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The use of Mathematics in Economics and its Effect on a Scholar's Academic Career*

(Preliminary version. Comments are welcome.)

Miguel Espinosa[†] Carlos Rondon[‡] and Mauricio Romero[§]

September 14, 2012

Abstract

There has been so much debate on the increasing use of formal methods in Economics. Although there are some studies tackling these issues, those use either a little amount of papers, a small amount of scholars or a short period of time. We try to overcome these challenges constructing a database characterizing the main socio-demographic and academic output of a survey of 438 scholars divided into three groups: Economics Nobel Prize winners; scholars awarded with at least one of six worldwide prestigious economics recognitions; and academic faculty randomly selected from the top twenty economics departments. We give statistical evidence on the increasing trend of number of equations and econometric outputs per article, showing that for each of these variables there have been four structural breaks and three of them have been increasing ones. Therefore, we provide concrete measures of mathematization in Economics. Furthermore, we found that the use and training in mathematics has a positive correlation with the probability of winning a Nobel Prize in certain cases. It also appears that being an empirical researcher as measured by the average number of econometrics outputs has a negative correlation with someone's academic career success.

Keywords: Nobel Prize, Mathematics, Economics, Reputation.

JEL classification numbers: B3, C14, C82, N01

All our mathematics is constructed. It is a construction we make in order to think about the world... [It] is the only way we have to think logically about things we observe...The book of Nature is not written in mathematics; rather, mathematics is the only language we know to explain nature logically.

Ingrid Daubechies

When you have mastered numbers, you will in fact no longer be reading numbers, any more than you read words when reading books. You will be reading meanings.

W. E. B. Du Bois

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1 Introduction

For decades, the increasing use of formal methods in the social sciences has generated controversy. Of these, economics has been the primary focus of criticism. More specifically, most of the debate has centered on the so-called mathematization of economic theory, and the related bias towards formal methods.[1] The central question concerns how the use of mathematics has changed over time in economics, and how its use affects a scholar's academic career. For our analysis, a database made up of 438 scholars divided into three groups was constructed. The first group consists of 64 individuals that have won the Nobel Prize in economics; the second one consists of 205 individuals selected on the basis of them winning at least one of the following awards: the John Bates Clark Medal (JBCM); Distinguished Fellowship of the American Economic Association (DF); Richard T. Ely Lecturer (RTEL); Foreign Honorary Member of the American Economic Association (FHM); President of the American Economic Association (PAEA); and President of the Econometric Society (PES)[2]; the third group consists of 169 scholars randomly selected from the academic faculty of the top twenty economics departments according to IDEAS/RePEc ranking for 2010. For the third group, selection was restricted to academics who had achieved at least an 'associate professor' position. These groups are labeled as Nobel Laureates, Awarded Scholars, and Non-Awarded Scholars respectively.

For these authors, all the articles available in JSTOR[3] were compiled and reviewed. In order to assess the relative importance of mathematics to their work, we counted the number of equations per article, the number of equations per footnote, the number of econometric results and the number of mathematical appendixes per paper[4]. Although similar methods have been used before, this paper uses a database, that combines an objective measure of each academic's proximity to mathematics (the average number of equations per paper, a B.A. and/or Ph.D. in mathematics, among others variables) with socio-demographic information (such as country and date of birth, gender, and other related control variables). However, the database lacks a variable for measuring a scholar's ability or intelligence (e.g., IQ, GRE scores, SAT scores, etc.). Since it is possible that the use of mathematics is correlated with this variable, the econometric models in this article only imply correlation, and by no means causality.

As a general result, the use of mathematics is related with a higher probability of winning a Nobel Prize if the scholar has already won another award, otherwise it reduces the probability of winning any award. Being an awarded scholar is interpreted here as a person who has both a deep understanding

[1] It has been noted that leading universities and the students themselves regard mathematical knowledge as fundamental to the study of economics. In a survey conducted among graduate students at six leading universities in the U.S., Colander & Klamer (1987) reported that only 3% of students find a thorough knowledge of economic theory as being very important for professional success, compared to 57% who considered excellence in mathematics as fundamental. However, Colander (2005) finds a change in this tendency in recent data, where 9% the students consider a thorough knowledge of economic theory as being very important for professional success, while only 30% considered excellence in mathematics as fundamental.

[2] The database includes information for the following years: JBCM (1947-2009), DF (1965-2009), RTEL (1962-2009), FHM (1975-2007), PAEA (1930-2010), and PES (1931-2010). Further information can be found in Appendix A.

[3] Although there are other databases like ECONLIT that specialize in economics, three arguments make JSTOR the most convenient database for the purpose of this article: 1. JSTOR contains articles written before 1900, giving access to the academic production of the oldest scholars; 2. JSTOR also contains journals dedicated to other sciences and areas of knowledge outside of economics; and 3. JSTOR contains journals that have been discontinued or which were completely absorbed by other publications.

[4] For this article, an equation is defined as any expression that has either variables or numbers, or both, on both sides, such as: $x0 = x1$, $z0 > z1$, $w \subset W$ and $p = 1$. We consider an econometric result as any econometric output in the form of a table, but, not in the form of a graph. Charts are not included because, our intention is to measure the effect when using a strictly formal mathematical language, although a graph is a functional construction and a mathematical tool in the strict sense of the term. The choice between writing an equation and using a graph has a substantially different effect on the measurement of the so-called "mathematization" of economics. A mathematical appendix is one where a theorem is explained, demonstrated or expanded. Data appendices were not taken into account, since they do not represent expressions in mathematical terms.

of economic theory and ideas that are socially accepted as brilliant contributions to the state of the art in the mainstream economics. Since mathematics is a natural language for scientific diffusion in economics, we suggest the following explanation: the probability of winning a Nobel Prize rises when brilliant ideas are communicated through a language that other academics understand, and therefore, are easy to disseminate. These results are in line with a vision wherein formality and rigor should be accompanied by a solid understanding of economic theory. This conclusion is robust for different econometric analysis.

Using this database, an analysis of the evolution of mathematics in economics can also be portrayed. We show that the use of equations per article and the average number of econometric outputs increased consistently over time. Our evidence suggests that the 1950s were a decade of great influence for the way modern theoretical and empirical economics is done. This result is aligned with Debreu (1991) hypothesis wherein he states that during the period 1944-1977, there was a significant increase in the number of pages published in journals related to mathematical economics.

This article contributes to the economics literature in at least four different ways. First, to the best of the authors' knowledge, a work such as this one has never been done. We are not aware of any article in the literature, which addresses these questions and answers them in the way this article does. Second, the database presented here fills a gap in the literature relating to socio-demographic and academic production in economics. This database has a great potential to test several hypotheses about what economists do and the role of mathematics in the history of the economic thought. Furthermore, conclusions based on this database are a good proxy of what has been happening in the mainstream of economics. Third, we construct an outline of the mathematization of economics in the 20th century, measuring the evolution over time of the average number of equations per article and the average number of econometric outputs per article. Fourth, discrete choice models are presented in order to estimate a scholar's probability of winning a Nobel Prize and other prestigious awards controlling by different socio-demographic characteristics and several features of his (or her) published articles.

This paper is organized as follows: the next section presents an analysis of the use of mathematics over time, and disentangles certain facts regarding the historic trend. Section 3 presents descriptive statistics of our sample, analyzing such things as geographical origins and scholars' academic formation. Section 4 presents our econometric analysis and the results. Section 5 concludes.

2 Mathematics in Economics Over Time

The debate concerning the role of mathematics in economics has been an ongoing one for several years. A large number of authors, both economists and non-economists, have addressed the subject and have given pros and cons of the intensive use of mathematical methods in studying social problems. Regardless of this discussion, the incidence of mathematics being utilized in economics has undoubtedly increased, and nowadays an advanced knowledge in mathematics is a basic need for any economist willing to go beyond the undergraduate level. Although there are many arguments both in favor and against the use of mathematics in economics, this article takes no sides whatsoever. The results found here merely attempt to provide an objective account of the use of mathematics in economics through history and the effect this has had on a scholar academic careers[5].

[5]According to (Rader 1972), mathematics has at least three important roles in economic theory. First, the production of mathematics is in part an accumulation from other sciences. Second, mathematics is a valuable aid in long sequences of reasoning, where it is easy to make mistakes. Third, mathematics makes possible a greater degree of generality than verbal or graphical methods of discourse. Nevertheless, there are economists who object to the use of mathematics; According to Rader their objections may be summarized in three statements: 1. Mathematical treatment implies quantification, which is impossible for the whole of economics since some variables are not measurable or observable; 2. The search for mathematic generality is a tedious enterprise that substitutes convoluted definitions and notation manipulation for new ideas; and 3. A common question about the use of mathematics in economics is that, even where mathematics does apply, the use of given mathematic result can lead to perverse orientations in economic theory, in as much as mathematical

Grubel & Boland (1986) found an increasing trend in the use of mathematics in the articles published in the *American Economic Review* from 1950 to 1983, by counting the number of graphs, diagrams and tables of data as well as the number of equations present in each publication. In a similar exercise, Mirkowski (1991) tabulated the number of pages with mathematical discourse (although he does not explicitly state what he considers as constituting mathematical discourse) from 1887 to 1955 for every volume of four economic journals: the *Revue D'Economie Politique*, *Economic Journal*, *Quarterly Journal of Economics*, and *Journal of Political Economy*. Between 1887 and 1924, the author found that these journals devoted less than 5% of their pages to mathematical discourse. In contrast, after 1925, about 20-25% of the pages were mathematical in nature. Debreu (1986) quantified the number of pages published per year by the five main periodicals treating mathematical economics (*Econometrica*, *Review of Economic Studies*, *International Economic Review*, *Journal of Economic Theory*, and *Journal of Mathematical Economics*) and found that 1930 - 1943 marked a period of decline, while 1944-1977 was a period of "exponential" growth during which the number of pages grew at an annual rate of 8.2%. Debreu (1991) shows that for 1940, less than 3% of the pages of volume 30 of the *American Economic Review* included mathematical expressions, while in 1990, 40% of the pages of its eightieth volume include sophisticated math.

Although the evidence shows an increasing trend in the use of mathematics in economics, the periods analyzed are insufficient to cover the evolution of academic work in economics throughout the twentieth century. Given that the database created for this article collects information from 1894 to 2006 on the number of equations and econometric outputs in each article published by the featured authors, a possible way to analyze the last century is now possible.

The purpose of this section is to analyze how the use of mathematics and the production of empirical results have evolved over time. Using time-series of the average number of equations and the average number of econometric outputs for the period 1894 - 2006, an analysis based on the trend of both series is proposed for the purpose of identifying possible structural changes. Working with the trend is more appropriate, given that it is more sensible to analyze long term changes than short ones, thus silencing the noise created by year-to-year undesired spikes[6]. Given that the number of structural breaks in both series, as well as their relative position in the series, are unknown, Bai & Perron (2003) methodology fits perfectly. Bai (1997) and Bai & Perron (2003) proved that individual structural change tests for a series containing unknown multiple structural breaks increase the probability of being biased towards not rejecting the hypothesis *No presence of structural breaks*. Briefly explained, Bai-Perron's (1998) methodology uses a sequential process of minimization that takes every local minimum in the series as critical points for structural breaks.

