

The economic mathematization: a bibliometric analysis

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Abstract: The aim of this paper is to present data to verify the process of mathematization in economic theory. For this we used two representative samples from three of the most influential academic journals in the years 1955-56-57 and the years 2015-16-17. Thus, a contingency table was drawn up, showing that the occurrence of mathematical models is not specific to a particular theme, but rather covers all the economical themes of the categories presented, without distinction. Finally, it is argued that there is a rise of mathematical techniques that negatively correlates with conceptual works, causing a theoretic congestion that converges with a problem of legitimacy in the choice of the model for practical purposes.

Resumen: El objetivo del presente trabajo es el de presentar datos que verifiquen el proceso de matematización en la teoría económica. Para esto se recurrió a dos muestras representativas de tres de las revistas académicas más influyentes en los años 1955-56-57 y los años 2015-16-17. A partir de esto, se confeccionó una tabla de contingencia donde se muestra qué la ocurrencia de los modelos matemáticos no es específico de un tema económico en particular, sino que recorre todos los temas de las categorías presentadas, indistintamente. Por último, se argumenta que hay un auge de las técnicas matemáticas que correlaciona negativamente con los trabajos conceptuales, pudiendo producirse una congestión teórica que converge con un problema de legitimidad en la elección de los modelos para fines prácticos.

Palabras Clave: modelos matemáticos; metodología; teoría económica; análisis bibliométrico, Mathematical Models; Methodology; Economics Theory; Bibliometric Analysis

JEL: B40; B41; C02

Introduction

In his Nobel Prize acceptance conference, Hayek (1974) warned economists of the dangers of what he called *scientificism*, where Economics research relies on the quantitative assessment of data as it is done with mathematical models¹. Thus, to try to analyze past events and to recommend a certain course of action on the basis of known quantities leads to overestimate the factors for which there was available data and to ignore those that cannot be put in figures. When there are relevant factors than cannot be quantified, inadequate policies are drafted and advice is given with very damaging consequences. In a similar fashion, institutionalist (i.e., Hodgson, 2006; North, 1990, 2005) and heterodox Neo-Keynesian approaches have challenged the Mathematics-centred quantitative model as the sole methodological resource (i.e., Davidson, 2003; Galbraith, 1991); also, part of the Austrian school is of the view that deduction turned into praxeology is the most appropriate methodology (i.e., Hoppe, 1995)

In order to better understand these views, it is imperative to distinguish between the two ways in which Mathematics has traditionally had an impact on Economics. The first concerns the mathematical expression of Economic theory in a purely formal, mathematical language. The second is about empirical validation through Econometrics. Both ways feedback themselves, but in general it is possible to identify the main role that Mathematics plays: some papers bring forward an economic model and they might even carry on empirical validation, which is sometimes incomplete, to show its economic functioning; other papers are just purely econometric. In this second kind of impact,

¹ *Mathematical model* should be understood to be an abstract description of certain relations amongst quantities such as prices, production, employment, savings, investment, etc., with the purpose of analyzing its logical implications with the aid of formal tools.

Mathematics can turn itself into a method for understanding reality with a certain degree of accuracy². On one hand, the Austrian's objection was aimed mainly against the first scenario, in particular in its beginnings. Thus, for example, when Menger wrote to Walras –whose marginalism was expressed in mathematical notation³– he adamantly pointed out that not only quantitative relations are to be studied but also the nature of economic phenomena, specially the ways by which it can be studied (for example, the nature of value, rent, benefit, the division of labor, bimetallism, etc.) through mathematical methods (see: White, 1984)⁴. On the otherhand, this challenge to mathematization has been described by McCloskey (1985) as Economics rhetoric, a cult to statistical signification, being as such one of the most prominent advocates of methodological dissent⁵. At the same time, these methodological approaches hold the view that economies based solely upon mathematical models tend to confuse *validity* for *truth*. As Friedman (1953) had already established, the role of Statistics is not about uncovering the truth but to solve disagreements between persons.

