The Binding Force of Economics

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Abstract

A discipline is bound by some combination of a shared subject matter, shared theory, and shared technique. Yet modern economics is seemingly without limit to its domain. As a discipline without a shared subject matter, what is the binding force of economics today? We combine topic modeling and text analysis to analyze different approaches to inquiry within the discipline of economics. We find that the importance of theory has declined as economics has increasingly become defined by its empirical techniques. We question whether this trajectory is stable in the long run as the binding force of the discipline.

1 Introduction

What defines a discipline? What distinguishes economics from sociology, anthropology, political science, or any other social science discipline? Early definitions of economics were centered around the subject matter of wealth and economic growth (Backhouse and Medema 2009). Jean-Baptiste Say (1803 [1834]: 15), for example, considered economics to be the science that "unfolds the manner in which wealth is produced, distributed, and consumed." Alfred Marshall offered a similar subject-centric definition, but with an important and expansive addition. Marshall (1890 [2013]: 1) defined economics as the "study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of well being. Thus it is on the one side a study of wealth; and on the other, and more important side, a part of the study of man."

More recent definitions have embraced Marshall's "more important side" to economic inquiry, choosing to center the definition on the problem that ails us all, scarcity. Lionel Robbins' definition is perhaps the most famous in this regard. According to Robbins (1932: 15), economics is "the science which studies human behavior as a relationship between ends and scarce means which have alternative uses." And while this definition better identifies the all-encompassing problem to be studied, it says little about *how* it is to be studied (Becker 1976).

To further distinguish the discipline, economists sought to identify and embrace a distinct methodology for studying the problem of scarcity. Consider George Stigler's (1942: 12) definition of economics as "the study of the principles governing the allocation of scarce resources among competing ends when the objective of the allocation is to maximize the attainment of the ends." This definition is practically identical to Robbins' yet adds an important methodological assumption about the aim of those facing scarcity, maximization. Or consider Gary Becker's framing of what would uniquely qualify an economic approach to understanding behavior. As Becker (1976: 5) sees it, "The combined assumptions of maximizing behavior, market equilibrium, and stable preferences, used relentlessly and unflinchingly, form the heart of the economic approach". The problem of scarcity may be ubiquitous, but the discipline of economics could be distinguished by its unique methodology—price theory (Becker 1976; Weyl 2019).

Ronald Coase offers an alternative approach to defining a discipline, one rather fitting for an economist. According to Coase (1978: 204), a discipline is bound together by some combination of "common techniques of analysis, a common theory or approach to the subject, or a common

subject matter". However, instead of being constrained by a rigid definition or strict methodology, the boundaries of a discipline are determined by competition. An established discipline may increase their market share and expand their domain in the short run by applying better attuned techniques and theories, but in the long run the practitioners in these other fields will simply adopt the more successful approaches and, with their deeper knowledge of the subject matter, displace the encroaching scholars. Accordingly, the competitive forces that Coase outlines brings us back to the earlier subject-centric definition as a discipline will come to be defined by "the normal binding force of a scholarly profession, its subject matter." For economists, this would mean studying "the working of the social institutions which bind together the economic system: firms, markets for goods and services, labour markets, capital markets, the banking system, international trade, and so on" (Coase 1978: 206-207).

If Coase is correct about the long run dynamics of the discipline, then we are well within the short run. The domain of economic inquiry has further expanded since the time Coase was writing, not contracted. A cursory reading of the table of contents of a modern economics journal can bear little resemblance to traditional topics and articles on pirates (Leeson 2007a), magical beliefs (Nunn and de la Sierra 2017), teacher quality (Araujo et al. 2016), media bias (Chiang and Knight 2011), Islam and female empowerment (Meyersson 2014), and MTV shows (Kearney and Levine 2015) can be found in leading economics journals.[1]

This expansion has largely been attributed to the methodological approach of Becker and the Chicago school which helped usher in and accelerate an era of "economic imperialism" as economists expanded into the traditional domains of other disciplines (Lazear 2000). Becker was even awarded the Nobel Prize in 1992 for his contribution of "extend[ing] the domain of economic theory to aspects of human behavior which had previously been dealt with by other social science disciplines".[2] The success of the Chicago school can be attributed to their use of a simple theory with testable predictions and a commitment to empirical falsification (Weyl 2019; for particular reference to Becker's approach see Heckman 2015).[3] Economics became synonymous with

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[1] Economics books aimed at popular audiences, such as Stephen Dubner and Steven Levitt's *Freakonomics* or Peter Leeson's *WTF?!: An Economic Tour of the Weird*, also suggest that there is seemingly no limitation to the domain of modern economic inquiry.

[2] See https://www.nobelprize.org/prizes/economic-sciences/1992/becker/facts/

[3] This approach is, of course, not without critics. Behavioralists attacked the core assumptions as unrealistic while experimentalist econometricians attacked it for holding "hard core" propositions which were protected from falsification, such as utility maximization or demand curves sloping downward. Any evidence to the contrary was suggestive of misspecification rather than falsehood (Leamer 1983).

explanations of human behavior based on changes in relative prices and constraints (price theory), modeled mathematically to generate formal predictions which were tested using empirical data and statistical techniques (econometrics). As economics became a discipline without a shared subject, it emerged as one bound by a shared theory and techniques. To what extent is this true today?

To answer this question, we combine topic modeling and text analysis to analyze different approaches to inquiry within the discipline of economics. Section 2 provides a brief explanation of topic modeling and text analysis and then outlines our data and methods. Section 3 presents our results. We find that the importance of theory has declined as economics has increasingly become defined by its empirical techniques. Our results are not surprising. Panhans and Singleton (2017), for example, document a paradigm shift in economics away from rationality-based models towards causal identification strategies beginning in the 1970s. Hamermesh (2013) finds a similar decline in theory and rise in empirical analysis. Our results also align with the applied turn hypothesis of Backhouse and Cherrier (2014) in which applied economic work is increasingly afforded elevated status in comparison to theoretical work. While our results may be unsurprising, we provide better systematic evidence of this trend given our more thorough empirical approach—we don't simply look at some articles in some journals in some years, we look at every article published in the top five journals since their creation.

Second 4 analyzes our results in light of Coase's arguments about the competitive dynamics of a discipline. To the extent Coase is right about the long run, economists may be forced back to the discipline's original domain or become subsumed as a subdiscipline of statistics. Alternatively, we identify a third way out of this dilemma, one embraced by modern Beckerians and Austrians. Section 5 concludes.

2   Data and Methods

In order to trace the different approaches to doing economics, we first must be able to identify and distinguish between them. We employ a machine learning topic model to identify the key words—called topic words—that define each approach. The prevalence of these topic words is subsequently traced through the top five economic journals as representative of the mainstream of the discipline. We are primarily interested in identifying and comparing the main theoretical approach to economics, price theory, and the main empirical technique, econometrics. However,

we identify and analyze three additional approaches for robustness purposes. The additional approaches include graduate microeconomics, mathematical economics, and Austrian economics.[4]

Our topic model approach features a variety of benefits over manual identification and analysis. First, we generate our topic words using textbooks representative of each approach as training data. As a result, we are able to identify words associated with the methods of an approach, rather than terms that are common across applied examples. This is a notable improvement from other attempts to apply text analysis to the economics discipline. Kosnik (2017), for example, employs text analysis using the key words found in JEL-codes. The JEL-code keywords identify and group like-topics, but they do not identify the common approach to these topics. For example, text analysis using JEL-codes can tell us that "Labor" is a more popular research topic than "Economic History," but they cannot tell us what constitutes the approach taken in a standard labor or economic history article.

Second, whereas manual classification methods are extremely resource-intensive and cannot cover an entire literature, our automated method allows us to analyze a broader subsection of the discipline. Hamermesh (2013), for example, finds a similar decline in theory and rise in empirical analysis as we do, yet, because he was required to manually identify the approaches in each paper, he was only able to examine the articles published in one year per decade (totaling 748 articles). In contrast, our approach allows us to analyze the content of 28,462 individual articles.

Finally, researcher bias is minimized in our design because topic words are automatically generated by the machine learning topic modeling approach. Our topic words for each approach align well with our prior beliefs of what constitutes and is distinct about the various approaches, but they are not generated by our priors.

2.1 Topic Modeling

Topic modeling is a form of unsupervised machine learning in which an algorithm generates groupings of words that have a high probability of occurring together within a given set of documents. If texts are structured so that like-words appear together frequently and such co-incidences define a text's meaning, then the model's word groupings reflect the inner structure of

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[4] Because macroeconomics has no central method akin to that of price theory for microeconomics, we focus exclusively on microeconomics for our analysis. Without a central method, the topic modeling approach we utilize is likely to identify subjects (e.g. money, growth, business cycles) rather than methods for macroeconomics. For a related analysis on methodological trends in macroeconomics, see Glandon et al. (2019).

a set of documents (Blei 2012). Topic modeling is considered a form of unsupervised machine learning because the only inputs required are a set of documents and an integer corresponding to the number of groups desired to be identified.

Originating in computer science about 15 years ago, topic modeling is only a recent addition to the social scientist's toolbox (Meeks and Weingart 2012; see Gentzkow et al. 2019 for an introduction to text as data for economists). Ambrosino et al. (2018) outline how topic modeling might be usefully applied to understanding the structure of economics over time while Wehrheim (2019) is the first to employ topic modeling techniques to the economic literature. By identifying the key topics in the *Journal of Economic History*, Wehrheim dually illustrates the relevance and technical foundations of the approach. Wehrheim concludes that "topic models are the right tool for research on publication trends" (2019: 85).

There are a variety of topic modeling algorithms built upon different assumptions about the set of input documents (Steyvers et al. 2007). We use the literature standard Latent Dirichlet Allocation (LDA). To estimate the posterior distribution we use Gibbs sampling, again the literature standard (Griffiths and Steyvers, 2004).

Multiple applications for topic modeling are publicly available. We use the Machine Learning for Language Toolkit (MALLET) developed by Andrew McCallum (2002).[5] MALLET is a versatile tool that allows for numerous topic modeling configurations. We run individual LDA topic models for each of our five approaches with group sizes of 1, 3, 5, 10, 15, and 20, generating 30 distinct topic word groupings. Each topic model is run using 2000 iterations and contains 20 words per topic grouping. Following Wehrheim (2019), we allow for hyperparameter optimization (allowing for dynamic topic and group weights) after every iteration.

Our method of analysis requires two types of textual input: a training set and longitudinal text corpus. The training set constitutes the input for our topic model while the text corpus is used to trace the over-time variation in topic words.

The ideal training set for our analysis encapsulates the entirety of an approach and its methods of analysis while remaining insulated from spurious application-specific content material. Textbooks, as the foundation of each approach's knowledge, encapsulate the essence of each approach in this manner. Thus, we construct our training set by selecting the seminal textbooks of each approach. In total, this training set incorporates 24 digitized textbooks. For a complete

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[5] For more information on MALLET, see http://mallet.cs.umass.edu/.

breakdown of the training set, see Table A.1. We construct five groupings (called approaches) of twenty topic words each.

In most topic modeling applications, it is necessary to manually classify the subject—or 'topic'—of each group based upon the model-generated words. However, because we aim to capture the topic words of each approach as a whole (rather specific approaches' topics, e.g. the topic of individual chapters) we are first selective in our training texts (e.g. only Chicago affiliated price theory textbooks are used as training texts to model "price theory") and then use the output when group size is one as our primary group for analysis. Despite our preference for the singular group output, our results remain substantively the same when using a variety of different group sizes.[6]

While it is impossible to capture the entirety of an economic approach in twenty topic words, we believe that our topic words trace the overall method of each approach. For example, our price theory topic words highlight what one might first think defines price theory, including terms such as price, cost, marginal, demand, supply, quantity, and utility.[7]

2.2   The Top Five

We use the articles published in the top five economics journals as our text corpus to be representative of the mainstream of the profession. Scholars have recently formed a consensus on the makeup of the top five. Based on ranking processes, Pieters and Baumgartner (2002), Card and DellaVinga (2013), Hamermesh (2013), Heckman and Moktan (2017) and Bornmann et al. (2017) conclude that the top five journals are: *American Economic Review* (AER), *Econometrica* (ECMA), *Journal of Political Economy* (JPE), *Quarterly Journal of Economics* (QJE), and *Review of Economic Studies* (RESTUD).[8]

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[6] As an example, Figure A.5 shows price theory follows almost identical trends whether we use group sizes of 1 or 20.

[7] A potential shortcoming of using a training set composed of textbooks is that our keywords may reflect the core concept in its applied rather than general form. For a relevant price theory example, the core concept of a constraint may be identified in the key words as "income" given the most common illustration of constrained maximization utilizes income as the constraint. To address this concern, we analyze the data using general-form analogues of applied keywords whenever applicable (e.g. "constraint" instead of "income" and "maximization" instead of "utility). Our findings remain substantially the same. See Figure A.6.