Figure 1 shows how the average number of equations per article per year (henceforth, *equations p.py*) has increased over time, passing from an average of 4 equations per article for the decade 1895 - 1905, to an average of 70 equations per article for the decade 1996 - 2006[7]. Figure 2 shows the evolution of econometric outputs per article (henceforth, *econometric outputs p.py*) through time. A clear increase in the average number of econometric outputs p.py is evident, especially since the 1950's. Before 1950, on average, one finds 1 econometric output for every 10 articles revised; after, one finds 12 econometric outputs for every 10 articles. This steep change in the trend might be related with the introduction of personal computers to the academic world. According to *Columbia's University* website[8], the first attemp of a small scientific computer was designed in that university between 1948 and 1954 by John Lentz. The computer was launched by IBM under the reference IBM-610 Auto-Point

theory is developed along lines not relevant to questions of economic interest.

[6]In order to isolate the trend of each series, we use a Hodrick-Prescott filter. Following Backus & Kehoe (1992), the smoothing parameter is set at 100.

[7]Since 1980, a u-shaped trend is observed in the average number of equations p.py. Given data limitations we are not able to provide a formal explanation of this behavior.

[8]http://www.columbia.edu/cu/computinghistory/610.html

Computer and included a special control panel to create subroutines involving different mathematical functions. Given that first computers were being designed and tested first in universities; and that these reduced significantly the cost and time of processing large datasets and performing complex calculus, it is plausible that the developing of modern of computers allowed a boom in empirical research that involved econometric analysis and simulations.

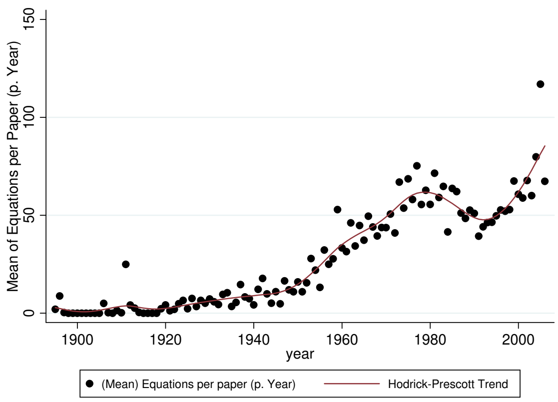


Figure 1: The use of equations per article per year. Source: JSTOR. Calculations: authors.

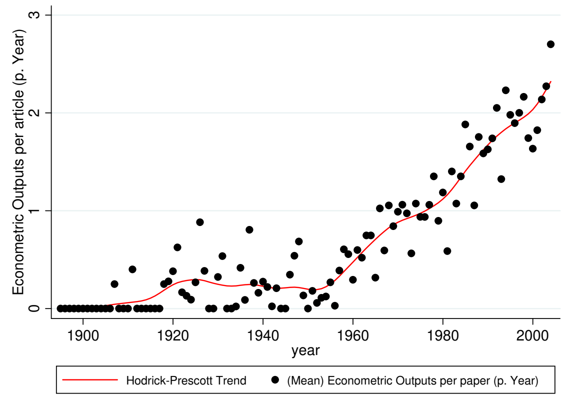
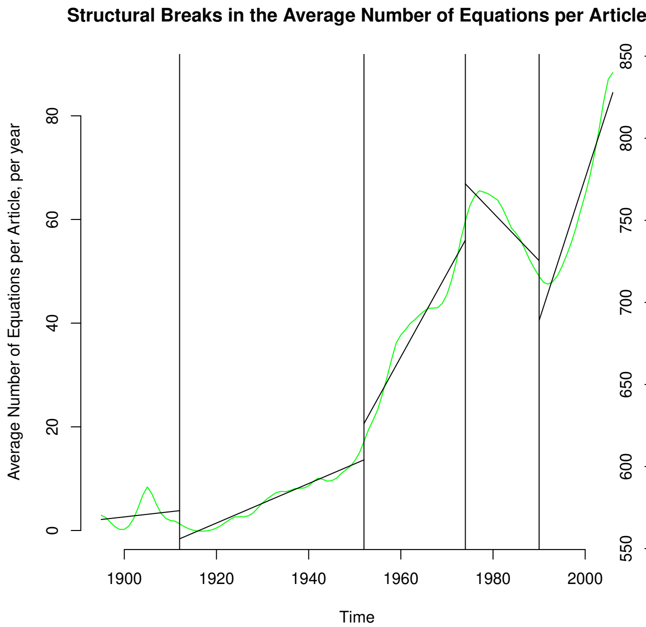


Figure 2: The use of econometric outputs per article per year. Source: JSTOR. Calculations: authors.

As can be seen in Figure 3, four structural changes were identified in the series of *equations p.py*. The years corresponding to those points are 1912, 1952, 1974 and 1990. Figure 4 shows that the Bayesian Information Criterion (BIC) curve is consistent with the selection of four structural breakpoints for this series. Two of the breakpoints identifyed are within the period that Debreu (1991) established as a period of significant increase in the number of pages published in journals featuring mathematical economics. On the other hand, three out of four of these changes are positive, meaning that the average equations per article aumented after the break point. These points were 1912, 1952 and 1990. Structural break in 1974 is negative and represented a decline in the average of equations per article. The positive changes are aligned with our hyphotesis of an incresing use of mathematics through time; however, our data does not allow us to explain the negative change in 1974. In order to fully identify the series, we follow the Box-Jenkins methodology and find that this series is an ARIMA(3,1,0) process.

Similarly, the same methodology was applied to the series of *econometricoutputs p.py*. Figure 5 shows that the series of econometric outputs has four structural changes in 1918, 1951, 1967 and 1983. This variable could be modelled as an ARIMA (2,2,2) process. Figure 6 shows the BIC curve for the series and its consistency with the choice of four structural break points. Once again, three out of four breakpoints are associated with an increasing average of econometric outputs per paper. The only negative breakpoint is located between the years 1918 and 1951. After 1951, the positive trend resumes and since then, the average number of econometric outputs per article per year has more than doubled. As we said before, this ever increasing trend might be related with the availability of faster and better computers to researchers.

By itself, finding that 3 out of 4 structural changes were positive does not prove that each series had an increasing trend over the years. However, if we combine these results with the increasing levels in the average of equations and econometrics outputs per paper that were observed in Figure 1 and Figure 2, we can clearly provide evidence of the mathematization in Economics.



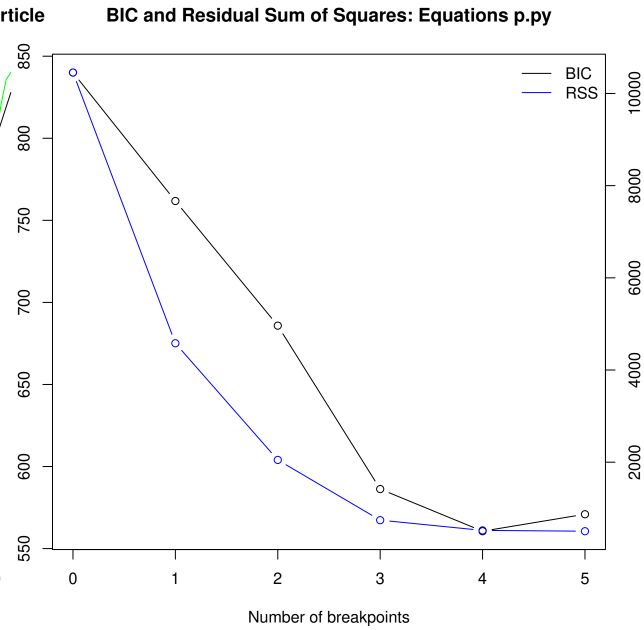
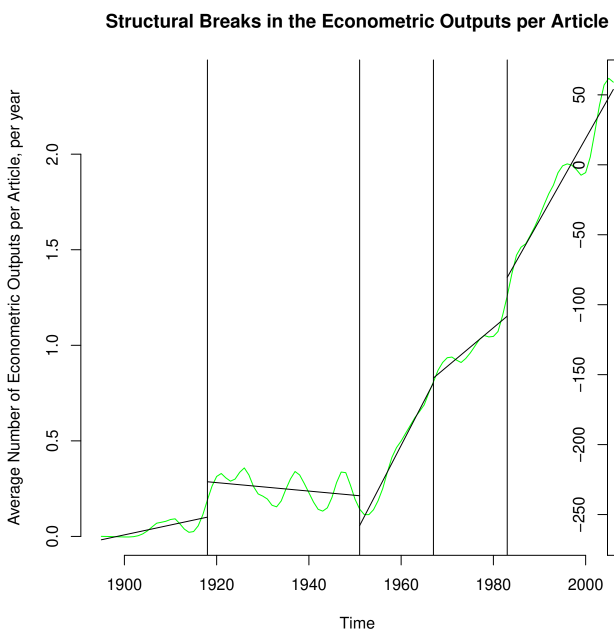


Figure 3: Structural Breaks in the Average Number of Equations per Article.Source: JSTOR. Calculations: authors.

Figure 4: BIC and Residual Sum of Squares: Equations p.py. Source: JSTOR. Calculations: authors.



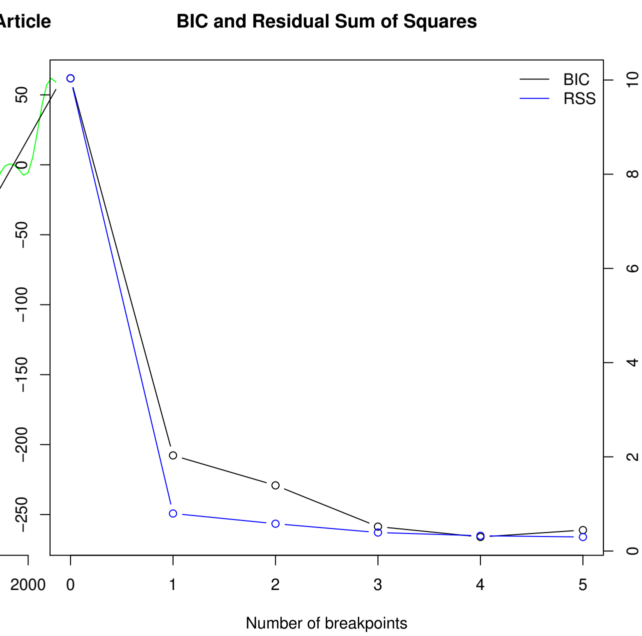


Figure 5: Structural Breaks in the Average Number of Econometric Outputs per Article. Source: JSTOR. Calculations: authors.

Figure 6: BIC and Residual Sum of Squares: Econometric Outputs p.py. Source: JSTOR. Calculations: authors.

3 Data Analysis

This section describes some of the most important socio-demographic statistics in our sample. Our specific intention is to provide a descriptive analysis of our database in order to justify and explain the inclusion of certain control variables in the econometric model we will use. This analysis is also revealing because it shows several remarkable facts about the scholars included in our sample.

The database compiles some demographic information about the scholars, such as gender, date and country of birth. It also collects information on their academic backgrounds, namely, where they got their B.A, M.A or Ph.D. (both university and country), and what subject of study they chose. We divided the subject of study into economics, mathematics and other. Mathematics includes applied and theoretical mathematics, but not physics or other related subjects.