Contrary to the critical assessment of the role of mathematical models, Samuelson (1947/2010) argued that Mathematics formalistic rigor must replace the literary vagueness which was typical of the early stages of economic analysis. On the same line of thought, Lucas (1991) stated that discussions around economic policy and Macroeconomics, if they intend to be in some way productive, would include mathematical model-based quantitative assessments with which the effects of such policies try to be estimated. More recently, Roderick (2015) has emphasized that the methodological relationship between Economics and mathematical models is most helpful when trying to explain the real world and to formulate public policies. These are merely three examples of what the main economic trend is about, where mathematization has taken the place of conceptual development⁶. In fact, it is even suggested that mathematical models are what make Economics a science as they are tools that simplify economies relations so it is possible to discover and comprehend mechanisms and to isolate variables that may cause confusion. This has made economic

² Of course, Mathematics in the form of Econometrics is not always a method suitable for the assessment of empirical knowledge as it can also be considered as a formal tool which may provide evidence or help reinforce the validation or one or more hypotheses.

³ Although Walras's analysis not only encompasses mathematical elements, his line of thought's influence can be observed in its formal aspects. See Ingrao & Israel (1990), for whom the problem of mathematization is not a secondary characteristic of the theory of general economic equilibrium but one of the basic reasons for its creation and development.

⁴ Von Mises (1984) took on from the same idea when he upheld that history, which includes economic statistics and descriptive economics, is not able to teach us any kind of general principle or law. In fact, the interpretation of statistics and other complex historical evidence presupposes the praxeological knowledge in causal relations and group-related events. So, history or statistics, which derive towards experience or empirical investigation, cannot either prove or disprove the praxeological laws.

⁵ In fact, McCloskey (1994) presents a historical-statistical study of papers that had been published in economic journals from the beginning of the Twentieth Century to this day. In that ways he found that papers have mostly kept some kind of relationship between theoretical and empirical approaches, but that the amount of mathematical expressions has largely increased throughout the years. (For a development of McCloskey's view, see Balak, 2006)

⁶ See, for example, Blaug (1992). For a short characterization of the role of mathematization in economic history, see: Weintraub (1991), who traces a historical review of the economic dynamics theory between the late 1930s and the early 1950s

analysis prey to ideas that are foreign to the fundamentals of analysis itself; economic analysis is detoured from its appropriate concerns towards the use of mathematical models that do not allow for the continuous, non-quantifiable expression of a series of important ideas.

Now that both points of view have been summarized, this paper has two aims: the first, to present a sample that demonstrates that mathematization has gone under way for the past 50 years in the main academic journals –where *mathematization* is understood simply as the growing emphasis placed upon mathematical economics. The second, to argue that if said process were to continue as it has done till now, together with the amount of papers published, a theoretical congestion of mathematical models could be due to excess supply of them. In other words, the main concern of this paper is to encourage debate upon two questions: (a) What relevance do mathematical models have within the main Economics academic journals publishing criteria? (b) Is it possible for this trend to continue?

Sampling design and methodology

In order to begin answering the above mentioned questions, it was necessary to do a survey of the state of the art by means of an observational study. For that, an unbiased representative sample made up of three high-profile Economics journals was built, from where 100 articles in total (33 per magazine for the years 2015/2016/2017, except for one which was chosen at random favoring the first journal) were drawn. For the sample to be representative, cluster sampling was observed for the journals and simple random selection for the articles. As a whole, a multiple stage sampling design was chosen. Cluster sampling is very important as it tends to yield the best results when the cluster represents the population, so the high impact journals cluster is the one that best represents the journal population. Thus, the journals population was divided into sections in order to choose the publications with the highest impact index representing the total of magazines. To determine which journals had the greatest impact, the “Scimago” index for Economics journals with a generalist ⁷perspective was used. The journals, which were selected by random, were⁸:

1. *Quarterly Journal of Economics* (20.761)
2. *Review of Economic Studies* (9.250)
3. *Journal of International Economics* (3.723)

If the intention is to determine the editorial line, then the journals with the greatest impact, as they are the most often quoted by the other publications, will be taken into account by the entire

⁷ <http://www.scimagojr.com/journalrank.php?area=2000>

⁸ Selection was made at random because, at this stage, we are dealing with a random sample in which each journal had the same probability of been drawn out so as to avoid any kind of bias in selection.