[8] Wei (2018) and Hamermesh (2013) use this conception of the top five in their bibliometrics analyses. Other studies of publication trends may limit their selection of journals depending on their goal. For example, Sutter and Pjesky (2007) desire to identify the level of economics publications which do not utilize math. As such, they purposely excluded journals with an explicit math focus. Even though there is likely to be a heavier econometrics focus in

Our text corpus data was gathered from JSTOR's Data for Research website (DFR).[9] The data is provided at the article level and includes a count of each word in an article (i.e. an n-gram format). We include only "research articles" as classified by JSTOR and eliminate book reviews, front matter, and other unrelated materials. Figure 1 illustrates the number of research articles in our dataset per year. Our data begins with the first edition of each journal and runs through at least 2014 (see Table A.2 for complete coverage information). In total, our data constitutes 28,462 individual articles containing 124,403,287 words. This is approximately 212 times the quantity of text in Tolstoy's *War and Peace.*

Figure 1:

Journal Article Data Descriptive Statistics
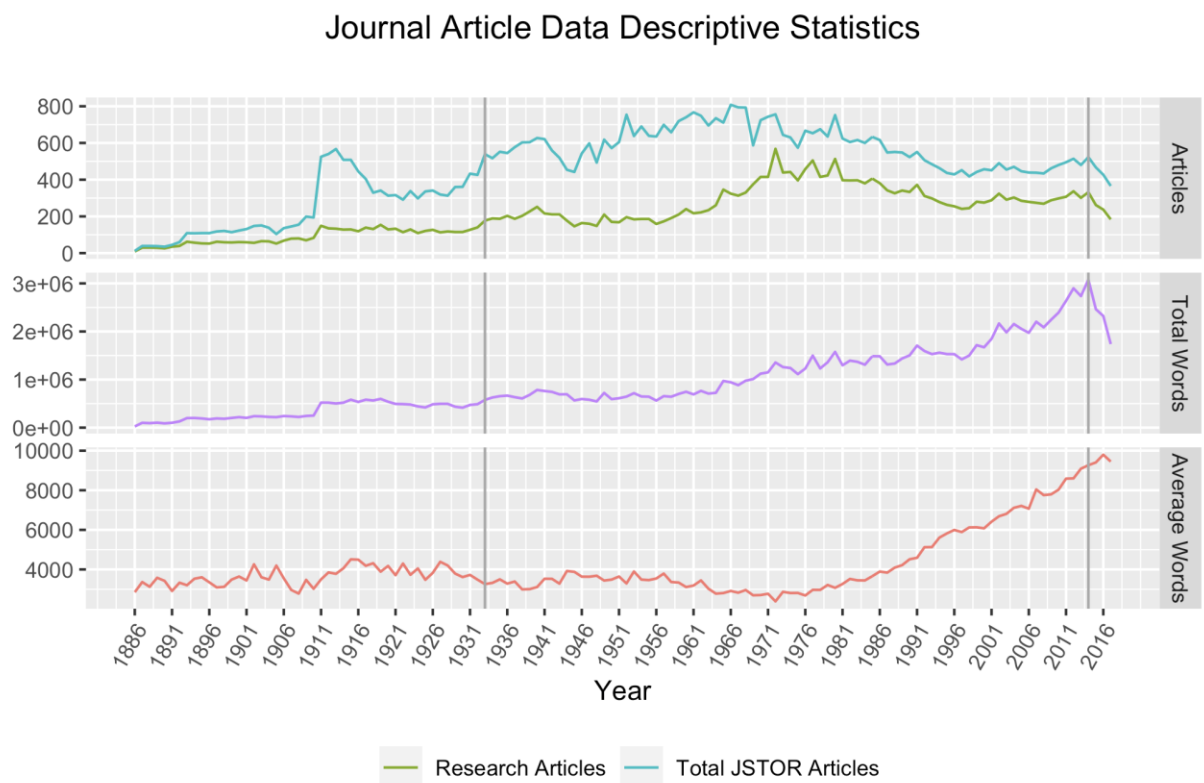
Note: Grey lines indicate beginning (1933) and end (2014) of our complete data set.

We pre-process this data in two steps. First, we remove any n-gram that does not contain standard English characters from A to Z. Second, we stem the n-grams using the standard Porter stemming algorithm. Stemming allows us to capture a wider variety of the uses of each topic word.

Copies of the resulting data are aggregated and stored at the article and year levels for each individual journal.

Finally, as a means interpreting our analysis, we compare our main results to the works of notable scholars within our identified approaches to economics, including Gary Becker, Steven Levitt, Peter Leeson, Raj Chetty, and Joshua Angrist. We collect the top 20 article publications by number of Google Scholar citations for each author.[10] See Table A.5 for a complete listing of each author's top 20 articles. These texts are pre-processed in a similar fashion to our JSTOR data with the addition that we remove JSTOR's list of stop words.[11]

With the topic words and journal text corpus complete, we analyze the frequencies of topic word groupings across journals and time. Our primary measure analyzes topic word trends at the article level. To construct this measure, we first calculate the percentage of each article's total word count that falls into a distinct topic word approach. We then average these percentages within each year. Another potential approach would be to simply calculate a topic word fraction within each year. We prefer the article-level approach to a year-level approach because it minimizes the impact of outlier articles with very high or low counts of topic words and outliers related to article length. However, in Figure A.3 we demonstrate that the article and year-level analyses follow almost-identical trends.

3 The Decline of Price Theory

In this section we present the results of our bibliometric analysis. All topic words employed are listed in their unstemmed form in Appendix Table 3.
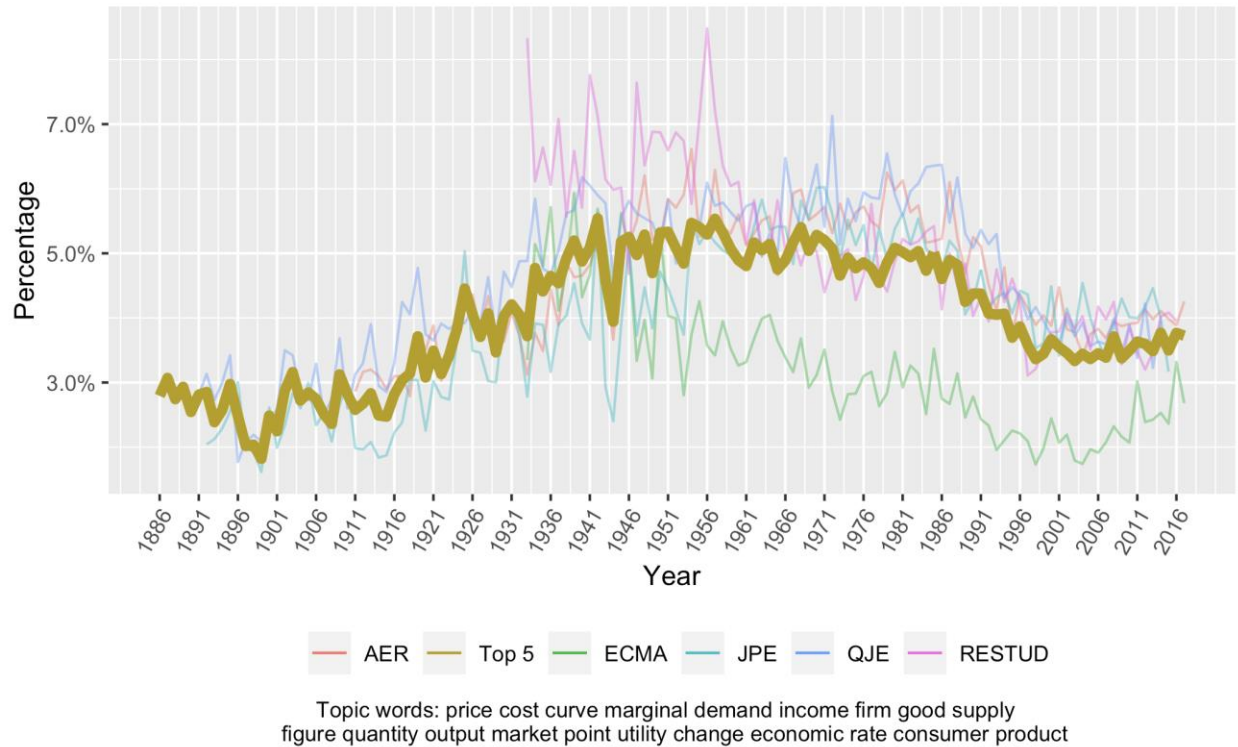
We begin in Figure 2 by tracing the trajectory of price theoretic language. Price theoretic language rises from an average of 3% of all words in our dataset in 1886 to approximately 5.5% in 1940 where it remains nearly constant for five decades. The average percentage of price theory words declined steadily after 1980, ending around 3.5%. Not surprisingly, *Econometrica* sees a steeper and earlier decline in price theoretic language than its peers. Interestingly, by the time Becker was awarded the Nobel Prize in 1992 for his wide-ranging application of price theory, price theory in the profession was nearing its lowest point in sixty years.

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[10] Of the five, Leeson is the only author without a Google Scholar page. To identify his topic 20 cited articles, we identified the citation count for every one of Leeson's publications.
[11] Refer to https://www.jstor.org/dfr/about/technical-specifications for a complete listing on stop words removed.

Figure 2:

Price Theory: Average Topic Word Percentage per Article

Topic words: price cost curve marginal demand income firm good supply
figure quantity output market point utility change economic rate consumer product

## 3.1 The Decline of Formal Theory

Rather than a decline in price theory, Figure 2 may reflect a transition from verbal to mathematical theoretical language. Under this scenario, price and constraint-centric explanations of human behavior may be equally as prominent today as ever before but are now discussed in their equivalent mathematical terms. To account for this possibility, we examine the prominence of topic words associated with graduate microeconomics and mathematical economics textbooks. The topic words for microeconomics generally resemble those of price theory with the addition of terms from game theory such as "game", "player", and "strategy" and more mathematical words such as "function", "set", "condition", and "equilibrium". Our mathematical economics topic words feature technical terms used often in formal neoclassical models, such as "function", "theorem", "equation", "vector", "linear", and "derivative," but does not contain any price theory content terms.

Figure 3 traces the trends in price theory, mathematical economics, and microeconomics. Microeconomics follows the general trend of price theory but has a steeper growth rate post-1966

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following a slight decline in the 1950s. Mathematical economics grows minimally over time and peaks in the late 1970s. These simultaneous positive growth rates indicate that mathematical economics and microeconomics were likely complements to price theoretic analysis rather than substitutes. All three, however, decline simultaneously beginning in the 1980s, making it unlikely that the decline in price theory evidenced in Figure 2 can be attributed to a rise in mathematized theoretic language.

Figure 3:

Average Topic Word Percentage per Article
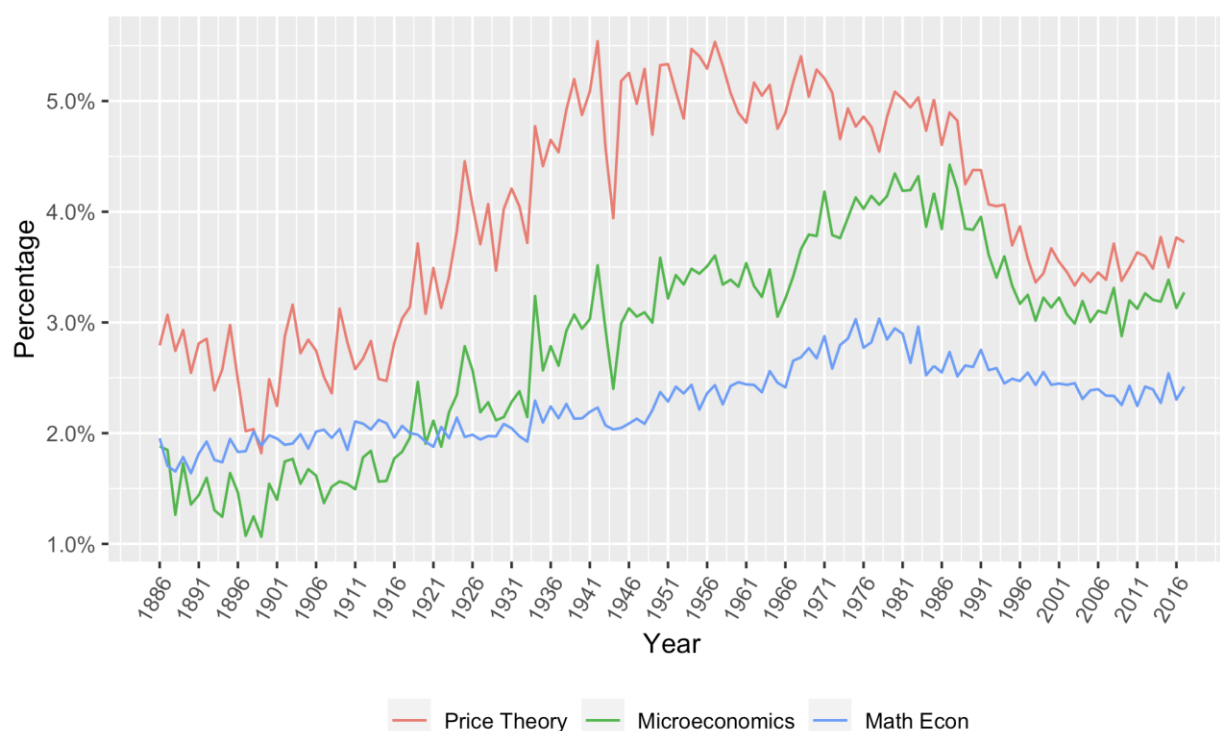
3.2 The Austrians

In order to further illustrate the decline we identify in price theory is a decline in theory rather than a change in form, we consider the case of the Austrians.