3.1 Generalities

The average number of papers per author in our database is 18.81; however, there is great variation between authors. For instance, the scholar with the most articles has 126 papers, and the one with the least number of articles has 1 one paper. The average number of pages, footnotes and equations per paper are 17.5, 15.8 and 56.0, respectively. The average number of equations in footnotes is 5.3. Finally, 0.51 and 1.75 are the average number of mathematical appendices per paper and the average number of econometrics tables per paper, respectively.

As can be seen in the left panel of Figure 7, Non-Awarded Scholars are the younger group, while Awarded Scholars and Nobel Laureate have a similar age distribution. However, if we compare the age when Awarded Scholars and Nobel Laureates received their first prize with the current age of Non-Awarded Scholars, the distribution is very similar (right panel of figure 7). This last comparison is reasonable because Non-Awarded scholars would pass on to another group once they win their first prize. This suggests that Non-Awarded Scholars are more comparable to Nobel Laureates and Awarded Scholars before the scholars in these last two groups won their first prize. Therefore, from now, when is relevant, all exercises will be performed comparing the entire academic production of all three groups up through 2010 and using only the academic production of Nobel Laureates and Awarded Scholars up through the year they won their first prize. In general the conclusions from the statistical exercises do not change if we change the time frame for which the academic production of Nobel Laureates and Awarded Scholars is taken.

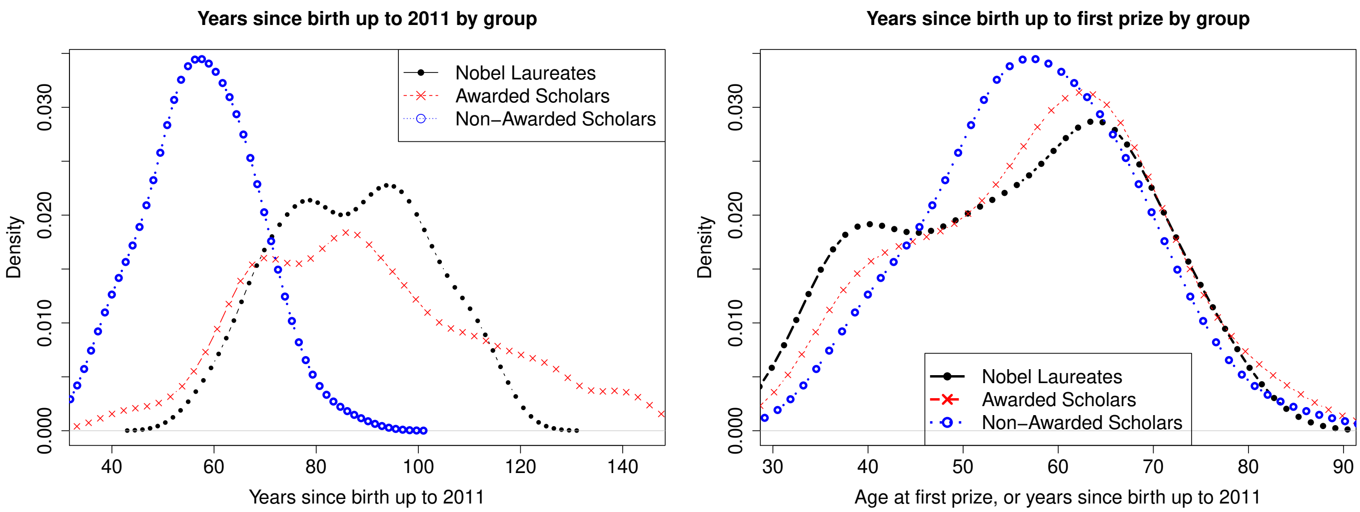


Figure 7: Kernel density estimation of year of birth/age per group, with a bandwidth of 5 given by Silverman's "rule of thumb". Source: JSTOR. Calculations: authors.

Table 1 shows descriptive statistics for the three different groups in our sample: Nobel Laureates, Awarded Scholars and Non-Awarded Scholars. It also includes information for Nobel Laureates and Awarded Scholars taking into account only their academic production up through the year they won their first prize. Non-Awarded Scholars have, on average, more equations per page, equations in footnotes, mathematical appendices and econometric tables per article than scholars that won any of the awards being considered, either before they win any award or after. Nonetheless, on average, scholars that have not won any award have fewer papers published. That is less production but more mathematical and empirical intensive research for Non-Awarded Scholars. On the other hand, Awarded Scholars do less empirical intensive research after their first award, while both Awarded Scholars and Nobel Laureates use less equations after being awarded.

	Papers	Pages per Paper	Equations	Equations per Footnote	Mathematical Appedixes	Econometric Outputs
Nobel Prize Winners (N=64)						
Mean (SD)	25.88 (21.02)	15.97 (5.59)	50.12 (52.79)	3.4 (4.34)	0.42 (0.47)	0.52 (1.08)
Min/Max	1/119	9.02/37.33	0/212.38	0/26	0/1.2	0/6.21
Nobel Prize Winners Prior to First Prize						
Mean (SD)	14.62 (10.82)	15.46 (4.39)	53.58 (57.07)	3.4 (4.34)	0.13 (0.31)	0.44 (0.78)
Min/Max	0/51	7/31.66	0/247.16	0/26	0/2	0/3.85
Awarded Scholars (N=205)						
Mean (SD)	22.61 (19.17)	15.57 (5.06)	39.01 (61.62)	3.02 (7.13)	0.49 (0.77)	0.86 (1.43)
Min/Max	1/156	0.636/37.38	0/478.31	0/86.27	0/9.09	0/8
Awarded Scholars Prior to First Prize						
Mean (SD)	16.40 (15.13)	15.55 (6.46)	41.26 (66.46)	3.02 (7.13)	0.16 (0.61)	1.26 (3.06)
Min/Max	0/116	0.67/43	0/478.31	0/86.27	0/7.66	0/25.42
Non-Awarded Scholars (N=169)						
Mean (SD)	12.2 (10.41)	20.45 (6.63)	78.91 (74.08)	9.03 (29.33)	0.58 (0.64)	2.69 (3.78)
Min/Max	1/52	1.2/45	0/494	0/247	0/4	0/22.4

Table 1: Source: JSTOR. Calculations: authors.

Figure 8 shows a kernel density estimation of the mean number of equations per page for our different groups. As can be seen, the Non-Awarded Scholars distribution has a higher level of skewness. The distribution does not change drastically whether we use the entire academic production of Nobel Laureates and Awarded Scholars up to the year they won their first prize or up to 2010.

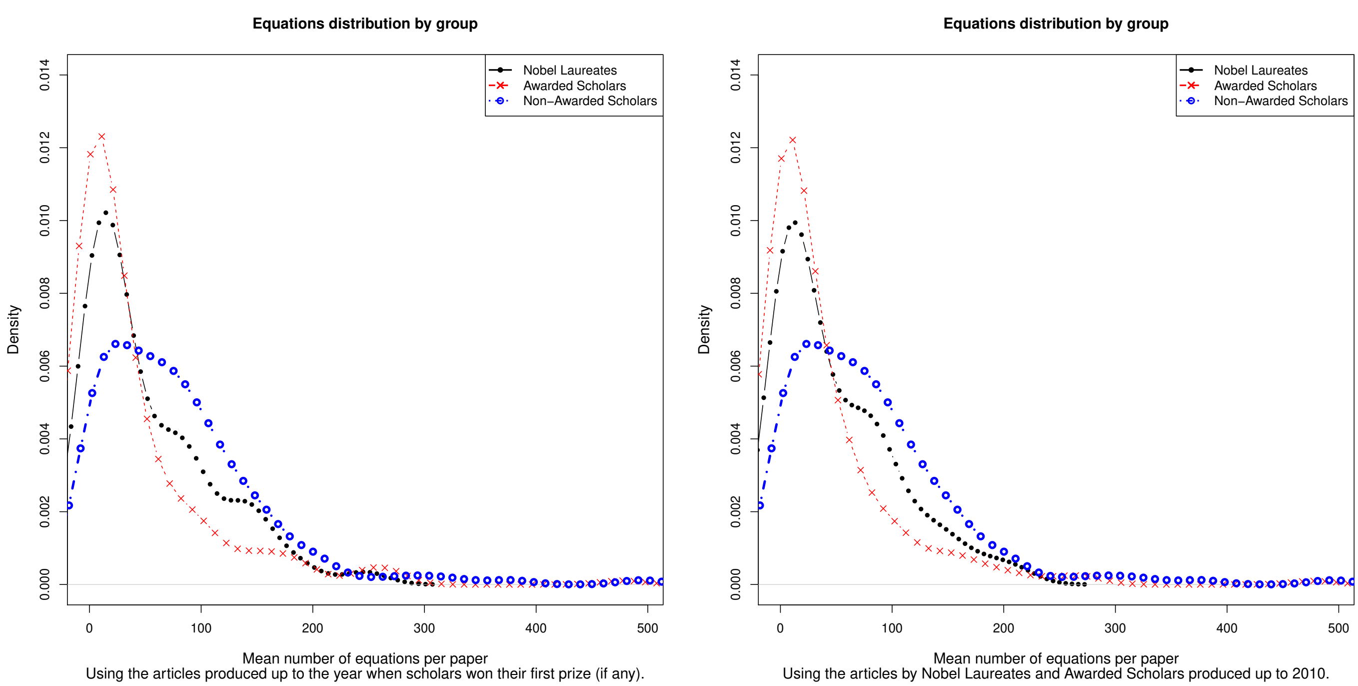


Figure 8: Kernel density estimation, with a bandwidth of 4 given by Silverman's "rule of thumb", of the mean number of equations per group. Source: JSTOR. Calculations: authors.

Table 2 shows the mean difference in the use of mathematics for our different groups. Performing a t test for the difference in means we find that Non-Awarded Scholars use a greater number of equations compared to Nobel Laureates and Awarded Scholars. Using a "proportion test" to find out whether differences in the proportions of scholars above the median (e_i) is greater in one group that in another, we find that fewer Awarded Scholars than Nobel Laureates use more equations than the median, but that proportionately more Non-Awarded Scholars are over the median than any other group. For example, on average, Nobel Laureates and Awarded Scholars use 37.261 fewer equations per paper than Non-Awarded Scholars and that proportion of scholars above the median is 0.332 greater for Non-Awarded Scholars than for Nobel Laureates and Awarded Scholars. These results suggest that, on average, Non-Awarded Scholars used more mathematics, but that if we restrict ourselves to Awarded Scholars and Nobel Laureates, the last group uses more equations on average. Table 3 contains similar information but using only the academic production of Nobel Laureates and Awarded Scholars up to and including the year when they won their first prize; the results are similar to those in table 2.

It can be seen from Tables 2 and 3 that the difference in the mean number of equations between groups is in general smaller (except for Nobel vs. Awarded Scholars) when we restrict the articles used for Nobel Laureates and Awarded Scholars to those published before they won their first prize. However, they are both significant. Interestingly, the third row has the only not significant difference. Perhaps, the effect of less equations of Awarded Scholars with the effect of more equations from the Non-Awarded Scholars (both with respect to the Nobel Prize Winners) cancel each other out.