discipline and will not only be taken as a guideline for the other journal's editorial line but also as a feedback for their own papers⁹. From this cluster sample, a simple random sample was made in order to point out the three above-mentioned journals from a total of 20, each with the same probability of being drawn out. The sections put under study are conglomerates that represent the population's inner diversity and the 20 journals were selected amongst the ones of the highest impact, excluding those which, like for example the *Journal of Econometrics*, are specific to a certain field and thus respectful of its homogeneity. As for the articles, a simple random sample was performed but, in this case, it was intended for the sample to comply with the central limit theorem so that it may be the closest possible to a normal distribution. In both cases, as this is a retrospective study (or case control), selection will be without replacement: once an element of the population is included in the sample, it will not be selected for a second time.

Once the 100 articles per journal were drawn out, they were sorted into four categories depending on the influence the mathematical model has in each of them:

Figure 1: Mathematical uses categories

| | |
|------------|---|
| Category 1 | Makes little or no use at all of mathematical resources, although it may provide data by using descriptive statistics |
| Category 2 | It uses simple mathematical resources to uphold or assess a hypothesis with empirical data |
| Category 3 | It uses a mathematical model to uphold or describe a conceptual hypothesis, with little empirical data used as examples |
| Category 4 | It presents its own complex mathematical model, being that the article's aim, without empirical data |

Source: prepared by the author

Regarding the previously defined categories, it is necessary to provide three basic clarifications. Firstly, categories 1 and 2 may be considered as a single category, and the same may be done for categories 3 and 4, when the use of mathematical resources is taken into consideration. Secondly, these categories deal with an ordinal measurement level of the sample since discrete data can be accommodated to at least one order, although the difference between data values (obtained from subtraction) either cannot be calculated or they are meaningless. This data will provide information for relative comparisons but not on the differences' magnitudes. Thirdly, it is necessary to establish that there is no natural zero starting point as zero, represented here by category 1, implies a relative position with other difference (fully conceptual paper).

⁹ See Lovell (1973)

The papers here selected were not only sorted into the four categories above stated but they were also grouped according to the subject they bring forward –using the *JEL code*– into four main topics:

- I. Microeconomics and industrial organization (*JEL*, D-L)
- II. Macroeconomics and public economy (*JEL*, E-H)
- III. Systems and economic history, together with quantitative methods (*JEL*, B-C-P)
- IV. International and financial economics (*JEL*, F-G)

From this code grouping, it will be possible to determine if there is one which has represented the dealing with a mathematical model better than any other (in which category they were most used and in which they were not). Thus, this data will make the production of a contingency table possible, enabling us to register and to analyze the association among variables. From there, it will be possible to establish if there is an editorial line as a subject in its own right where there is a correlation between the use of mathematical models and the probability that a paper may be accepted for publication.

Results and relevant data

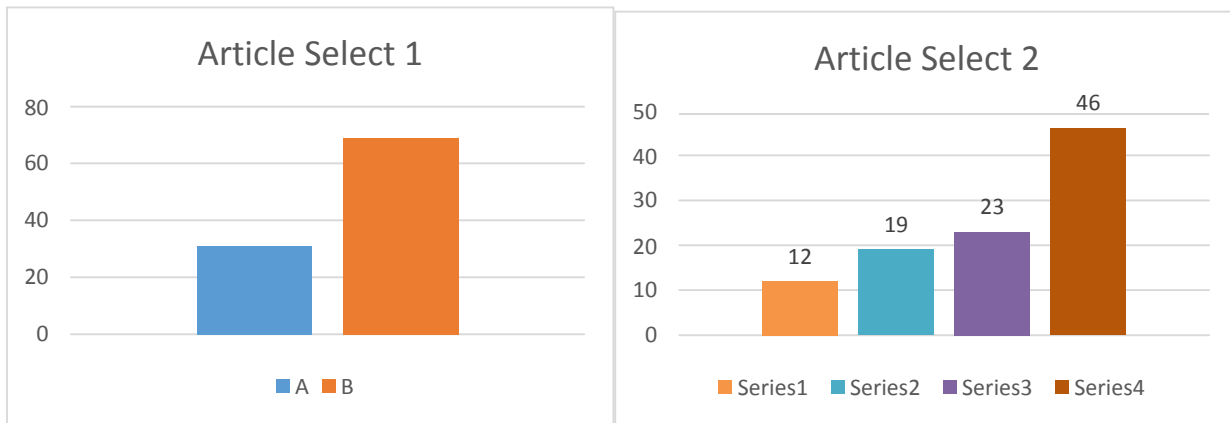
The following initial results were obtained from the initial sample, consisting of 100 papers that have been grouped into the four categories as follows:

Figure 2: Journals sorted by categories

| | |
|------------|----|
| Category 1 | 12 |
| Category 2 | 19 |
| Category 3 | 23 |
| Category 4 | 46 |

None of the journals selected was considered to be purely conceptual. Most journals come between categories 3 and 4; so, if we merge categories 1 and 2 on one side and categories 3 and 4 on the other as categories A and B respectively, then a difference of 31 to 69 can be observed.

Figure 3: Comparison between the selections of papers according to groups of categories



Source: prepared by the author

If *JEL* categories are taken into account, then 53 journals will fall into category D-L; 28 into B-C-P; and 53 into F-G. Of course that it is possible to make different groupings, but the logic behind the proposed assortment is to point out not only subject vicinity but also the division between private and public. It may also happen that a journal may fall into more than one *JEL* category; in this case, the entirety of said categorization was observed.

From this data, a contingency or frequency table can be produced as it will enable us to determine whether the variables are independent or not. The statistical test that was used for the independence trial is the following:

$$x^2 = \sum \frac{(O - E)^2}{E}$$

Where O is the frequency observed in a cell and E is the expected frequency obtained through evaluation.

$$E = \frac{(\text{total row})(\text{total column})}{(\text{grand total})}$$

The statistical test allows us to measure the degree of difference (discordance) between empirically observed frequencies and those that would be theoretically expected if variables were independent. The statistical test biggest values fall on the far right side of the distribution and show significant differences between observed and expected frequencies. The distribution of the statistical test can be approximated through distribution as long as all expected frequencies are equal or greater than 5. The amount of degrees of freedom, where r represents the amount of lines in the table and c represents the amount of columns, exposes the fact that, as we know the total number of frequencies, we can freely allocate frequencies before the frequency for each cell is determined.

Data for categories A and B are as follow:

Figure 4: Table of contingency for categories A and B

| | D-L | E-H | B-C-P | F-G |
|---|-----|-----|-------|-----|
| A | 13 | 6 | 8 | 15 |
| B | 40 | 22 | 18 | 38 |

Source: prepared by the author

The *Chi-square* test was 0.8, which is close to zero, situation where we may conclusively state that there is no relationship. If the expected and observed values are close enough, then the statistical test result will be small and the *p-value* will be big. Here, the *p-value* is 84.4% with 3 degrees of freedom. From this point of view, the fact that a mathematical model might be used is independent from the economic subject of the paper. In this case, the expect values will be close to the observed values too. As such, the expected values for the first cell matches the observed value (13.9) where,

$$E = \frac{(total\ row\ A = 42)(total\ column\ D - L = 53)}{(grand\ total = 160)}$$

The expected values will be, in sum, close to the observed ones, which means that there will be a trend towards mathematical models independent of each particular *JEL* category. From this perspective, it may be possible to think that mathematical models are not peculiar to a certain kind of subject but that, instead, they occur without distinction, in all subjects of the categories presented above.

Now, what might happen if we break down these figures into the four categories we presented above? Then, the obtained data will look as follows:

Figure 5: Contingency table with broken down results

| | D-L | E-H | B-C-P | F-G |
|------------|-----|-----|-------|-----|
| Category 1 | 6 | 1 | 4 | 5 |
| Category 2 | 9 | 5 | 4 | 10 |
| Category 3 | 14 | 11 | 7 | 11 |
| Category 4 | 24 | 11 | 11 | 27 |

Source: prepared by the author

P-value is also too high so as to reject independence among categories of use of mathematics and economic subjects. This analysis excessive fragmentation makes some expected values to be less than 5 (two cases with expected frequency 4, and one case with 1), casting doubts on the validity of the *chi-square* law of probability when applied to the calculation of *p-value*. Nevertheless, the

forcefulness of the difference between the empirical statistical value and the critical theoretical value allows us to state independence with considerable soundness.