Becker was not the first to argue that economics is defined by its theoretical approach and that this approach can be applied to understand any human behavior. Austrian economists also defined economics in terms of rational choice theory, believing that economics could be applied to all human action. Ludwig von Mises' magnum opus *Human Action* is titled as such because he believed that economics applied to the full domain of human behavior, rather than just actions

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dealing with money, exchange, or business. In Mises' (1949: 491) words, "Economics is not about goods and services; it is about human choice and action". And this "Action is, by definition, always rational" (Mises 1960: 36). As Peter Leeson (2012: 189), an economist with affiliation and affinity for both the Chicago and Austrian approaches, notes "The Austrian approach to economic science is, in my view, the same one Becker (1976, 1993) articulates. It views economics as a method rather than a subject matter."

Given Leeson's equivalence of the Austrian and Chicago approach to economics, it is not surprising that our Austrian and price theory topic words share many of the same terms. Such is evident in Figure 4 which illustrates the near parallel trends of Chicago price theory and Austrian topic words across the top five journals.

Figure 4:

Price Theory and Austrian Approaches:
Average Topic Word Percentage per Article

Yet, despite their big picture similarities, there are important differences between the two approaches.[12] The fundamental difference between the Chicago and Austrian approaches relevant

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[12] In a typical discussion on the differences between the Austrian school and Chicago school, the different emphasis placed on formal mathematical models and empirical verification would be highlighted (Boettke 1996). While these differences exist, they are not fundamental for our analysis. Afterall, none of our (Chicago) price theory topic words

for our purpose is their focus on comparative statics vs. process orientated analysis, respectively (Boettke 1996; see Boettke and Candela 2017). As Mises (1978: 30) puts it, "What distinguishes the Austrian School and will lend it everlasting fame is its doctrine of economic action, in contrast to one of economic equilibrium or nonaction." In contrast to the equilibrium emphasis in Chicago's price theory (Becker's "market equilibrium" assumption), the Austrian approach highlights the ever-evolving nature of an economy, preferring to focus on entrepreneurs and individual actors rather than aggregate movements.

This difference between the two approaches can be identified when we look to our broader topic words groups (e.g. n=3, 5, 10, 20). At the broader level, the terms "entrepreneur(ship)", "order", "process", and "system" can be found in 7 distinct Austrian topics. These words do not appear in the topics generated for Chicago other than "system" appearing once at the broadest (n=20) level. "Exchange" appears in 11 Austrian topics but only once in price theory topics.

The Austrian's market process approach still constitutes a rational choice perspective, but it is one that is significantly more challenging to formalize. Hence, a rise in the price theory relative to the Austrian approach may reflect price theory's acceptance of formalism in the profession rather than the acceptance of the rational choice (maximization) assumption. Thus, to further suggest a real decline in price theory, we examine a broader grouping of Austrian and price theory topic words.

In Figure 5, Austrian and price theory (Chicago) are almost identical in prominence until the 1930's. In the late 1930's, the Austrian approach saw a steep and consistent decline while Chicago maintained its steady rate until its decline in the 1980s. To the extent that the more nuanced Austrian topic words represent verbal price theory whereas Chicago represents more formal or mathematical price theory, the divergence in trends may suggest that the unique aspect of price theory are declining even faster than our initial results suggest.[13]

Figure 5:

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include ones which would signify formal theory or statistical analysis as a central theme of the approach. We instead focus on the central difference between these two schools of thought that is relevant for our analysis, which is static vs. dynamic analysis.

[13] The timing of this divergence also aligns with our historical expectations. The initial parallel trend mimics Mises (1981: 214) belief that by 1933 there were little substantive differences between the Austrian and neoclassical perspectives. As Boettke (1997: 14) notes, "[Mises] viewed Austrian economics as squarely within the mainstream of neoclassical thought". Yet following the Great Depression, Keynesian interventionism, and WWII, the "Austrian School of Economics … has increasingly claimed a unique position within the scientific community of economists" only really noticeable by the following generations (Boettke 2002: 263-264).

Price Theory and Austrian: Average Topic Word Percentage per Article
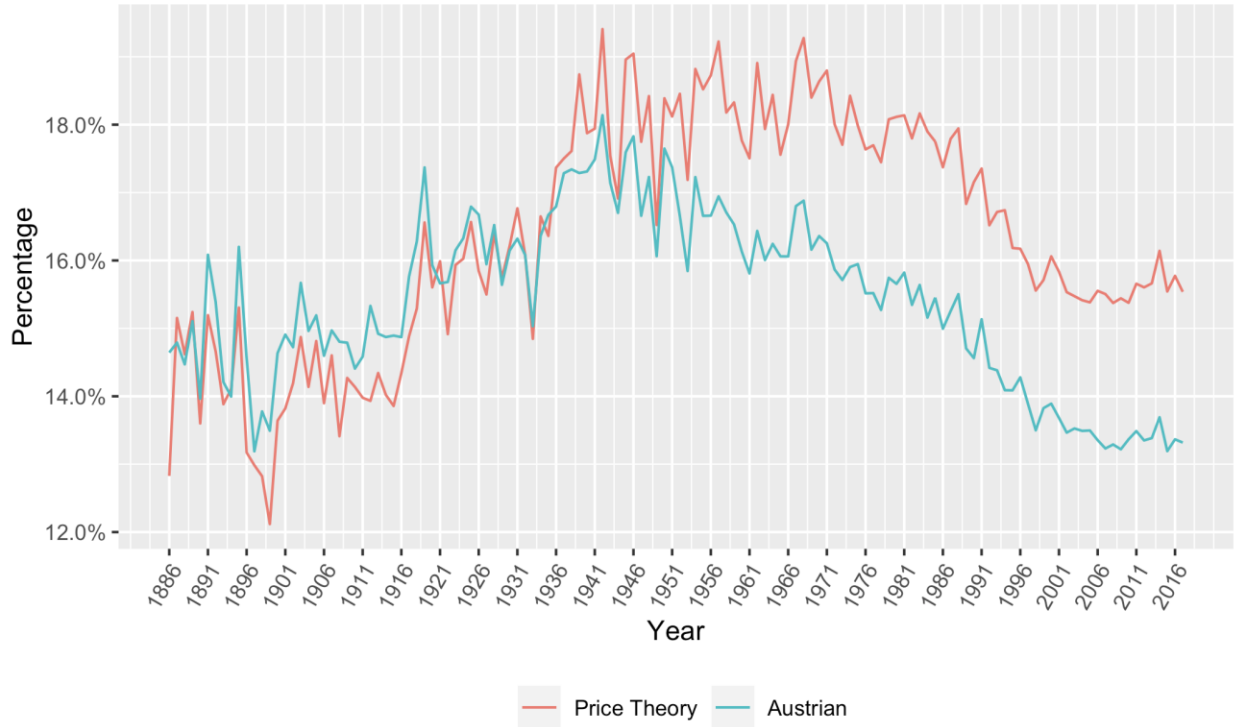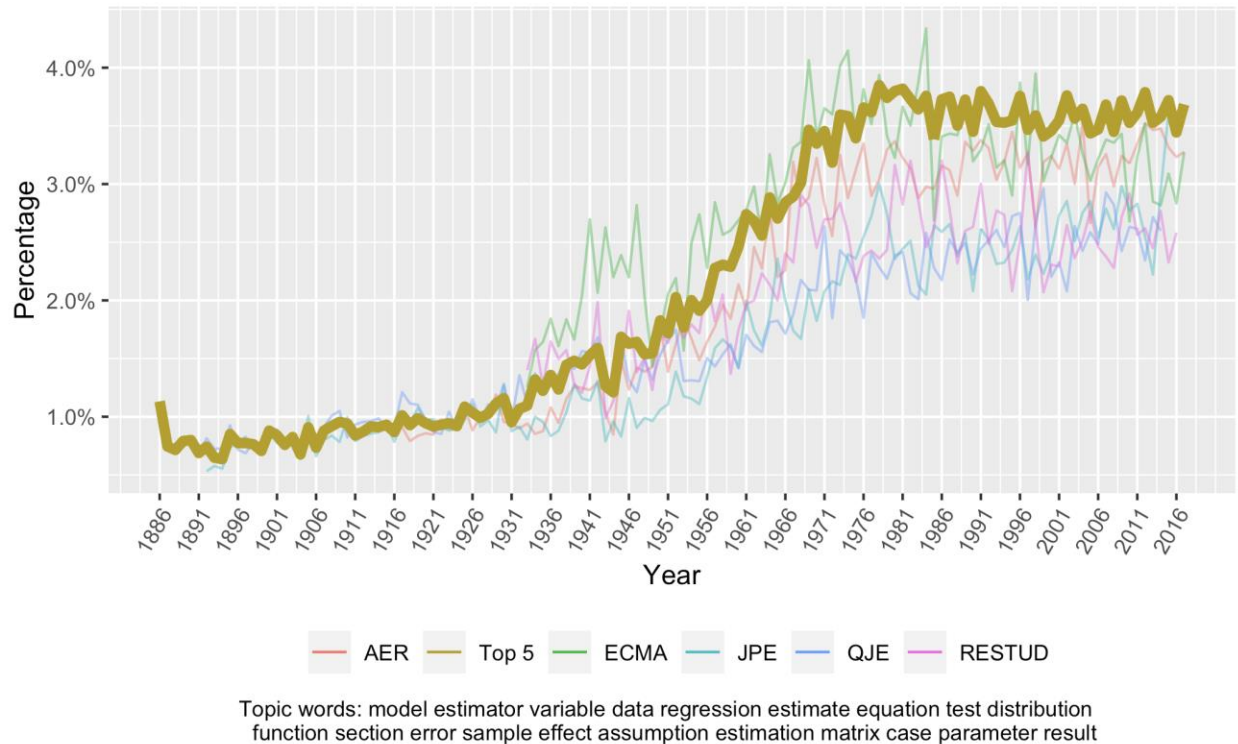

3.3   The Rise of Econometrics

The primary empirical technique of economics has been the application of econometrics. Figure 6 depicts the average percentage of each article's total word count that are econometric topic words. As a whole, econometric language increases from about 1% of all words in 1886 to approximately 3.5% in 1980. Econometric language remains stable from the 1980s onward. The top five journals vary considerably in their level of econometric language. ECMA and AER average greater than 1% more econometric language than QJE, JPE, and RESTUD. These results evidence the considerable rise in empirical analysis.

Figure 6:

Econometrics: Average Topic Word Percentage per Article

Topic words: model estimator variable data regression estimate equation test distribution
function section error sample effect assumption estimation matrix case parameter result

In order to evaluate the extent to which the economics profession has substituted econometric analysis for price theoretic analysis, Figure 7 compares both approaches. In Figure 7, price theoretic and econometric language rise in equal measure, indicating that statistics was initially employed to evaluate economic theory. However, price theoretic language declines post-1980 without a change in econometric language. By 2017, articles in the top five feature approximately equal proportions of price theoretic and econometric language.