Groups	Mean difference in the use of equations	Proportional difference of e_i
Nobel vs. Awarded (i=1)	11.111	0.162^{**}
Nobel vs. Non-Awarded (i=2)	-28.794^{***}	-0.175^{**}
Nobel vs. Awarded + Non-Awarded (i=3)	-6.921	-0.037
Awarded vs. Non-Awarded (i=4)	-39.905^{***}	-0.351^{***}
Nobel+Awarded vs. Non-Awarded (i=5)	-37.261^{***}	-0.332^{***}

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Mean difference in the use of equations by group. Variables measured using the articles by Nobel Laureates and Awarded Scholars produced up to 2010. Source: JSTOR. Calculations: authors.

Groups	Mean difference in the use of equations	Proportional difference of e_i
Nobel vs. Awarded	12.318	0.152^{**}
Nobel vs. Non-Awarded	-25.332^{***}	-0.148^{**}
Nobel vs. Awarded + Non-Awarded	-5.406	-0.058
Awarded vs. Non-Awarded	-37.650^{***}	-0.346^{***}
Nobel+Awarded vs. Non-Awarded	-34.731^{***}	-0.329^{***}

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Mean difference in the use of equations by group. Variables measured using only the academic production of Nobel Laureates and Awarded Scholars up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

According to Table 4 economics is the predominant subject of study chosen for B.A.s and Ph.D.s. However, there is an important presence of mathematics in the sample. Comparing the subsamples, it is clear that Nobel Prize laureates make up the largest percentage of scholars with a B.A. or a Ph.D. in mathematics. With the exception of Nobel Laureates, almost 70% of scholars have a B.A in economics.

	%B.A		%Ph.D.	
	Economics	Math	Economics	Math
Nobel Laureates	39.1%	32.8%	78.1%	12.5%
Awarded Scholars	68.9%	22.3%	85.6%	5.2%
Non-Awarded Scholars	68.8%	17.4%	89.8%	3.7%

Table 4: Source: JSTOR. Calculations: authors.

Finally, according to the collected information 52% of our sample are born in the U.S.A. , while 16% are U.S.A. nationalized citizens. That is, almost 70% of the scholars in our survey have a U.S.A. nationality in one or other way.

3.2 Prizes

Table 5 shows the distribution of awards in our sample for Nobel Prize recipients. In order to properly interpret the table, lets consider for instance the first row. PAEA stands for the presidency of the AEA, and the number in parenthesis refers to the number of presidents in our sample. The number of Nobel Prize recipients that were presidents of the AEA after (or the same years) being a Nobel recipient is eight (out of 80 recipients) and there are 14 scholars that were president of the AEA before being elected a Nobel recipient. The fourth column shows that 34.4% of all Nobel winners were president of the AEA as well. The fifth column shows that 27.5% of the presidents of the AEA were Nobel recipients.

Remarkably, the award with the largest percentage of Nobel winners is the PAEA, while the one with the lowest percentage is FHM. As expected, none of the JBCM winners who won a Nobel, won it prior to winning the JBCM, in an as much as the JBCM is restricted to scholars under 40. As an interesting remark, from the sample of Nobel Laureates and Awarded Scholars, 164 scholars (61.19% of the total) have only won one award.

Award	After or S.Y.	Before	% Nobel	% Prize	Mean Age
PAEA (80)	8	14	34.4	27.5	61.33
RTEL (47)	2	10	18.8	25.5	61.10
DF(87)	1	16	26.6	19.5	68
FHM (39)	1	4	7.8	12.8	53
JBCM (31)	0	12	18.8	38.7	37.51
PES (71)	12	18	31.3	28.2	49.84

Table 5: Source: JSTOR. Calculations: authors.

4 The effect of using mathematics

The objective of our econometric analysis is to determine the influence of academic formation in mathematics and the use of mathematics itself over the academic career of a scholar. Several discrete choice models are proposed in order to find which socioeconomic and academic factors are determinants of the probability of being awarded the Nobel Prize or another award.

Before setting up the model, a more general debate must be resolved. When analyzing the incidence of academic formation of and mathematics used by scholars vis-à-vis the possibility of achieving success and academic recognition, it is necessary to consider the problem of the possible interaction of both sides of this equation with unobservable factors. This problem stems from the existence of a series of factors that may influence the election of a Nobel Prize winner or the winner of another prestigious award and which, because of insufficient information, are non-observable such as IQ, ability and the size and quality of a scholar's social network.

The database lacks a variable measuring a scholar's ability or intelligence (e.g., IQ, GRE scores, SAT scores, etc.), and since it is possible that the use of mathematics is correlated with this, the econometric models in this article may suffer from endogeneity. We do not have an instrumental variable that helps disentangle the effect of ability over the probability of winning a Nobel Prize. As a result, our empirical findings only imply correlation, and by no means causality. Nevertheless, to complement our results we present explanations assuming that the relationship between the use of mathematics and the probability of winning an award are direct.

Now regarding our model, as variables, mathematical formation and intensive use of mathematics must be approximated, in as much as they are not observable. We believe that B.A. or Ph.D. in mathematics is a proxy of mathematical formation although its not perfect since there are other degrees corresponding to a curriculum with a high concentration in mathematics or individuals who learned mathematics out of personal interest. To measure the use of mathematics, as we explained in the introduction, we use, as a proxy, the average number of equations per paper and per footnote for the articles in our sample. Dummy variables for those who won any of the awards being considered are also included where necessary. This allows for a control for academic success, reputation and to some extent, networking, given the interconnectedness of the prizes; it is possible that winning one of them results in a social referent, that will lead to a nomination for another prize. Variables for gender and year of birth are also included[9].

Because the main objective is to explain the probability of winning a prestigious award in economics based on proxy variables for the use of mathematics, a Probit model is used[10]. The model to be estimated is:

$$P(Y = 1|X, M) = \Phi(\beta X + \gamma_1 M) + \epsilon, \tag{1}$$

where X is a set of controls; M measures the use of mathematics, which can either be the average number of equations used or the dummy variable e_i which is equal to one if someone uses more equations than the median of the population under study. The variable γ_1 shows the general effect of using more mathematics on the probability of belonging to group Y (which can be either Nobel Laureates, Awarded Scholars, or both).

Five different exercises were performed, using all the reasonable combinations of treatment and control groups: Nobel Laureates compared to (1) Awarded Scholars, to (2) Non-Awarded Scholars, and to (3) both; (4) Awarded Scholars compared to Non-Awarded Scholars; and (5) Nobel Laureates and Awarded Scholars compared to Non-Awarded Scholars. Exercises were performed measuring academic output variables in two different ways. The first measure uses all the papers written by an author, the second one, which only affects Awarded Scholars and Nobel Laureates, uses only the papers written by an author the year he won his first prize or prior to that year (in the case of Non-Awarded Scholars it uses all their articles). The objective of this second exercises is to compare Awarded Scholars and Nobel Laureates to Non-Awarded Scholars at a point when their academic careers were most similar. Tables 6-10 show the results. The first two columns in each table include all the academic work up to 2010 of every scholar. The last columns only use the academic work produced the year Nobel Laureates and Awarded Scholars won their first prize or prior to it. The results of all 5 tables are in general similar.

[9] We tried to use, as proxy of the quality of the education recieved, a dummy variable indicated if the Ph.D. was done at a top ten university according to the IDEAS/RePEc ranking for 2010. We also tried to use, as proxy for networking, a dummy variable indicating whether or not a scholar is or not in the book *"Who's Who in Economics"* (Blaug & Vane 2003). As it turned out, both of these two variables were not significant to several specifications, and therefore were not included in the final exercises.

[10] All the results hold for different specifications, and can be found in Appendix D.

In the enconometric tables below, *pages* is the mean number of pages of all papers written by a scholar; *e_foot* is the average number of equations per footnote; *jbcm_d*,*df_d*, *fhm_d* and *pes_d* are dummy variables indicating whether a scholar has won the John Bates Clark Medal, has been a Distinguished Fellow, has been a Foreign Honorary Members or has been President of the Econometric Society; *age_award* indicates the age when the scholar won his first awar; *age_squared* is the square of this number; *phd_math* and *math* are dummy variables for a Ph.D. and an undergraduate degree in mathematics; *phd_other* and *other* are dummy variables for a Ph.D. and an undergraduate degree in an area other than economics or mathematics; *d_i* are dummy variables for the decade in which the scholar was born (for example *d_*1880 is equal to one if the scholar was born between 1880 and 1889); *se* is the mean number of econometrics outputs per paper; *pp* is the mean number of footnotes per paper; *equations* is the average number of equations per paper; *prize* is equal to one if a scholar has won an award different from the Nobel Prize; *namy* is the mean number of mathematical appendices per paper; *ei* has the same meaning as in section 3.1 and Table 2. All variables were included in the final exercises unless there were specification problems.

As can be seen in Table 6, which compares Awarded Scholars with Nobel Laureates, more mathematics - measured as *equations* and e_1 - have a positive correlation with the probability of winning a Nobel Prize. A formation in mathematics, measured by *math* also has a mild positive correlation and this effect is stronger before winning their first prize. The results confirm the general intuition that the JBCM is a good indicator of future Nobel Prizes. Although, it may seem strange to use a dummy variable for awards when the information prior to any of the scholars winning their first prize is used, this variable might be representing non observable characteristics, such as networking. These non observable characteristics are still present before the scholars win their first award. For the sake of completeness, a regression without the variables for the awards was done as well and is presented in the last two columns.

The age at which a scholar was awarded his first prize has a quadratic effect. It seems you need to reach a certain age (or gain a certain level of experience) in order to be eligible for a Nobel Prize, but beyond a certain threshold, it might be too late. Having a Ph.D. in an area other than mathematics or economics has a positive correlation with the probability of winning a Nobel Prize. *pages* has a positive effect, which can be explained by the fact that there is space restriction in most journals; thus, if one is permitted extend oneself, it should be because one is writing about something worthy. Finally, the number of econometric outputs (*se*) has a mild negative effect. This result could be interpreted as follows: ceteris paribus, if someone does more empirical intensive research, he or she may be focusing on proving theories rather than proposing them, and it seems academia does not recognize this kind of contribution as much (in award terms) as less empirical intensive contributions. The results from columns 1 and 2 are similar to those in the last columns. The results in the following tables are similar and if not, differences will be pointed out.

