Journal of Economic Literature 2020, 58(1), 3–52
https://doi.org/10.1257/jel.20181508

Inside Job or Deep Impact? Extramural Citations and the Influence of Economic Scholarship†

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Does academic economic research produce material of general scientific value, or do academic economists write only for peers? Is economics scholarship uniquely insular? We address these questions by quantifying interactions between economics and other disciplines. Changes in the influence of economic scholarship are measured here by the frequency with which other disciplines cite papers in economics journals. We document a clear rise in the extramural influence of economic research, while also showing that economics is increasingly likely to reference other social sciences. A breakdown of extramural citations by economics fields shows broad field influence. Differentiating between theoretical and empirical papers classified using machine learning, we see that much of the rise in economics' extramural influence reflects growth in citations to empirical work. This growth parallels an increase in the share of empirical cites within economics. At the same time, some disciplines that primarily cite economic theory have also recently increased citations of economics scholarship. (*JEL* A11, A14)

1. *Introduction*

Academic scholarship is often evaluated by the nature and extent of academic citations. This essay looks at the influence of economic scholarship through the lens of *extramural citations*, quantifying the extent to which economic research in peer-reviewed journals is cited by scholars working in other disciplines. Citations by noneconomists provide insights complementary to those revealed by analyses of within-discipline citations. We also comment on the insularity

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† Go to https://doi.org/10.1257/jel.20181508 to visit the article page and view author disclosure statement(s).

of the economics profession as revealed by its citations of other disciplines. Our central focus, however, is the frequency with which other disciplines cite economics. Here, we exploit the fact that comparisons of how often economics and, say, sociology are cited by journals in a third discipline, perhaps political science, provide a perspective on relative influence. Extramural citation trends from 1970 to 2015 show that economics has large, and in some cases increasing, influence on a number of its sister social sciences, as well as on disciplines further afield. We describe the features of economic research that shape this extramural influence.

Economics is sometimes seen as a social science that stands apart, with a unique theoretical infrastructure and highly developed quantitative methodology. This uniqueness has sometimes drawn criticism; our analysis comes in the wake of popular and academic skepticism regarding the value of economic scholarship. In the popular sphere, the movie *Inside Job* highlights macro and finance economists' failures to predict the great recession, while failing to note that these fields are but one part of economics, not representative of the bulk of economics scholarship.[1] On the academic side, Fourcade, Ollion, and Algan (2015) offer a jaundiced view of economics' interactions with other disciplines. They argue that insularity "particularly characterizes economics" and they support the *Inside Job* narrative by arguing that there has been a "reorientation of economics toward business subjects and especially finance" since World War II. Our inquiry follows Pieters and Baumgartner (2002) and Fourcade, Ollion, and Algan (2015) in exploring extramural citation patterns, extending their work in various ways and covering a longer period.[2]

We use the Web of Science citation database for the period 1970–2015 to explore citations between economics and sixteen other disciplines. We define "disciplines" as sets of journals. For this reason, we look only at disciplines with a largely journal-based academic literature. Several of our analyses compare citation flows among five social science disciplines that can be seen as offering complementary or competing paradigms for the study of human behavior. These are anthropology, economics, political science, psychology, and sociology. We also discuss citation flows between these social sciences and several non-social-science disciplines.

Our analysis begins with an aside on the "insularity" of economics. Pieters and Baumgartner (2002) note that few of the papers cited by economics journals in 1995–97 are in other social sciences. More recently, Fourcade, Ollion, and Algan (2015) compare top journals in economics, political science, and sociology in 2000–2009, arguing that economics' alleged insularity causes "resentment and hostility" in other disciplines. Our tabulations of citations for a broader set of journals over a longer time span likewise shows that economics is more insular than political science and sociology. But our analysis also reveals that economics is not uniquely insular: psychology is less outward looking than economics, and anthropology looks more like economics than like political science or sociology. We also document a clear trend showing economics to be increasingly outward looking. Finally, trends in the rate at which economists cite social science and business journals fail to support the view that economics' interest in business

[1] The film's concerns about conflicts of interest may be more widely relevant. Partly in response, the American Economic Association and the National Bureau of Economic Research have raised requirements for disclosure of potential conflicts of interest. See Zingales (2014) for more on conflicts of interest in academic economics.

[2] Inquiries of this nature date back as far as John Stuart Mills's methodological writings, as described in Robbins (1932) and Hausman (1992).

disciplines (including finance) has grown disproportionately since 1970.

Our main agenda is to quantify the extramural influence of economics. Economic research can be highly valuable even if read only within the discipline, but extramural influence provides a complementary view of the value of economic scholarship. Extramural influence is formalized here as the extent to which other disciplines cite economics. Of course, citations need not be due solely to scientific influence. Even so, several features of the extramural citation concept suggest this is a worthy inquiry.

Extramural citations are valuable for three reasons. First, they allow us to objectively say one discipline reads more economics than another. We think it's likely, for example, that growth in psychology and computer science citations to economics, in comparison with these disciplines' references to (say) sociology, reflects differentially increasing scientific interest rather than changing citation practices. Second, extramural citations seem more likely than internal citations to reflect genuine interest or exposure to economic ideas. Internal references may reflect within-discipline faddishness or authors' perceptions of the need to pay homage to leading scholars and potential referees. Finally, extramural citation flows help gauge the changing influence of fields (like macro or labor) and styles (the distinction between theoretical and empirical work) inside economics. When economics publishes more in a particular field or style, that field or style necessarily gets more intramural citations. Extramural references provide a gauge of interest shaped less by internal feedback.

We begin by documenting levels and trends, comparing extramural citations to economics with citations between and to other social sciences. The relative influence of economics and sociology is measured, for example, by comparing the rates at which economics and sociology are cited by political science and computer science since 1970. This analysis answers questions distinct from the question of whether individual social sciences are insular or outward looking. In particular, we document a high level of extramural citations to economics, suggesting that many noneconomists find economics useful or interesting.

Other social sciences also have considerable extramural influence, with sociology appearing most important to some of the other social sciences, while psychology is widely read in several business and scientific disciplines. But we are especially interested in changes since the 1990s, economics' extramural influence on many disciplines, including psychology, computer science, public health, operations research, and medicine, has grown steadily.

After documenting levels and trends in overall influence, we explore the types of economic research that seem responsible for high and increasing extramural influence. Specifically, we use machine learning techniques to classify 140,000 economics articles in two ways. First, papers are classified into "fields," such as macroeconomics or industrial organization. We also classify papers into one of three research "styles": theoretical, empirical, or econometric. The diversity of economics appears to be an important source of its appeal. Different disciplines cite papers from different fields and many fields are heavily cited by at least one discipline. For example, sociologists cite labor economics; public health and medicine cite public finance; marketing cites industrial organization; computer science, psychology, and operations research cite microeconomics; and statistics cites econometrics.

Our examination of research styles is motivated by the marked shift toward empirical work within economics. We document this shift for a longer period and wider sample of journals than have earlier analyses of

changes in economics scholarship.[3] Angrist and Pischke (2010) argued that the growing importance of empirical work has been concomitant with increasing quality, a phenomenon the Angrist–Pischke essay calls a "credibility revolution." By this account, empirical work in economics has benefited from the increased use of randomized trials and quasi-experimental research designs. In contrast, Fourcade, Ollion, and Algan (2015) argue that research topics and styles primarily reflect the interests or career concerns of a narrow professional elite, rather than scientific evolution. Citations by outsiders provide independent evidence on the forces behind economics' empirical shift.

Our investigation of styles extends a similar analysis by Hamermesh (2018), showing here that the fraction of top journal citations made to empirical papers has increased roughly 20 percentage points since 1990. Slightly less than half of this growth reflects an empirical "affinity effect" explained by the fact that empirical papers tend to cite empirical work. Rising economics citations to empirical papers also reflects substantial within-style growth. Moreover, other disciplines' citations to economics should be less influenced by style-affinity effects. In citation flows from most of the disciplines where economics has long been influential, and in some where economics' influence is growing, we also see a shift toward empirical references. Computer science is an important exception, however, with strong and growing interest in theoretical work. Operations research also remains mostly interested in economic theory.

[3] See Hamermesh (2013) and Backhouse and Cherrier (2017), among others. Backhouse and Cherrier (2014) uses the fields of Clark medalists as an indicator of economics' growing empiricism. Biddle and Hamermesh (2017) and Panhans and Singleton (2017) also document trends within empirical microeconomics, focusing on the movement away from Cowles-Commission-inspired structural empirical work.

2. *Measuring Influence*

2.1 *Defining Disciplines*

What defines an academic discipline? We define disciplines as groups of journals, developing a largely rule-based scheme that minimizes the need for judgment as to what belongs where. This naturally limits the disciplines covered to those that, like economics, are largely journal-based.

The sixteen noneconomics disciplines in our study seem interesting, relevant, and have bodies of scholarship suitable for bibliometric analysis. The social science discipline group consists of anthropology, political science, psychology, and sociology, in addition to economics. This rules out humanities disciplines like history that rely heavily on books. It seems likely that the humanities interact more with sociology than with economics, an important qualification to the comparisons presented here. In the universe of social science scholarship, books are more important to political science and sociology than to academic economics, so the results reported here should be understood as representative of journal-based social science scholarship alone. Our focus on journals allows us to rely on the Web of Science, which has good coverage of scholarly journal output published since the mid-twentieth century. A journal-based framework also lends itself to impact-factor-type quality weighting of citation flows.

We are also interested in interactions with non-social-science disciplines. Some of these, like statistics and marketing, have a long history of interaction with economics. Others, like mathematics, medicine, and physics, cite social science rarely. These disciplines are included because we see evidence of increasing citation flows between them and the social sciences, while others that we have omitted, like chemistry, remain

isolated from social science.[4] We omit most engineering subjects, though some of these, like civil engineering, interact with economics. Engineering disciplines rely heavily on conference proceedings and are therefore ill-suited to our journal-based classification scheme. On the other hand, our list includes two disciplines that might be considered engineering: operations research and computer science. These two publish heavily in traditional journals as well as in conference proceedings.[5]

After exploring alternatives (such as the Web of Science disciplinary classification scheme), we opted for a mostly algorithmic journal-based framework. Other schemes proved hard to implement or failed to cover a long enough horizon. Our algorithm begins with a set of "trunk journals" for each discipline, mostly flagship journals published by a leading American professional association. For example, the *American Economic Review* (*AER*), published by the American Economic Association, and the *American Sociological Review*, published by the American Sociological Association, provide the economics and sociology trunks. Each discipline's journal list is built from the journals most highly cited by its trunks. The economics and sociology disciplines therefore consist of journals highly cited by the *AER* and the *American Sociological Review*. Online appendix table A1 lists professional associations and trunk journals for each discipline. For disciplines without an obvious trunk, we chose one or two leading journals.[6]

We also consider a distinct "multidisciplinary science" discipline, defined as the set of publications in three highly regarded multidisciplinary journals, *Science*, *Nature*, and *Proceedings of the National Academy of Science* (PNAS).

The fifty journals most cited by any trunk in any decade comprise an initial journal list (decades refer to citing paper publication date and are defined as 1970–79, 1980–89, 1990–99, 2000–2009, and 2010–15). Lists are refined so that journals belong to only one discipline. Rules for discipline assignment consider the frequency with which a journal is cited by each trunk, the frequency with which it cites each trunk, and the frequency with which it cites the journals most cited by trunk journals. Finally, we occasionally overrule algorithmic classification to correct what seem like obvious mistakes. Assignments are time invariant and a few hard-to-classify journals are dropped. Online appendix A details this process and online appendix table A2 lists the journals ultimately assigned to each discipline.

Although initial journal lists are of uniform length, final lists are of variable length. This variability is not very important for our work because the lowest-ranked journals on any list are typically cited little. Our weighted citation measures ensure that down-list journals have little effect on measures of extramural influence by emphasizing citations from the leading journals in each discipline. It is also worth noting that most extramural citations of economics papers are to journals that are widely cited in and central to economics itself.[7]

[4] We looked for disciplines that at some point in our sampling horizon have shown interest in economics and/or other social sciences. For this reason, physics and mathematics make the cut, while chemistry does not.

[5] The Web of Science "Conference Proceedings Citation Index" coverage of cited references begins only in 1999, a further consideration weighing against inclusion of most engineering disciplines. Along the same lines, the Web of Science "Book Citation Index" starts only in 2005.

[6] Medicine trunks are *Journal of the American Medical Association* and *New England Journal of Medicine*. The American Mathematical Society's leading research journal is relatively new, so the mathematics trunk is *Annals of Mathematics*, a historically important and leading journal published by Princeton University.

[7] Pieters and Baumgartner (2002) comment that interdisciplinary citation flows "run through central, influential rather than more applied peripheral journals." We similarly find high citation rates to central journals, but our analysis

2.2 *Data*

The citation sample analyzed here comes from the Web of Science and includes citing articles published between 1970–2015 and cited articles published since 1955. These restrictions are motivated by the fact that the Web of Science appears to be less complete and less accurate in earlier years.[8] We matched economics articles in the Web of Science data to more detailed bibliographic content found in the EconLit database, including abstracts and keywords. Importantly, EconLit includes *Journal of Economic Literature* (*JEL*) codes, which are used to classify papers into economics fields. The Web of Science indexes a broader set of publications than does EconLit, including book reviews, conference notes, and editors' introductions. The cited economics sample used in the fields and styles components of our analysis is therefore smaller than the sample used for discipline-level analyses. Since most of these additional publications neither cite nor are cited, their omission has little effect on our statistics. We matched 94 percent of EconLit articles to the Web of Science and use this matched sample to examine citation to economics fields and styles.[9]

Our sample covers a period of changing journal influence and prestige and, especially, changing composition of journal output. We therefore allow for changes in a journal's intellectual importance using a weighting scheme that implicitly values citations by the importance of the *citing* journal, a kind of customized "impact factor." This produces a weighted citation rate along the lines of the impact-factor-weighted indices seen in popular journal rankings. As a robustness check, we consider two weighting schemes when looking at citations from economics.

2.3 *Conceptual Framework*

Extramural influence is defined by citations from papers in the journals of one discipline to papers in the journals of another. Citations from discipline d to discipline d' are measured using a weighted average that can be written:

$$s^t_{dd'} \equiv \sum_{\{j|D(j)=d\}} w^t_j s^t_{jd'}, \tag{1}$$

where $s^t_{jd'}$ is the fraction of year t citations in journal j (among citations for which we can identify the discipline of the cited reference) made to articles in the journals of discipline d'. The sum runs over all journals, indexed by j, classified as belonging to discipline d (a set denoted $\{j\,|D(j)=d\}$). The weights, w^t_j, emphasize journals that are important to discipline d at time t. Specifically, the w^t_j are proportional to the number of citations from discipline d's trunk journal(s) in year t to journal j, rescaled so that in each year they sum to one across the journals in each discipline. The measure $s^t_{dd'}$ can be thought of as a citation share, showing, for example, the (weighted) fraction of citations in economics papers published in 1997 to articles in sociology journals.[10]

(in particular, table 3) does not replicate the implied association between "applied" and "peripheral."

[8] In earlier decades, numbers of articles per journal year and numbers of references per article are in some cases worryingly low. Spot checks suggest the Web of Science misses many references in older publications.

[9] The match rate is 71 percent with Web of Science publications as the denominator. Unmatched Web of Science items are mostly book reviews, announcements, and problems (for teachers) that make and receive few citations, though there are some differences in coverage, especially in earlier years.

[10] Note that journal-to-discipline shares, $s_{jd'}$, are defined so as to sum to one across all disciplines, indexed by d', for each journal j in each year t. Because the w^t_j sum to one across journals, the discipline-to-discipline shares, $s^t_{dd'}$, also sum to one across disciplines d' for each d and t. Note also that the weights w^t_j are a rescaling of journal j's citations from the trunk journal *in the discipline*

Some of the statistics discussed below characterize citations to *groups* of disciplines. The share of citations from discipline d to a group of disciplines, denoted by G, is described using the sum

$$s^t_{dG} \equiv \sum_{d' \in G} s^t_{dd'}.$$

For example, the citation share from economics to the group of business disciplines is the sum of shares of economics cites to finance, marketing, management, and accounting. Most citations are within discipline, so counts of extramural citations can be small, even when grouped. Our plots show five-year moving averages to smooth some of the resulting variation.

Citations are interpreted here as a measure of influence. Authors surely cite for many reasons, some more strategic than scientific. But scholars have long used citation flows, including citations to patents, publications, and various types of research output, to quantify research quality or knowledge flows. Economists have also noted that citations are correlated with other measures of research quality and impact. Within economics, citations are correlated with academic salaries (Hamermesh, Johnson, and Weisbrod 1982; Hilmer, Ransom, and Hilmer 2015); employment at top schools (Ellison 2013), and prestigious awards, which are often made in view of "highly cited work." Some citations are critical, of course, so the citing article might be seen as rejecting or criticizing the content of the cited paper. But even negative citations reflect influence in the sense that the critically citing author finds the content of the paper being cited worthy of response.

Social scientists outside economics are often critical of the rational, optimizing theoretical framework of neoclassical economics. It is therefore noteworthy that, as we show below, the majority of economics citations from social science disciplines are to empirical papers. It seems likely that critical references to empirical papers are reacting to, rather than simply dismissing, the cited work.[11]

3. *Economics Insularity*

In an earlier examination of citation data, Pieters and Baumgartner (2002) conclude that "no area of economics appears to build substantially on insights from its sister disciplines." Constructing an interdisciplinary network derived from cross-journal citation data, Moody and Light (2006) find that several sociology journals are among the most central in the citation network and that political science, psychology, and especially economics journals occupy distinct, well-differentiated clusters, a marker for being more self-referential.[12] More recently, Fourcade, Ollion, and Algan (2015) compare citation flows between economics, sociology, and political science trunk journals, arguing that economics is uniquely insular among social sciences. As a prelude to our evaluation of economics' extramural influence, we ask whether our data support this view. In addition to being of intrinsic interest, evidence of insularity helps calibrate differences in extramural citation flows. Sociology might cite economics more than political science does simply because sociology cites all other social sciences more than political science does.

The left panel of figure 1, which compares extramural citation rates from each

to which journal j belongs. Subscript j therefore identifies the citing discipline as well as the citing journal.

[11] Lynn (2014) similarly gauges interdisciplinary influence using extramural and intradisciplinary citation flows, without regard to the tone of the underlying references.

[12] Centrality in this study is determined by an initial weighted network formed by journals that often cite one another, and then mapped into a two-dimensional space. The data used for this were originally compiled by Leydesdorff (2004).

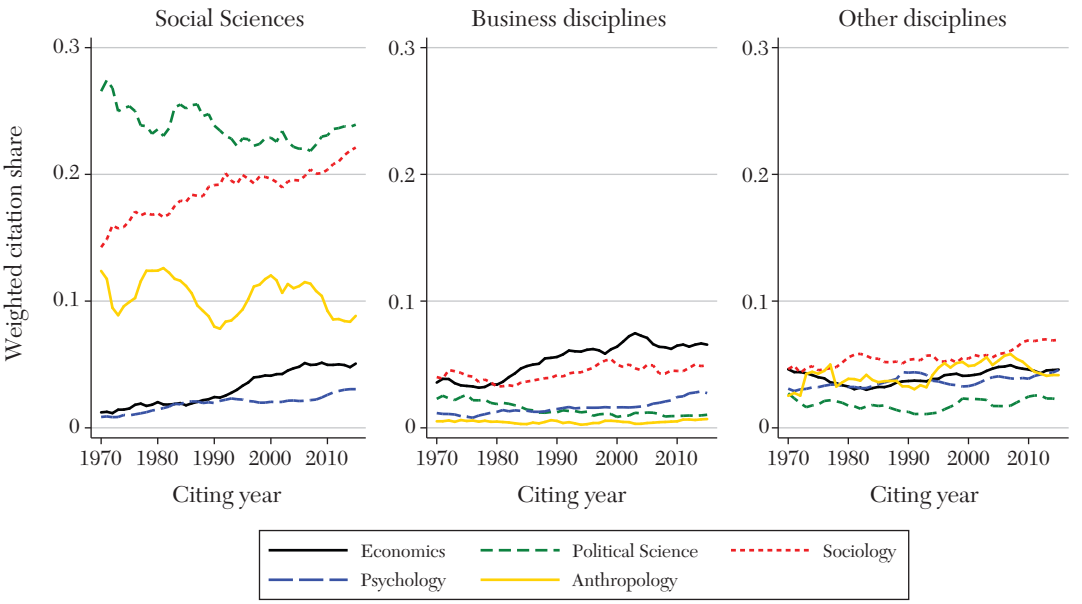

Figure 1. Social Science Insularity

Notes: The left panel of this figure shows citation rates from each social science to all other social sciences as a proportion of the total for each citing discipline. The center panel shows citation rates from each social science to four business disciplines. The right panel shows citations to seven other disciplines (this group includes all non-social-science and non-business disciplines, excepting multidisciplinary science). Plots are smoothed using five-year moving averages. Papers cited were published between 1955 and 2015.

social science discipline to the group consisting of the other four, shows large differences in insularity across disciplines as well as important changes in extramural citation rates. Political science is the most outward-looking social science, though political science's extramural citation rates were trending downward through about 1990. Sociology is the second most outward-looking social science, with a mostly increasing extramural citation rate.

