem of Social Cost," no matter what other strange errors may appear in the citation. The computer, not having that information, will exclude a large number of citations that, armed with this information, I can include. Thus, searches performed with the cited reference search function return much higher totals than do searches performed with the basic search function.

Once the potential citations have been reviewed and potentially correct citations have been selected, the cited reference search will return the (post-1956) articles that incorporate the citations that have been selected. Results can be restricted by subject area to obtain citations in law and economics. Note, however, that citing articles have been selected, not total citations; that is, one citing article may contain multiple citations to the work of interest.

A3. Adding across Searches

Because we wanted to obtain total citations to our researchers of interest, we added results obtained with the basic search to results obtained with the cited

[25] Although some hand filtering is required in the general search to remove articles not written by your author, this is a limited, objective process and can be replicated exactly, unlike the filtering involved in the cited reference search, which is wide-ranging, is inevitably subjective and cannot be replicated exactly.

reference search. This means that we added total citations (to post-1956 articles) to citing articles (to pre-1956 articles and books). It also means that if an article cited a pre-1956 article and a post-1956 article, a pre-1956 article and a book or a post-1956 article and a book, that article will have been counted twice. Further, because we searched for each book and each pre-1956 article separately, articles that cited more than one book, or more than one pre-1956 article, will have been counted twice.

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