	Nobel vs Awarded					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
equations	0.006**		0.007**		0.004*	
	(0.003)		(0.003)		(0.002)	
e1		0.772**		0.692**		0.830***
		(0.317)		(0.332)		(0.289)
gender	-1.770***	-1.452***	-1.810***	-1.519***	-0.858*	-0.536
	(0.449)	(0.462)	(0.455)	(0.453)	(0.498)	(0.519)
age_award	0.817***	0.745***	0.939***	0.855***	0.470***	0.464***
	(0.191)	(0.183)	(0.218)	(0.207)	(0.131)	(0.128)
age_square	-0.005***	-0.005***	-0.006***	-0.005***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
d_1890	5.585***	5.487***	5.621***	5.603***	3.843***	5.153***
	(0.649)	(0.667)	(0.691)	(0.707)	(0.368)	(0.419)
d_1900	5.882***	5.757***	5.978***	5.828***	3.597***	4.799***
	(0.553)	(0.582)	(0.582)	(0.589)	(0.368)	(0.442)
d_1910	6.591***	6.514***	6.491***	6.357***	3.853***	4.953***
	(0.609)	(0.629)	(0.674)	(0.678)	(0.274)	(0.321)
d_1920	6.143***	5.867***	6.030***	5.770***	3.631***	4.517***
	(0.557)	(0.568)	(0.617)	(0.651)	(0.302)	(0.421)
d_1930	6.775***	6.475***	6.769***	6.489***	3.847***	4.777***
	(0.634)	(0.626)	(0.710)	(0.690)	(0.355)	(0.432)
d_1940	6.306***	5.879***	6.380***	6.001***	3.868***	4.726***
	(0.682)	(0.735)	(0.830)	(0.871)	(0.404)	(0.500)
d_1950	6.559***	6.216***	6.394***	6.150***	4.452***	5.298***
	(0.750)	(0.794)	(0.801)	(0.849)	(0.601)	(0.635)
math	0.501	0.574	0.673*	0.743**	0.655**	0.706**
	(0.361)	(0.351)	(0.389)	(0.376)	(0.305)	(0.308)
other	0.419	0.437	0.440	0.466	0.535**	0.555**
	(0.319)	(0.318)	(0.345)	(0.341)	(0.273)	(0.281)
phd_math	0.099	-0.052	0.150	0.060	-0.080	-0.174
	(0.422)	(0.427)	(0.444)	(0.458)	(0.399)	(0.416)
phd_other	1.196***	1.222***	1.235***	1.226***	0.831**	0.976**
	(0.429)	(0.419)	(0.462)	(0.451)	(0.385)	(0.390)
namy	-1.569*	-1.239	-1.224**	-0.853	-0.169	-0.171
	(0.841)	(0.859)	(0.540)	(0.538)	(0.560)	(0.538)
se	-0.250*	-0.313**	-0.243	-0.314**	-0.150*	-0.191**
	(0.130)	(0.122)	(0.155)	(0.153)	(0.090)	(0.097)
pages	0.090***	0.099***	0.113***	0.121***	0.042	0.048*
	(0.033)	(0.033)	(0.037)	(0.036)	(0.028)	(0.029)
pp	-0.020	-0.028	-0.015	-0.020	-0.006	-0.006
	(0.019)	(0.019)	(0.017)	(0.017)	(0.013)	(0.014)
e_foot	0.010	0.013	0.008	0.010	-0.001	0.000
	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
jbcm_d	3.257***	2.916***	4.218***	3.674***		
	(0.613)	(0.541)	(0.863)	(0.811)		
df_d	-1.739***	-1.748***	-1.697***	-1.691***		
	(0.412)	(0.412)	(0.419)	(0.419)		
fhm_d	-1.340***	-1.373***	-1.430***	-1.421***		
	(0.446)	(0.424)	(0.488)	(0.458)		
paea_d	-0.770*	-0.737*	-0.636	-0.611		
	(0.395)	(0.408)	(0.405)	(0.409)		
rtel_d	-0.156	-0.090	-0.102	-0.044		
	(0.409)	(0.413)	(0.419)	(0.418)		
pes_d	0.300	0.272	0.366	0.406		
	(0.337)	(0.340)	(0.365)	(0.378)		
Constant	-38.035***	-35.475***	-43.022***	-39.973***	-22.104***	-23.365***
	(6.726)	(6.367)	(7.869)	(7.415)	(4.493)	(4.256)
Observations	240	240	234	234	234	234

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: The first two columns compare Nobel Laureates and Awarded scholars using their papers from their academic careers up through 2010. The last four columns only feature papers produced the year the scholars won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Table 7 shows that, when comparing Nobel Laureates with Non-Awarded Scholars, there is little evidence that using more mathematics is correlated with winning a Nobel Prize. Conversely, *equations* and e_2 have a mild negative correlation. However, it seems that mathematical formation, measured by *math*, does have a positive correlation. This suggests that the use of mathematics increases the probability of winning a Nobel Prize only if you are an Awarded Scholar, but that a mathematical formation augments the probability in either case (see Tables 6 and 7). The negative effect of the mean number of econometric outputs per paper persists.

Nobel Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.006		-0.010*	
	(0.007)		(0.005)	
e2		-0.919		-0.874
		(0.724)		(0.561)
d_1920	-0.346	-0.152	0.463	0.469
	(0.667)	(0.648)	(0.730)	(0.702)
d_1930	-0.976	-0.772	-0.397	-0.338
	(0.714)	(0.779)	(0.623)	(0.632)
d_1940	-1.445**	-1.437**	-0.838*	-0.900*
	(0.651)	(0.649)	(0.478)	(0.478)
d_1950	-3.053***	-2.915***	-2.356***	-2.363***
	(0.790)	(0.770)	(0.704)	(0.685)
math	3.133***	3.322***	2.415***	2.415***
	(0.930)	(1.004)	(0.713)	(0.712)
other	0.795	0.695	0.872*	0.727
	(0.581)	(0.539)	(0.496)	(0.464)
phd_math	0.003	-0.138	0.192	-0.075
	(0.633)	(0.569)	(0.523)	(0.549)
namy	-5.963***	-5.748***	-2.854***	-2.723***
	(1.218)	(1.204)	(0.609)	(0.693)
se	-0.603***	-0.632***	-0.591***	-0.565***
	(0.153)	(0.163)	(0.174)	(0.175)
pages	-0.005	-0.011	0.003	-0.002
	(0.055)	(0.053)	(0.058)	(0.058)
pp	-0.139***	-0.145***	-0.082***	-0.079***
	(0.040)	(0.042)	(0.031)	(0.030)
e_foot	0.181***	0.181***	0.144***	0.124***
	(0.048)	(0.049)	(0.043)	(0.037)
Constant	4.318***	4.512***	2.785***	2.695***
	(1.042)	(1.081)	(0.798)	(0.781)
Observations	117	117	113	113

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: The first two columns compare Nobel Laureates and Non-Awarded scholars based on papers from their entire academic careers up through 2010. The last two columns reference only papers by Nobel Laureates produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Table 8 shows the results when comparing Nobel Laureates with everyone else (Awarded and Non-Awarded Scholars). The variable *prize* is a dummy variable equal to one if the scholar won any of the seven awards apart from the Nobel Prize. Let *interaction* be equal to $prize * equations$ and $interaction2 = prize * e_3$. Mathematics have a mild negative effect when measured using $e3$, but a positive effect for award winners. From these results, as well as those found in Tables 6 and 7, it seems that a greater use of mathematics leads to a higher probability of success in academia only if you are an award winner.

The effect of the variable *Prize* is negative, which might be explained by the fact that most of the award winners do not go on to become Nobel Laureates. Note that the number of mathematical appendixes is not significant for columns 3 and 4.

Nobel Vs Awarded+Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.003		-0.003	
	(0.004)		(0.004)	
e3		-0.588		-0.818*
		(0.401)		(0.425)
prize	-1.257***	-1.624***	-1.132***	-1.548***
	(0.348)	(0.366)	(0.358)	(0.367)
interaction	0.005		0.004	
	(0.004)		(0.004)	
interaction2		1.152**		1.216***
		(0.449)		(0.466)
gender	-0.958**	-0.955**	-0.839**	-0.871**
	(0.404)	(0.395)	(0.418)	(0.403)
d_1890	4.867***	4.827***	5.374***	5.173***
	(0.368)	(0.404)	(0.515)	(0.434)
d_1900	4.941***	5.016***	5.356***	5.267***
	(0.336)	(0.370)	(0.499)	(0.441)
d_1910	5.653***	5.673***	5.995***	5.862***
	(0.250)	(0.274)	(0.441)	(0.338)
d_1920	4.967***	4.900***	5.428***	5.248***
	(0.242)	(0.270)	(0.406)	(0.302)
d_1930	5.130***	5.024***	5.508***	5.295***
	(0.282)	(0.284)	(0.396)	(0.308)
d_1940	4.712***	4.568***	5.126***	4.869***
	(0.326)	(0.299)	(0.382)	(0.287)
d_1950	4.391***	4.274***	4.692***	4.494***
	(0.471)	(0.461)	(0.458)	(0.401)
math	0.561**	0.475*	0.587**	0.511**
	(0.254)	(0.261)	(0.248)	(0.255)
other	0.542**	0.419*	0.540**	0.465*
	(0.247)	(0.243)	(0.241)	(0.241)
phd_math	-0.050	-0.042	-0.040	-0.012
	(0.404)	(0.413)	(0.386)	(0.390)
phd_other	0.783**	0.895**	0.768**	0.808**
	(0.331)	(0.352)	(0.343)	(0.354)
namy	-1.287***	-1.143**	-0.423	-0.300
	(0.478)	(0.449)	(0.537)	(0.486)
se	-0.233**	-0.236**	-0.216**	-0.231**
	(0.106)	(0.105)	(0.104)	(0.107)
pages	0.039	0.040	0.007	0.008
	(0.026)	(0.025)	(0.027)	(0.026)
pp	-0.035***	-0.037***	-0.019	-0.020*
	(0.013)	(0.013)	(0.012)	(0.012)
e_foot	0.017	0.017	0.012	0.013
	(0.015)	(0.014)	(0.015)	(0.014)
Constant	-4.975***	-4.673***	-5.247***	-4.732***
	(0.567)	(0.556)	(0.519)	(0.520)
Observations	292	292	286	286

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: The first two columns compare Nobel Laureates, Awarded Scholars and Non-Awarded Scholars based on all the papers from their entire academic career up trough 2010. The last two columns only reference papers by Nobel Laureates and Awarded Scholars produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Table 9 shows that an increase in the use of mathematics, when measured using $e4$, is correlated with a lower probability of becoming an Awarded Scholar. Having a high average number of econometric outputs (se) still has a negative effect.

Awarded Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.007***		-0.004	
	(0.002)		(0.002)	
e4		-1.297***		-0.944***
		(0.320)		(0.301)
gender	-0.209	-0.282	-0.445	-0.496
	(0.444)	(0.440)	(0.411)	(0.413)
d_1920	0.663	0.991*	1.119	1.576
	(0.522)	(0.542)	(0.833)	(1.064)
d_1930	0.090	0.161	0.378	0.413
	(0.433)	(0.439)	(0.435)	(0.421)
d_1940	-0.412	-0.230	-0.408	-0.249
	(0.304)	(0.325)	(0.290)	(0.302)
d_1950	-1.279***	-1.006**	-1.310***	-1.014***
	(0.380)	(0.392)	(0.344)	(0.363)
math	0.676*	0.760**	0.675*	0.747**
	(0.364)	(0.348)	(0.352)	(0.336)
other	-0.555	-0.563	-0.541*	-0.526*
	(0.349)	(0.365)	(0.308)	(0.316)
phd_math	-0.692	-0.703*	-0.747*	-0.626
	(0.424)	(0.425)	(0.425)	(0.423)
namy	-0.117	-0.092	-0.298	-0.256
	(0.158)	(0.176)	(0.191)	(0.167)
se	-0.088*	-0.109**	-0.041	-0.056
	(0.045)	(0.049)	(0.038)	(0.039)
pages	-0.072***	-0.078***	-0.045*	-0.045**
	(0.028)	(0.027)	(0.024)	(0.022)
pp	-0.053***	-0.060***	-0.036**	-0.039**
	(0.017)	(0.017)	(0.015)	(0.016)
e_foot	0.045**	0.050***	0.018	0.025
	(0.021)	(0.019)	(0.019)	(0.018)
Constant	3.560***	3.939***	2.688***	2.879***
	(0.531)	(0.531)	(0.400)	(0.426)
Observations	229	229	227	227

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: The first two columns compare Awarded Scholars with Non-Awarded Scholars based on all of their papers from their entire academic careers up through 2010. The last two columns are based on only the papers by Awarded Scholars produced up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

Finally, Table 10 shows the result when Nobel Laureates and Awarded Scholars are compared with Non-Awarded Scholars. If success in an economics academic career is defined as winning awards, once again, more mathematics by itself is not enough to succeed, and can in fact have a negative effect. It also shows that mathematical formation, measured by *math*, has a positive effect. It seems that understanding mathematics is necessary but not sufficient for achieving academic success. Additionally, as before, the average number of econometric outputs (se) has a negative effect on the probability of success.