Economics is less outward looking than sociology and political science, but not uniquely or irredeemably insular. Since around 1990, economics has paid more attention to other social sciences than has psychology. Moreover, economics' citation rates to other social sciences have been increasing for most of our sample period (though they have leveled off recently).

Fourcade, Ollion, and Algan (2015) note that the fraction of citations from six top economics journals going to the *Journal of Finance* rose from near zero in 1950 to over seven percent in the early 2000s. They also show an increasing fraction of extramural economics citations by papers in top-five journals going to finance. This observation motivates the middle panel of figure 1, which compares citation shares going from each social science discipline to the four business disciplines in our sample (finance, accounting, marketing, and management). Not surprisingly, economics is

indeed the most business focused of the social sciences, with modest growth in the economics citation share to business since 1980. While this pattern is consistent with the Fourcade analysis of *Journal of Finance* citations, it does not suggest a reorientation toward business disciplines in particular: the increase in the share of economics citations to business disciplines is no steeper than the increase in the share going to other social sciences.[13] Sociology citations to business disciplines also mostly show modest growth over the same period. Since 2000, the strongest growth in extramural social science citations to business disciplines has been in citations from psychology.

Social science citation shares to seven other disciplines are about on par with those to business. This can be seen in the third panel of figure 1, which plots extramural citation shares from social science disciplines to operations research, statistics, computer science, mathematics, physics, medicine, and public health; this group includes all of our remaining disciplines except multidisciplinary science.[14] Sociology is again the least insular social science in terms of the fraction of citations going to these disciplines, but economics is as outward looking as psychology and anthropology and ahead of political science.

[13] The largest recipient of economics citations among business disciplines is finance; economics cites finance more than other social sciences. In sociology the largest share of extramural cites to business disciplines goes to management. In psychology, the largest share goes to marketing. Since 1990, economics has been in the middle of the pack in extramural cites to nonfinance business disciplines, ahead of anthropology and political science, behind sociology and psychology. See also Azar (2008, 2009), which explore trends in the influence of economics on nonfinance business disciplines between 1995 and 2005.

[14] Multidisciplinary science is an exception to our rule that disciplines are defined by their journals. It seems interesting to ask what top multidisciplinary science journals are *citing*, as we do below. It's harder to interpret inbound citations to these journals as indicative of other disciplines' extramural interests, since the content of these journals comes almost exclusively from traditional disciplines.

While contradicting polemical claims of economics' unique insularity, figure 1 also highlights the importance of context when comparing extramural citation rates. Our assessment of economics' extramural influence considers relative citation rates; we compare, for example, the extent to which sociology cites economics and political science, thereby controlling for sociology's high overall extramural citation rate. Our analysis of the influence of economics fields and styles likewise contrasts, say, the *share* of extramural citations received by macroeconomics and labor economics, and by theoretical and empirical economics.

4. *Extramural Influence*

Our analysis of extramural influence begins by describing citation flows between individual social science disciplines. Since 1980, sociology and political science have been most influenced by economics, that is, economics is the social science they cite most often. As can be seen in figure 2, which plots extramural citation rates for five social sciences, these historically outward-looking disciplines are also increasingly likely to cite economics. Political science citations to economics grew rapidly in the 1970s and early 1980s, with ups and downs around a modest upward trend thereafter. At the same time, the political science citation rate to sociology fell. Extramural citation shares from sociology to economics also rose steeply in the 1970s and early 1980s, overtaking sociology's citation rate to psychology and political science in the 1970s. Sociology's attention to economics flattened in the 1990s, but has trended up since the early 2000s.

Psychologists and anthropologists appear to read less economics than do sociologists and political scientists. Sociology has historically had more influence on these

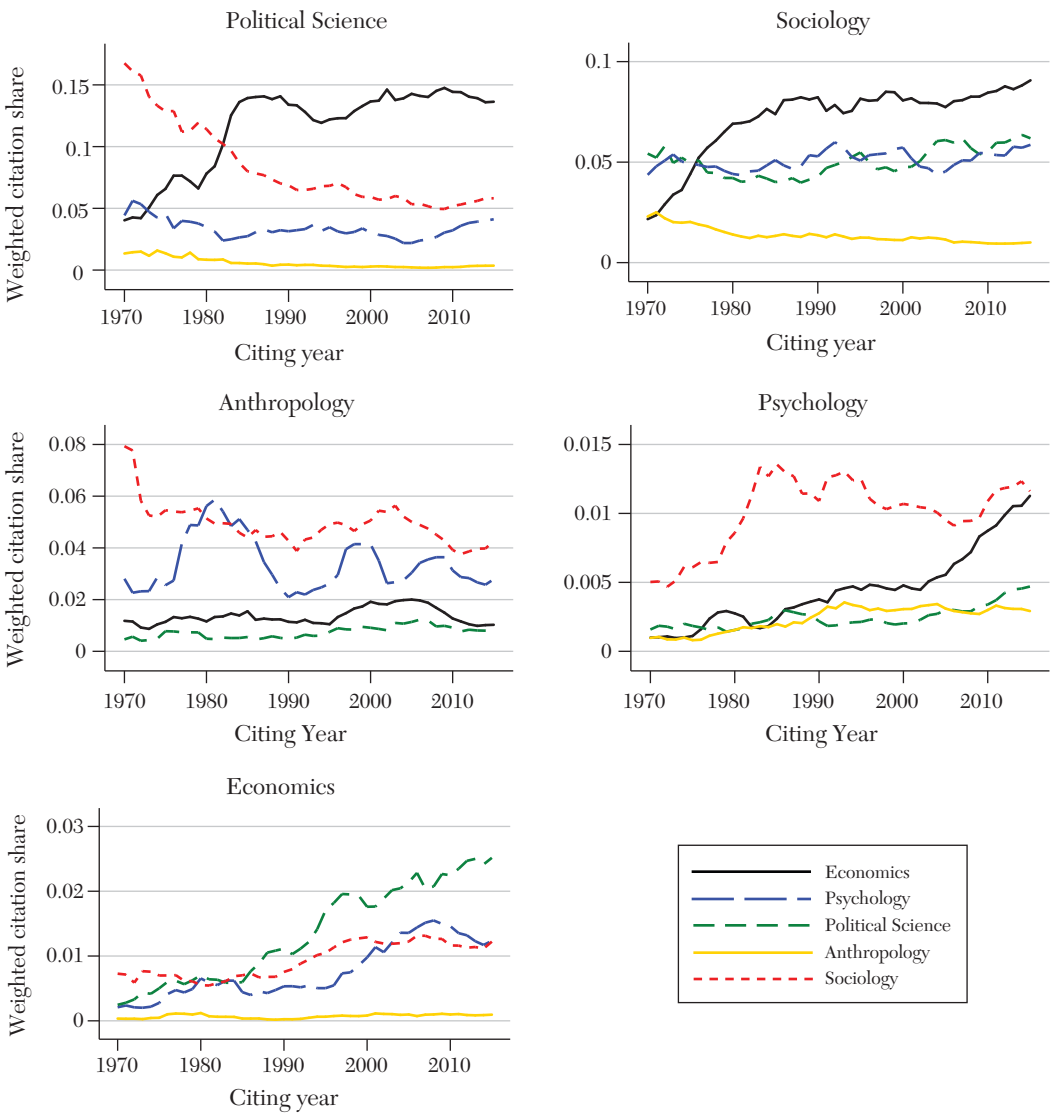

Figure 2. Citation Rates between Social Science Disciplines

Notes: This figure shows weighted citation rates from each of five social sciences to the other four. Plots are smoothed with five-year moving averages. Papers cited were published between 1955 and 2015.

fields than does economics, and psychology's influence on anthropology also outpaces that of economics. Yet economics' influence on psychology has recently accelerated, more than doubling since the early 2000s. This presumably reflects the influence of behavioral economics on both disciplines. The extramural citation rate from psychology to economics now roughly matches the corresponding rate to sociology (at a little over 1 percent).

The bottom panel of figure 2 shows citations from economics to other social sciences individually (the left side of figure 1 examines this for noneconomics social sciences as a group). Political science emerged in the 1990s as the social science most important to economics, now capturing about 2.5 percent of (weighted) economics citations. This puts economics in second place in citations to political science, behind sociology (with about 5 percent). Economics citations to psychology and sociology have also grown since 1990, with both extramural citation rates now running a little over one percent.

Not surprisingly, economics is widely read by scholars working in business-related disciplines, especially those in finance and accounting. This can be seen in figure 3, which plots extramural citation rates by finance, accounting, marketing, and management.[15] Economics has long been the dominant social science influence on finance, garnering over 40 percent of finance citations in the 1970s. But the attention paid by finance to economics declined markedly in the 1980s, and has remaining at a lower level (just under 30 percent) since.

Accounting's extramural citation rates show an up-and-down pattern. Economics and psychology both had steeply increasing influence on accounting in the 1970s and 1980s. Economics' share of accounting citations peaked in the mid-to-late 1980s and has since fallen to about half of its peak. Psychology's influence declined more steeply starting in the early 1980s, and psychology is now referenced little in accounting journals, though it was once remarkably influential.

Management and marketing are more attentive to psychology than to economics, a gap that has grown in the past ten years, especially for marketing. But the gap between extramural citation rates from management to economics and from management to sociology narrowed in the 1980s. Social sciences other than psychology and economics receive little attention from scholars publishing in business disciplines, with the exception of management, which also cites sociology.

The four mathematically oriented disciplines covered by our analysis are operations research, statistics, computer science, and mathematics. We expect operations research, which emphasizes optimization, and statistics, which overlaps with econometrics, to pay much more attention to economics than to other social sciences. This is borne out by figure 4, which plots extramural citation rates for the mathematical disciplines. Perhaps surprisingly, however, the share of operation research's cites that are to economics has roughly doubled since the late 1990s, cresting recently at around 13 percent. After declining in the 1970s and 1980s, economics' influence on statistics has also increased since about 1990.

Economics influences computer science and mathematics much less than it influences operations research and statistics. Interestingly, however, citations from computer science to economics have grown from a vanishingly small share before 1990 to claim about 1 percent in the 2000s. Also noteworthy is the fact that computer sciences cites to economics have been on par with those to psychology since the mid-2000s. Mathematics cites economics very rarely, and annual citation shares from mathematics are noisy and heavily affected by a few citing articles. Here too, however, there are signs of growing (though still small) influence since 1990.[16]

[15]The management series starts in 1980 because one of the management trunks (*Academy of Management Review*) began publishing in 1976 and is not indexed by the Web of Science before 1983, while indexing of the other (*Academy of Management Journal*) appears to be substantially incomplete until the mid-seventies.

[16]The table-top-shaped spike in mathematics citations around 2003 is an artifact of our use of a five-year moving average and the highly ranked *Bulletin of the*

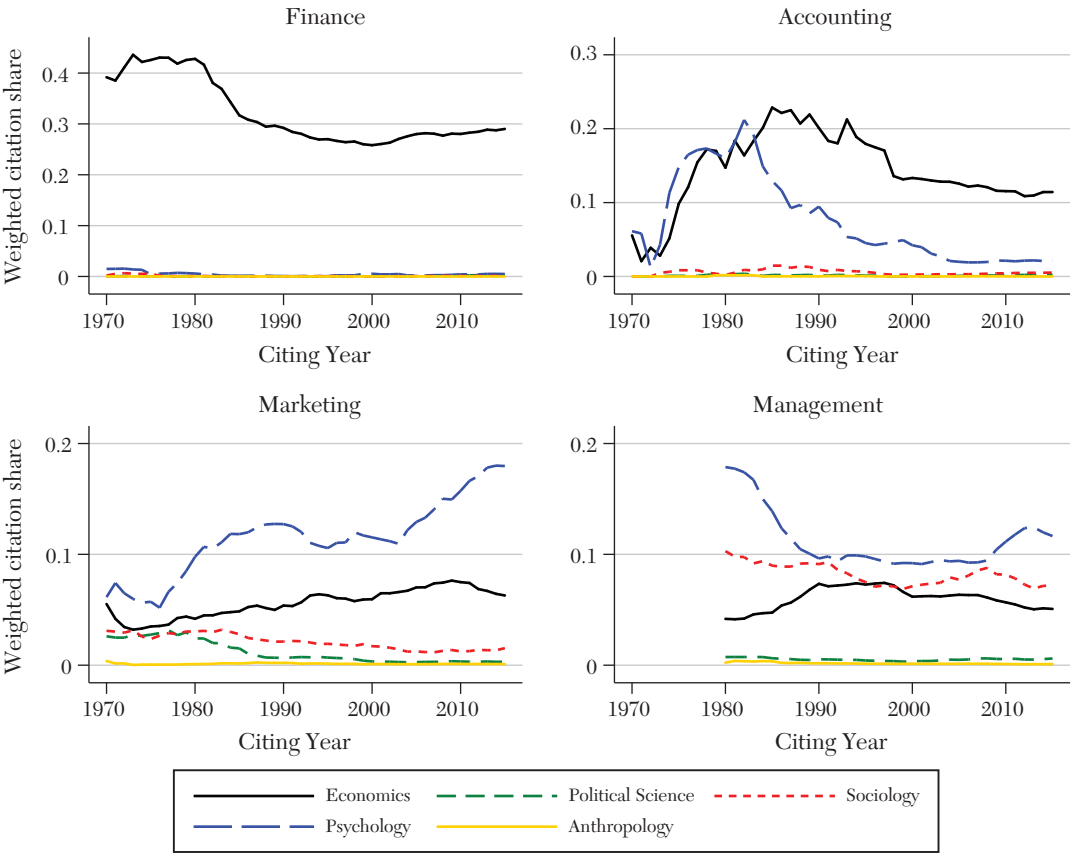

Figure 3. Social Science Citation Rates from Business Disciplines

Note: This figure shows weighted citation rates from each of four business disciplines to five social science disciplines. Plots are smoothed with five-year moving averages. Papers cited were published between 1955 and 2015.

Extramural citation rates by other disciplines are plotted in figure 5. This group includes multidisciplinary science, public health, medicine, and physics. Psychology is the leading beneficiary of extramural citations from three of four of these disciplines. Economics garners a small but growing share of extramural cites in this discipline group starting around 2000, taking second place in three cases and bypassing sociology for extramural citation rates by medicine after 2000. Although citation rates to economics remain low in these four disciplines, the attention they pay to economics scholarship is significant by historical standards and in comparison with the attention they give anthropology and political science. Rising from virtual invisibility, economics now gets 2 percent of citations by public health and almost 1 percent by multidisciplinary science.

American Mathematical Society's publication of Hofbauer and Sigmund (2003), which cites many game theory papers published in economics journals.

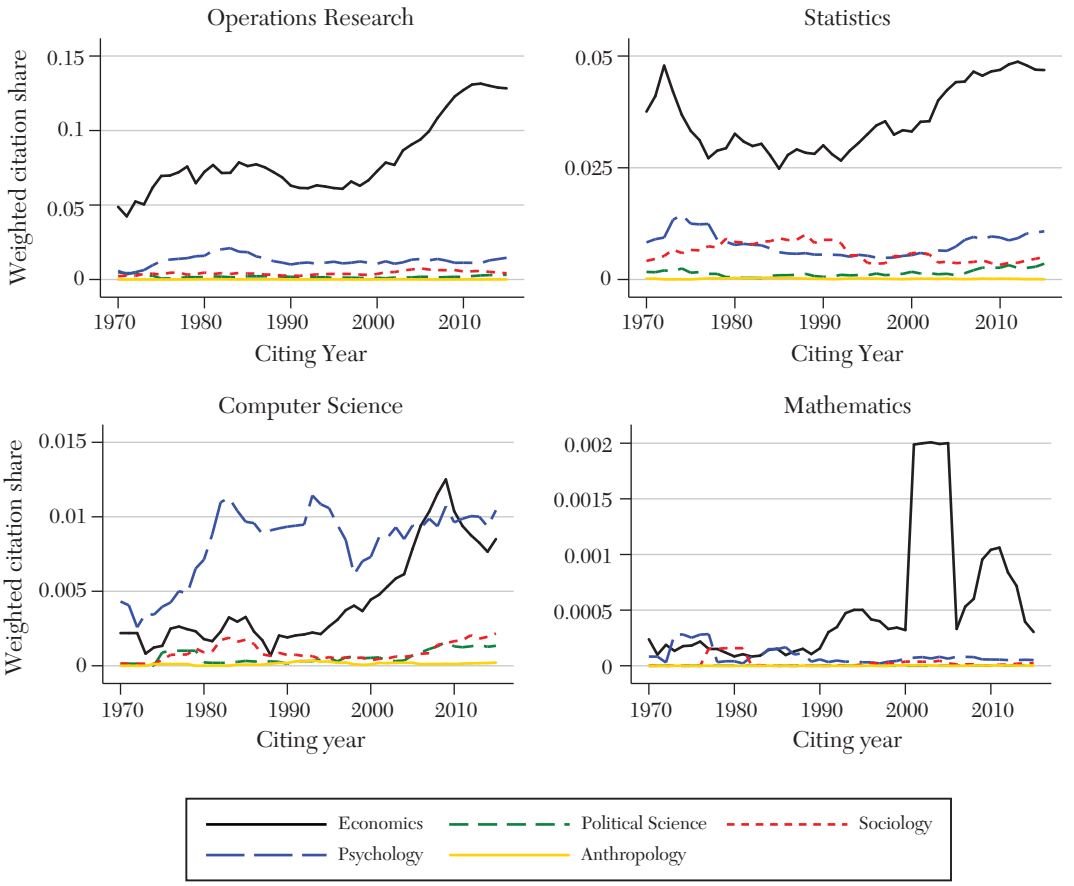

Figure 4. Social Science Citation Rates from Mathematical Disciplines

Notes: This figure shows weighted citation rates from each of four mathematical disciplines to five social science disciplines. Plots are smoothed with five-year moving averages. Papers cited were published between 1955 and 2015.

These comparisons show economics to be the most widely cited social science in seven of the sixteen disciplines we examined, and tied for first in two more. In the social sciences, sociology is comparably influential. Outside the social sciences, psychology is economics' main competitor for extramural influence. In particular, psychology is the most influential social science in marketing and management and also ahead of economics in all of the disciplines in our "other sciences" discipline group.