Figure 7:

## Price Theory and Econometrics: Average Topic Word Percentage per Article
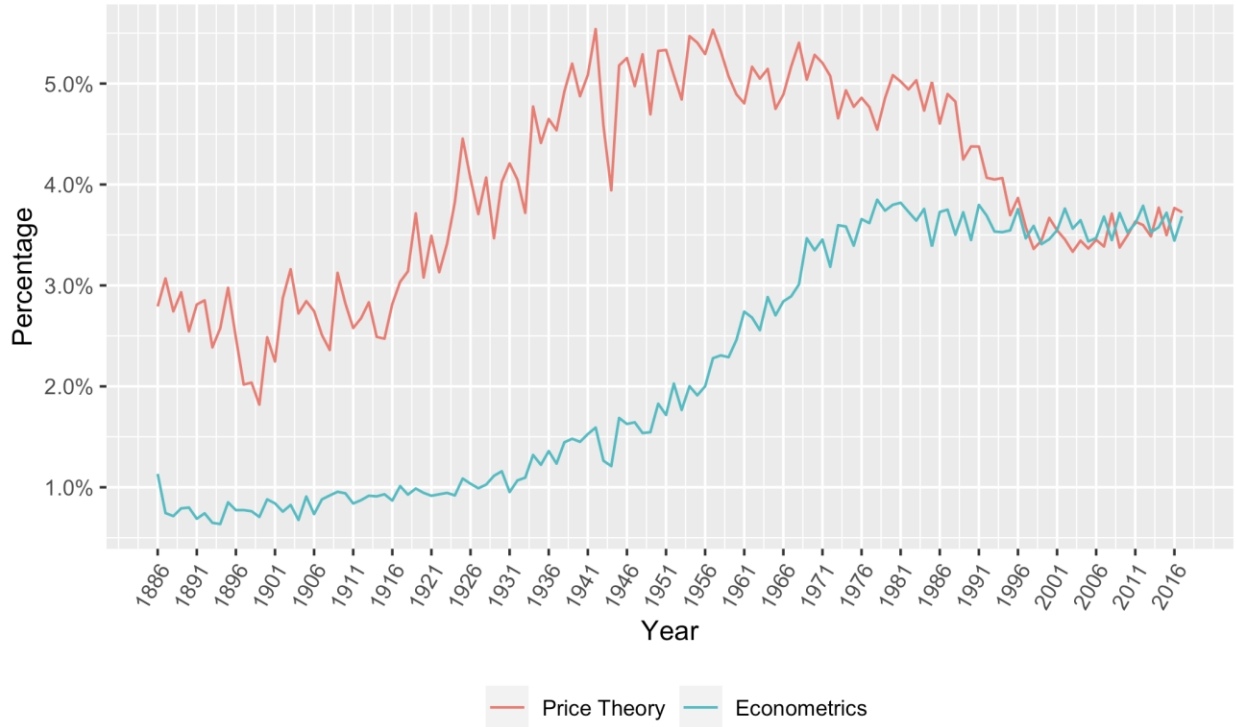
The steady econometrics level at 3.5% post 1980 may surprise the reader, given anecdotal evidence of the continued rise of econometrics or Hamermesh's (2013) evidence referenced earlier. We contextualize these findings in relation to what scholars have called the "credibility revolution" stemming from Edward Leamer's (1983) famous call to take the 'con' out of econometrics (Angrist and Pischke 2010). Before the credibility revolution, the use of basic statistical methods, such as OLS models, was widely accepted. However, around the 1980s, basic OLS models became much less acceptable as a primary means of evidencing a theory. Our econometric topic words largely capture the pre-credibility revolution universe of econometric methods, as indicated by the basic words like regression, variable, error and model. Modern econometric methods focus instead on causal identification and use new tools and methods that our initial n=1 topic word group does not capture.

In order to capture this post-credibility revolution, we manually identify a causal identification topic word grouping from our econometric topic model output. This casual identification grouping contains words such as: effect, treatment, estimate, estimator, matching, control, covariate, sample, average, causal, error, difference, instrument, and case. Many of these

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topic words relate to various causal strategies, such as instrumental variable, difference in difference, matching models, and treatment effects. Figure 8 compares these causal econometric key words to our standard econometric key words. Figure 8 demonstrates that, rather than leveling off like the broader econometrics approach, causal econometric topic words continue to increase post-1980. These results suggest that econometrics has maintained a positive growth rate after the 1980s, albeit using different tools.

Figure 8:

Causal Econometrics:
Average Topic Word Percentage per Article
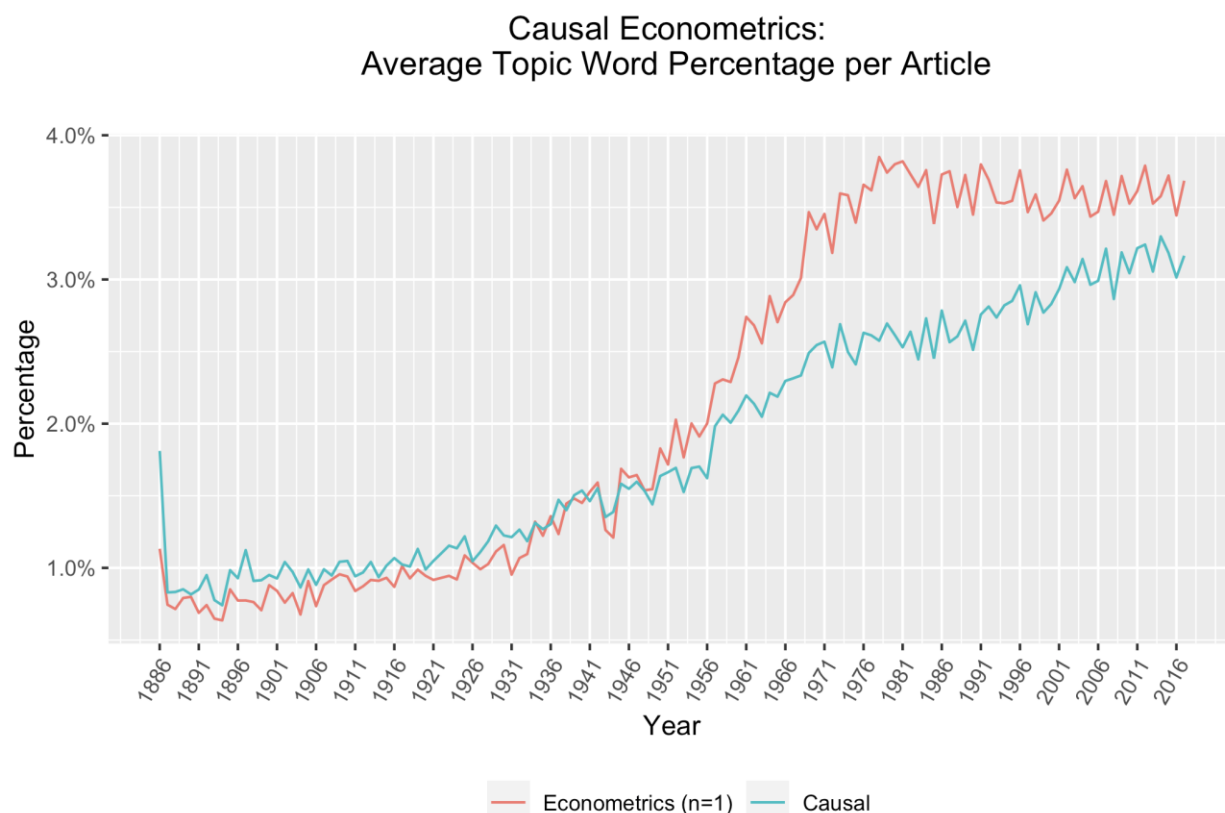
3.4 Providing Context

To provide context to the previous subsections, we analyze scholars associated with these various approaches. Gary Becker is chosen as the representative of price theory. Angrist is selected as representative of the econometric approach.

In Figures 9 and 10 we contextualize the decline in price theoretic and rise in econometric language with reference to Becker and Angrist's publications. With the authors' top 20 most cited journal publications as data, we calculate the fraction of each authors' language that falls into our price theory and econometric language categories. Approximately 4% of the non-stop word diction

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in Becker's top 20 journal publications are price theoretic compared to 1.7% of econometric language. Nearly the reverse holds for Angrist: about 1.5% of Angrist's language is price theoretic while about 5% is econometric. We call these values "thresholds".
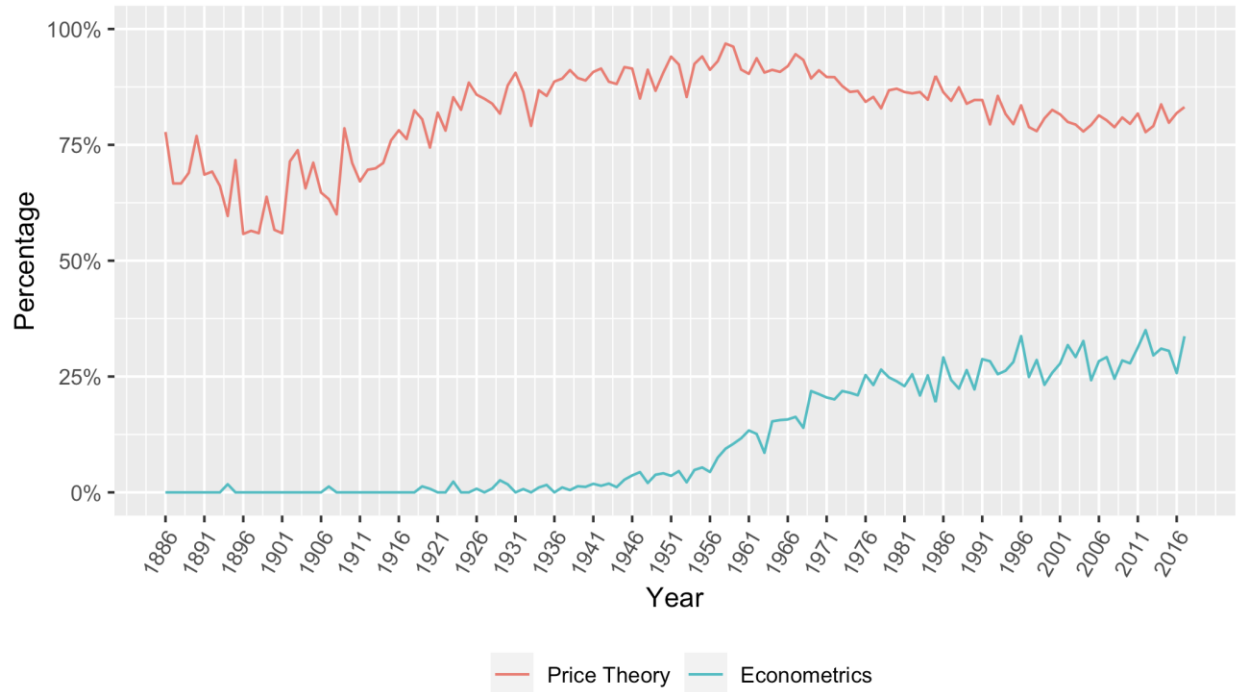
Figure 9:

Figure 9 analyzes the publication trends in reference to Becker's work. We find that, between 1886 and 1920, only about 25% of Top 5 articles had as much or more price theoretic content than Becker. By the mid twentieth century, about 2/3 of all articles contained at least Becker's level of price theoretic language, hinting at the widespread adoption of price theory during this time. However, the fraction of articles containing at least Becker's level of price theoretic language declined starting in the 1980s, ending at around 35%. Conversely, throughout our dataset the fraction of articles with at least Becker's level of econometric language rises to approximately 85% of all articles. Today, the articles in the top five journals are much more likely to exceed Becker's level of econometric language than his price theoretic language. Before the decline of price theory, more articles were price theoretic than econometric using Becker's threshold.

Figure 10:

Top 5 Articles with at least Angrist's Level of
Price Theory and Econometric Language

In Figure 10 we further contextualize the decline in price theoretic and rise in econometric language with reference to Joshua Angrist's publications. At the start of our data zero articles had more econometric language than Angrist, while today approximately 40% exceed Angrist's econometrics language. During the peak of price theory, nearly 100% of top five articles had more price theoretic language than Angrist. Today, nearly 20% of modern articles having even less price theoretical language than Angrist.

Another way to provide context is to compare price theory to econometrics. Chicago price theory emphasized empirically testing the predictions that stemmed from their price theory, so it's not surprising that an article should contain both types of language. Figure 11 depicts the ratio of the average percentage of each article's total word count that are price theoretic topic words to the average percentage of each article's total word count that are econometric. Setting aside early outlier years driven by the small initial sample size, our ratio increases and remains stable through 1950; price theory is consistently used to contextualize statistical tests. However, the ratio declines

after 1950 by over 100% to about 2 in 2017, indicating that there is less theory per empirical language in the average article and possibly some empirics that are not guided by theory.