Nobel+Awarded Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.008***		-0.004*	
	(0.002)		(0.002)	
e5		-1.135***		-0.826***
		(0.296)		(0.277)
gender	-0.297	-0.436	-0.506	-0.582
	(0.414)	(0.405)	(0.389)	(0.386)
d_1920	0.630	0.822*	1.093	1.347
	(0.500)	(0.495)	(0.765)	(0.896)
d_1930	0.109	0.189	0.331	0.331
	(0.401)	(0.409)	(0.405)	(0.396)
d_1940	-0.485*	-0.356	-0.470*	-0.352
	(0.289)	(0.305)	(0.276)	(0.291)
d_1950	-1.368***	-1.200***	-1.336***	-1.137***
	(0.355)	(0.359)	(0.324)	(0.340)
math	0.799**	0.799**	0.774**	0.826**
	(0.375)	(0.343)	(0.355)	(0.328)
other	-0.318	-0.221	-0.320	-0.227
	(0.293)	(0.310)	(0.271)	(0.288)
phd_math	-0.397	-0.475	-0.475	-0.451
	(0.415)	(0.411)	(0.411)	(0.397)
namy	-0.146	-0.142	-0.343*	-0.308*
	(0.149)	(0.150)	(0.207)	(0.186)
se	-0.119***	-0.129***	-0.057	-0.068*
	(0.043)	(0.046)	(0.038)	(0.039)
pages	-0.051**	-0.050**	-0.042*	-0.040*
	(0.021)	(0.021)	(0.023)	(0.021)
pp	-0.060***	-0.061***	-0.036***	-0.037***
	(0.015)	(0.015)	(0.013)	(0.014)
e_foot	0.058***	0.053***	0.022	0.024
	(0.018)	(0.017)	(0.016)	(0.015)
Constant	3.446***	3.570***	2.761***	2.882***
	(0.468)	(0.420)	(0.375)	(0.381)
Observations	292	292	286	286

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: The first two columns compare Nobel Laureates, Awarded Scholars with Non-Awarded Scholars based on all the papers from their entire academic careers up through 2010. The last two columns are based on only the papers by Nobel Laureates and Awarded Scholars produced up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

4.1 Propensity score matching

There is another way to perform a similar analysis, by means of Propensity Score Matching (PSM), which allows an unbiased calculation of the treatment effect in observational experiments where there is no randomization of the group assignments for subjects. This reduces the noise generated by other variables and isolates the treatment effect. By using PSM, one can determine if the number of equations used by a group with characteristic X is substantially higher than the number used by individuals from a group without that characteristic. The idea is to pair people from the group with characteristic X with people that are almost identical to them, except for the fact that they do not have that specific characteristic (X). In other words, let's assume that there are two scholars which have the same probability of winning a Nobel Prize, and that one actually won it and the other did not. It is desirable to know if the difference between these two scholars can be explained based on the number of equations used. Moreover, we would like to know the average difference in the number of equations of all such pairs of individuals. The mathematical expression summarizing this idea is:

$$E(Equations^1|X=1) - E(Equations^0|X=1). \quad (2)$$

The first term is the number of equations used by people in group X; the second, the number of equations used by people who are perfect candidates to be in group X, except for the number of equations he used. Nearest neighbor matching and kernel matching are used. The underlying probit model is:

$$P(X=1|C) = \Phi(\beta C) + \epsilon, \quad (3)$$

where C includes a gender variable, the dummy variables for the born decade, the variables for education characteristics, and the variables of article characteristics (namy, se, pages, pp, e_foot). The estimated difference for different groups is shown in Table 11. The analysis is performed with and without bootstrapping[11] in order to calculate the standard error. The results are very similar. We only present the standard errors with bootstrapping. The results with nearest neighbor matching are in the Appendix, in table 24.

PSM Kernel Matching

VARIABLES	(1)	(2)	(3)	(4) .	(5)
.					
Coeficient Ex. 1	10.67	-37.59**	4.654	-32.49***	-32.49***
	(9.624)	(17.65)	(9.240)	(11.42)	(11.12)
Coeficient Ex. 2	11.25	-25.81	8.851	-23.10*	-15.90
	(11.82)	(33.41)	(10.70)	(13.48)	(12.86)
Observations	234	111	286	227	286

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Columns correspond to the groups shown in the rows of Table 2. Mean number of equations comparison using kernel matching. The first exercise (first row) uses only *se* and *pp* in the matching equation. The second exercise (second row) uses *namy*, *se*, *pages*, *pp* and e_foot in the matching equation. Source: JSTOR. Calculations: authors.

5 Conclusions

The Nobel Prize is, by itself, the highest recognition granted by the scientific community to researchers whose contributions are considered worthy, and which have had a high impact in terms of the accumulation and innovation of research and knowledge. The extent to which the use of mathematics, by these and other prestigious scholars, is an important factor in determining whether they were worthy of receiving the award is difficult to answer. This article has aimed to provide some statistical evidence to tackle these and other related questions. We have analyzed how the use and training in mathematics is correlated with the probability of winning a Nobel Prize in economics and any other prominent awards. There are several for and against arguments concerning the "extreme" formalization in economics. Apart from defending or attacking the mathematization of economics, it is important to stress its power in the formalization and universalization of knowledge. Optimistically, our data base and quantitative analysis present results that go beyond political or ideological positions. Ahead of this debate, the popular belief is that the use of mathematics in economics has consistently increased over time. Although, we are not aware of a comprehensive study in authors and time period that engage in this question. We have given econometric and statistical evidence on this mathematization. This holds true with respect to the average number of equations per article and the average number of econometric outputs per article. For instance, for each variable there have been four structural breaks and three of them were increasing ones.

If we go a little further and try to build a probabilistic model to predict which are the most important variables in order to explain getting one of the seven particular awards, then we can tell a deeper story. Interestingly, we bring into the discussion the effect of variables to measure empirical and theoretical bias into the probability of being awarded or receive the Economics Nobel prize. A preliminary look at the data shows that the non-awarded scholars have less research production but are more mathematical and empirical intensive research than the other two groups. On the other hand,

[11]The standard error is calculated without taking into account that the propensity score is estimated, on account on which we introduce a bootstrap estimator, with 10,000 simulations. Nevertheless, it is not clear if bootstrapping is appropriate in this context, especially when using nearest neighbor matching. The results are similar, regardless of the matching algorithm used (kernel matching or nearest neighbor matching).

Awarded Scholars do less empirical intensive research after their first award (Nobel Laureates do the opposite), while both Awarded Scholars and Nobel Laureates use less equations after being awarded. On average, Nobel Laureates use more equations than other awarded scholars.

When we look at the econometric exercises performed above, we found the use of mathematics has a positive correlation with the probability of winning a Nobel Prize if the scholar is an awarded one. Otherwise, it seems to have a negative correlation with the probability of winning any honor. It also seems that mathematical formation is a significant explaining variable in either case and has a positive effect. As a final remark, it appears that being an empirical researcher as measured by the average number of econometrics outputs has a negative correlation with someone's academic career success.

Some future research with this data base might include, among others: A characterization of the path of a Nobel prize and the other 6 awards in terms of their empirical and theoretical bias; time series analysis of relevant variables discriminated by area of research and award received; econometric exercises on the effect of other highly mathematical sciences on the probability of being awarded on of our seven chosen awards; an analysis of papers published by the area of the journals where the they have been published and expanding the analysis presented in this article to universities and scholars beyond the orthodox sphere of economics; and analysis of the academic production (in terms of frequency, length, equations and econometric outputs) of scholars before and after receiving an award.

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A Awards

The goal of this section is to explain and justify the choice of seven particular awards in economics as proxies of academic success. The authors are aware that there are hundreds of academic prizes that are awarded in recognition of great contributions to theory and research in economics. However, the seven awards chosen here are the most important and distinguished, and convey quite well academic success. Also, many other prizes have been established only recently, such that their inclusion could induce noise in our econometric results.

Among those prizes not included are: the Yrjo Jahnsson Award, which is comparable to the JBCM, but is based in Europe. It is not included because it has only been awarded since 1993; The Grossen Prize Bianual and the Nakahara Prize, both of which are given to the most prominent economist under 45 in Germany and Japan respectively. These are not included because they have only been awarded since 1997 and 1995 respectively; The Frisch Medal, awarded during the previous five years by the Econometric Society for research published in Econometrica is not included because it has only been awarded since 1978. Moreover, it is awarded for a single paper rather than a series of academic contributions; Finally, the Royal Economic Society Prize, which has been awarded since 1990.

Next, a brief description of each one of the prizes is presented and their relevance to the election of a Nobel Prize winner. The best known award in economics is undoubtedly the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, commonly known as the Nobel Prize in economics. We also include the Presidency of the American Economic Association, as well as several different awards and honors given by this association: the John Bates Clark Medal, the Distinguished Fellow and Foreign Honorary Member distinctions, and appointment as the Richard T. Ely Lecturer. Finally, Presidency of the Econometric Society is included. This selection allows for the inclusion of scholars from different countries.

A.1 The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel. 1969-2009. The Nobel Prize in Economics.

In 1968, the Central Bank of Sweden created a special award to commemorate its tercentenary anniversary. The award recognizes scholars who make the most relevant and significant contributions to the economics field, and is awarded by the Royal Swedish Academy of Sciences under the same principles as a Nobel Prize. Each year, a committee is specially set up to analyze and filter the nominations (usually numbering between 200-300). The committee then presents its selection to the Social Science Class of the Academy, which suggests a Laureate to the entire Academy. The entire Academy then meets to make the final decision. (Lindbeck, 2001).

Up through 2009, the Nobel Prize in Economic Sciences was awarded forty-one times to sixty-four scholars. The laureates correspond to a wide socio-demographic group, and however with common academic characteristics. The most remarkable characteristic is that until 2008, all the laureates were men. In 2009, Elinor Ostrom became the first woman to receive the Nobel Prize in Economic Sciences. As can be seen from a review of the database, most of the laureates were born in the United States or became naturalized U.S. citizens. The exclusive list doesn't include Latin American or African scholars, nor scholars under the age of fifty.

The sixty-four prizes were awarded for specific contributions as well as life-time contributions. According to Lindebeck (2001), the Academy has sought to award "particularly important contributions" early and chronologically that is, following the order of the contributions. Furthermore, it has included different views of the world and different methods of analysis, taking a pluralistic approach to economics when selecting winners. To regard a contribution as "worthy" the academy takes into account the impact it has had on economics as a whole, its originality and its practical importance. The selected contributions, in many cases, just happen to be the initial steps that have led to the development of knowledge in many areas in economics. These contributions are also considered as having had an impact on society and public policy.