Interest in economics also appears to be growing in many disciplines, and has surged recently in some. Even among scholars who have historically read no economics, interest has ticked up. This evidence of engagement weighs against claims that economic scholarship is narrow or captured by special interests (by "narrow," we mean scholarship

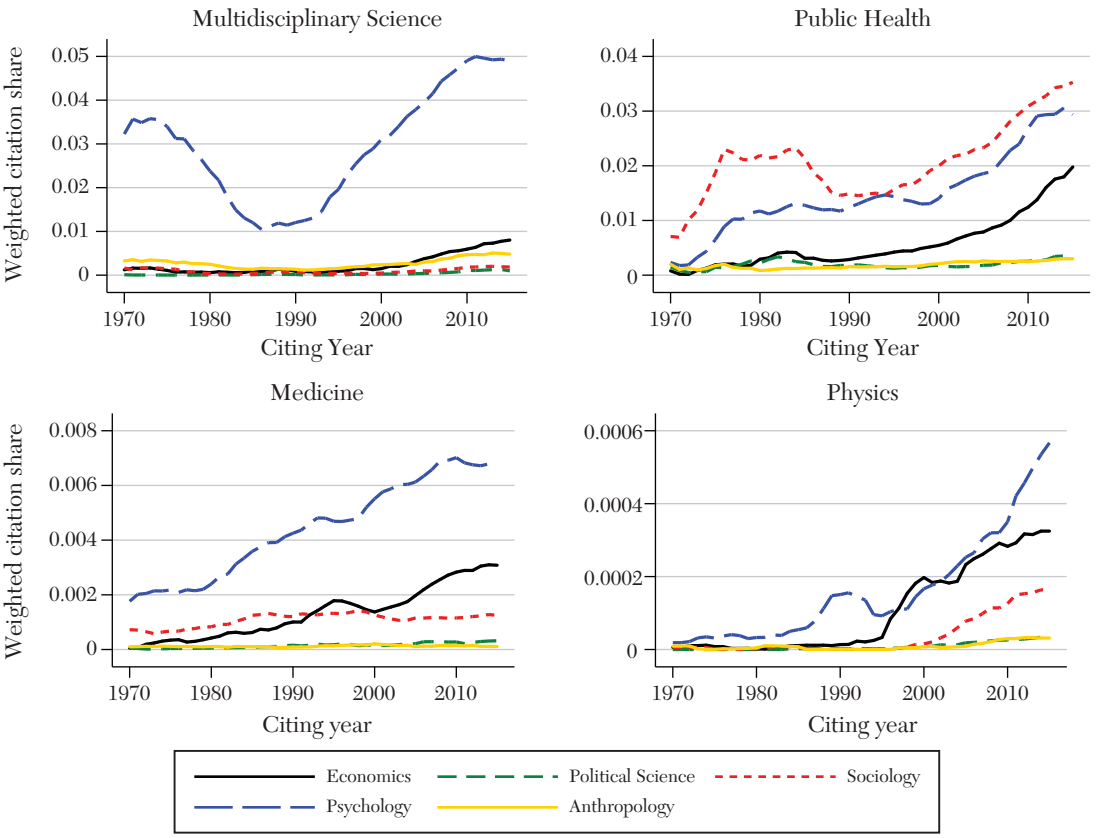

Figure 5. Social Science Citation Rates from Other Sciences

Notes: This figure shows weighted citation rates from each of four other science disciplines to five social science disciplines. Plots are smoothed with five-year moving averages. Papers cited were published between 1955 and 2015.

of interest only to those who create it). Of course, as noted at the outset, our analysis covers journal scholarship only, and does not distinguish critical or negative citations from the rest. Likewise, our findings shed no light on economics' interactions with the humanities.

5. *Sources of Influence: Economics Fields*

We turn next to a finer-grained analysis of the sources of economics' extramural influence. The first part of this investigation considers the extramural influence of economics papers differentiated by field.

5.1 *Defining Fields*

As with our analysis of extramural citation rates by discipline, the first step in an investigation of citations to fields is classification. We classified cited economics articles into fields using information in article titles, keywords, and *JEL* codes. Because the Web of Science omits article keywords and *JEL* codes, the field analysis looks only at articles matched to the AEA's EconLit database,

which provides *JEL* codes and keywords for each paper. EconLit started in the 1960s but coverage seems patchy in the first few years, so fields are classified for articles published since 1970. Because citations are necessarily backward looking and it takes time for citation patterns to emerge, the universe of citing articles in our study of fields includes papers published since 1980.

Our field classification scheme exploits three types of information: the *JEL* codes assigned to a paper; words in titles and keywords; and the *JEL* codes of the articles in a paper's reference list. We process this information in two steps. The first uses articles' *JEL* codes, titles, and keywords as inputs to a random forest algorithm that assigns papers to one of the seventeen economics fields defined in Ellison (2002).[17] The second step applies a clustering algorithm that boils these seventeen "initial fields" down to a group of nine.

Our nine final fields are development, econometrics, industrial organization, international, labor, macroeconomics, microeconomics, public finance, and a miscellaneous category that includes several smaller fields. As with the 1988 revision of *JEL* codes under John Pencavel's leadership, our field taxonomy is meant to distinguish between substantive areas of economic research, such as product market structure, labor market behavior, taxation, and business cycles.[18] The distinction between research *styles*, that is differences between theoretical and empirical work within each of these fields, is tackled separately.

The "microeconomics" field includes work in areas like game theory, contract theory, general equilibrium, welfare economics, and behavioral economics. We call this field microeconomics rather than theory to remind readers that it includes a mix of classical price theory, "applied theory" papers that fall outside other fields like industrial organization or labor, and experimental and empirical papers exploring general microeconomic questions like decision making under uncertainty.[19] The miscellaneous field includes most of the papers classified initially as economic history, environmental, lab experiments, finance, law and economics, political economy, productivity, and urban economics, as well as some that were simply hard to classify.[20] Miscellaneous papers are about two-thirds empirical (interactions between fields and research styles are discussed below).

The challenge of classifying EconLit's 140,000 or so papers into fields is magnified by the fact that EconLit lists several *JEL* codes for most papers. The codes for any one paper are often diverse, pointing to different fields. Although some articles in EconLit are indexed with *JEL* codes in an informative order, papers published since 2004 are mostly indexed with codes in alphabetical order. We therefore constructed a large training data set containing papers whose *JEL* code order appears to be informative, supplemented with papers classified using other information.[21] The training data

[17] Random forest classifiers use a training data set to construct a decision model that is used to classify the remaining observations based on the most informative features. The algorithm is detailed in Breiman (2001).

[18] Cherrier (2017) provides a history of *JEL* codes.

[19] The fraction of microeconomics papers that are empirical has risen from about 5 percent in the early years of our data set to about 15 percent recently.

[20] "Finance" appears both as part of the miscellaneous field within economics and as a noneconomics discipline. The distinction here is based on journals. For example, articles published in the *Journal of Finance*, whatever the topic, belong to the finance discipline, while papers on corporate finance in the *Quarterly Journal of Economics* (*QJE*) mostly end up in the miscellaneous field in the economics discipline.

[21] The latter includes papers in field journals clearly associated with a single field, e.g. *The Journal of Labor Economics.* For purposes of training, *JEL* codes ordered informatively were given field labels following the algorithm used in Ellison (2002).

were used to train a random forest algorithm to classify papers as a function of fields associated with unordered *JEL* codes, (words in) titles, and keywords. This step classifies papers into the seventeen fields defined by Ellison (2002).

The second field classification step uses k-means clustering to produce a set of nine "final fields." The clustering algorithm looks at each article's initial field and the initial fields of the papers it references. In a random sample of 100 articles, the results of our machine learning classification scheme match those from one of two human raters about 74 percent of the time. It should be noted, however, that the human raters themselves agree on article fields only about 76 percent of the time. Other details related to field classification appear in online appendix B.[22]

5.2 *Economics Intramurals*

5.2.1 *Output by Field*

To put extramural citations to fields in context, we look first at economics field output and the within-discipline citation distribution over fields. Figure 6 traces the evolution of economics journal *output* by field for the period 1970–2015 using three weighting schemes. The unweighted share of articles published in field f in year t, reported in the left panel of figure 6, is defined as $n_f^t / \sum_{f'} n_{f'}^t$ where n_f^t is the number of Web of Science papers matched to EconLit that are classified as belonging to field f, and published in journals on our economics journal list in year t. Unweighted shares provide an easily interpreted description of journal output. A drawback of unweighted shares, however, is that they give equal weight to more and less prestigious outlets. They may also be sensitive to down-list journals on our discipline-defining journal lists.

The middle panel of figure 6, labeled "*AER* weighted," reports field shares averaged using trunk journal importance weights, as defined in section 2.3. Specifically, the *AER* weighted journal output share is computed as

$$\tilde{m}_f^t \equiv \frac{m_f^t}{\sum_{f'} m_{f'}^t},$$

where the weighted publication share by field, m_f^t, is defined by $m_f^t \equiv \sum_{\{j|D(j)=\text{econ}\}} w_j^t m_{jf}^t$, where w_j^t is the share of the *AER*'s year-t references to economics journal j and m_{jf}^t is the fraction of papers published in journal j in year t classified in field f. This measure captures the relative prevalence of fields among papers published in year t in "top" journals, defined as those that are cited heavily by papers in the *AER*. It is analogous to the weighting scheme defined by citations from extramural trunk journals.

A drawback of the *AER* weighting scheme is that it may privilege *AER* authors' style of work. The weights placed on the *Journal of Econometrics* would presumably be higher and the weight on the *Journal of Development Economics* lower were *Econometrica* used as the economics trunk. We therefore construct weights that consider other top journals as well. The right panel of figure 6, labeled "Top-6 weighted," uses the broader journal weights discussed in Angrist et al. (2017). These are derived from the citation behavior of a set of six top journals, which includes the usual top five plus the *Review of Economics and Statistics* (once cited as often as the *Quarterly Journal of Economics*). Top-six weights are year specific and constructed by applying the Google Page Rank algorithm to the matrix of cross-citations between these six

[22] Raters agreed with one another at about the same rate across decades. Machine learning/rater disagreement on fields is higher for papers published recently.

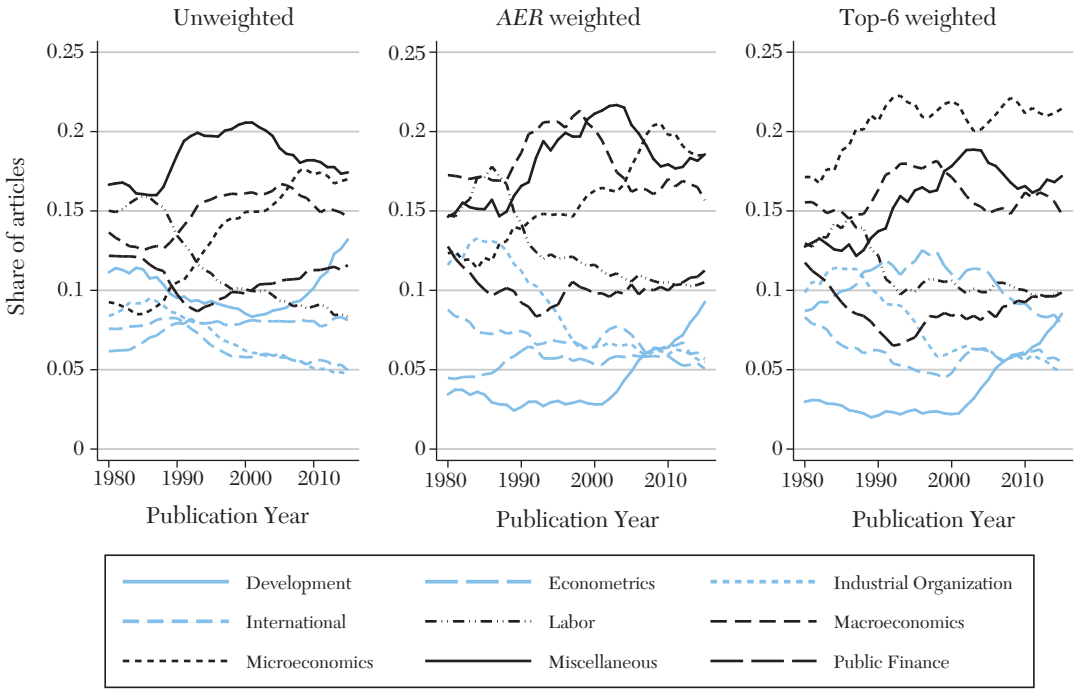

Figure 6. Economics Publications by Field

Notes: This figure shows publication shares of economics papers in each field. Unweighted shares are presented in the left panel. Publications are weighted by importance of the publishing journal using *AER* weights in the center panel and by top-six weights in the right panel. Plots are smoothed with five-year moving averages.

journals.[23] Top-six weighting emphasizes journals cited heavily by articles in *Econometrica* as well as in the *AER*, thereby weighting technical articles more heavily than the *AER*-only weighting scheme. This weighting scheme may be seen as providing a better measure of the field distribution of papers in top journals. Top six weights also evolve to reflect changes in importance within the top six.

Unweighted shares show microeconomics to be the field that has grown the most over the past thirty or so years, with a publication share that roughly doubled since 1990 and is now around 17 percent. This growth partly reflects the proliferation of microeconomic theory journals and their increasing page space. For example, *Games and Economic Behavior* started in 1989, *Economic Theory*

[23] Formally, let A^t be the 6×6 matrix with entries A^t_{kj} equal to the fraction of journal j's citations to all top six journals in year t made to journal k; and let μ^t be the solution to $\mu^t = dA^t\mu^t + ((1-d)/6)\mathbf{1}$, i.e., $\mu^t = (I - dA^t)^{-1}((1-d)/6)\mathbf{1}$, where $d = 0.85$. We set $\tilde{w}^t_j \equiv \sum_k \mu^t_k s^t_{kj}$, where k indexes the top six, and s^t_{kj} is the number of citations from journal k to journal j in year t as a fraction of all year t citations from journal k to journals in our full economics list. The final top six weighting series, denoted w^{T6t}_j, is the five-year moving averages of the $\tilde{w}^t_j$. Figure 1 in Angrist et al. (2017) plots these weights. The right panel in figure 6 plots weighted shares computed as

$$\tilde{m}^{T6t}_f \equiv \frac{m^{T6t}_f}{\sum_{f'} m^{T6t}_{f'}},$$

where $m^{T6t}_f \equiv \sum w^{T6t}_j m^t_{jf}$.

started in 1991, and the number of papers appearing in the *Journal of Economic Theory* more than doubled between 1980 and 2014.[24] The size of the increase in microeconomics as a share of top journal publications depends on the weighting scheme used to measure this growth. The *AER*-weighted series portrays microeconomics as growing by about 50 percent over the past thirty-five years and only recently becoming the largest field. Under top six weighting, microeconomics has long been dominant, increasing primarily in the 1980s and accounting for a little over 20 percent of weighted publication output ever since.

Another notable feature of the field distribution in journal output is sharp growth (starting around 2001) in the weighted share of papers in development economics. Weighted measures show development pulling ahead of industrial organization and international economics by around 2010. By contrast, labor economics and industrial organization have suffered clear declines in weighted publication shares, falling markedly from peaks in the 1980s. It is also interesting that macroeconomics and the miscellaneous category have been in the top three since around 1990, though these fields' output shares seem to have peaked around 2000.

5.2.2 *Field Citation Shares*

We report citation rates to economics fields using importance-weighted measures analogous to those used to estimate extramural citation rates to the economics discipline. Here, however, we graph the (weighted) shares of the citation distribution garnered by labor, international, and so on, using measures that sum to one *across fields*. These shares are constructed the same way for extramural disciplines as for economics and so are detailed below for any discipline, index by d.

Let s^t_{jf} be the fraction of journal j's year t citations made to papers in economics field f. The extramural influence of field f on discipline d is measured using a weighted average of journal-specific citation rates across the set of journals in discipline d:

$$s^t_{df} \equiv \sum_{\{j|D(j)=d\}} w^t_j s^t_{jf}. \tag{2}$$

The sum over fields of the s^t_{df} equals the weighted share of citations in discipline d made to economics papers matched to EconLit and classified into fields.[25] For each discipline d, this measure uses the same trunk-journal-based importance weights, w^t_j, used when computing extramural citation rates by discipline.[26] Measure s^t_{df} answers questions about which economics fields account for citations of economics articles by discipline d in year t. Like our overall citation rates, citations to fields emphasize journals that are important to discipline d and that are inclined to cite economics. The description of cites from economics journals to economics fields also includes a version of $s^t_{\text{econ},f}$ that uses top-six weights as well as *AER* weights.

[24] Kelly and Bruestle (2011) find that increasing the number of a field's specialty journals indeed increases that field's publication shares, though Card and DellaVigna (2013) note that citation rates to fields also change independently of the number of papers published. It may also be relevant that *Games and Economomic Behavior* and *Economic Theory* have been indexed by the Web of Science only since 1991 and 1995, respectively.

[25] The denominator for s^t_{jf} is the Web of Science count of journal j's cites in year t. The sum across fields of journal j's cites to fields f, that is, the sum of s^t_{jf} over f, may be less than the share of journal j's cites to economics as a whole ($s^t_{j,\text{econ}}$) because the data underlying our analysis of cites to entire disciplines include articles without *JEL* codes and articles not matched to EconLit.

[26] Recall these weights are proportional to journal j's share of all year t citations from discipline d's trunk journal to journals in that discipline. They sum to one over discipline d's journals in each year.

Our analysis of extramural citations to economics fields includes citation rates for groups of related disciplines like the social sciences and business disciplines. Group citation rates are computed as unweighted averages of the discipline-level shares, s^t_{df}, averaged over the disciplines in the group:

$$s^t_{Gf} \equiv \frac{1}{|G|}\sum_{d\in G} s^t_{df}, \tag{3}$$

where $|G|$ is the number of disciplines in group G. Note that this unweighted average emphasizes disciplines in the group where economics is influential (this is, those with large s^t_{df}).

Finally, because we are interested in the *relative* importance of economics fields to disciplines like sociology, rather than how often sociology, say, cites labor economics, the field-level measures described by equations (2) and (3) are normalized to sum to one over fields. It is these field *shares* that appear in our figures. Specifically, we gauge the influence of economics fields using

$$\tilde{s}^t_{df} \equiv \frac{s^t_{df}}{\sum_{f'} s^t_{df'}}, \tag{4}$$

where f' indexes fields in the sum in the denominator. These shares sum to one across fields by construction. Plots of the extramural influence of economics fields on discipline groups similarly show normalized group-level shares,

$$\tilde{s}^t_{Gf} \equiv \frac{s^t_{Gf}}{\sum_{f'} s^t_{Gf'}}. \tag{5}$$

As with the formula in (3), this quantity is most affected by the disciplines in group G that cite economics most heavily.

As a benchmark for the distribution of extramural citation shares to fields, figure 7 reports the field distribution of intramural citation shares. This figure plots versions of $\tilde{s}^t_{\text{econ},f}$ defined in equation (4) using *AER* weights and top six weights. Both weighting schemes generate a broadly similar picture of the current distribution of field influence. We see, for example, that microeconomics has the largest weighted citation share, macroeconomics is roughly tied with the group of miscellaneous fields for second place, and labor economics is fourth. At the other end, international economics and development are the least cited fields.

Some features of intramural field influence are sensitive to weighting. The *AER*-weighted series suggests microeconomics became increasingly influential from the early 1980s through the late 2000s, while top six weighting paints a picture in which the microeconomics citation share is larger in general, but peaked in the early 1990s. Viewed through the lens of either weighting scheme, the collection of miscellaneous fields appears to have become increasingly influential, while development has become markedly more influential in the past ten years. The *AER*-weighted series shows macroeconomics, labor economics, and industrial organization with generally declining citation shares. Top six weighting makes the post-2000 decline in macroeconomics and the decline in labor more moderate. The decline in citations to industrial economics since the mid-1980s remains pronounced under both weighting schemes. Citations to econometrics rise and fall in both versions, peaking earlier in the *AER*-weighted series.

5.3 *Extramural Influence by Field*

Different disciplines find different parts of economics relevant or useful. This claim is supported by figures 8 and 9, which plot field shares (formula (5)) for four discipline groups. These figures show trunk-journal-weighted extramural citations to the five most highly cited fields, plus other economics fields for which the average extramural citation rate exceeds 5 percent.