Following this line of arguments, it is also worth asking ourselves if mathematical modelization of the economy happened within the last 60 years or if there was any indication as to if that was already happening in the 1950s. In order to determine if there were important changes in the way the economy was taken into consideration, it is necessary again to construct a representative sample. For this 1950s sample, the years selected were 1955, 1956 and 1957, for the first two journals –as the *Journal of International Economics* was founded in 1971, we have included the *American Economic Review* in its place as it was one of the most representative journals then-. It must also be noted that *JEL* codes did not exist back then –they were created in 1991–, so it is not possible to produce a contingency table, as it was done for the contemporary journals, to determine the degree of independence of some of Economics areas of research. Of course, this problem could be overcome if key words were to be taken as indicators and used to sort papers into the *JEL* categories they might fall into. Nevertheless, this could be done in future studies as it may help elucidate whether mathematical models were first used in a specific area of economic research and then trickled down to other areas of scientific endeavor or if they appear at the same time in most areas. This question lies outside the present study’s scope.

Besides the sorting into categories, it is interesting to compare papers from the past three years with those from the 1950s in the terms of the use of mathematical formalism according to the categories previously defined for this study. For that, we have produced the following classification for the papers from the 1950s (1955, 56 and 57):

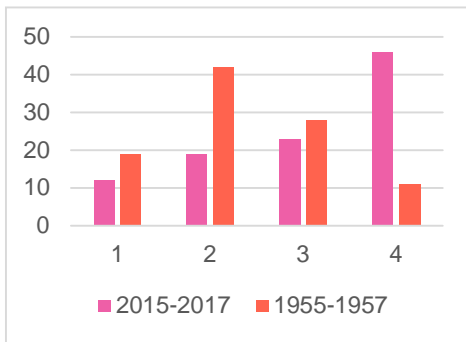
Figure 6: Classification of papers from the years 1955/56/57

| | |
|------------|----|
| Category 1 | 19 |
| Category 2 | 42 |
| Category 3 | 28 |
| Category 4 | 11 |

Source: prepared by the author

When grouped into A and B, the difference is that domain A sums up to 61% while B to the remainder 39%. As it has been previously stated, this marks an important difference towards the present day values, as it is shown in the following graph.

Figure 7: Comparison between years 2015/16/17 and 1955/56/57



Source: prepared by the author

At this point, a new contingency table can be constructed to compare the level of mathematical formalization, for the surveyed years, in order to uphold the hypothesis that mathematical formalization has experienced a growing trend. Thus, we arrive to the following figure:

Figure 8: comparison of the evolution of mathematical formalization (1955-57 / 2015-17)

| Years/level of formalization | 1 | 2 | 3 | 4 |
|------------------------------|----|----|----|----|
| 1955-1957 | 19 | 42 | 28 | 11 |
| 2015-2017 | 12 | 19 | 23 | 46 |

Source: prepared by the author

The table of contingency confirms a sound dependency upon a *chi-square* of 32 in a degree of freedom equal to 3 and a P-value of 0.0%. In this way, the variables are indeed linked together, the level of mathematization is linked to time in a way that the incorporation of mathematical models has been a growing trend through time.

Mathematized Economics

From the data presented above, it seems that mathematical models have become during the past 60 years a constant in economic research. This is also associated with the growth of an area of research such as econometrics, which renders relevant the requisite of prediction of a model. If one ponders upon the fact that the selection of academic papers follows some kind of *status quo*, then the concentration and selection of mathematical models in those papers would have been gradual. But, is it possible to foresee that this trend might continue?