A.2 Presidency of the American Economic Association. 1930-2010.

The American Economic Association (AEA) was established in 1885, with the objective of promoting and consolidating the study of political economy and the economic phases of political and social questions (Bell, 1953). Since then, the fellowship has founded three of the most recognized journals, and its member list includes names like Milton Friedman, Paul Samuelson and Robert Solow, among others. Over time, the tradition and the academic reputation of its members have made the AEA one of the two most important academic societies in economics, the other one being the Econometric Society. Within the AEA, the most important honor is Presidency of the association; the candidates are always American members of the economic elite, and have included many Nobel Prize winners. Some statements of famous economists reflects the importance of being president of the AEA for example, William Vickrey (President in 1992) said that "Becoming the group's president is the greatest tribute, short of the Nobel Prize, that an economist could receive" inf reference to the presidency of the AEA. (*New York Times*, Jan 4, 1992).

Although the Association was established in 1885, we only consider presidents from 1930 onwards, in order to make our data comparable with that for other awards. Moreover, this period of time is very appropriate, since the election process of Nobel winners is designated to choose scholars who have had made lifetime achievements, and does not consider individuals who have passed on. Almost four decades (1930-1968) seems an adequate period of time for consolidating the academic work of a scholar as a contribution to economic thought worthy of winning the Nobel Prize.

Since 1930, eighty members have been elected Presidents, twenty-two of which have also been Nobel Award winners. Among those who also won the Nobel award, only eight were elected as Presidents of the AEA after winning the Nobel Prize. On average, it takes five years for a President of the AEA to win the Nobel Prize after having been elected President of the association. Since 1930, only two women have been elected as Presidents, less than three percent of the total of elected Presidents.

A.3 John Bates Clark Medal (1947 - 2009)

The John Bates Clark Medal (JBCM) was created in 1947, by the Executive Committee of the American Economic Association to honor "that American economist under the age of forty who is adjudged to have made a significant contribution to economic thought and knowledge" (American Economic Association, 1948). The selection and evaluation of candidates is conducted by a special committee exclusively created for this purpose. The Committee is composed of representatives selected from different parts of the country and different schools of thought. The Committee is intended to select and review the profiles and curricula of a sizable number of scholars worthy of the award. The whole list is then reduced to three to five names. These candidates are then submitted to another committee, the Electoral Committee. This one is composed of eighteen members, all of which are members of the Committee of Honors and Awards and the Executive Committee.

Thirty scholars from our sample have won the medal; among them, twelve are also Nobel Prize recipients. On average, it takes twenty two years to be a Nobel award winner after having been elected JBCM winner. As of 2009, the medal will be awarded annually (it was awarded bi-annually prior to 2009). This decision was likely taken "to recognize the fact that the field, and its personnel, have grown significantly since the 1940s" (*New York Times*, January 2, 2009); many, in fact, went un-awarded. As stated before, almost 40% of the total winners of the medal have also won the Nobel Prize. This statistic has made the JBCM a commonly used predictor of future Nobel laureates. Statements like "[a]nother indicator of a possible future Nobel laureate is being recipient of the John Bates Clark Medal" (Zahka, 1992), or "The Clark is often a harbinger of things to come", made by the founder of the world famous Marginal Revolution blog, Tyler Cowen, in 2009, are evidence of this. In our sample, only one woman,Susan Athey, has been chosen as a recipient of the medal.

A.4 Richard T. Ely Lecturer. 1962-2009.

The AEA holds an annual meeting to present papers on general economic subjects. In 1962, it instituted the Richard T. Ely Lecture as the main address of the meeting, in honor of one of the founders of the AEA. The list of former lecturers includes Kenneth Arrow, Stanley Fischer and Simon Kuznets, among others. A proof of the high distinction of this appointment is that more than a quarter of the lecturers have also been Nobel Prize laureates. Since 1962, forty-seven scholars have been appointed as Richard T. Ely Lecturers, ten of whom would later win the Nobel Prize; two of those were elected as lecturers, already won the Nobel Prize. For these scholars, it took an average of eight years to win the Nobel after being elected a lecturer. Less than five percent of the lecturers have been women. Scholars from all over the world are considered for this prize, making it important for our sample as it includes data on non-American scholars. Given that seven prizes considered in this paper are granted by the AEA, most of the candidates are Americans.

A.5 Foreign Honorary Members. 1975-2007.

As tated, most of the awards and appointments given by the AEA are for American economists only. However, each year the AEA recognizes the contributions of foreign scholars, electing them as Foreign Honorary Members (FHM). Along with the RTEL and the Presidency of the Econometric Society, the FHM is an important source of information about successful foreigners (defined as non-American scholars).

Since 1975, thirty-nine scholars have been elected as Foreign Honorary Members. The list includes such names as Jean Tirole, Robert Aumann and Amartya Sen. Of those thirty-nine, five are also Nobel Prize winners; none are women. On average, it takes ten years to win the Nobel Prize after being awarded a FHM distinction. There has been only one exception, Reinhard Selten, who won the Nobel Prize in 1994, and was elected an FHM in 1995.

A.6 Distinguished Fellow. 1965-2009.

The award of Distinguished Fellow (DF) is given by the American Economic Association to high profile and recognized economists in the United States and Canada. In contrast to the JBCM, it is not subject to age restrictions. The award was instituted in 1965, and since then, eighty-seven economists have been recipients. Twelve of these were also awarded the Nobel Prize in economics, all of them after having been granted the DF honor. On average, Nobel Prize winners received this prize eight years following their DF appointment. Compared with the other awards considered in this paper, the DF includes the greatest women number of among its winners, out of a total of eighty-one fellows, three have been women, or 3.7%.

Some references to the DF distinction in the literature are as follows: "There are two other AEA awards of significance. One is to be selected a Distinguished Fellow, the other is to be selected as the Richard T. Ely lecturer at the annual meeting of the Association" (Zahka, 1992). Herbert Simon (1991) also wrote "The year 1976 brought a more surprising event: my election as a Distinguished Fellow of the American Economic Association. In view of my inactivity in the association (in fact, I had never been even a member), I had to suspect that my selection was another step on the way to a Nobel nomination. At the AEA national meeting, where I accepted the award, Albert Ando hinted as much. Kenneth Arrow, evidently the moving spirit behind my nomination for the AEA's election, had to educate the younger economist on the selection committee on who I was and on my standing as a Fellow of the Econometric Society."

A.7 Presidency of the Econometric Society. 1930-2010.

In 1930, at the initiative of Irving Fisher and Ragnar Frisch, the Econometric Society was founded as "an international society for the advancement of economic theory in its relation to statistics and mathematics" (Aide Memoire, 2008). According to the society's Constitution, its main object is "to promote studies that aim at a unification of the theoretical-quantitative and empirical-quantitative approach to economic problems and that are penetrated by constructive and rigorous thinking similar to that which has come to dominate in the natural sciences" (Gordon, 1997).

Today, the Society has more than five hundred fellows, and recognized globally as one of the two most prestigious academic societies in economics. Its reputation was built over the years on the quality of its publications, meetings and fellows. The society most important publication is *Econometrica*, which was founded in 1933, and is well known for its scientific rigor and the high academic level of its content. The Society has two other journals, *Quantitative Economics* and *Theoretical Economics*; the last one has been under the Society's management since 2009.

Being elected as president or fellow of the Society is considered a great honor by most members of the economics profession. This election recognizes the contributions and achievements of the elected scholars (Hamermesh & Schmidt, 2003). Before 1960, the fellows and officers of the Society were elected by the Council of the Society; now, they are elected by mail ballot by active fellows. The Society's constitution does not allow for the election of two consecutive presidents from the same region. Thus, the society's presidents for consecutive years rotate between the following six regions: North America, Europe, Latin America, Australasia, Far East and India-Southeast Asia, although, in fact, only scholars from the U.S., Israel, Japan and some European countries have been elected as presidents (Gordon, 1997). Many of the former Presidents of the Society have been elected as Nobel winners. This exclusive list includes names such as Kenneth Arrow, Robert Lucas, and Robert Solow, among others. Although there are many Nobel winners who have been PES, it is important to clarify that the criteria for electing a scholar as PES or Nobel as well as the councils that elects them, are very different, so there is no endogeneity problem regarding these two prizes.

B Scholars

The following table shows all the scholars in our data base. The authors are organized in alphabetical order by group. The first column contains Awarded Scholars, the second column Non-Awarded Scholars, and the third column Nobel Laureates.

Table 12: Scholars in the data base.

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
Abba P. Lerner	Alan J. Auerbach	A. Michael Spence
Abram Bergson	Alan Manning	Amartya Sen
Alan S. Blinder	Albert Marcet	Bertil Ohlin
Alan W. Heston	Alberto Alesina	Clive W.J. Granger
Albert B. Wolfe	Alberto Bisin	Daniel Kahneman
Albert O. Hirschman	Alessandro Lizzeri	Daniel McFadden
Alexander Gerschenkron	Alvaro Sandroni	Douglass C. North
Alexander K. Cairncross	Alvin E. Roth	Edmund S. Phelps

Continued on next page

Table 12 – continued from previous page

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
Alfred E. Kahn	Andrew Caplin	Edward C. Prescott
Alice M. Rivlin	Andrew F. Newman	Elinor Ostrom
Allan H. Meltzer	Andrew Postlewaite	Eric S. Maskin
Alvin H. Hansen	Anthony J.Venables	Finn E. Kydland
Alvin S. Johnson	Antoine Bommier	Franco Modigliani
Andrei Shleifer	Antoine Faure-Grimaud	Friedrich A. von Hayek
Andreu Mas-Colell	B. Douglas Bernheim	Gary S. Becker
Andrew F. Brimmer	Balazs Szentes	George A. Akerlof
Angus Maddison	Barton L. Lipman	George J. Stigler
Angus S. Deaton	Benjamin Friedman	Gerard Debreu
Anna J. Schwartz	Bent Nielsen	Gunnar Myrdal
Anne O. Krueger	Botond K szegi	Harry M. Markowitz
Anthony B. Atkinson	Brian A. Jacob	Herbert A. Simon
Ariel Rubinstein	Bronwyn H.Hall	James A. Mirrlees
Armen A. Alchian	Bruce Greenwald	James E. Meade
Arnold C. Harberger	Bruce Preston	James J. Heckman
Arnold Zellner	Bruno Biais	James M. Buchanan, Jr.
Arthur F. Burns	C. Fritz Foley	James Tobin
Arthur L. Bowley	Calestous Juma	Jan Tinbergen
Arthur S. Goldberger	Canice Prendergast	John C. Harsanyi
Assar Lindbeck	Casey Mulligan	John F. Nash Jr.
Avinash K. Dixit	Cecilia Rouse	John R. Hicks
Calvin B. Hoover	Charles W. Calomiris	Joseph E. Stiglitz
Carl S. Shoup	Ching-to Albert Ma	Kenneth J. Arrow
Charles F. Roos	Christopher J. Flinn	Lawrence R. Klein
Charles L. Schultze	Christopher Jencks	Leonid Hurwicz
Charles P. Kindleberger	David A. Wise	Leonid V. Kantorovich
Charles R. Plott	David M. Cutler	Maurice F. C. Allais
Christopher A. Sims	David S. Lee	Merton H. Miller
Claudia Goldin	Derek A. Neal	Milton Friedman
D. Gale Johnson	Dilip Mookherjee	Myron S. Scholes
Dale T. Mortensen	Dirk Krueger	Oliver E. Williamson
Dale W. Jorgenson	Dmitriy Stolyarov	Paul A. Samuelson
Daron Acemoglu	Drew Fudenberg	Paul R. Krugman
David Cass	Edward A. Snyder	Ragnar Frisch
David E. Card	Efe A. Ok	Reinhard Selten
David F. Hendry	Efraim Benmelech	Richard Stone
David Landes	Esther Duflo	Robert A. Mundell
David M. Kreps	Faruk R. Gul	Robert C. Merton
Don Patinkin	Fernando Alvarez	Robert E. Lucas Jr.
Donald J. Brown	Frank A. Wolak	Robert F. Engle
E.A. Goldenweiser	Frank P. Stafford	Robert J. Aumann
Edmond C. Malinvaud	Frank Schorfheide	Robert M. Solow
Edward F. Denison	Gavin Wright	Robert W. Fogel
Edward H. Chamberlin	George J. Borjas	Roger B. Myerson
Edward S. Mason	George J. Mailath	Ronald H. Coase