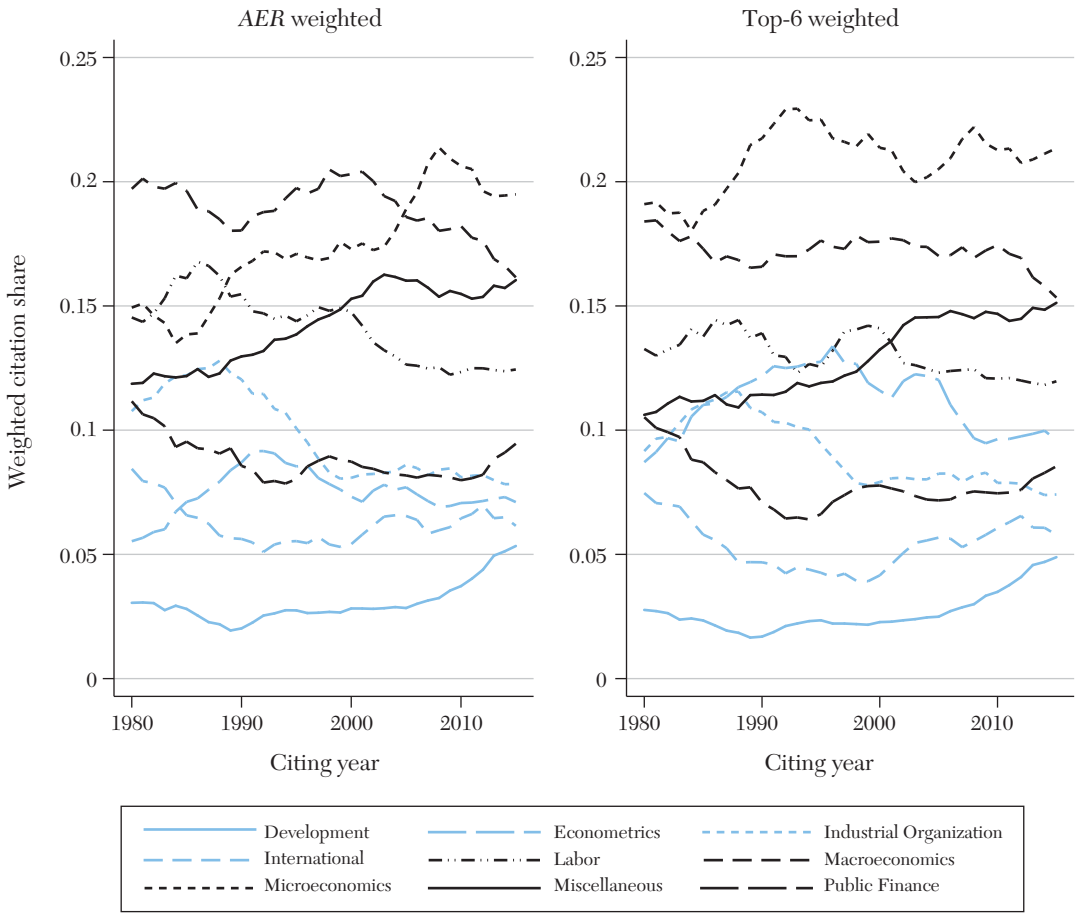

Figure 7. Economics Citation Shares to Fields

Notes: This figure shows weighted citation shares of economics papers to economics fields. Citations are weighted by importance of the citing journal using *AER* weights in the left panel and top six weights in the right panel. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

As can be seen in the left panel of figure 8, social science disciplines (political science, sociology, anthropology, and psychology) cite labor, microeconomics, and the group of miscellaneous fields most heavily, but social scientists also reference macroeconomics and econometrics and, increasingly, development and public finance. Social scientists' citations to the group of miscellaneous fields have also increased markedly since the mid-1990s, while the citation share going to microeconomics has fallen. Increased citations to the miscellaneous group reflect, in part, political scientists' increased propensity to cite political economy papers in economics journals.

Not surprisingly, the group of business disciplines (finance, accounting, marketing, and management) cite the miscellaneous category heavily, since the latter includes

Figure 8. Aggregate Extramural Citation Shares to Fields, Social Science and Business

Notes: This figure shows aggregated weighted citation shares from social science disciplines (psychology, sociology, political science, anthropology) and business disciplines (management, finance, accounting, marketing) to economics fields. Shares are plotted for the top five fields most cited, as well as for any field with at least a 5 percent average share across years. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

finance papers published in economics journals. This can be seen in the right panel of figure 8. Notably, however, the majority of extramural citations by business disciplines to economics are to nonfinance papers, with substantial citation shares going to microeconomics, industrial organization, macroeconomics, and econometrics. The share of business-discipline citations made to industrial organization increased considerably in the 1980s and early 1990s, but has since fallen to a little over half of its late-1990s peak. A similar rise and fall appears in citations to econometrics. On the other hand, following a modest decline in the 1980s, the share of business-discipline citations to macroeconomics has been increasing for the past twenty years.

Figure 9. Aggregate Extramural Citation Shares to Fields, Mathematical and Other Sciences

Notes: This figure shows aggregated weighted citation shares from applied mathematical disciplines (statistics, operations research, computer science, mathematics) and other sciences (medicine, public health, physics, and multidisciplinary science) from to economics fields. Shares are plotted for the top five fields most cited, as well as for any field with at least a 5 percent average share across years. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

The mathematical disciplines (operations research, statistics, computer science, and mathematics) increasingly cite microeconomics, with strong trend growth visible in the left panel of figure 9. In fact, microeconomics has recently passed econometrics to become the most cited field for this group of disciplines. We see especially steep growth in microeconomics cites after 2000, a period in which the influence of economics as a whole on mathematical disciplines has been increasing. Until recently, industrial organization was the third most influential economics field in the mathematical discipline

group, but industrial organization's citation share has dropped sharply since around 2008.

The right panel of figure 9 traces field influences on the discipline group containing public health, medicine, physics, and multidisciplinary science journals. As in the plot for mathematical disciplines, this figure shows evidence of an interesting swap, with public finance replacing labor as the most cited field in the mid-1990s. This probably reflects the growing importance of health economics within the larger public finance field, as well as health-related disciplines' growing interest in empirical methods. But there also seems to have been a secular decline in this discipline group's interest in labor economics. Meanwhile, the attention paid to microeconomics, econometrics, and development, which was very low in the early 1980s, has increased substantially.

A more detailed picture of field influence emerges from an examination of specific disciplines. Figure 10 presents citation data for the four disciplines in which economics looms especially large, in the sense of claiming a 10 percent or higher citation share recently. These "group A disciplines" include finance, accounting, operations research, and political science. Not surprisingly, our miscellaneous field, which includes finance, garners a large share of cites from the finance discipline. Macroeconomics' citation share has risen, however, to become the second largest for finance since the late 1990s, recently approaching one-quarter.

Other panels in this figure suggest that the diversity of economics contributes to its extramural influence (as in the figures showing discipline-group citations to fields, figures in the "A/B/C" series likewise show cites to the five most cited fields plus any field with an average share of at least 0.05). The marked increase in microeconomics' share of operations research citations since 2000 coincides with the substantial increase in overall citations to economics from operations research, suggesting the microeconomics field is driving this growth. At the same time, microeconomics' influence on accounting and political science has fallen. Citations from political science to microeconomics appear to have been replaced by citations to the miscellaneous group of fields, which includes political economy and, recently, to development economics. While political scientists' overall interest in economics has increased (a pattern documented in figure 2), the economics fields capturing political scientists' attention have shifted.

Figure 11 reports field citation shares for four other disciplines in which economics is influential (sociology, statistics, marketing, and management). Economics recently gets 5–10 percent of citations from these "group B disciplines." Labor economics has been and remains the dominant field influencing sociology. Statistics is (unsurprisingly) most influenced by the econometrics field, which receives a large and steadily increasing share of extramural cites by this discipline. Industrial organization has long been the dominant influence on marketing, although marketing cites to industrial organization have fallen steeply since 2000, with some substitution toward microeconomics and econometrics. Industrial organization also has the largest citation share from management for much of the sample period, but again this has fallen since 2000. Citations from management to labor fell dramatically in the 1980s and 1990s. It should be noted, however, that early 1980s trends in management cites may be influenced by the absence of one of our management trunk journals in this period.

Finally, figure 12 describes the field interests of five disciplines where economics is not (yet) highly influential, but where the share of citations to economics has more than

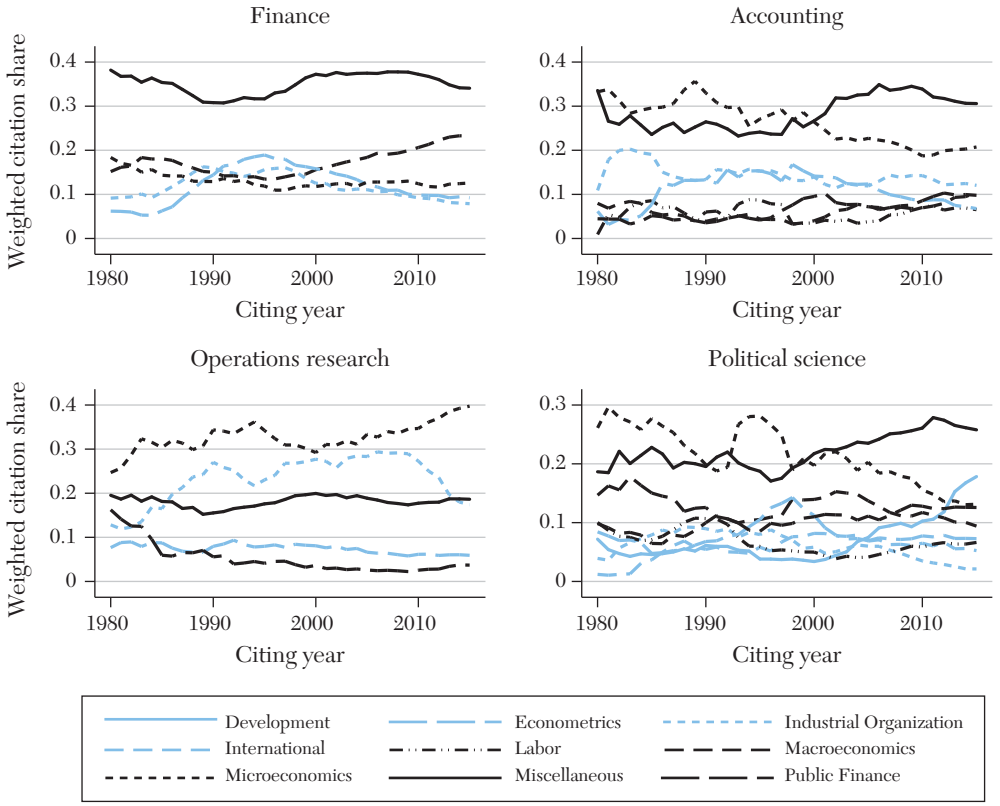

Figure 10. Citations from Discipline Group A to Economics Fields

Notes: This figure shows weighted citation rates from disciplines where economics is very influential (those where economics has a 10+ percent citation share) to economics fields. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

doubled over the past twenty-five years. (These "group C" disciplines are computer science, psychology, public health, medicine, and multidisciplinary science). The surge in citations from computer science to economics is attributable to growing interest in microeconomics (with cites going mostly to papers on game theory and mechanism design). Psychologists are also attentive to microeconomics, especially since the 1990s.

In public health and medicine, increasing interest in economics is driven mostly by citations to public finance, which includes health economics. Consistent with figure 9, public finance appears to have replaced labor as the main recipient of extramural citations from health-related disciplines outside economics. Also noteworthy is the fact that, starting from zero in 1980, econometrics has in recent decades garnered over 10 percent of these two disciplines' extramural citation

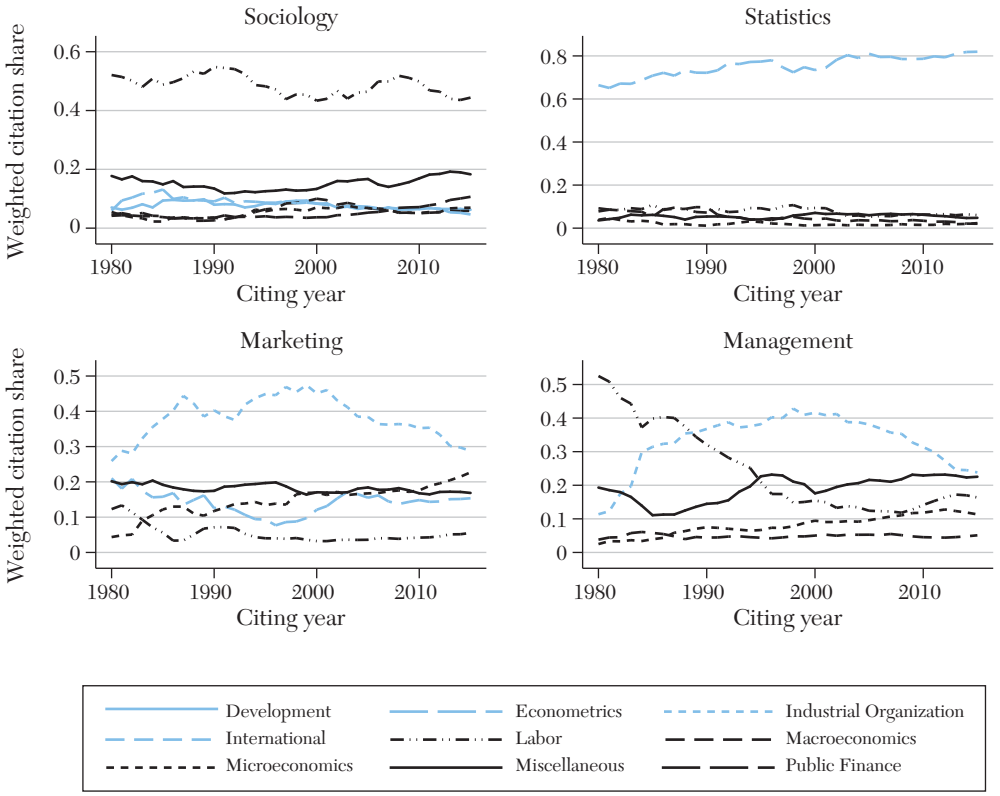

Figure 11. Citations from Discipline Group B to Economics Fields

Notes: This figure shows weighted citation rates from disciplines where economics is influential (those where economics has a 5–10 percent citation share) to economics fields. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

shares. Development has similarly emerged from virtual invisibility in 1980 to claim a significant share of public health references. The data for multidisciplinary science are especially noisy, reflecting the overall low citation rates to economics from general science journals. Still, figures 5 and 12 suggest an uptick in these journals' interest in economics, driven by references to microeconomics and the group of miscellaneous fields (which includes political economy and lab experiments).

Importantly, no single field appears to monopolize economics' extramural influence. For the business disciplines to which economics has long been important, finance is most influential, but other fields also get attention. A few disciplines focus on a particular field, but the subjects of this focus are diverse: econometrics is read in statistics, labor in sociology, microeconomics in computer science and operations research, and industrial organization in marketing and management. Political science now focuses

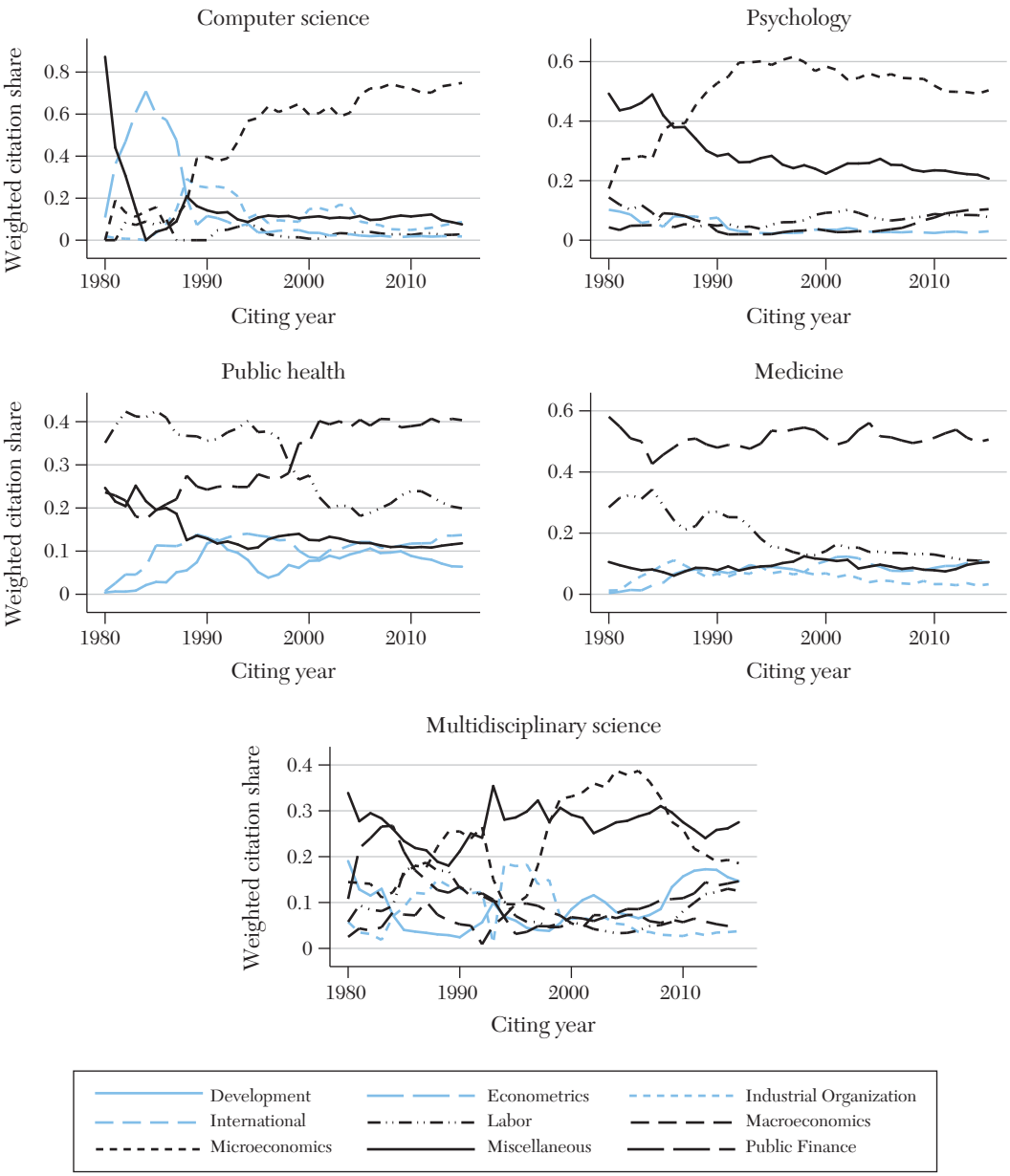

Figure 12. Citations from Discipline Group C to Economics Fields

Notes: This figure shows weighted citation rates from disciplines where the influence of economics is growing to economics fields. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

on fields in our miscellaneous category. The recent growth in references from public health and multidisciplinary science is driven by papers in public finance, while recent interest in psychology and computer science focuses on microeconomics. Far from being a monolithic structure dominated by finance, economics has long been and remains a diverse and evolving enterprise. Economics' extramural influence reflects this dynamic diversity.

6. *Sources of Influence: Empirical versus Theoretical Economics*

Empirical economics has flowered in recent decades, a development documented by Hamermesh (2013), Panhans and Singleton (2017), Backhouse and Cherrier (2017), and Hamermesh (2018), among others. Angrist and Pischke (2010) argue that this shift in economics research style reflects the proliferation of "design-based" empirical methods that yield more credible results than did earlier empirical economic research. The fact that theoretical economic models are less central to much of the research in this mold may make it more interesting or accessible to outsiders.[27] These arguments motivate our investigation of the role of empirical work in the growth of economics' extramural influence.

We classified articles published since 1970 into research styles, again using data from EconLit. Our style classifier uses abstracts where available. But because EconLit includes abstracts only since the mid-1980s, older papers are harder to classify (abstracts are missing both because EconLit failed to digitize them and because older publications were less likely to include them). We therefore plot publications by style since 1980 and citations by style since 1990.

6.1 *Classifying Economics Research Styles*

We used machine learning techniques to classify papers published in the journals on our economics journal list as empirical or theoretical. This classification procedure aims to distinguish research that produces data-based estimates of economically meaningful parameters from research of a purely theoretical nature. Papers that address methodological or theoretical issues while also producing estimates that might be seen as substantively meaningful are classified as empirical.[28] Because methodological econometric research seems distinct from both economic theory and empirical work, we assign all papers in the econometrics field to a distinct econometrics style category. Our style analysis therefore distinguishes papers in three categories: empirical, theoretical, and econometrics.