Figure 11:
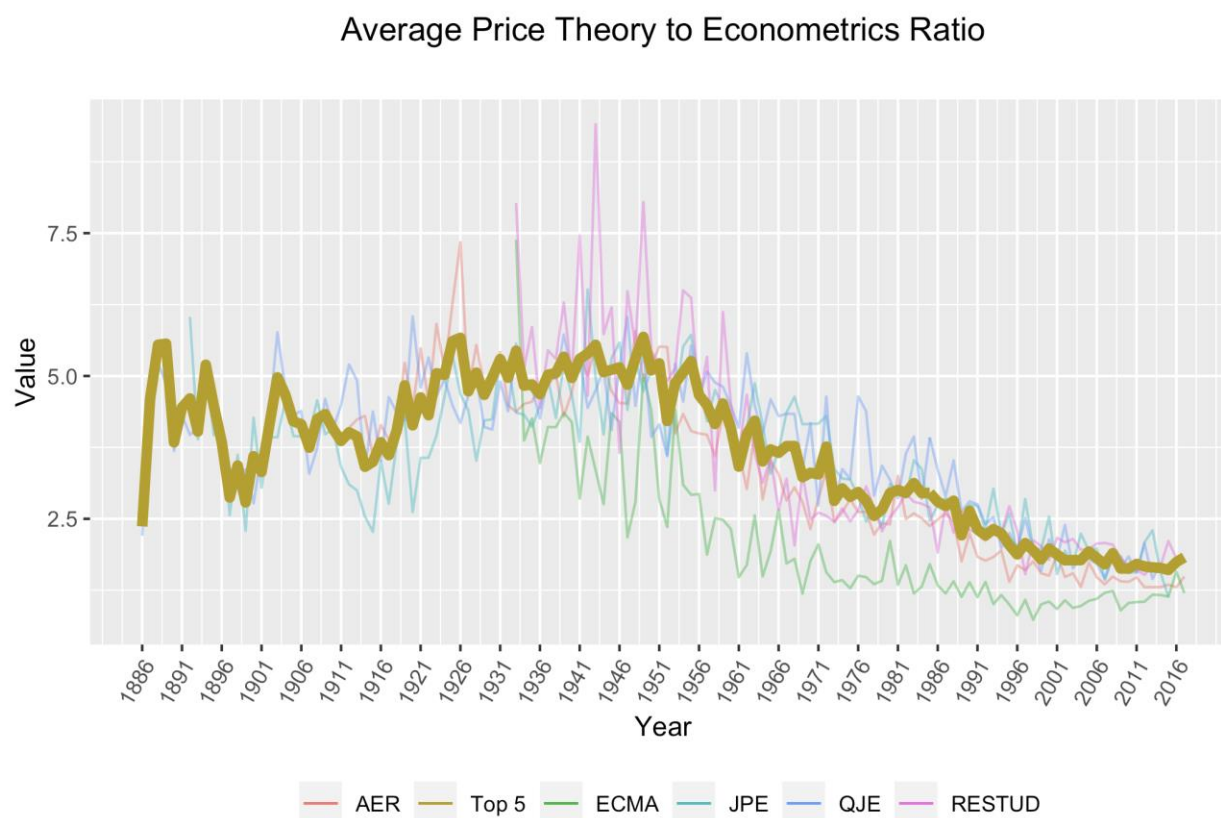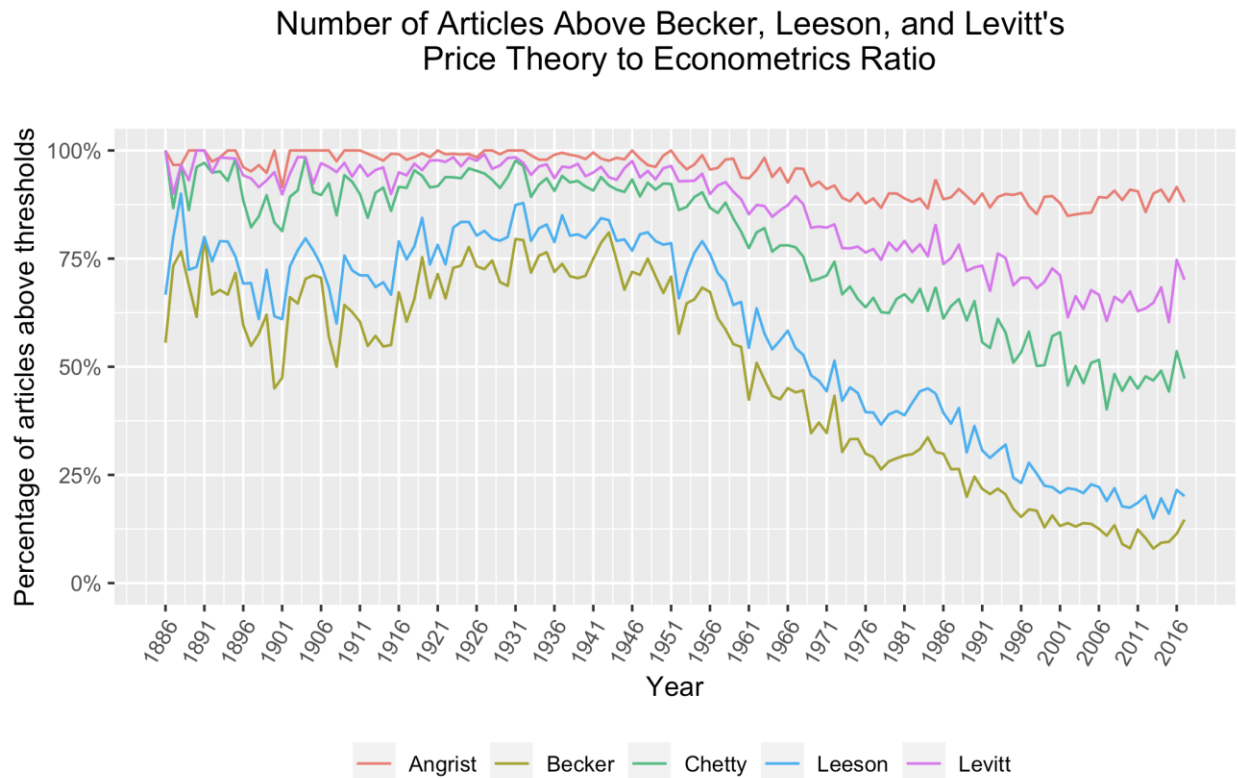
Average Price Theory to Econometrics Ratio

Figure 12 contextualizes this finding in relation to easily identifiable scholars affiliated with the different approaches. We calculate the fraction of top five articles whose price theory to econometrics ratios are greater than Gary Becker, Peter Leeson, Steven Levitt, Joshua Angrist, and Raj Chetty's top 20 journal article publications. Levitt's work is similar to Becker's but utilizes econometric tools more frequently. Leeson is a scholar with connections to both the Chicago and Austrian schools and is notable for pushing Becker's (and Mises') perspective to the limit (see Leeson 2017). Chetty has, rightly or wrongly, been associated with the data over theory approach.[14] Finally, as noted above, we consider Angrist's work as representative of advanced applied econometric analysis methods and Becker's as representative of price theory.

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[14] Our results suggest perhaps wrongly. Despite being the director of an institute focused on using "big data" and the VOX piece on Harvard doing away with principles of economics to replace it by a big data course, Chetty actually

Figure 12:

Number of Articles Above Becker, Leeson, and Levitt's
Price Theory to Econometrics Ratio

Thresholds: Becker: 2.3202   Leeson: 1.8162   Levitt: 0.6436   Angrist: 0.2799   Chetty: 0.9778

In parallel with our findings in Figure 11, the price theory to econometrics ratio compared to all five scholars declines. Almost 100% of articles published before 1950 contain more price theoretic language to empirical language than Angrist's, Levitt's, and Chetty's work. Today, nearly 90% of articles contain more price theoretic to empirical language than Angrist. Thus, the prominence of price theory has declined in even the most econometric-focused literature.

At the other extreme, econometric language also overtakes price theoretic language by the metric of price theory-heavy authors such as Becker and Leeson. The price theory to econometrics ratios for Becker and Leeson follow similar paths. The number of articles with at least Becker or Leeson's price theory per econometric word ratio declines by approximately 80% from its peak. Today, only about 15% of articles contain as much price theoretic language to econometric language as Becker or Leeson.

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utilizes a similar amount of price theoretic topic words as Becker, he just additionally uses more econometric words. See https://www.vox.com/the-highlight/2019/5/14/18520783/harvard-economics-chetty.

4 The Short Run and the Long Run

George Stigler (1984: 312) suggested that the "imperialistic age" of economics was brought about by its "growing abstractness and generality." Such abstraction was facilitated by an increased use of "mathematical language" which turned economics into a "general analytical machine, the machine of maximizing behavior" and "made the extensions to other bodies of phenomena easy and natural." Stigler concluded that if he's correct about why economics was able to expand its domain, "there will be no reversal of the imperialism."

However, our results indicate that shortly after economics expanded to other domains, economists began to substitute their reliance on the maximization machine for a different one, the statistical machine. In the short run, the economist's comparative advantage in both formal modeling techniques and statistics has allowed them to maintain their edge. Yet, as Coase believes, such an advantage and expansion cannot persist in the long run. Other scholars will learn how to use the econometric toolbox and out-compete economists with their discipline specific knowledge. In the long run, only a common subject can unite a discipline. There are, of course, opponents to Coase's competition view—most notably Stigler (1984) who suggests that scholars will further erect barriers to entry in order to preserve their rents. But, suppose that Coase is right, that a shared theory or technique as the primary binding force of a discipline is an unstable equilibrium. What does Coase's perspective suggest for the future of the discipline?

There are three plausible long run scenarios if economics were to become defined primarily by its subject, technique, or theory, respectively. The first scenario aligns with Coase's long run argument. Compared to techniques and theory which can be easily learned and adopted, Coase believes that deep subject matter knowledge is difficult to obtain. Thus, as practitioners in other disciplines adopt advanced mathematical or econometric techniques, economists will lose their competitive edge that allowed them to expand to other domains. Economics as a discipline, then, will have to revert back to one that studies wealth, scarcity, and the social institutions of markets. If this scenario were to play out, an economist would be someone who studies markets, regardless of any particular theoretical approach or empirical technique.

While this scenario is plausible in the long run, it is not currently relevant. For decades economic analysis has expanded beyond traditional market analysis and there is seemingly no

stopping it now. While it's possible that the profession is still in the short run, a limitation to the domain of economic inquiry seems unlikely in the near future.[15]

In the second scenario, economics would become primarily defined by its empirical techniques. Perhaps more than at any point in the discipline's history, this scenario is becoming more likely. But if Coase is right about the competitive forces in the academic market, then economists will lose market share as sociologists or historians or epistemologists learn statistics. However, instead of reverting back to the arena in which economists have deep subject knowledge, there is another option: economics as a discipline could become subsumed as a subdiscipline of statistics. In other words, statisticians would become the discipline-imperialists and overtake the traditional (and non-traditional) economic domain with their superior empirical skills. In this scenario, an economist would be an applied statistician, one who utilizes advanced statistical techniques and causal identification strategies to inquire about causal relations, regardless of the subject matter or underlying theory.

The third scenario is that economics becomes defined by its unique theoretical methodology to studying human behavior. An economist would then be someone who utilizes price theory to explain behavior through changes in relative prices and constraints, regardless of the subject matter or techniques of empirical analysis. According to Coase, defining discipline by its theoretical approach is equally as fragile as defining it by its empirical approach as other disciplines could (and have, see Udehn 2003) simply adopt economic theory. As a result, economists may lose income or prestige as practitioners of other disciplines adopt their toolkit. Yet for Beckerians or Miseasians, such an outcome isn't a problem. In fact, it is a success.

As scholars of other disciplines adopt price theory, they become practitioners of economics, rather than the outcome in scenario two where economists becoming practitioners of statistics. The economist's rents may dissipate, but economic science as a whole would be applied and practiced as broadly as possible. Simply, the adoption of the economic approach by other disciplines would mean that economics as a science "won." And as Mises (1949: 875, 879) suggests, this is nothing to lament: "Whether we like it or not, it is a fact that economics cannot remain an esoteric branch of knowledge accessible only to small groups of scholars and specialists.

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[15] The irrelevancy of subject-centric definitions and perspectives in the mainstream of the profession does not suggest that it is not what economists ought to do. Buchanan (1964: 222), for example, suggests that economists "should be 'market economists'" who should "concentrate on market or exchange institutions".

Economics deals with society's fundamental problems; it concerns everyone and belongs to all. It is the main and proper study of every citizen."

5 Conclusion

If Coase is right about the long run, then perhaps the current trajectory is unsustainable and the boundaries of economics as a discipline remain in question. There is, however, another perspective one could take from our results that we haven't yet discussed: the decline in theory is not something to cause concern, it's simply a return to the norm following a meteoric rise and dominance of price theory for nearly five decades. Perhaps the mainstream of the profession has reached a new equilibrium with theory and techniques each accounting for their equal share of the profession's attention—each with a near share of 3.5% (see Figure 13). This is a plausible interpretation and perhaps this new equilibrium will prove stable. And yet, for the modern Beckerian or Misesian, the decline in price theory is not simply a reshuffling of the importance of techniques and theory. A decline in price theory *is* a decline in economics. As Leeson (2020: 423) states, "Economic analysis is a *theoretical* approach, not an empirical one. It is a way of thinking, not a way of testing." Or, as he puts it succinctly in the title, "Economics is not statistics (and vice versa)."