Card & Krueger (1995) identify three sources of bias for the selection of journals in Economics: (i) the reviewers and editors are willing to accept studies which are consistent with conventional views; (ii) researchers can use the presence of a conventionally expected result as proof that the study will be selected for publication; (iii) we might all have a predisposition to treat results

that present themselves as more favorable to our views as “statistically significant”. When it is likely that the three sources of bias for publication are operating together, an empirical literature can therefore be really biased, thus distorting the evaluation of empirical findings¹⁰. If the publication bias continues, then the trend for the inclusion of mathematics in economics will deepen. In effect, if the success of economic theory and its consequent expansion as a theory can only be explained in part because of the success of the maths it contains, then it is to be expected that the mathematical method will go on dominating academic publications.

The development that Mathematical Economics has experienced for the past half century can be detected thanks to the total number of pages published each year in academic journals. According to Debreu (1991), between 1933 -year when both *Econometrics* and *The Review of Economic Studies* began to be published- and 1959, the index begins on a high point –700 pages– and reaches a trough of 400 pages in 1943-44. But, from 1944 onwards, the amount of published pages experienced an explosive growth in which *Econometrics* and *Review of Economic Studies* were joined –in 1960– by the *International Economic Review* and, in 1969, by the *Journal of Economic Theory*. In 1977 these five journals alone amounted for a total of 5000 published pages. During the period 1944-1977, the index doubled itself every nine years. While journals in the field of Mathematical Economics grew at an unsustainably fast pace, *American Economic Review* suffered a radical change in its identity. In 1940, less than 3% of its thirtieth volume peer-reviewed pages dared to include rudimentary mathematical expressions. Fifty years later, almost 40% of the eightieth volume pages include mathematics of some more elaborate kind. The perception of the profoundness of said change is reinforced when a comparison is drawn between the levels of included mathematics needed in 1940 and in 1990 to follow the development of economic theory’s evolution through the avenues it was exploring.

This cluster of data coincides with the data presented in this study, which are therefore in some way validated. One may think that the increase in the number of pages could be due to the possibility of mathematically expressing economic models of growing complexity, as both Card and DellaVigna (2014) have stated. Even in the case this may not be the cause, as Debreu points out, fifty years ago the basic mathematical undergraduate education was, almost always, enough. Nowadays, postgraduate training in Mathematics is necessary. If, instead of being just a follower, one wished to become an active participant in these developments’ most technical aspects, a high degree of mathematical professionalism is required.

In contrast to mathematicians, there is another group of economists that consider that having a greater knowledge of Economics could improve the world, but as the use of mathematical tools

¹⁰ For further information, see Stanley (2005)

grants them with visibility, they adopt a cynical attitude that enables them to survive in the academic world (see: Klamer & Colander, 1990; Diamond, 1993). These prevents some kind of creative destruction from happening (Diamond, 2007). If the only type of accepted evidence is the validation of an econometric hypothesis deduced from formal models, a more plural methodology would see itself encased in very specific heterodox niches.

On the same line as we have followed in this analysis, Stigler *et al* (1995) showed the following table representing the use of Economic techniques in seven high-profile journals, expressed in percentages:

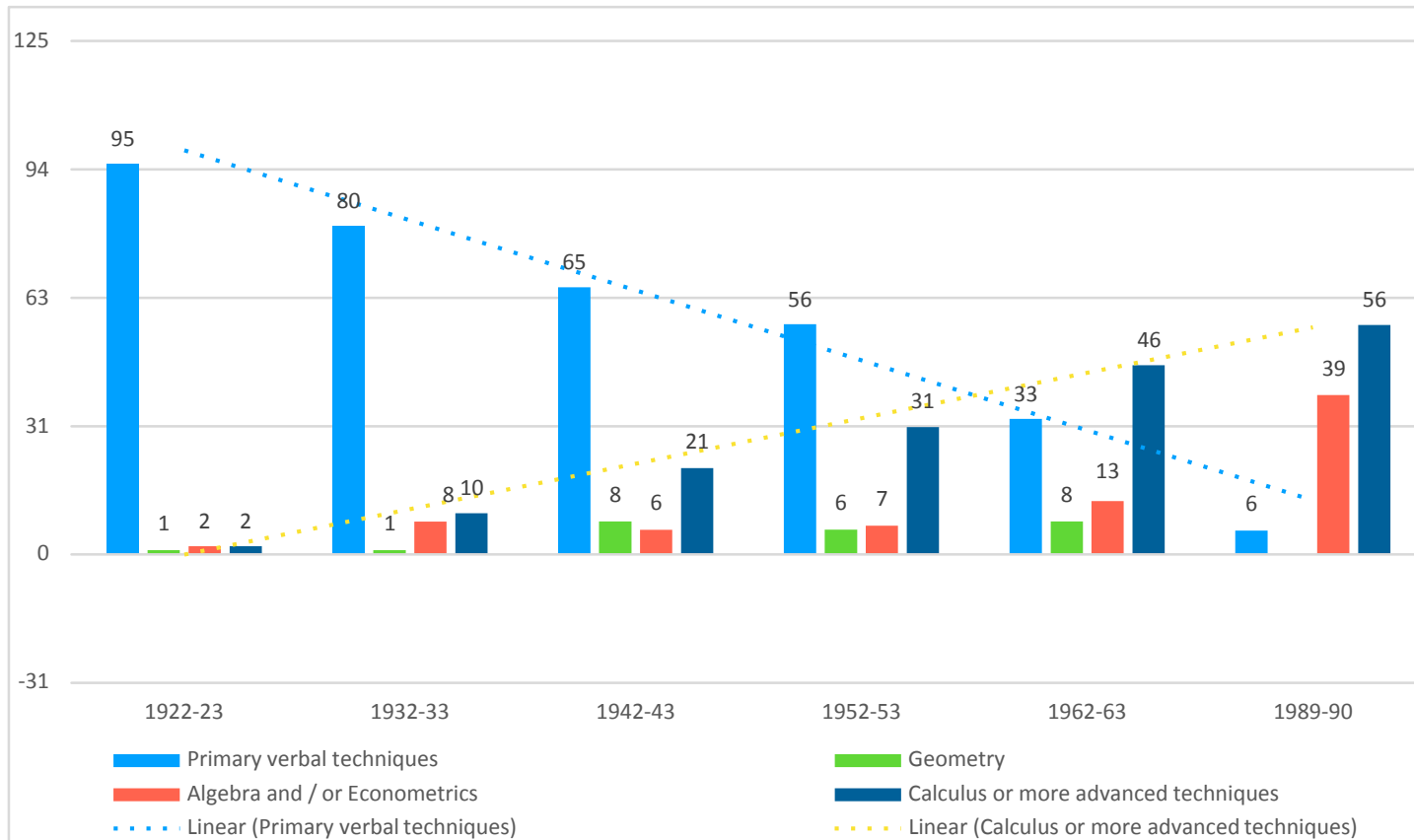
Figure 9: Stigler ‘a sample of economic techniques’ use

| Year | Primary verbal techniques | Geometry | Algebra and/or Econometrics | Calculus or more advanced techniques |
|---------|---------------------------|----------|-----------------------------|--------------------------------------|
| 1892-93 | 95 | 3 | 2 | ... |
| 1902-03 | 92 | 1 | 6 | ... |
| 1912-13 | 98 | 1 | 1 | ... |
| 1922-23 | 95 | 1 | 2 | 2 |
| 1932-33 | 80 | 1 | 8 | 10 |
| 1942-43 | 65 | 8 | 6 | 21 |
| 1952-53 | 56 | 6 | 7 | 31 |
| 1962-63 | 33 | 8 | 13 | 46 |
| 1989-90 | 5.8 | | 38.8 | 55.9 |

Source: Stigler, G., Stigler, S. M., & Friedland, C. (1995)

To put it in graphical form,

Figure 10: Mathematical calculus and verbal techniques lines of tendency (from Stigler's sample)