The machine learning algorithm for style classification starts with a training sample of 5,469 English-language papers, of which 1,503 were hand-classified by Ellison (2002). We updated the Ellison (2002) training sample by sampling from top journals and by drawing a random sample from all journals on the economics journal list. These additional training papers were classified by our (trained) research assistants. Papers in the training data were classified as empirical if they report econometric estimates of substantive interest, constructed using real-world data (as opposed to made-up or simulated data).

Features of empirical papers are "learned" using a logistic ridge regression

[27] Biddle and Hamermesh (2017) show that the fraction of empirical applied microeconomics papers in top journals that present theoretical models or link to theory was lower in 2007–08 than in 1973–78.

[28] Our concept of "empirical" can also be taken as a shorthand for "not purely theoretical." Hamermesh (2013) provides a finer breakdown into five research styles, for a much smaller and more homogeneous sample of 748 articles classified by human readers.

algorithm fit to a dummy variable indicating empirical papers, with predictors derived from *JEL* codes and keywords, and from words in article titles and abstracts (where available). Although *JEL* codes are meant to be topic-based, in practice they help predict style. Other predictive article features include the (initial) economics field coded earlier and the decade of publication. In a random sample of 100 articles, the classification algorithm predicts the style classifications made by two raters about 80 percent of the time (the raters themselves agree on style 82 percent of the time, a fact that highlights the challenges of automated classification). The style classification process is detailed further in online appendix C.

The dramatic change in economics research styles over the past half century is visible in table 1, which lists the top ten most cited papers published in each decade since 1970, along with their fields and styles.[29] Kahneman and Tversky (1979), classified as theoretical, tops the 1970s list. Heckman (1979) and Hausman (1978), classified as econometrics, come next. Hall (1978) is the most highly cited empirical paper of its era, and the only paper classified as empirical to make either the 1970s or 1980s top ten. By contrast, the 1990s top ten list includes three empirical papers: Katz and Murphy (1992); Berry, Levinsohn, and Pakes (1995); and Hall and Jones (1999). After 2000, empirical papers surge ahead, with six empirical in the top ten lists for both the 2000s and the 2010s.

Table 1 suggests machine learning successfully classifies research styles. Katz and Murphy (1992); Acemoglu, Johnson, and Robinson (2001); and Kling, Liebman, and Katz (2007) are surely empirical. But Eaton and Kortum (2002) and Christiano, Eichenbaum, and Evans (2005) are also classified as empirical, even though they combine theory with empirical work. Likewise, Kydland and Prescott (1977), Romer (1986), and Laibson (1997) are surely theoretical. Note that Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) are also classified as theoretical, even though they discuss the extent to which the models they develop can be calibrated to experimental results. This accords with our conception of empirical articles as involving meaningful econometric estimates computed from real data. The algorithm is not perfect; Fischbacher (2007) is coded as empirical in spite of not analyzing any data. But this is an unusual paper, which describes software for the planning and implementation of lab experiments (and is appropriately classified in the "experimental" field), while presenting neither a theoretical model nor an empirical analysis.

The table also shows a measure of classification confidence for leading papers. Confidence is scaled from 50–100, with higher numbers indicating increasing confidence. For example, the algorithm confidently slots Hölmstrom (1979) as theoretical, assigning this paper a score of 86. By contrast, Hall (1978) is only marginally empirical, with a score of 66. Not surprisingly, confidence is generally lower for 1970s and 1980s papers, reflecting the fact that older papers are missing abstracts. Classification confidence scores for more recent articles are mostly very high. Interesting exceptions include Eaton and Kortum (2002), with a score of 75 and McRae (2015), with a score of 72. Both of these have a large economic modeling component that might be described as "structural."

The distribution of articles reported in table 2 shows a strong interaction between fields and styles. Specifically, this table cross-tabulates the field-by-style distribution

[29] Papers in this table are ranked by the annual average (top six) weighted per-paper citation rate, c_i, defined in equation (6), below. Specifically, we divide c_i by 2015 minus the publication year to produce an annualized measure. A similar list constructed using *AER* weights appears in online appendix table A3.

TABLE 1
HIGHLY CITED ECONOMICS ARTICLES BY DECADE

Author(s) (1)	Year (2)	Journal (3)	Title (4)	Field (5)	Style (6)	Style Confidence (7)	Citations: Weighted (8)	Citations: Raw (9)
Kahneman, Tversky	1979	*Econometrica*	Prospect Theory: An Analysis of Decision under Risk	Misc	Theoretical	65	0.071	1,053
Heckman	1979	*Econometrica*	Sample Selection Bias as a Specification Error	Metrics	Metrics		0.064	969
Hausman	1978	*Econometrica*	Specification Tests in Econometrics	Metrics	Metrics		0.053	743
Lucas	1978	*Econometrica*	Asset Prices in an Exchange Economy	Misc	Theoretical	64	0.050	416
Dixit, Stiglitz	1977	*AER*	Monopolistic Competition and Optimum Product Diversity	Misc	Theoretical	83	0.048	742
Holmstrom	1979	*Bell*	Moral Hazard and Observability	Micro	Theoretical	86	0.043	447
Hall	1978	*JPE*	Stochastic Implications of the Life Cycle-Permanent Income Hypothesis:	Macro	Empirical	66	0.040	357
Mirrlees	1971	*RES*	An Exploration in the Theory of Optimum Income Taxation	PF	Theoretical	78	0.038	493
Akerlof	1970	*QJE*	The Market for 'Lemons': Quality Uncertainty and the Market Mechanism	Micro	Theoretical	66	0.038	551
Kydland, Prescott	1977	*JPE*	Rules Rather Than Discretion: The Inconsistency of Optimal Plans	Macro	Theoretical	74	0.038	529
Hansen	1982	*Econometrica*	Large Sample Properties of Generalized Method of Moments Estimators	Metrics	Metrics		0.136	1,013
Newey, West	1987	*Econometrica*	A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent. . .	Metrics	Metrics		0.116	926
Lucas	1988	*JME*	On the Mechanics of Economic Development	Macro	Theoretical	92	0.113	985
White	1980	*Econometrica*	A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for. . .	Metrics	Metrics		0.091	1,112
Romer	1986	*JPE*	Increasing Returns and Long-run Growth	Misc	Theoretical	65	0.090	849
Grossman, Hart	1986	*JPE*	The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration	IO	Theoretical	56	0.084	665
Engle, Granger	1987	*Econometrica*	Co-integration and Error Correction: Representation, Estimation, and Testing	Metrics	Metrics		0.081	988
Cho, Kreps	1987	*QJE*	Signaling Games and Stable Equilibria	Micro	Theoretical	95	0.076	488
Rubinstein	1982	*Econometrica*	Perfect Equilibrium in a Bargaining Model	Micro	Theoretical	97	0.075	558
Milgrom, Weber	1982	*Econometrica*	A Theory of Auctions and Competitive Bidding	Micro	Theoretical	95	0.074	524
Fehr, Schmidt	1999	*QJE*	A Theory of Fairness, Competition, and Cooperation	Micro	Theoretical	86	0.090	791
Katz, Murphy	1992	*QJE*	Changes in Relative Wages, 1963–1987: Supply and Demand Factors	Labor	Empirical	97	0.087	530
Andrews	1991	*Econometrica*	Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation	Metrics	Metrics		0.085	503
Laibson	1997	*QJE*	Golden Eggs and Hyperbolic Discounting	Macro	Theoretical	95	0.083	458
Berry, Levinsohn, Pakes	1995	*Econometrica*	Automobile Prices in Market Equilibrium	IO	Empirical	93	0.073	410
Romer	1990	*JPE*	Endogenous Technological Change	Dev	Theoretical	96	0.069	486
Hall, Jones	1999	*QJE*	Why Do Some Countries Produce So Much More Output Per Worker Than Others?	Macro	Empirical	88	0.069	506
Staiger, Stock	1997	*Econometrica*	Instrumental Variables Regression with Weak Instruments	Metrics	Metrics		0.069	594
Imbens, Angrist	1994	*Econometrica*	Identification and Estimation of Local Average Treatment Effects	Metrics	Metrics		0.069	351
Holmstrom, Milgrom	1991	*JLEO*	Multitask Principal–Agent Analyses	Micro	Theoretical	85	0.068	478

(*continued*)

TABLE 1
HIGHLY CITED ECONOMICS ARTICLES (*continued*)

Author(s) (1)	Year (2)	Journal (3)	Title (4)	Field (5)	Style (6)	Style Confidence (7)	Citations: Weighted (8)	Citations: Raw (9)
Melitz	2003	*Econometrica*	The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity	Intl	Theoretical	74	0.126	694
Fischbacher	2007	*EE*	Z-Tree: Zurich Toolbox for Ready-Made Economic Experiments	Misc	Empirical	95	0.099	840
Bertrand, Duflo, Mullainathan	2004	*QJE*	How Much Should We Trust Differences-in-Differences Estimates?	Metrics	Metrics		0.097	609
Christiano, Eichenbaum, Evans	2005	*JPE*	Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy	Macro	Empirical	91	0.089	581
Acemoglu, Johnson, Robinson	2001	*AER*	The Colonial Origins of Comparative Development: An Empirical Investigation	Misc	Empirical	98	0.077	518
Smets, Wouters	2007	*AER*	Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach	Macro	Empirical	85	0.067	372
Bolton, Ockenfels	2000	*AER*	ERC: A Theory of Equity, Reciprocity, and Competition	Micro	Theoretical	82	0.065	536
Eaton, Kortum	2002	*Econometrica*	Technology, Geography, and Trade	Intl	Empirical	75	0.064	287
Kling, Liebman, Katz	2007	*Econometrica*	Experimental Analysis of Neighborhood Effects	Misc	Empirical	99	0.063	178
Chernozhukov, Hong, Tamer	2007	*Econometrica*	Estimation and Confidence Regions for Parameter Sets in Econometric Models	Metrics	Metrics		0.063	116
Bloom et al.	2013	*QJE*	Does Management Matter? Evidence from India	Dev	Empirical	98	0.074	36
Pavan, Segal, Toikka	2014	*Econometrica*	Dynamic Mechanism Design: A Myersonian Approach	Micro	Theoretical	95	0.059	36
Grubb, Osborne	2015	*AER*	Cellular Service Demand: Biased Beliefs, Learning, and Bill Shock	Micro	Empirical	90	0.055	14
Lee, Lemieux	2010	*JEL*	Regression Discontinuity Designs in Economics	Metrics	Metrics		0.054	143
Arkolakis, Costinot, Rodriguez-Clare	2012	*AER*	New Trade Models, Same Old Gains?	Intl	Empirical	98	0.052	73
Mcrae	2015	*AER*	Infrastructure Quality and the Subsidy Trap	Misc	Empirical	72	0.046	8
Manzini, Mariotti	2014	*Econometrica*	Stochastic Choice and Consideration Sets	Micro	Theoretical	98	0.045	14
Maestas, Mullen, Strand	2013	*AER*	Does Disability Insurance Receipt Discourage Work?	PF	Empirical	99	0.045	29
Andrews, Soares	2010	*Econometrica*	Inference for Parameters Defined by Moment Inequalities Using Generalized Moment...	Metrics	Metrics		0.045	59
Ito	2014	*AER*	Do Consumers Respond to Marginal or Average Price?	IO	Empirical	98	0.044	31

Notes: This table lists the ten most-cited papers among those published in each decade, for papers ranked by top six weighted citation rates. Journal abbreviations in column 3: *AER*, *American Economic Review*; *Bell*, *Bell Journal of Economics*; *EE*, *Experimental Economics*; *JEL*, *Journal of Economic Literature*; *JLEO*, *Journal of Law, Economics, and Organization*; *JME*, *Journal of Monetary Economics*; *JPE*, *Journal of Political Economy*; *QJE*, *Quarterly Journal of Economics*; and *RES*, *Review of Economic Studies*. Weighted citation rates (reported here as percentages) can be interpreted as the average across post-publication years of the weighted share of all citations from the journals on our economics journal list to each paper. Columns 5 and 6 show each article's field and style classification. Column 7 shows a measure of style classification confidence between 50 and 100, with higher numbers indicating increasing confidence. Column 8 shows the raw citation count to papers on the list.

TABLE 2
THE DISTRIBUTION OF ECONOMICS FIELDS AND STYLES

Field	Distribution by initial field				Distribution by final field			
	Empirical (1)	Metrics (2)	Theoretical (3)	Total (4)	Empirical (5)	Metrics (6)	Theoretical (7)	Total (8)
Development economics	11,784	98	2,951	14,833	11,062		2,779	13,841
Econometrics	513	8,796	737	10,046		10,072		10,072
Industrial organization	3,780	69	4,757	8,606	4,201		5,314	9,515
International economics	4,247	69	4,402	8,718	4,608		4,502	9,110
Labor economics	12,887	129	2,552	15,568	13,471		2,716	16,187
Macroeconomics	10,364	265	9,295	19,924	10,573		9,559	20,132
Microeconomics	2,511	118	15,502	18,131	2,787		15,407	18,194
Public finance	8,927	117	5,758	14,802	8,830		5,816	14,646
Miscellaneous					16,854		8,611	25,465
Economic history	3,759	25	254	4,038				
Environmental economics	2,259	37	1,896	4,192				
Experimental economics	1,714	18	366	2,098				
Finance	1,668	163	1,800	3,631				
Law and economics	897	13	875	1,785				
Political economy	214	6	394	614				
Productivity	395	27	327	749				
Urban economics	2,996	49	834	3,879				
Unclassified	3,471	73	2,004	5,548				
Total	72,386	10,072	54,704	137,162	72,386	10,072	54,704	137,162

Notes: This table reports the number of economics articles published 1970–2015, indexed in both the Web of Science and EconLit, classified by economics field and research style. Initial fields follow the classification scheme used by Ellison (2002), with modifications discussed in the text and appendix. Final fields are produced by applying k-means clustering to initial fields. Styles are classified by machine learning.

of the roughly 137,000 economics papers published since 1970 found in both EconLit and the Web of Science. This is the set of papers used for our analysis of citations to economics fields and styles. Papers in the microeconomics field are mostly (though not entirely) classified as theoretical, while papers in what are today often thought of as "applied micro" fields (labor, development, and public finance) are mostly empirical. On the other hand, papers in industrial organization, also an applied micro field, tilt toward theory. Macroeconomics and international are about evenly split. Smaller fields grouped under the miscellaneous heading (environmental, finance, lab experiments, history, law and economics, political economy, productivity, urban, and unclassified) comprise a set of papers that is two-thirds empirical.

6.2 *Intramural Style Changes*

Paralleling our discussion of fields, we launch the discussion of styles with an intramural benchmark, looking at the style distribution of economics publications and citations. The citation rates used to trace both the intramural and extramural influence of styles are constructed like those for fields, modified by replacing the citation

rates for nine fields in formulas (2) and (3) with analogous rates for three research styles. As in the analysis of fields, we focus on normalized shares, computed as in (4) and (5); normalized style shares sum to one over styles. Economics journal output and intramural citations to styles are again weighted to reflect journal importance using top six as well as *AER* (trunk journal) weights. Extramural citations to styles are computed using trunk journal weights only.

Figure 13 traces the style mix of economics journal output since 1980. Unweighted publication counts, plotted in the left panel, show that the empirical share of economics publications has increased from about 50 percent to about 60 percent, with most of the increase since the late 1990s. We also see some growth in econometrics publications. The middle of the figure shows a trend toward empirical work that is more pronounced and starts sooner when tabulated using *AER* weights. Top-six weighting yields an even larger proportional increase in the empirical share of influential journal publications, from a low of just over one-third in the mid-1980s to around 56 percent today.

Figures A1 and A2 in the online appendix distinguish empirical papers more finely, plotting empirical style shares for articles classified more and less confidently. As suggested by table 1, empirical papers with low to moderate classification scores are more likely to have a theoretical component or involve structural empirical work than those with high scores. These figures also show that increased empirical output is due entirely to a sharp rise in empirical papers with classification scores of 75 or higher. The share of empirical papers scored below 75 has declined, falling, for example, from 19 percent of economics journal output in 1980 to 12 percent in 2015 when tabulated using *AER* weights.

Consistent with the increase in empirical output, the weighted empirical citation shares plotted in figure 14 show strong and steady growth since 1990. The *AER* weighted series, plotted in the left panel of the figure, shows the empirical share increasing from 33 percent in 1990 to 52 percent in 2015. The top-six weighted series shows a larger increase, starting from a slightly lower base. Both weighting schemes also suggest a modest decline in citations to econometrics, with a much larger decline in citations to theoretical work.

Are individual empirical papers increasingly cited, or are there just more of them? A regression analysis of citations per article isolates dimensions of economics' increasing empirical influence.[30] We quantify the influence of individual papers using an *AER*-weighted measure of citations to individual economics paper i. This measure is

$$c_i \equiv \sum_t \sum_{\{j|D(j)=\text{econ}\}} w_j^t s_{ji}^t, \tag{6}$$

where s_{ji}^t is the share of journal j's year t citations made to paper i.

The conditional mean of c_i is modeled as a time-varying exponential function of style dummies (EMP_i and MET_i), a vector of article-level covariates (denoted X_i), and, in some specifications, a battery of year-specific field and journal indicators, indexed by $f(i)$ and $j(i)$. Baseline controls include a cubic in article page length and dummy variables indicating the number of authors. The model of interest can be written as

$$E\left[c_i|X_i, EMP_i, MET_i, f(i), j(i), t(i)\right] = e^{\beta_1^t EMP_i + \beta_2^t MET_i + \beta_3^t X_i + \delta_{j(i)}^t + \gamma_{f(i)}^t}, \tag{7}$$

[30] Our work here extends the analysis in Hamermesh (2018), which tabulates per-paper citations for papers in top five journals in 1974–75 and 2007–08, and notes increased references to empirical papers in the later sample.

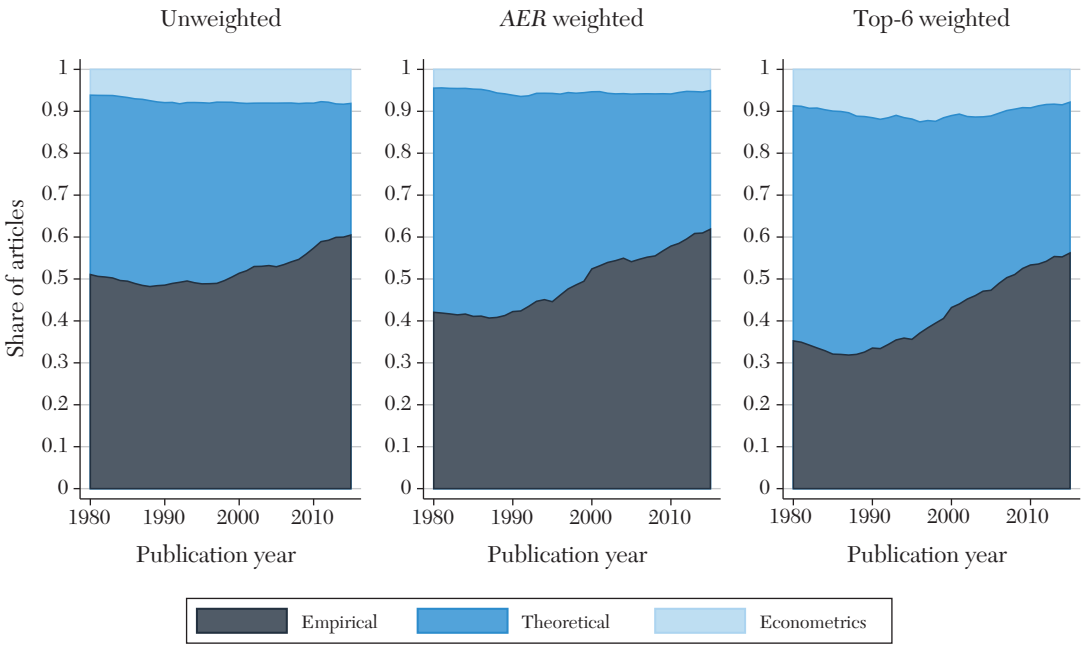

Figure 13. Economics Publications by Style

Notes: This figure shows publication shares of economics papers in each style. Unweighted shares are presented in the left panel, and shares weighted by the importance of the publishing journal are plotted in the center and right panels using AER and top-six weights, respectively. Plots are smoothed with five-year moving averages.

where $t(i)$ is publication year and the β_j^t (j=1,2,3) and other parameters are year specific. Because many papers are never cited and the citation distribution is highly skewed, this exponential model fits the conditional mean function of interest better than a linear model (37 percent of papers in the sample are never cited by another paper in the sample). The coefficient β_1^t captures a time-varying covariate-adjusted log ratio of empirical to theoretical citations per paper. When the ratio is close to one, this is the approximate percentage difference in citation rates by style.[31]

Theoretical articles published in the 1980s and 1990s were cited far more often than empirical work of the same period. This can be seen in panel A of figure 15, which plots the time series of estimates of β_1^t from a model omitting field and journal effects. Starting from around −0.7, the empirical citation deficit began to shrink in the late 1980s, and by around 1995 citation rates to empirical papers had attained a rough parity with citation rates for theoretical work.