Figure 13:

Average Topic Word Percentage per Article
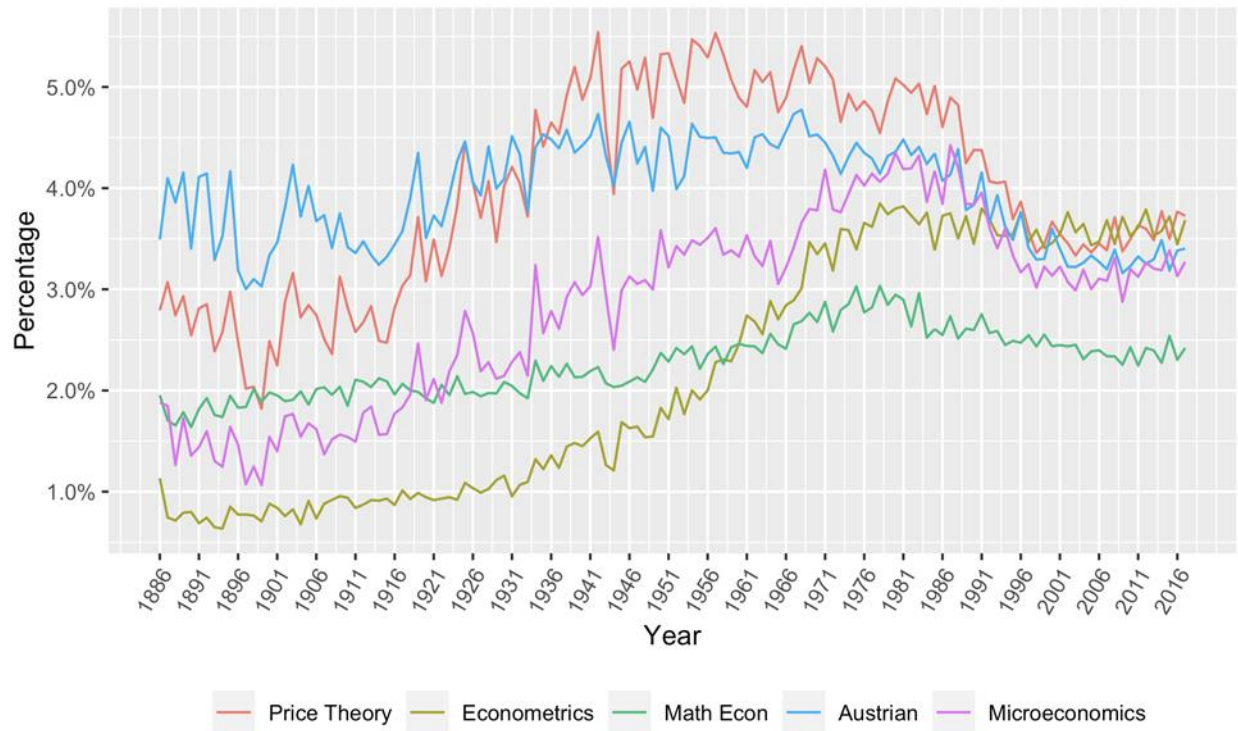
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Appendix

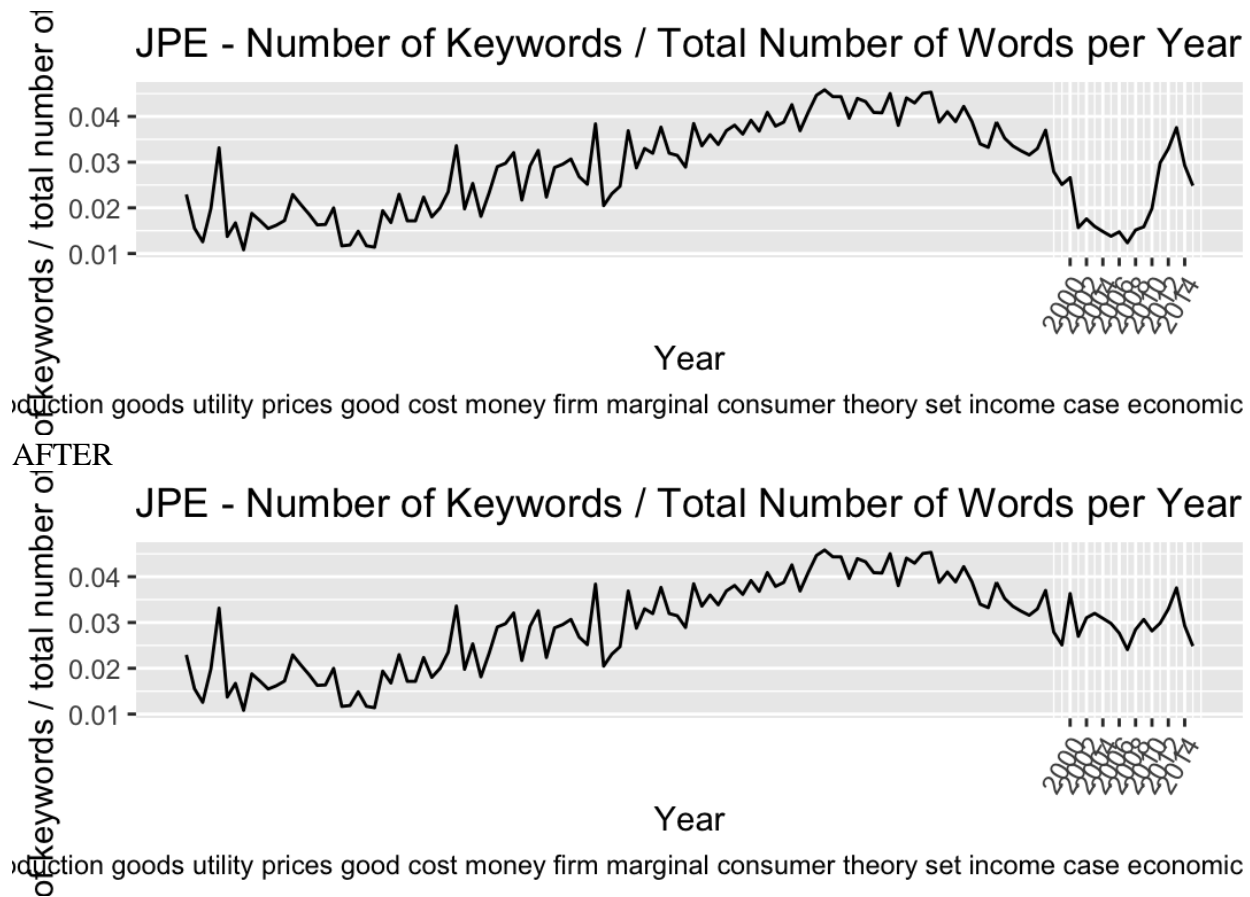**Section A.1** – Data Cleaning Details

In this section we outline data cleaning details not included in Section 3.

<u>Cleaning JPE JSTOR data</u>:

Due to an OCR error in the n-gram data provided by JSTOR, our JPE data between 2000 and 2010 contains erroneous document-related filler terms. Since these terms are not related to the publications themselves, we remove all such instances from our analysis dataset. The words removed are (separated by one space): *"usepackage renewcommand cyr document aastex amsbsy amsfonts amsmath amssymb amsxtra bm declaremathsizes declaretextfontcommand documentclass empty encodingdefault fontenc landscape mathrsfs newcommand normalfont pagestyle pifont portland rmdefault selectfont sfdefault stmaryrd textcomp textcyr wncyr wncyss xspace"*

JPE - Number of Keywords / Total Number of Words per Year
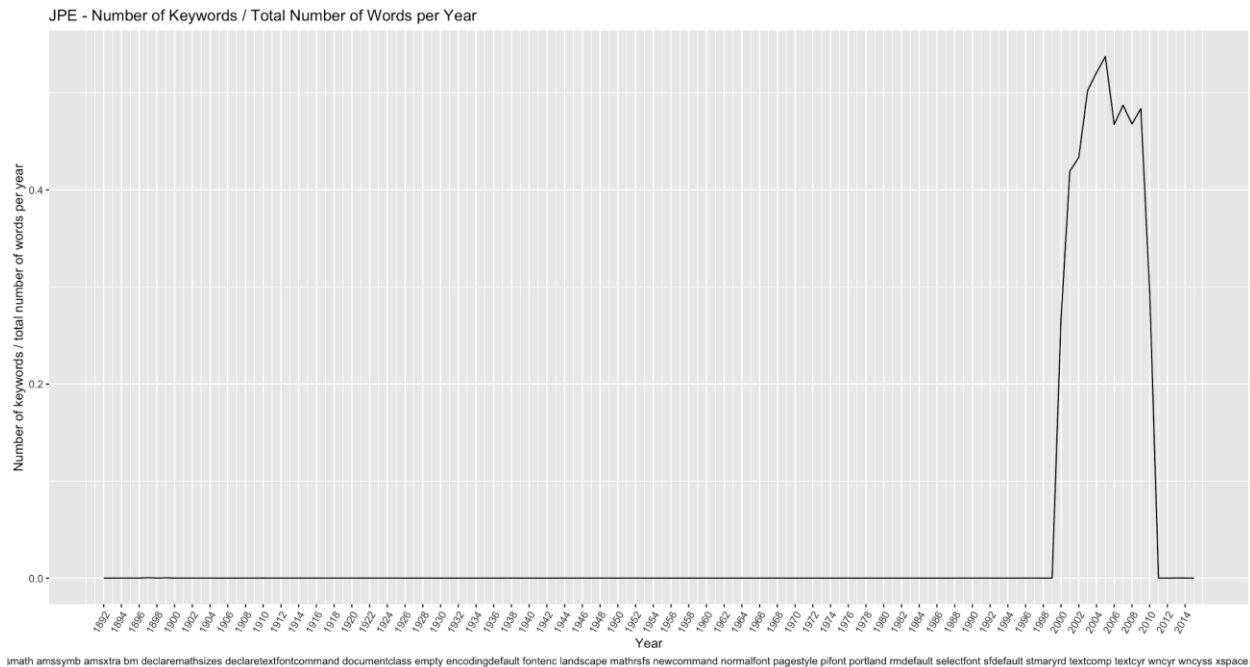
This could also be identified in the base level results. Below is an example of our price theory trend for JPE before and after the removal of these words.

JPE - Number of Keywords / Total Number of Words per Year

...oduction goods utility prices good cost money firm marginal consumer theory set income case economic

AFTER

JPE - Number of Keywords / Total Number of Words per Year

...oduction goods utility prices good cost money firm marginal consumer theory set income case economic

Singularization and Stemming:

For our purpose, the topic model's topic word outputs are themselves a final product. Thus, we seek to maximize the value of each word. One option is to stem the training data (e.g. transforming both "maximization" and "maximize" into "maximiz"). However, Schofield and Mimno (2016) demonstrate that stemming training sets before topic modeling yields less consistent topic word assignments. Instead, we singularize our training set (e.g. transforming "goods" into "good") before running the topic model. Then the topic words obtained from the topic model are stemmed in order to facilitate comparison with our journal data.

Correcting Singularization Error:

In general, the singularization of our training text does not alter our stemming function's output. This allows us to stem our singularized topic model outputs for direct comparison with our stemmed top five data. However, the stemming function cannot stem singularized Latin terms. Thus, we manually change our topic model's output "datum" to "data" in the econometrics approach's topic word list.

Removing May AER Publications:

In parallel with other bibliometric studies, we exclude AER publications in the month of May. Publications in the AER's May edition are invited instead of peer reviewed.

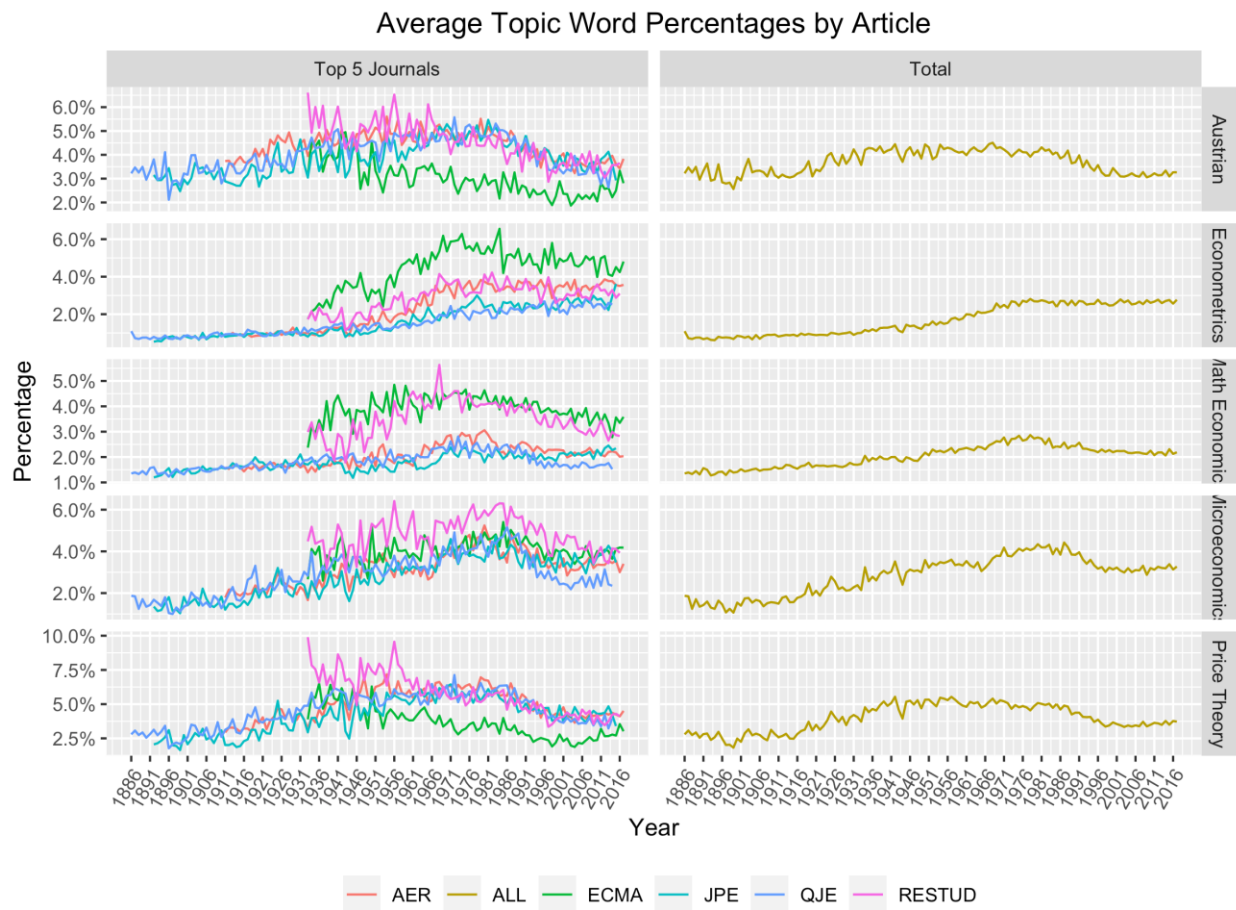**Figure A.1** – Complete Article-Level Results (Grouped by Approach)