Source: prepared by the author

In this graph it can be mainly observed that: (I) a line of mathematical calculus growing tendency at the expense of verbal, conceptual development; (ii) some kind of point of equilibrium between both tendencies during the late 1950s; (iii) the lines of tendency match the data shown in this study; (iv) there seems to be a negative -or inverse-correlation between verbal techniques and the calculation of more advanced techniques. In fact, the correlation coefficient between both variables is $r = -0.989^{11}$. Possibly, this negative correlation is due to that, as mathematization progressed, there might have not been enough space to publish the entire supply of conceptual papers. Of course, this is an editorial decision that prioritizes mathematical models instead of conceptual models -this can also be seen in how the use of algebra and econometric data has been accompanying the use of more advanced calculus or techniques. This suggest that mathematical techniques have had a considerable impact on the papers' plausibility or theoretical credibility subjective assessment; to paraphrase Galileo: the economic world, economic relations between human beings, are a kind of book written in mathematical language. Nevertheless, this statement, if not mere prejudice, requires additional

¹¹ Given that P-value is 0%, which is smaller than the significance level of 0.10, it can be concluded that there is enough evidence to state that there is a linear correlation between verbal techniques and calculus or more advanced mathematical techniques.

argumentative support that, to prevent it from becoming a petition of principle, should not be written in the language of Mathematics.¹²

So, it is possible to argue that if the amount of mathematical models required for publication continues to increase, together with the number total of publications at the rate it has been growing since the 1950s, then it would be likely that a theoretical congestion point might be reached in the long run. That is to say that the system will collapse. Furthermore, if we were to take category 1 as being the only one that spares the use of mathematical tools while the remaining ones use them one way or another, in a greater or a lesser extent, then the difference will be even greater, matching thus the data put forward in this paragraph.

Theoretical congestion bears two implications: (i) a surplus of models might render choosing amongst them an extremely complicated affair mainly because of under determination -to those situations for which we have alternative models available, each with sufficient reasons to determine a set of beliefs or actions; (ii) a surplus of models may limit the methodological pluralism that is necessary in all fields of knowledge in order to preserve their epistemological diversity. In both cases, theoretical congestion can prevent mathematical models from being regarded as representatives of underlying processes that yield empirically relevant phenomena: a congestion in the net of models would make their application legitimacy problematic as it would not be possible to establish a hierarchy amongst them at the same time that, as it establishes itself as an omnipresent method, it would limit alternative ways of studying the world from appearing. Lastly, it may also be possible to think that the problem with mathematical model congestion would be caused by the need to be a published author in order to gain prestige.

Conclusion

During this century, also, economic theory has become increasingly more abstract and mathematical. Although it is not simple to accurately characterize the technical level included in each paper –i.e., a mathematical technique could be used in some section and the article could still be comprehensible for a reader that is not mathematically proficient–, it is possible to detect an intensive use of econometric methods, generally accompanied by algebra and mathematical analysis; where, furthermore, 46% of the total surveyed presents a complex, proprietary mathematical model, being its presentation the paper's aim. This proportion has increased 35% since the 1950s, when there was some kind of equilibrium between mathematical models and verbal or conceptual developments.

¹² In a letter to *Science* magazine, Leontief (1982) examined papers that had been published in the *American Economic Review* throughout the 1970s and found out that more than 50% had used mathematical models without empirical data while 15% consisted of non-mathematical theoretical analysis, likewise without resorting to any kind of empirical data, with a remainder of 35% of papers that had used empirical data in their analysis. Morgan (1988) updated Leontief's data for the 1980s, with identical results.

At this point, three important conclusions can be stated. Firstly, that such a tendency is not exclusive to a particular field but that it has permeated through the entire discipline. Secondly, that a point of mathematical model theoretical congestion might be encountered and that it would make it hard to legitimize the application of a model. Thirdly, that there seems to be some kind of feedback process going on in the mathematization process -that is, that there is a need to mathematize economic models so that the paper can be considered persuasive enough.

Finally, if we set ourselves to ponder, as a small treat of imagination, what would Adam Smith have to do in order to be able to publish his work in a high-impact journal, we might never know for sure but, what we do know is that, regardless of the subject, he would not be able to avoid the use of some kind of mathematical analysis model. In other words, we might not know what he should do but we do know what he should not stop doing: that is, to make use of statistical or mathematical tools in order to explain his hypothesis. His luck would have been different, although by not much, if he would have desired to publish his ideas in the 1950s¹³.

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