[31] Each observation in the sample used to estimate equation (7) is one economics paper, published 1980–2015 (N = 119,069), the sample described in figure 13. Observations are unweighted. The model is fit using Poisson regression with robust standard errors; regressions are run separately for each publication year. See Angrist et al. (2017) for estimates of a model like equation (7) fit to paper-level top six weighted citation shares; these are similar to the estimates reported here.

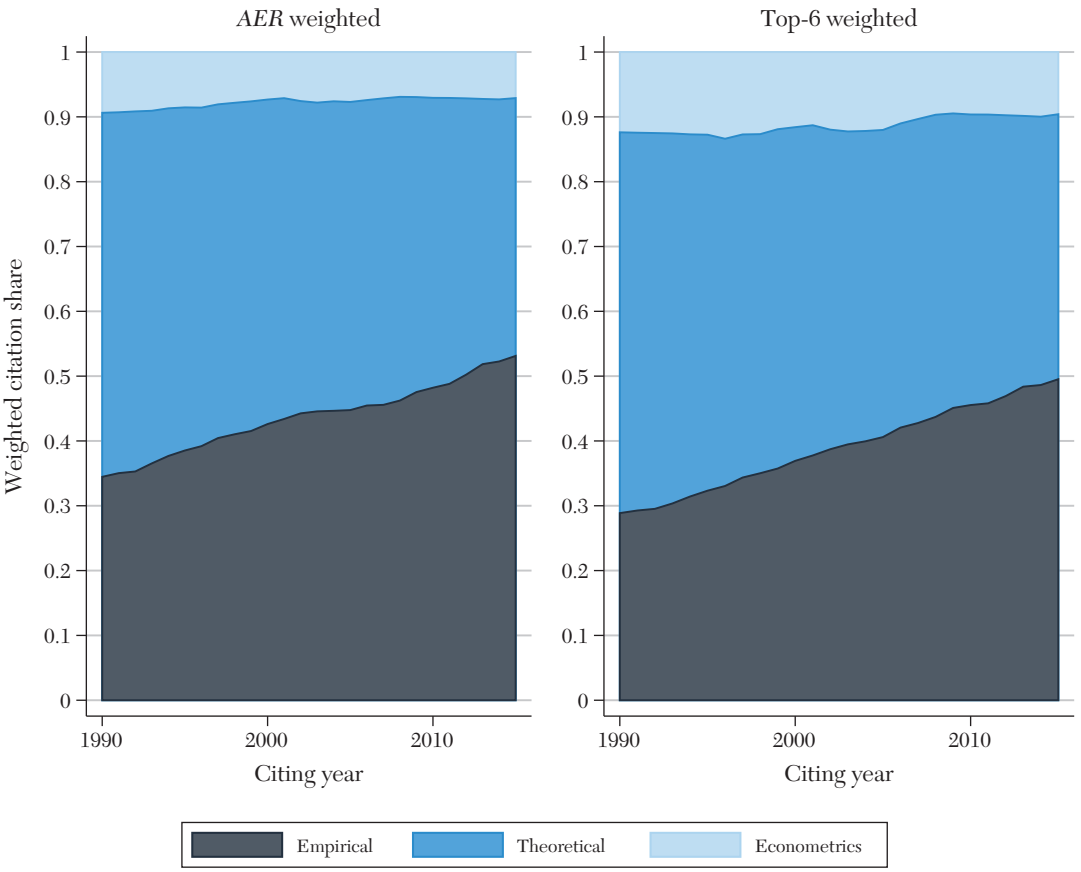

Figure 14. Economics Citation Shares to Styles

Notes: This figure shows weighted citation shares of economics papers to economics styles. Citations are weighted by importance of the citing journal using *AER* weights in the left panel and using top-six weights in the right panel. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

Estimates of β_1^t from a model with field and journal controls, reported in panel B of figure 15, show that some of the early theoretical citation advantage can be attributed to differences in the distribution of paper styles across fields and journals. Most importantly, theoretical papers used to appear disproportionately in more highly cited journals. Controlling for field and journal dummies—that is, looking within fields and journals—the empirical citation deficit shrinks to around −0.5 in the 1980s and disappears in the early 1990s. Since around 2000, empirical papers have been cited more often than theoretical papers in the same field, journal, and year. The increasing attention paid by the economics discipline to empirical work therefore reflects more than improved journal placement.

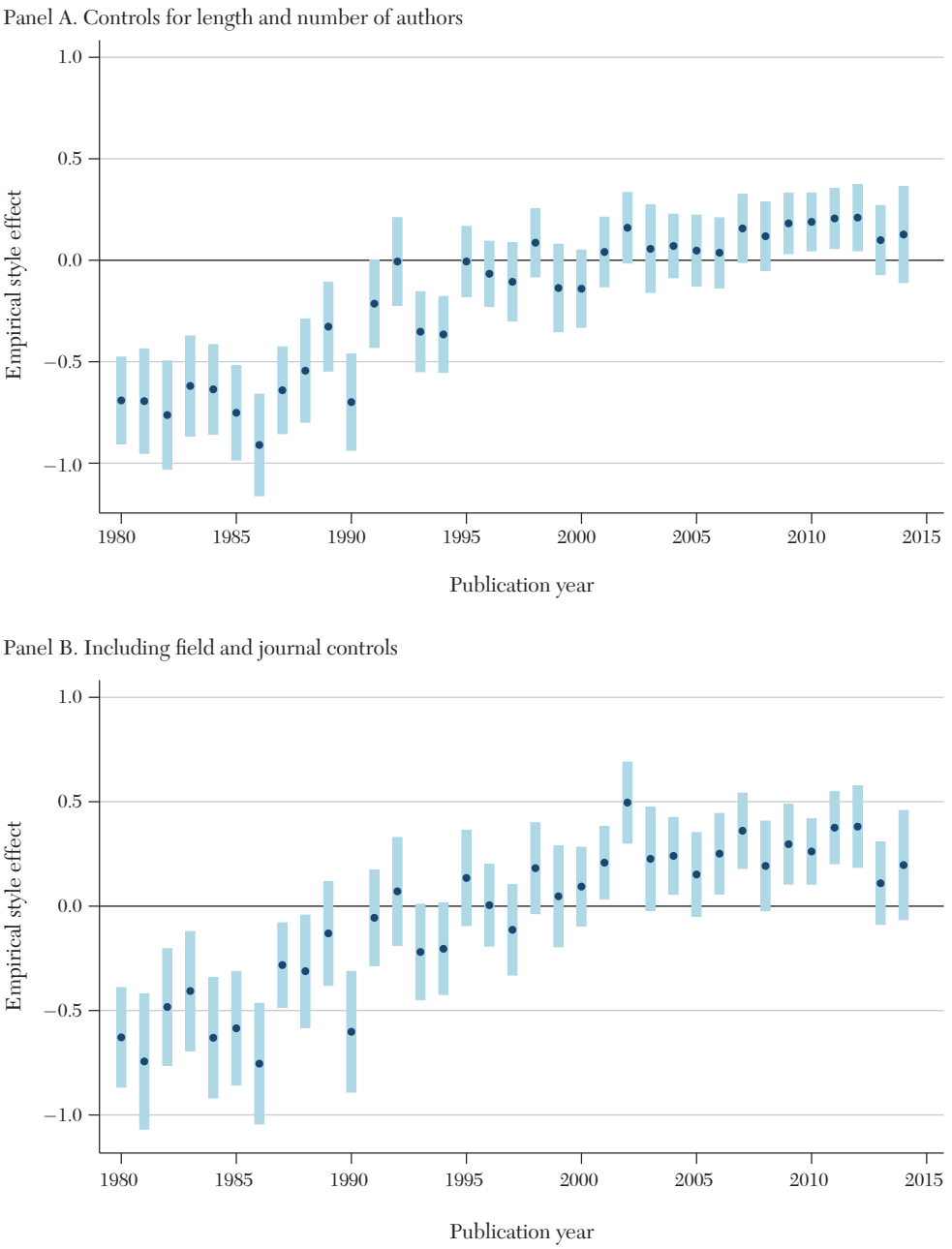

Figure 15. The Empirical Effect in Economics Citations per Paper

Notes: This figure plots Poisson regression estimates of the empirical effect on weighted citations per paper. Panel A estimates are from models estimated separately by year, with flexible controls for paper length and number of authors. Estimates in panel B add field and journal controls. Confidence bands use robust standard errors.

Intramural citation rates naturally reflect publication patterns. If empirical papers mostly cite empirical work and theoretical papers mostly cite theoretical work, then increases in the empirical publication share naturally boosts empirical citation rates. Online appendix D develops a decomposition of citation rates that quantifies the importance of "like-cites-like" for changes in style-specific citation rates. This decomposition allocates changes in the empirical citation share into effects due to: (1) increased empirical publication shares; (2) changes in the average number of articles cited; and (3) changes in the fraction of empirical citation rates from papers in each style. The first effect accounts for slightly less than half of the increase in the empirical share of intramural citations. The second is of no consequence because reference lists for papers of all styles have similarly lengthened. Remaining empirical citation growth is therefore the result of increased empirical citation rates within styles. Notably, this increase occurs for papers of all three styles.

6.3 *Extramural Influence by Style*

The empirical share of extramural social science citations has grown steadily since around 2000, with nearly 70 percent of references from noneconomics social sciences going to empirical work by 2015. This can be seen in the left panel of figure 16, which, like figure 8, describes (trunk-journal weighted) economics citations from noneconomics social sciences as a group. The right panel of figure 16 plots citations from business-related disciplines. These disciplines cite empirical economics in a proportion similar to that for economics itself, and also at an increasing rate. Interestingly, growth in the share of social science and business disciplines' cites to empirical papers seems to lag growth in the empirical share for economics itself.

The left side of figure 17 suggests that mathematical disciplines are more heavily influenced by theoretical and econometric papers than by empirical papers. In recent years, about half of extramural citations from this discipline group have been to theoretical papers and about a quarter to econometrics. Even so, the empirical share of citations from math disciplines has increased modestly, from about 20 to 27 percent over the sample period. By contrast, the theoretical share has nearly held steady, so the shift toward empirical work is mostly at the expense of econometrics.

Most extramural citations from our "other sciences" discipline group go to empirical work, a pattern documented in the right panel of figure 17. Results for this group primarily reflect citation patterns in public health and multidisciplinary science (since these cite economics much more than do other disciplines in the group). The empirical share for other-science citations is around 75 at the beginning and end of our sample period, while the citation share from this discipline group to econometrics holds steady at around 10 percent. We also see a modest shift toward theory in the late 1990s and early 2000s, but the expansion in references to theory faded in the late 2000s.

Figure 18 looks at citation shares to styles from the individual disciplines where economics is most influential (dubbed "group A" disciplines in the discussion of fields). Finance and accounting citations are now about as likely to be empirical as are cites from economics. Accounting was considerably more theory-influenced in the early 1990s, so the shift toward empirical work is larger there. Operations research remains heavily influenced by economic theory, but we also see a modest increase in operations research citations to empirical work. Like finance and accounting, political science has moved decisively to favor empirical papers, with an empirical citation share increasing

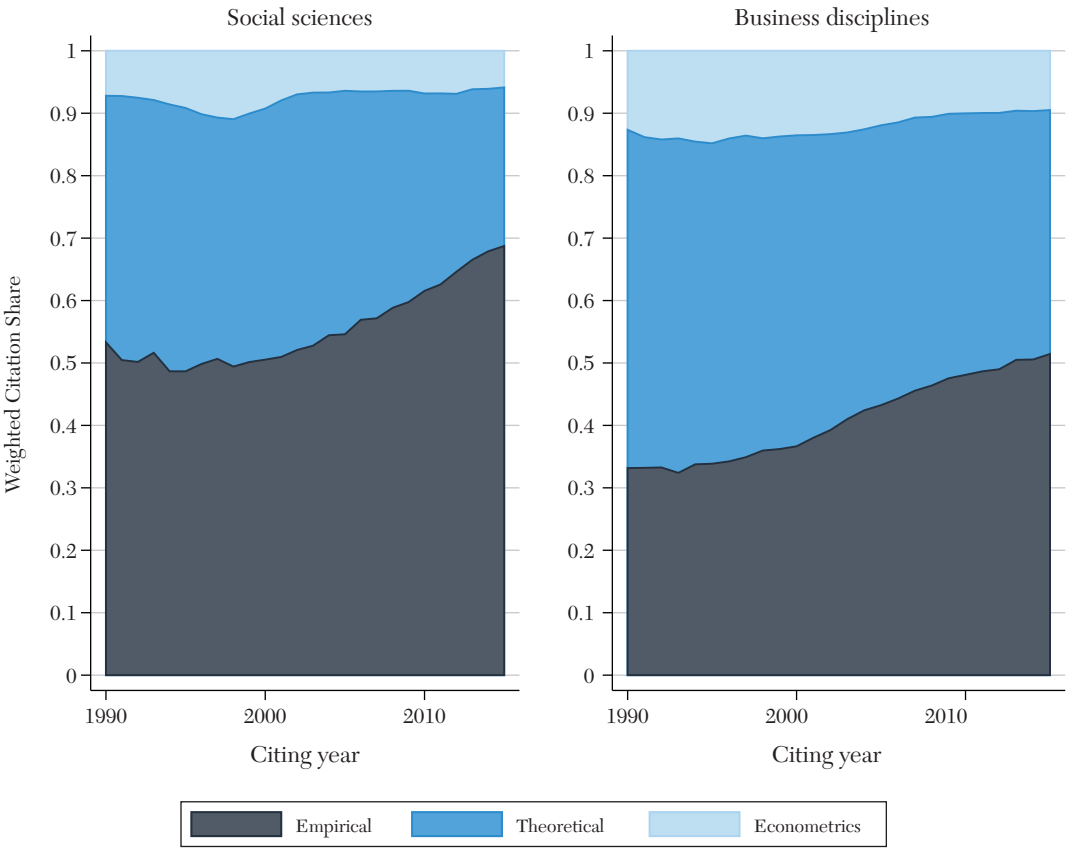

Figure 16. Extramural Citation Shares to Styles, Social Science and Business Disciplines

Notes: This figure plots aggregated weighted citation shares from social science disciplines (psychology, sociology, political science, anthropology) and business disciplines (management, finance, accounting, marketing) to economics styles. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

from around 40 percent in the 1990s to over 60 percent in 2015.

The style story for disciplines where economics has somewhat less influence is more mixed (these disciplines are labeled "group B" in the fields discussion). As can be seen in figure 19, sociology has long focused on empirical work. Even so, the empirical share in extramural citations from sociology increased steadily after the early 1990s, so that 80 percent of sociology references now go to empirical papers. Sociology's early empirical emphasis is noteworthy: this suggests sociology's engagement with economics has long been substantive, rather than merely critical of the neoclassical theoretical framework emphasizing rational choice.

Figure 19 also documents statistics' long-standing and growing interest in econometrics, a result discussed above in the context of figure 11 for fields. The same

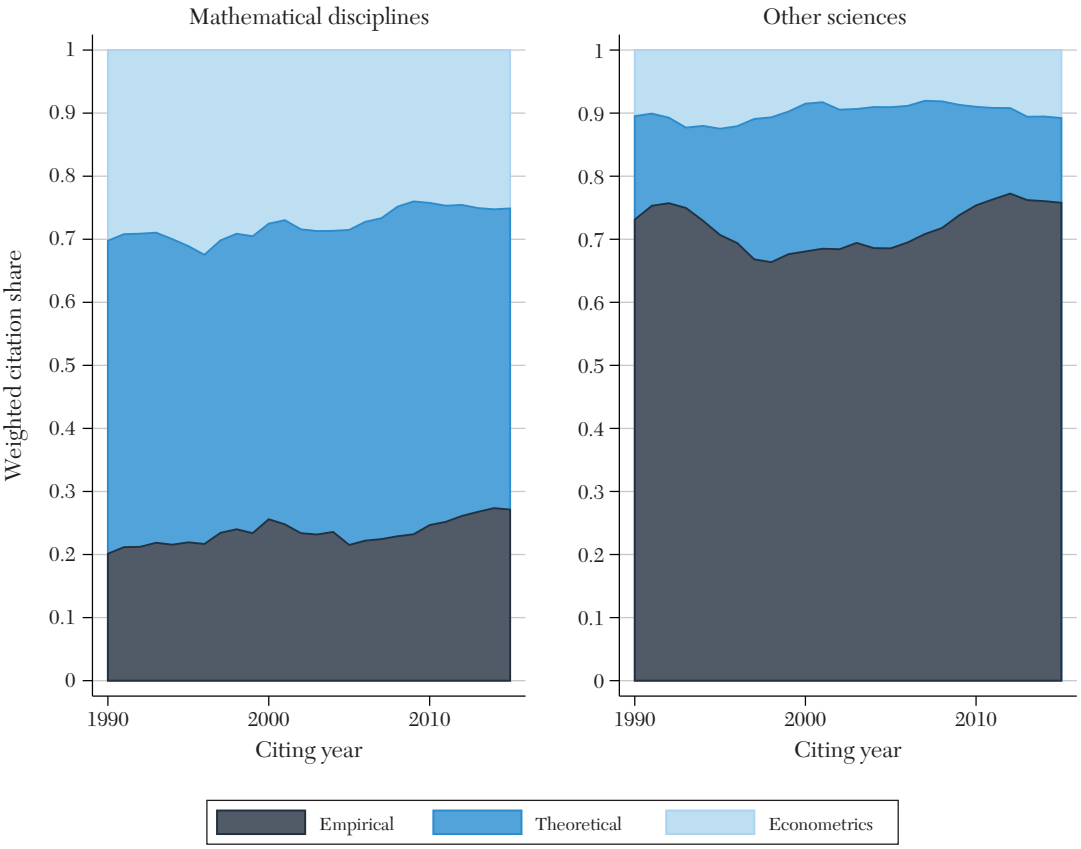

Figure 17. Extramural Citation Shares to Styles, Mathematical and Other Science Disciplines

Notes: This figure plots aggregated weighted citation shares from math disciplines (statistics, operations research, computer science, and math) and other sciences (medicine, public health, physics, and multidisciplinary science) to styles. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

figure shows that the empirical share in citations from marketing ends up below that in economics, while management directs considerably more attention to empirical work than does marketing. Extramural citations from marketing tilt more toward empirical work at the end of the sample period than at the beginning, but the changes here are modest. Starting from a very low base in 1990, management has recently begun to reference econometrics.

Figure 20 documents the changing mix of research styles cited by "group C" disciplines where economics' influence is growing. Bucking the trend toward empirical work in extramural citations from other disciplines, growth in extramural citations from computer science is driven by theoretical work.