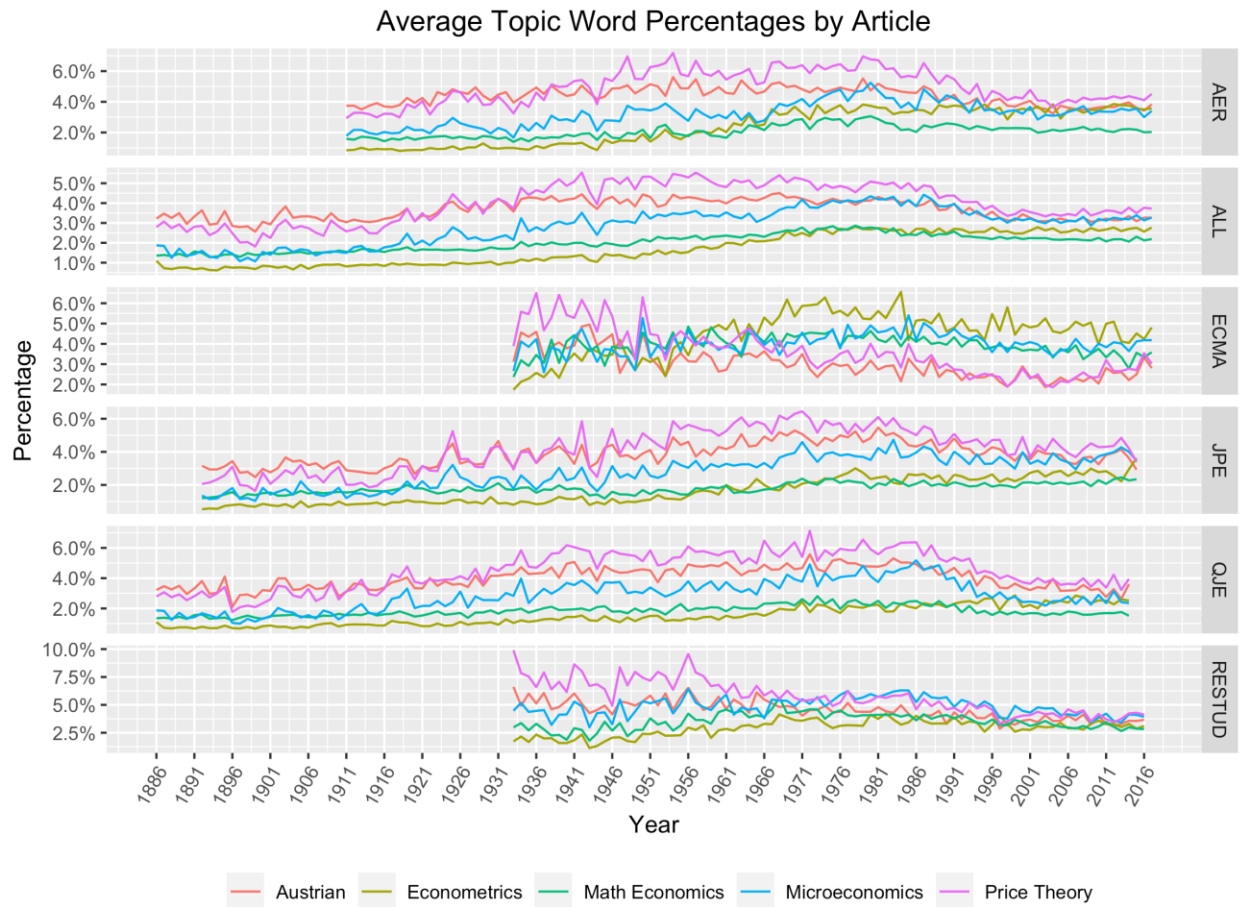**Figure A.2** – Complete Article-Level Results (Grouped by Journal)

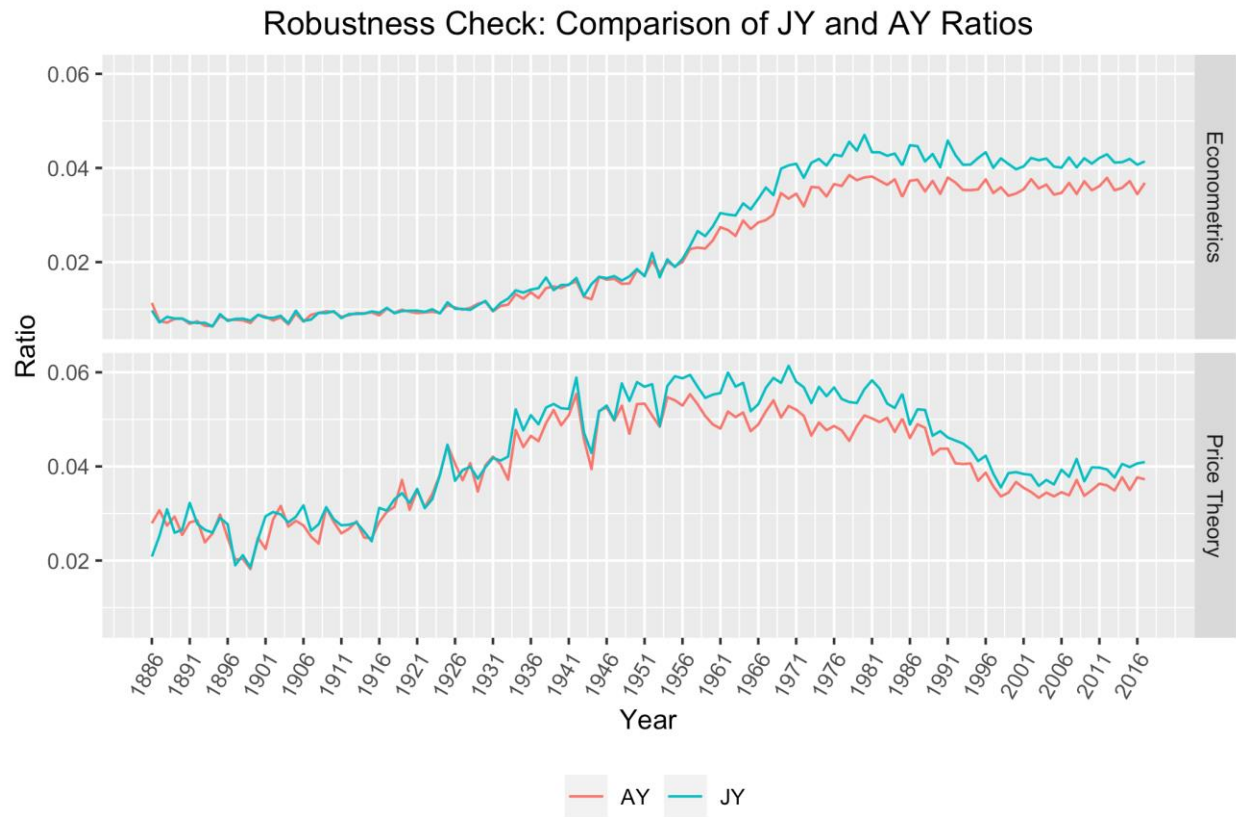**Figure A.3** – Article vs. Year-Level Robustness Check

Robustness Check: Comparison of JY and AY Ratios
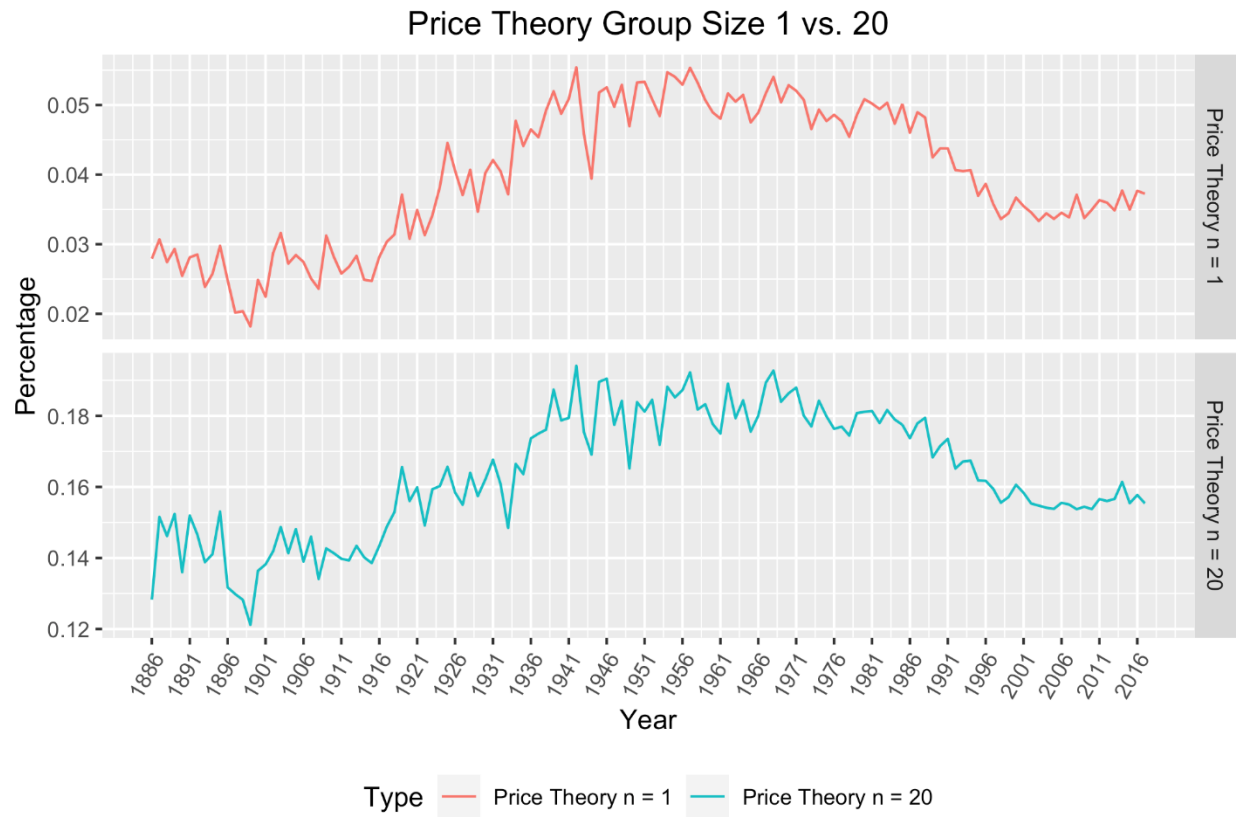
Figure A.5

Figure A.6

Price Theory: Average Topic Word Percentage per Article

Topic words: price cost curve marginal demand constraint firm good supply
figure quantity output market point maximiz change rational rate consumer product
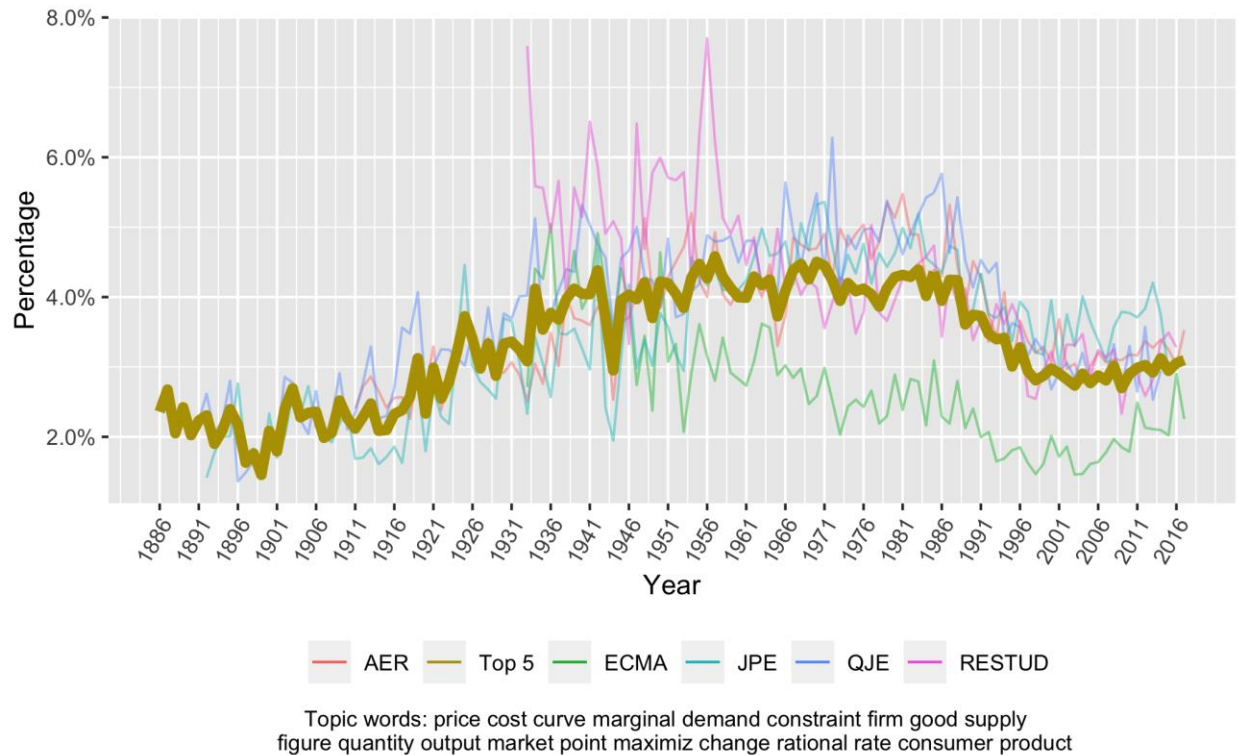
Table A.1 − Training Set Data

Approach	Text	Author(s)
Austrian	*Human Action*	Ludwig von Mises
Austrian	*Market Theory and the Price System*	Israel Kirzner
Austrian	*Man, Economy, and State with Power and Market*	Murray Rothbard
Austrian	*Principles of Economics*	Carl Menger
Price Theory	*The Applied Theory of Price*	Deirdre McCloskey
Price Theory	*Economic Theory*	Gary Becker
Price Theory	*Theory of Price*	George Stigler
Price Theory	*Price Theory*	Milton Friedman
Price Theory	*Price Theory: An Intermediate Text*	David Friedman
Microeconomics	*A Course in Microeconomic Theory*	David Kreps
Microeconomics	*Foundations of Economic Analysis*	Paul Samuelson
Microeconomics	*Advanced Microeconomic Theory*	Geoffrey Jehle and Philip Reny
Microeconomics	*Microeconomic Analysis*	Hal Varian
Microeconomics	*Microeconomic Theory*	Andreu Mas-Colell, Michael Whinston, and Jerry Green

Econometrics	*Microeconomics: Methods and Applications*	A. Cameron and Pravin Trivedi
Econometrics	*Econometric Analysis of Cross Section and Panel Data*	Jeffrey Wooldridge
Econometrics	*Mostly Harmless Econometrics: An Empiricist's Companion*	Joshua Angrist and Jörn Pischke
Econometrics	*Matching, Regression Discontinuity, Difference in Differences, and Beyond*	Myoung-Jae Lee
Econometrics	*Econometric Analysis*	William Greene
Mathematical Economics	*A First Course in Optimization Theory*	Rangarajan Sundaram
Mathematical Economics	*Mathematical Methods and Models for Economists*	Angel de la Fuente
Mathematical Economics	*Mathematical Optimization and Economic Theory*	Michael Intriligator
Mathematical Economics	*Fundamental Methods of Mathematical Economics*	Kevin Wainwright and Alpha Chiang
Mathematical Economics	*Mathematics for Economists*	Michael Hoy, John Livernois, Chris McKenna, Ray Rees, and Thanasis Stengos

Table A.2 – Journal Abbreviations and Data Coverage

Journal	Abbreviation	Coverage in Data
American Economic Review	AER	1911-2017
Econometrica	ECMA	1933-2017
Journal of Political Economy	JPE	1892-2015
Quarterly Journal of Economics	QJE	1886-2014
Review of Economic Studies	RESTUD	1933-2016

Table A.3 – Topic Words (n = 1)

Approach	Topic Words (unstemmed)
Price Theory	price cost curve marginal demand income firm good supply figure quantity output market point utility change economic rate consumer product
Econometrics	model estimator variable data regression estimate equation test distribution function section error sample effect assumption estimation matrix case parameter result
Mathematical Economics	function set point theorem problem solution matrix equation condition system vector case linear show number functions equilibrium sequence time derivative
Microeconomics	function equilibrium price consumer firm set utility good demand player game cost problem condition case strategy choice suppose preference level
Austrian	price good market money production economic man factor action economy consumer exchange capital state product labor rate demand time individual

Table A.4 – Leeson, Becker, Angrist, Chetty, and Levitt's Top 20 Papers

(Listed in Alphabetical Order, see references for full details)

Author	Title
Gary Becker	*A Reformulation of the Economic Theory of Fertility*
Gary Becker	*A Theory of Competition Among Pressure Groups for Political Influence*
Gary Becker	*A Theory of Marriage: Part I*
Gary Becker	*A Theory of Rational Addiction*
Gary Becker	*A Theory of Social Interactions*
Gary Becker	*A Theory of the Allocation of Time*
Gary Becker	*An Economic Analysis of Marital Instability*
Gary Becker	*An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility*
Gary Becker	*Child Endowments and the Quantity and Quality of Children*
Gary Becker	*Crime and Punishment: An Economic Approach*
Gary Becker	*De Gustibus Non Est Disputandum*
Gary Becker	*Human Capital and the Rise and Fall of Families*
Gary Becker	*Human Capital, Fertility, and Economic Growth*
Gary Becker	*Human Capital, Effort, and the Sexual Division of Labor*
Gary Becker	*Investment in Human Capital: A Theoretical Analysis*
Gary Becker	*Irrational Behavior and Economic Theory*
Gary Becker	*Law Enforcement, Malfeasance, and Compensation of Enforcers*
Gary Becker	*Market Insurance, Self-Insurance, and Self-Protection*
Gary Becker	*Nobel Lecture: The Economic Way of Looking at Behavior*
Gary Becker	*On the Interaction between the Quantity and Quality of Children*
Joshua Angrist	*Accountability and Flexibility in Public Schools: Evidence from Boston's Charters and Pilots*
Joshua Angrist	*Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size*
Joshua Angrist	*Consequences of Employment Protection? The Case of the Americans with Disabilities Act*
Joshua Angrist	*Does Compulsory School Attendance Affect Schooling and Earnings?*
Joshua Angrist	*Does School Integration Generate Peer Effects? Evidence from Boston's Metco Program*
Joshua Angrist	*Estimating the Labor Market Impact of Voluntary Military Service Using Social Security Data on Military Applicants*
Joshua Angrist	*Estimation of Limited Dependent Variable Models With Dummy Endogenous Regressors*
Joshua Angrist	*How Do Sex Ratios Affect Marriage and Labor Markets? Evidence from America's Second Generation*
Joshua Angrist	*How Large Are Human-Capital Externalities? Evidence from Compulsory Schooling Laws*
Joshua Angrist	*Identification and Estimation of Local Average Treatment Effects*

Joshua Angrist	*Identification of Causal Effects Using Instrumental Variables*
Joshua Angrist	*Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments*
Joshua Angrist	*Instrumental Variables Estimates of the Effect of Subsidized Training on the Quantiles of Trainee Earnings*
Joshua Angrist	*Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security*
Joshua Angrist	*New Evidence on Classroom Computers and Pupil Learning*
Joshua Angrist	*The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics*
Joshua Angrist	*The Effect of Age at School Entry on Educational Attainment: An Application of Instrumental Variables with Moments from Two Samples*
Joshua Angrist	*Two-Stage Least Squares Estimation of Average Causal Effects in Models with Variable Treatment Intensity*
Joshua Angrist	*Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement*
Joshua Angrist	*Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment*
Peter Leeson	*An-arrgh-chy: The Law and Economics of Pirate Organization*
Peter Leeson	*Better Off Stateless: Somalia Before and After Government Collapse*
Peter Leeson	*Efficient Anarchy*
Peter Leeson	*Endogenizing Fractionalization*
Peter Leeson	*Government's Response to Hurricane Katrina: A Public Choice Analysis*
Peter Leeson	*Institutional Stickiness and the New Development Economics*
Peter Leeson	*Liberalism, Socialism, and Robust Political Economy*
Peter Leeson	*Media Freedom, Political Knowledge, and Participation*
Peter Leeson	*Read All About It! Understanding the Role of Media in Economic Development*
Peter Leeson	*Robust Political Economy*
Peter Leeson	*Social Distance and Self-Enforcing Exchange*
Peter Leeson	*The Democratic Domino Theory: An Empirical Investigation*
Peter Leeson	*The Laws of Lawlessness*
Peter Leeson	*The New Comparative Political Economy*
Peter Leeson	*The Plight of Underdeveloped Countries*
Peter Leeson	*The Political, Economic, and Social Aspects of Katrina*
Peter Leeson	*The Use of Knowledge in Natural Disaster Relief Management*
Peter Leeson	*Trading with Bandits*
Peter Leeson	*Two-Tiered Entrepreneurship and Economic Development*
Peter Leeson	*Weathering Corruption*
Raj Chetty	*A New Method of Estimating Risk Aversion*
Raj Chetty	*Active vs. Passive Decisions and Crowd-Out in Retirement Savings Accounts: Evidence from Denmark*
Raj Chetty	*Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records*

Raj Chetty	*Are Micro and Macro Labor Supply Elasticities Consistent? A Review of Evidence on the Intensive and Extensive Margins*
Raj Chetty	*Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply*
Raj Chetty	*Cash-on-Hand and Competing Models of Intertemporal Behavior: New Evidence from the Labor Market*
Raj Chetty	*Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut*
Raj Chetty	*How Does Your Kindergarten Classroom Affect Your Earnings? Evidence From Project Star*
Raj Chetty	*Is the United States Still a Land of Opportunity? Recent Trends in Intergenerational Mobility†*
Raj Chetty	*Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates*
Raj Chetty	*Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood*
Raj Chetty	*Moral Hazard vs. Liquidity and Optimal Unemployment Insurance*
Raj Chetty	*Salience and Taxation: Theory and Evidence*
Raj Chetty	*Sufficient Statistics for Welfare Analysis: A Bridge Between Structural and Reduced-Form Methods*
Raj Chetty	*The Association Between Income and Life Expectancy in the United States, 2001-2014*
Raj Chetty	*The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment to Opportunity Experiment*
Raj Chetty	*The fading American dream: Trends in absolute income mobility since 1940*
Raj Chetty	*The Long-Term Impacts of Teachers: Teacher Value-Added and Student Outcomes in Adulthood*
Raj Chetty	*Using Differences in Knowledge Across Neighborhoods to Uncover the Impacts of the EITC on Earnings*
Raj Chetty	*Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States*
Steven Levitt	*An economic analysis of a drug-selling gang's finances*
Steven Levitt	*An empirical analysis of the gender gap in mathematics*
Steven Levitt	*Crime, urban flight, and the consequences for cities*
Steven Levitt	*Field experiments in economics: the past, the present, and the future*
Steven Levitt	*How do senators vote? Disentangling the role of voter preferences, party affiliation, and senator ideology*
Steven Levitt	*Juvenile crime and punishment*
Steven Levitt	*Market distortions when agents are better informed: The value of information in real estate transactions*
Steven Levitt	*Political parties and the distribution of federal outlays*
Steven Levitt	*Rotten apples: An investigation of the prevalence and predictors of teacher cheating*
Steven Levitt	*The black-white test score gap through third grade*

Steven Levitt	*The causes and consequences of distinctively black names*
Steven Levitt	*The effect of prison population size on crime rates: Evidence from prison overcrowding litigation*
Steven Levitt	*The effect of school choice on participants: Evidence from randomized lotteries*
Steven Levitt	*The impact of federal spending on House election outcomes*
Steven Levitt	*The impact of legalized abortion on crime*
Steven Levitt	*The impact of school choice on student outcomes: an analysis of the Chicago Public Schools*
Steven Levitt	*Understanding the black-white test score gap in the first two years of school*
Steven Levitt	*Understanding why crime fell in the 1990s: Four factors that explain the decline and six that do not*
Steven Levitt	*Using electoral cycles in police hiring to estimate the effect of police on crime*
Steven Levitt	*What do laboratory experiments measuring social preferences reveal about the real world?*