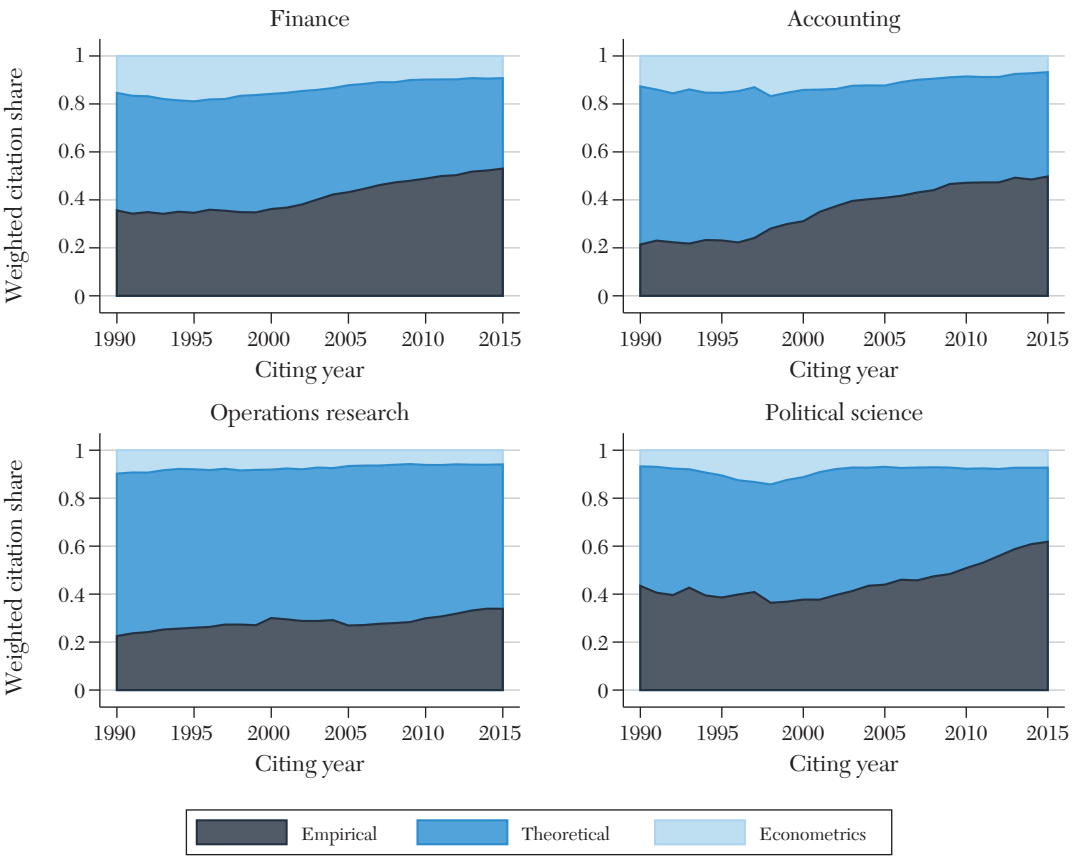

Figure 18. Citations from Discipline Group A to Economics Styles

Notes: This figure shows weighted citation rates from disciplines where economics is very influential to economics styles. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

By contrast, psychology's accelerating interest in economics seems to reflect increased interest in empirical work. Since around 2000, citations from multidisciplinary science have also increasingly tilted empirical. The extramural citation share going to empirical papers has crossed the 50 percent line for both of these disciplines. At the same time, medicine and public health have long favored empirical economics; this empirical emphasis is unchanged.

Figure 21 presents a per-paper analysis in the mode of figure 15, turning here to the style preferences of other disciplines. Panel A of this figure reports the coefficient on an empirical dummy in a Poisson regression model for trunk-journal-weighted citation rates from the group of noneconomics

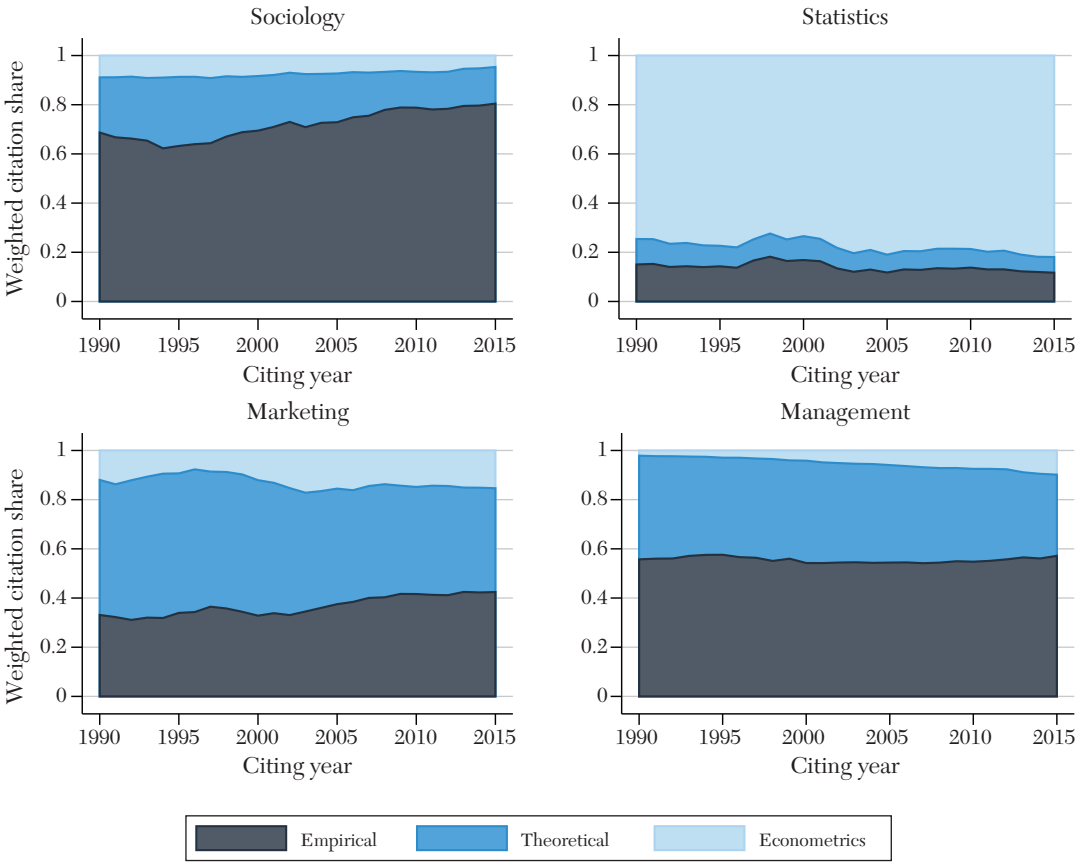

Figure 19. Citations from Discipline Group B to Economics Styles

Notes: This figure shows weighted citation rates from disciplines where economics is influential to economics styles. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

social sciences to specific articles (again, estimated using specification (7)). Panel B shows the empirical effect in a similar regression with the weighted citation share from non-social science disciplines as the dependent variable. The regressions generating these estimates include field and journal controls, as in panel B of figure 15.[32] The resulting estimates suggest that in the early 1980s, empirical economics papers received fewer extramural citations than did theoretical papers published in the same journal and field. Estimates of these effects are noisier than the estimates of our model examining

[32] Also as in figure 15, each observation in the sample used to compute these estimates is one economics paper. The dependent variable is the trunk-weighted citation share from noneconomics journals over the life of the article. Shares are averaged across disciplines in each citing group.

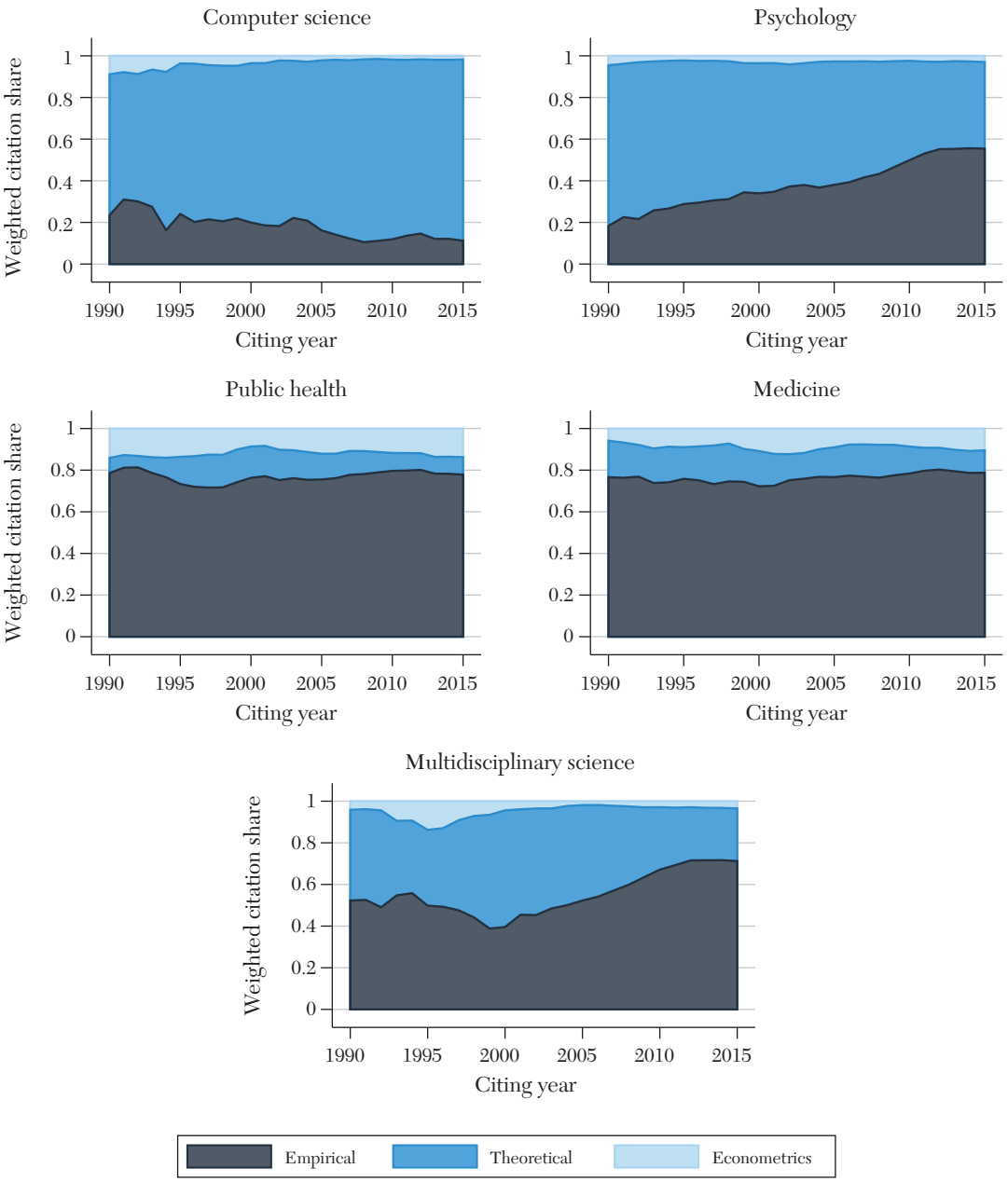

Figure 20. Citations from Discipline Group C to Economics Styles

Notes: This figure shows weighted citation rates from disciplines where the influence of economics is growing to economics styles. Plots are smoothed with five-year moving averages. Papers cited were published between 1970 and 2015.

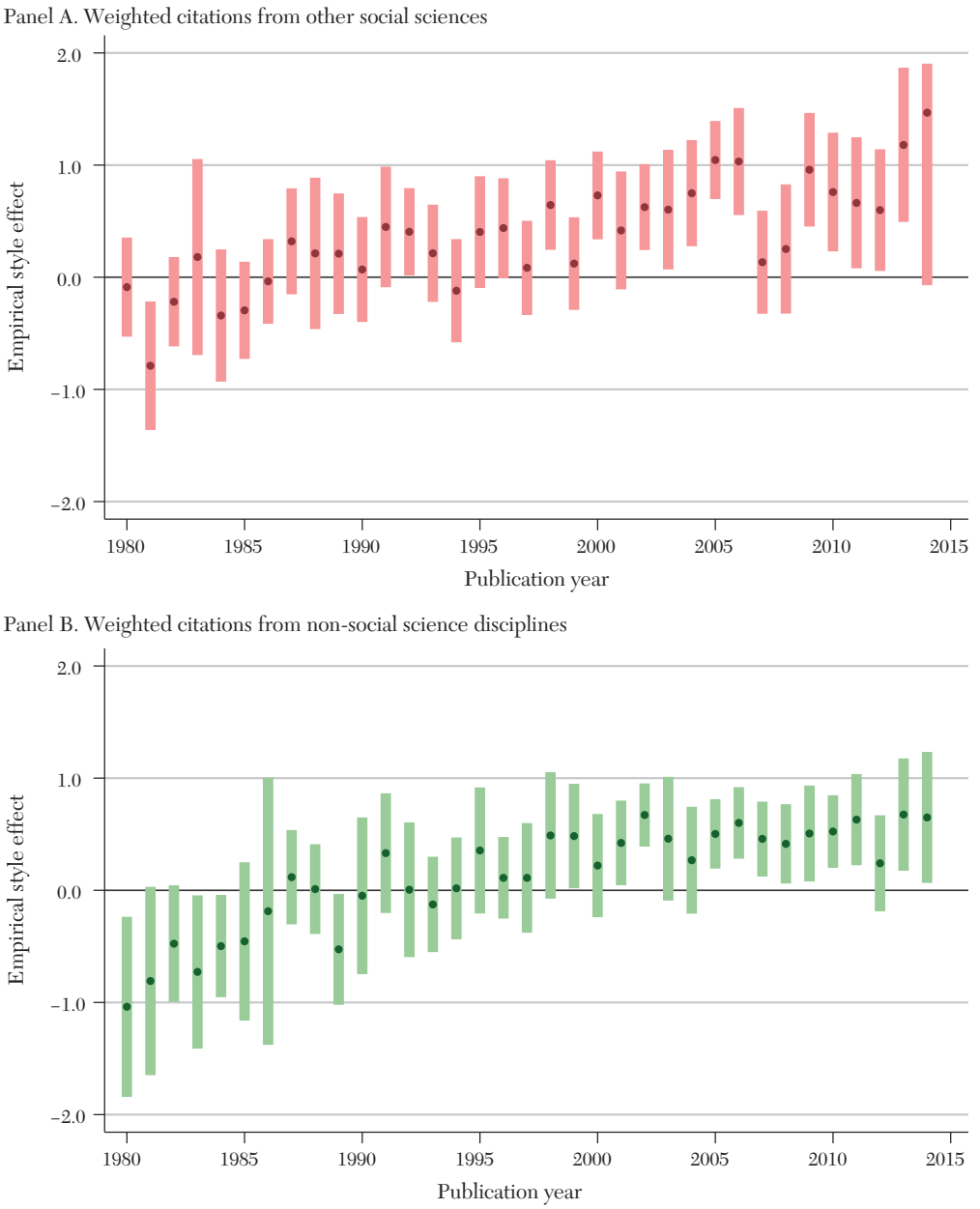

Figure 21. The Empirical Effect in Extramural Citations of Individual Articles

Notes: This figure plots Poisson regression estimates of the empirical effect on weighted citations per paper. Estimates are from models estimated separately by year, with flexible controls for paper length, number of authors, and field and journal controls. Panel A reports effects on weighted citations from noneconomics social sciences, and panel B reports effects on citations from all other disciplines. Confidence bands use robust standard errors.

intramural per-paper citations, but a few are significantly negative. Later, however, this pattern reverses: by the late 1990s, the empirical citation disadvantage had become a substantial and enduring empirical citation premium.

Just as economists have moved to write, read, and reference more empirical economic analysis, so too have most of the outsiders who follow economic scholarship. The shift toward empirical work in extramural citations per paper seems to have emerged around the same time as the empirical shift in per-paper citations from economics. This timing is consistent with the Angrist and Pischke (2010) claim that empirical economics has evolved since the 1980s to be more credible and increasingly worth attending to. But economic theory remains important both inside and outside economics. The theory share in citations from economics today runs around 40 percent; the corresponding share for extramural disciplines is 37 percent. Mathematical disciplines still cite theory more than empirical work.

6.4 *Extramural Centrality*

What sort of economics articles are most widely read by outsiders? Do sociologists, for example, read articles that are well cited within economics? Perhaps outsiders' attention goes mostly to economics research seen as peripheral inside the discipline.

We explore this question by characterizing the centrality of economics journals within economics and then asking whether extramural citations flow to more or less central journals. A journal is more central, for example, if it often cites the *AER*. Less central journals tend to cite *World Development* or *Land Economics*. Our reference-based centrality measure categorizes new journals, such as those in the AEA's *American Economic Journal* series, as central even though they are too new to have attracted many references. This accords with our view of how economists see economics journals.

Our centrality measure is constructed by first computing journals' eigenvector centrality (introduced by Bonacich 1972) from total intramural citation flows, normalized by the number of citable items published from 1960–2015.[33] The journals each journal references are then used to construct a weighted centrality score. For example, were a journal to cite only *The Journal of Public Economics* and *Econometrica*, its centrality measure for our purposes would be the citation-weighted average of these two journals' eigenvector centrality as computed in the first step. Finally, centrality scores are standardized to have unit variance.[34]

Figure 22 describes the relationship between economics journal centrality and weighted citation shares for citing papers in social science disciplines published 2010–15. Journals are ordered on the x axis by centrality, while filled circles mark their extramural citation shares and open circles plot the corresponding intramural shares. In the upper panel, for example, we see that highly central journals like the *AER* and the *QJE* are cited at a similar rate by economics and political science. On the other hand, *Econometrica* is cited less often by sociology and political

[33]This step uses Stata's netsis routine (Miura 2012). A high eigenvector centrality score means that a network node is connected to many other nodes that also have high scores. Google's PageRank algorithm uses a variant of eigenvector centrality to gauge the relevance of web pages to a search query.

[34]The six most central journals according to our measure are *Econometrica*, the *Journal of Economic Theory*, the *Journal of Political Economy* (*JPE*), the *Review of Economic Studies*, the *Quarterly Journal of Economics*, and the *American Economic Review*, while the six most peripheral journals are *Kyklos*, the *American Journal of Agricultural Economics*, *World Development*, the *Journal of Economic Education*, *Land Economics*, and the *Monthly Labor Review*. The *American Economic Review* is the least central of the traditional "top five." This is due in large part to the influence of items published in the annual *Papers & Proceedings* issue.

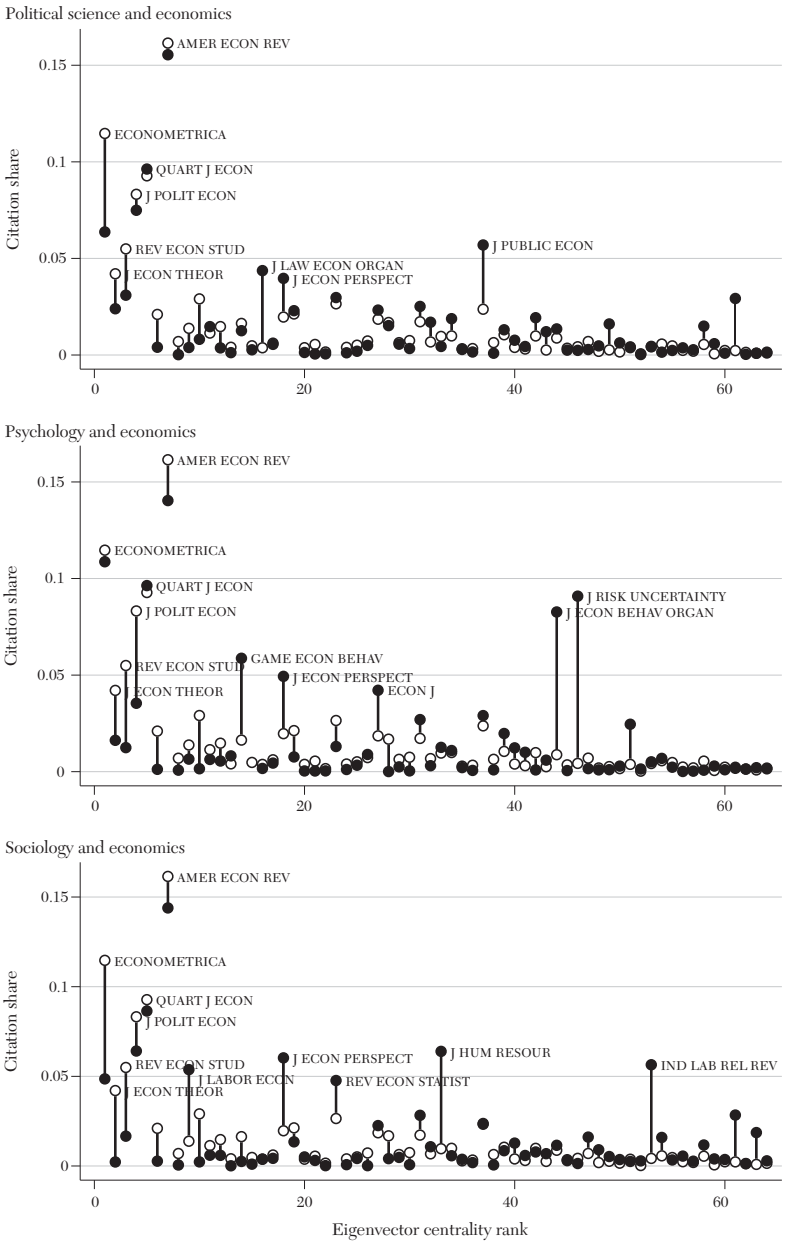

Figure 22. Share of Social Science Citations to Economics Journals Ranked by Centrality (2010–15)

Notes: This figure plots the trunk-weighted share of citations from social science disciplines to economics journals. Economics citation rates are plotted with hollow markers. Extramural discipline citation rates are plotted with filled markers. Journals are sorted by centrality within the economics citation network. The citing papers used to calculate the citation shares were published between 2010 and 2015.

science than by economics. Importantly, centrality is not just another impact factor. In particular, specialized but well-cited field journals like the *Journal of Public Economics*, *Industrial and Labor Relations Review*, and the *Journal of Risk and Uncertainty* receive low centrality scores.

Extramural social science citations mostly flow to the outlets that economists are likely to see as central. At the same time, social science disciplines also have idiosyncratic favorites. These are journals with content that is particularly well-aligned with specific extramural interests. For example, sociology references the *Journal of Human Resources* more intensively than does economics, while psychology favors the *Journal of Economic Behavior and Organization* over the *JPE*. Online appendix figure A3 reports comparisons like those in figure 22 for non-social-science discipline groups. The citation behavior of business disciplines matches that of economics closely. Journals in our combined mathematical disciplines are especially likely to reference the *Journal of Econometrics*, while multidisciplinary science journals cite the *Journal of Health Economics* more often than does economics.

Table 3 summarizes these patterns with regression estimates. Specifically, the table reports the coefficient on journal centrality in an extended version of equation (7) that includes centrality as an additional regressor, omitting journal fixed effects. These estimates show that journal centrality is associated with higher extramural citation rates from all four of our discipline groups. For example, a one standard deviation increase in centrality boosts social science citations by about 34 percent, a precisely estimated effect (reported in the first column of table 3). The association between centrality and extramural citation rates is roughly three times larger for business and mathematical disciplines than for social sciences. On the other hand, the centrality coefficient is small and not significantly different from zero for the group of other disciplines.

The extramural attention that central journals receive partly reflects the fact that these journals publish more influential papers inside as well as outside economics. We therefore add controls for the citations that paper i in journal j receives from economics journals and for the citations economics articles make to journal j as a whole. These results, reported in columns 5–8 of table 3, show that highly cited papers in economics are also well cited by others (the coefficient on economics citations ranges from about 0.5 to 0.8). The fact that a journal is highly cited by economics matters much less than economics citations to papers. Interestingly, controlling for economics citations reverses the centrality effect in the social science and other discipline groups, while shrinking it in the business and math groups. This pattern suggests that *within* the group of well-cited economics papers, extramural disciplines look more closely at work published in more peripheral journals. This seems consistent with the evidence for disciplinary favorites shown in figure 22.

6.5 *Extramural Leaderboards*

We conclude with a brief discussion of papers that have had the deepest extramural impact. In a format mirroring that of table 1, online appendix table A4 lists the ten papers most cited each decade by each of our four extramural discipline groups: social sciences other than economics, business disciplines, mathematical disciplines, and other sciences. These lists point to a number of interesting similarities and differences in disciplinary favorites.

The papers most cited by both economists and outsiders were published mostly in top outlets. As a benchmark, forty-four of the

TABLE 3
Effects of Journal Centrality on Weighted Extramural Citation Shares

	Without economics citation controls				With economics citation controls			
	Social science (1)	Business (2)	Math (3)	Other (4)	Social science (5)	Business (6)	Math (7)	Other (8)
Empirical	0.519	0.334	−0.550	1.093	0.272	0.086	−0.777	0.802
	(0.088)	(0.120)	(0.091)	(0.113)	(0.063)	(0.087)	(0.094)	(0.108)
Journal centrality	0.338	1.143	1.064	0.128	−0.355	0.238	0.527	−0.498
	(0.090)	(0.116)	(0.122)	(0.140)	(0.065)	(0.099)	(0.087)	(0.130)
log(paper cites: econ)					0.631	0.799	0.475	0.571
					(0.041)	(0.080)	(0.036)	(0.038)
log(journal cites: econ)					0.084	0.081	−0.014	0.088
					(0.023)	(0.038)	(0.030)	(0.036)

Notes: Each column reports estimates for extramural citations from a single discipline group. Models include year dummies, number of author dummies, and a cubic function for page length. Journal centrality is calculated as described in the text. Robust standard errors clustered by journal × decade are shown in parentheses. The sample used to compute these estimates contains 119,069 economics articles published 1980–2015.

fifty papers on the economics leaderboard are in just four journals: *AER*, *Econometrica*, *JPE*, and *QJE*.[35] The corresponding figure for other social sciences is 33. The *AER* has between four or nine papers on each of the economics and extramural discipline lists, while *Econometrica* has between 8 and 21. Representation of the *JPE* and *QJE* is more variable, with counts ranging from 0–1 in the list for mathematical disciplines to 12–13 in the list for business disciplines. Some field journals are well-represented on the extramural leaderboards. The mathematical disciplines' top ten list includes four or five papers each in the *Journal of Economic Theory*, the *Journal of Econometrics*, and *Games and Economic Behavior*. The list for the other sciences group includes ten papers in the *Journal of Health Economics* and seven in the *Journal of Human Resources*.

Leaderboards for economics and other discipline groups show moderate overlap. Four papers from the economics list appear on all four extramural lists: Hausman (1978), Heckman (1979), Kahneman and Tversky (1979), and White (1980). Five papers from the economics list appear on two extramural lists: Akerlof (1970); Hölmstrom (1979); Fehr and Schmidt (1999); Bertrand, Duflo, and Mullainathan (2004); and Kling, Liebman, and Katz (2007). But thirty-four of fifty papers on the economics list appear on no other list. Interestingly, the extramural leaderboards include well-known papers that nevertheless fail to make the economics top fifty. This includes Crawford and Sobel (1982) and Meltzer and Richard (1981), heavily cited by other social sciences, and Groves (1973), heavily cited by mathematical disciplines. The business list includes

[35] Perhaps surprisingly, only one of the fifty appears in the *Review of Economic Studies*, often categorized as "top five."

Merton (1973), and the other sciences list includes White (1982).

The extramural lists include articles by authors that straddle disciplines. For example, the social science leaderboard includes four by Barry Weingast, a scholar identified by Wikipedia as a political scientist as well as an economist. Political scientist Richard McKelvey (deceased) has two on the social science list. It seems noteworthy, though, that McKelvey was also an Econometric Society Fellow. Tim Roughgarden and Eva Tardos, authors on the mathematical disciplines leaderboard, are computer scientists. But most of the papers on extramural leaderboards were written by card-carrying economists writing on core economic topics. For example, the social sciences leaderboard includes papers by Acemoglu, Alesina, Fair, Duflo, Krueger, Rodrik, and Shleifer (and their coauthors); the other sciences list includes papers by Case, Cutler, Finkelstein, Gruber, Lleras-Muney, and Paxson (and coauthors); the mathematical leaderboard list includes Edelman, Ostrovsky, and Schwarz's study of Google's advertising auctions and a number of papers by leading econometricians and economic theorists.

Extramural leaderboards also reflect recent shifts in empirical methods. The Imbens and Lemieux (2008) survey of regression discontinuity methods appears on the social science list; Bertrand, Duflo and Mullainathan (2004) on differences-in-differences inference appears on the business and other sciences lists; Staiger and Stock (1997) on weak instruments makes the other sciences list; and the Imbens and Angrist (1994) interpretation of instrumental variables estimators appears in the mathematical disciplines list. It seems noteworthy, however, that most of the highly cited articles published in the twenty-first century focus on substantive questions rather than methods. The leaderboards also reflect methodological diversity in the empirical sphere. Many applied papers on these lists use simple regression methods, but some use more advanced or recently developed methods of causal inference. Several analyze randomized trials and one describes a field experiment. As economics scholarship has evolved to become more empirical, other disciplines have found value in economic research that deploys a variety of empirical techniques.

7. *Summary and Conclusions*

Is economics scholarship an enterprise with deep impact or merely an inside job? The value of any research enterprise is necessarily subjective, and a discipline's practitioners may provide a biased view. It's significant, therefore, that many sophisticated noneconomists find economics scholarship worth referencing. Economics is the most influential social science in seven out of the sixteen extramural disciplines we examine, and economics is recently tied for first in two more (psychology and computer science). In many disciplines, the extramural influence of economics is growing; only in business-related disciplines has economics' extramural influence fallen. Some disciplines' interest in economics started growing in the 1980s, while the increase for others is more recent. Many economics fields contribute to economics' extramural influence.

Consistent with the "credibility revolution" hypothesis advanced by Angrist and Pischke (2010), empirical work has come to draw an increasing share of attention from most of the disciplines where economics is important. This mirrors the growing importance of empirical work within economics, a sustained shift that's also visible within economics fields. At the same time, theoretical scholarship retains a large—and in the case of computer science, growing—share of extramural readership from our group of mathematically oriented disciplines.

The role of empirical economics as a *cause* of increasing extramural influence probably varies by discipline. In finance, accounting, and political science, economics' influence had reached or approached a peak by the mid-1980s, a period when empirical work played second fiddle to economic theory. But these long-attentive disciplines have moved since the late 1990s to focus more on empirical work, a factor likely contributing to their sustained interest. In psychology, public health, medicine, and multidisciplinary science, the empirical concentration of economics citations since 2000 is also consistent with empirical work as a causal factor driving citation growth. The proliferation of empirical economic research that makes less use of economic theory may have contributed to this. Noneconomists may find papers lacking formal economic models more accessible, and they may also be more willing to trust empirical results that are mostly data driven, rather than built partly on theoretical assumptions about behavior.

Two exceptions to this story of empirical influence are noteworthy. Increased interest in economics in operations research and computer science, which also starts around 2000, seems likely attributable to theory. This is consistent with our evidence that the diversity of economics fields and styles contributes to its increasing extramural influence. Almost every economics field has an extramural constituency. While this isn't proof that diversity causes interest, it's strongly suggestive of this. Imagine a counterfactual world in which the economics topic distribution matches that of the *Econometrica* table of contents in January 1960. Few extramural readers outside of mathematical disciplines would be tempted to pick this up at the newsstand. The fact that the leading economics journals (including *Econometrica*) have evolved and diversified seems important for economics' broadening appeal.

Finally, we return to the fact that economists are also increasingly likely to reference other social sciences. This expansion of horizons has generated an extramural citation rate from economics to other social sciences that now exceeds the extramural citation rate from psychology. Since 1990, economics has been especially and increasingly attentive to political science. We see little in citation statistics to support the notion that economics is intellectually isolated. And, just as economists do, other social scientists primarily reference articles in journals central to economics scholarship. The growing links between economic research and a wide range of other disciplines reinforce our view that economics scholarship has never been more exciting or useful than it is today.

References

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* 91 (5): 1369–401.

Akerlof, George A. 1970. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 84 (3): 488–500.

Angrist, Joshua, Pierre Azoulay, Glenn Ellison, Ryan Hill, and Susan Feng Lu. 2017. "Economic Research Evolves: Fields and Styles." *American Economic Review: Papers and Proceedings* 107 (5): 293–97.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2010. "The Credibility Revolution in Empirical Economics: How Better Research Design Is Taking the Con out of Econometrics." *Journal of Economic Perspectives* 24 (2): 3–30.

Azar, Ofer H. 2008. "The Impact of Economics on Management." *Journal of Economic Behavior and Organization* 68 (3–4): 667–75.

Azar, Ofer H. 2009. "The Influence of Economics Articles on Business Research: Analysis of Journals and Time Trends." *Journal of Industrial Economics* 57 (4): 851–69.

Backhouse, Roger, and Béatrice Cherrier. 2014. "Becoming Applied: The Transformation of Economics after 1970." Center for the History of Political Economy Working Paper 2014-15.

Backhouse, Roger E., and Béatrice Cherrier. 2017. "The Age of the Applied Economist: The Transformation of Economics since the 1970s." *History of Political Economy* 49 (Supplement): 1–33.

Berry, Steven, James Levinsohn, and Ariel Pakes. 1995.

"Automobile Prices in Market Equilibrium." *Econometrica* 63 (4): 841–90.
Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119 (1): 249–75.
Biddle, Jeff E., and Daniel S. Hamermesh. 2017. "Theory and Measurement: Emergence, Consolidation, and Erosion of a Consensus." *History of Political Economy* 49 (Supplement): 34–57.
Bolton, Gary E., and Axel Ockenfels. 2000. "ERC: A Theory of Equity, Reciprocity, and Competition." *American Economic Review* 90 (1): 166–93.
Bonacich, Phillip. 1972. "Factoring and Weighting Approaches to Status Scores and Clique Identification." *Journal of Mathematical Sociology* 2 (1): 113–20.
Breiman, Leo. 2001. "Random Forests." *Machine Learning* 45 (1): 5–32.
Card, David, and Stefano DellaVigna. 2013. "Nine Facts about Top Journals in Economics." *Journal of Economic Literature* 51 (1): 144–61.
Cherrier, Beatrice. 2017. "Classifying Economics: A History of the *JEL* Codes." *Journal of Economic Literature* 55 (2): 545–79.
Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans. 2005. "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy." *Journal of Political Economy* 113 (1): 1–45.
Crawford, Vincent P., and Joel Sobel. 1982. "Strategic Information Transmission." *Econometrica* 50 (6): 1431–51.
Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica* 70 (5): 1741–79.
Ellison, Glenn. 2002. "The Slowdown of the Economics Publishing Process." *Journal of Political Economy* 110 (5): 947–93.
Ellison, Glenn. 2013. "How Does the Market Use Citation Data? The Hirsch Index in Economics." *American Economic Journal: Applied Economics* 5 (3): 63–90.
Fehr, Ernst, and Klaus M. Schmidt. 1999. "A Theory of Fairness, Competition, and Cooperation." *Quarterly Journal of Economics* 114 (3): 817–68.
Fischbacher, Urs. 2007. "z-Tree: Zurich Toolbox for Ready-made Economic Experiments." *Experimental Economics* 10 (2): 171–78.
Fourcade, Marion, Etienne Ollion, and Yann Algan. 2015. "The Superiority of Economists." *Journal of Economic Perspectives* 29 (1): 89–114.
Groves, Theodore. 1973. "Incentives in Teams." *Econometrica* 41 (4): 617–31.
Hall, Robert E. 1978. "Stochastic Implications of the Life Cycle–Permanent Income Hypothesis: Theory and Evidence." *Journal of Political Economy* 86 (6): 971–87.
Hall, Robert E., and Charles I. Jones. 1999. "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *Quarterly Journal of Economics* 114 (1): 83–116.
Hamermesh, Daniel S. 2013. "Six Decades of Top Economics Publishing: Who and How?" *Journal of Economic Literature* 51 (1): 162–72.
Hamermesh, Daniel S. 2018. "Citations in Economics: Measurement, Uses, and Impacts." *Journal of Economic Literature* 56 (1): 115–56.
Hamermesh, Daniel S., George E. Johnson, and Burton A. Weisbrod. 1982. "Scholarship, Citations and Salaries: Economic Rewards in Economics." *Southern Economic Journal* 49 (2): 472–81.
Hausman, Daniel M. 1992. *The Inexact and Separate Science of Economics*. Cambridge and New York: Cambridge University Press.
Hausman, J. A. 1978. "Specification Tests in Econometrics." *Econometrica* 46 (6): 1251–71.1
Heckman, James J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47 (1): 153–61.
Hilmer, Michael J., Michael R. Ransom, and Christiana E. Hilmer. 2015. "Fame and the Fortune of Academic Economists: How the Market Rewards Influential Research in Economics." *Southern Economic Journal* 82 (2): 430–52.
Hofbauer, Josef, and Karl Sigmund. 2003. "Evolutionary Game Dynamics." *Bulletin of the American Mathematical Society* 40 (4): 479–519.
Hölmstrom, Bengt. 1979. "Moral Hazard and Observability." *Bell Journal of Economics* 10 (1): 74–91.
Imbens, Guido W., and Joshua D. Angrist. 1994. "Identification and Estimation of Local Average Treatment Effects." *Econometrica* 62 (2): 467–75.
Imbens, Guido W., and Thomas Lemieux. 2008. "Regression Discontinuity Designs: A Guide to Practice." *Journal of Econometrics* 142 (2): 615–35.
Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47 (2): 263–91.
Katz, Lawrence F., and Kevin M. Murphy. 1992. "Changes in Relative Wages, 1963–1987: Supply and Demand Factors." *Quarterly Journal of Economics* 107 (1): 35–78.
Kelly, Michael A., and Stephen Bruestle. 2011. "Trend of Subjects Published in Economics Journals 1969–2007." *Economic Inquiry* 49 (3): 658–73.
Kling, Jeffrey R., Jeffrey B. Liebman, and Lawrence F. Katz. 2007. "Experimental Analysis of Neighborhood Effects." *Econometrica* 75 (1): 83–119.
Kydland, Finn E., and Edward C. Prescott. 1977. "Rules Rather Than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy* 85 (3): 473–91.
Laibson, David. 1997. "Golden Eggs and Hyperbolic Discounting." *Quarterly Journal of Economics* 112 (2): 443–78.
Leydesdorff, Loet. 2004. "Top-down Decomposition of the *Journal Citation Report* of the *Social Science Citation Index*: Graph- and Factor-analytical Approaches." *Scientometrics* 60 (2): 159–80.
Lynn, Freda B. 2014. "Diffusing through Disciplines: Insiders, Outsiders, and Socially Influenced Citation Behavior." *Social Forces* 93 (1): 355–82.
McRae, Shaun. 2015. "Infrastructure Quality and the

Subsidy Trap." *American Economic Review* 105 (1): 35–66.
Meltzer, Allan H., and Scott F. Richard. 1981. "A Rational Theory of the Size of Government." *Journal of Political Economy* 89 (5): 914–27.
Merton, Robert C. 1973. "An Intertemporal Capital Asset Pricing Model." *Econometrica* 41 (5): 867–87.
Miura, Hirotaka. 2012. "Stata Graph Library for Network Analysis." *Stata Journal* 12 (1): 94–129.
Moody, James, and Ryan Light. 2006. "A View from Above: The Evolving Sociological Landscape." *American Sociologist* 37 (2): 67–86.
Panhans, Matthew T., and John D. Singleton. 2017. "The Empirical Economist's Toolkit: From Models to Methods." *History of Political Economy* 49 (Supplement): 127–57.
Pieters, Rik, and Hans Baumgartner. 2002. "Who Talks to Whom? Intra- and Interdisciplinary Communication of Economics Journals." *Journal of Economic Literature* 40 (2): 483–509.
Robbins, Lionel. 1932. *An Essay on the Nature and Significance of Economic Science*. London: Macmillan.
Romer, Paul M. 1986. "Increasing Returns and Long-run Growth." *Journal of Political Economy*
94 (5): 1002–37.
Staiger, Douglas, and James Stock. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65 (3): 557–86.
White, Halbert. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48 (4): 817–38.
White, Halbert. 1982. "Maximum Likelihood Estimation of Misspecified Models." *Econometrica* 50 (1): 1–25.
Zingales, Luigi. 2014. "Preventing Economists' Capture." In *Preventing Regulatory Capture: Special Interest Influence and How to Limit It*, edited by Daniel Carpenter and David A. Moss, 124–51. Cambridge: Cambridge University Press.

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1. Marlène Koffi. 2021. Gendered Citations at Top Economic Journals. *AEA Papers and Proceedings* **111**, 60-64. [Abstract] [View PDF article] [PDF with links]