Continued on next page

Table 12 – continued from previous page

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
Edwin E. Witte	George-Marios Angeletos	Simon Kuznets
Edwin G. Nourse	Glenn Ellison	Theodore W. Schultz
Elhanan Helpman	Godfrey Keller	Thomas C. Schelling
Emmanuel Saez	Graham T. Allison	Tjalling C. Koopmans
Ernest L. Bogart	Hanming Fang	Trygve Haavelmo
Evsey D. Domar	Harold L. Cole	Vernon L. Smith
Finis Welch	Howard Pack	Wassily Leontieff
Francois Divisia	Igal Hendel	William Arthur Lewis
Frank H. Hahn	Ingo Vogelsang	William F. Sharpe
Frank H. Knight	J. Bradford DeLong	William S. Vickrey
Franklin M. Fisher	J. Wesley Hutchinson	
Frederick C. Mills	James B. Ramsey	
Fritz Machlup	James M. Malcomson	
Gardner Ackley	Janet Currie	
Geoffrey H. Moore	Javier Hidalgo	
George E. Barnett	Jean-Paul Dï¿½camps	
George P. Shultz	Jeffrey H. Silber	
George W. Stocking	Jeffrey R. Russell	
Gordon Tullock	Jeremy Stein	
Gottfried Bombach	Jerry Wind	
Gottfried Haberler	Jianjun Miao	
Guy H. Orcutt	Joel Horowitz	
Guy Laroque	Joel Slemrod	
H. Gregg Lewis	John A. List	
Harold A. Innis	John C. Hershey	
Harold Hotelling	John Dinardo	
Harry A. Millis	John M. Quigley	
Harry G. Johnson	John Vickers	
Hendrik S. Houtthaker	Jonathan Gruber	
Henri Theil	Joseph Gyourko	
Henry J Aaron	Kai-Uwe Kuhn	
Herbert E. Scarf	Kenneth I. Wolpin	
Herbert H. Giersch	Kevin Roberts	
Herbert Stein	Kiminori Matsuyama	
Herman O. A. Wold	Larry G. Epstein	
Hirofumi Uzawa	Larry Sjaastad	
Howard S. Ellis	Lawrence J. Christiano	
Hugo F. Sonnenschein	Lester G. Telser	
I.L. Sharfman	Liran Einav	
Irma Adelman	Lucy White	
Irving B. Kravis	Luigi Pistaferri	
Irving Fisher	Marcelo J. Moreira	
Jack Hirshleifer	Marcia M. A. Schafgans	
Jacob Marschak	Margaret Bray	
Jacob Mincer	Mark Schankerman	
Jacob Viner	Mark V. Pauly	

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Table 12 – continued from previous page

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
Jacques Dreze	Martin Browning	
Jagdish Bhagwati	Martin Pesendorfer	
Jï¿½nos Kornai	Massimo Morelli	
Jean Tirole	Matthew S. Bothner	
Jean-Jacques Laffont	Melvin Stephens Jr	
Jean-Michel Grandmont	Michael J Piore	
Jerry Hausman	Michael Jansson	
Joan V. Robinson	Michael Woodford	
Joe Bain	Michel Cavagnac	
John Chipman	Michel Simioni	
John D. Black	Mihir A. Desai	
John D. Sargan	Morton Owen Schapiro	
John H. Williams	Muhamet Yildiz	
John Kenneth Galbraith	Nancy L. Rose	
John M. Clark	Nancy Stokey	
John M. Keynes	Noel Capon	
John Moore	Oliver Linton	
John Pencavel	Olivier J. Blanchard	
John Sutton	Padma Desai	
Joseph A. Pechman	Pankaj Tandon	
Joseph A. Schumpeter	Panle Jia	
Joseph J. Spengler	Patrick J. Kehoe	
Joseph S. Davis	Peter J. Hammond	
K. N. Raj	Peter J. Klenow	
Kelvin J. Lancaster	Peter M. Robinson	
Kenneth E. Boulding	Petra E. Todd	
Kevin M. Murphy	Philippe Aghion	
Lars Hansen	Phoebus J. Dhrymes	
Lawrence H. Summers	Pierre Collin-Dufresne	
Lionel C. Robbins	Pierre-Andre Chiappori	
Lionel W. McKenzie	R. Glenn Hubbard	
Lloyd A. Metzler	Ricardo Lagos	
Lloyd S. Shapley	Richard Cooper	
Ludwig E. von Mises	Richard E. Walton	
Marc Leon Nerlove	Richard J. Gilbert	
Marcel Boiteux	Robert D. Willig	
Margaret G. Reid	Robert E. B. Lucas Jr.	
Martin Bronfenbrenner	Robert Gibbons	
Martin Hellwig	Robert H. Topel	
Martin S. Feldstein	Robert J. Willis	
Matthew B. Hammond	Robert M. Anderson	
Matthew Rabin	Robert Shimer	
Menahem E. Yaari	Robert W. Staiger	
Mervyn A. King	Roger B. Porter	
Michael Bruno	Roger G. Noll	
Michael Rothschild	Roland Binabou	

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Table 12 – continued from previous page

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
Michio Morishima	Ronald D. Lee	
Morris A. Copeland	Ronald F. Ferguson	
Moses Abramovitz	Stanley Reiter	
Nicholas Georgescu-Roegen	Stefan Ambec	
Nicholas Stern	Steffen Habermalz	
Oliver M. W. Sprague	Stephen M. Walt	
Orley Ashenfelter	Stephen Morris	
Oskar Morgenstern	Sudhir Anand	
Partha Dasgupta	Suzanne Scotchmer	
Paul H. Douglas	Tilman Bï¿½rgers	
Paul Rosenstein-Rodan	Timothy F. Bresnahan	
Peter A. Diamond	Timothy G. Conley	
R.C.O. Matthews	Ulrich Dortszelski	
R.G.D. Allen	Urban J. Jermann	
Rene Roy	V. Kasturi Rangan	
Richard A. Easterlin	Victor Chernozhukov	
Richard A. Musgrave	Wei Jiang	
Richard A. Posner	Wilfred J. Ethier	
Richard Blundell	William Julius Wilson	
Robert B. Wilson	William P. Rogerson	
Robert Dorfman	Wolfgang Pesendorfer	
Robert E. Hall	Yacine Ait-Sahalia	
Robert Eisner	Yeon-Koo Che	
Robert J. Gordon		
Robert Summers		
Roger Guesnerie		
Ronald W. Jones		
Roy Radner		
Rudiger Dornbusch		
Ryutaro Komiya		
Sanford J. Grossman		
Sherwin Rosen		
Solomon Fabricant		
Stanley Fischer		
Stanley L. Engerman		
Stephen J. Nickell		
Steven D. Levitt		
Sumner H. Slichter		
Susan C. Athey		
T. N. Srinivasan		
Takashi Negishi		
Thomas J. Sargent		
Tibor Scitovsky		
Timothy Besley		
Torsten Persson		
Victor R. Fuchs		

Continued on next page

Table 12 – continued from previous page

Awarded Scholars	Non-Awarded (Yet)	Nobel Laureates
W. M. Gorman		
W. Max Corden		
Walter Erwin Diewert		
Walter W. Heller		
Walter Y. Oi		
Werner Hildenbrand		
Wesley C. Mitchell		
William A. Brock		
William D. Nordhaus		
William J. Baumol		
William J. Fellner		
William Z. Ripley		
Zvi Griliches		

C Universities

The universities used to select the Non-Awarded scholars were choosen on the basis of them being in the top 20 according to the RePEc ranking of august 2010. It is important to note that, although there has been some variation, the raking has not changed much among the top 20 in recent years. Table 13 shows the universities used.

Ranking	University
1	Harvard University, Cambridge, Massachusetts (USA)
2	University of Chicago, Chicago, Illinois (USA)
3	Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts (USA)
4	Princeton University, Princeton, New Jersey (USA)
5	London School of Economics (LSE), London, United Kingdom
6	University of California-Berkeley, Berkeley, California (USA)
7	Oxford University, Oxford, United Kingdom
8	New York University, New York City, New York (USA)
9	Yale University, New Haven, Connecticut (USA)
10	Stanford University, Palo Alto, California (USA)
11	Toulouse School of Economics (TSE), Toulouse, France
12	Boston University, Boston, Massachusetts (USA)
13	University of Pennsylvania, Philadelphia, Pennsylvania (USA)
14	Northwestern University, Evanston, Illinois (USA)
15	University of Michigan, Ann Arbor, Michigan (USA)
16	University of California-San Diego (UCSD), La Jolla, California (USA)
17	Columbia University, New York City, New York (USA)
18	University College London (UCL), London, United Kingdom
19	University of California-Los Angeles (UCLA), Los Angeles, California (USA)
20	Brown University, Providence, Rhode Island (USA)

Table 13: Top 20 universities according to the RePEc ranking of August 2010

D Robustness test

The following tables show the results of perfoming the five excercies presented in tables 6-10 doing a logistic regression instead of a probit one.

Nobel vs Awarded						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
equations	0.011**		0.012**		0.007*	
	(0.005)		(0.005)		(0.004)	
e1		1.388**		1.263**		1.358***
		(0.579)		(0.603)		(0.506)
gender	-3.290***	-2.763***	-3.362***	-2.900***	-1.406*	-0.886
	(0.924)	(0.918)	(0.982)	(0.949)	(0.827)	(0.871)
age_award	1.461***	1.346***	1.684***	1.535***	0.832***	0.807***
	(0.368)	(0.350)	(0.441)	(0.412)	(0.242)	(0.231)
age_square	-0.009***	-0.009***	-0.011***	-0.010***	-0.006***	-0.005***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
d_1890	17.764***	17.635***	16.261***	16.929***	16.626***	17.082***
	(1.248)	(1.794)	(1.231)	(1.303)	(0.671)	(0.641)
d_1900	18.257***	18.049***	16.781***	17.175***	16.230***	16.509***
	(1.232)	(1.481)	(0.928)	(0.990)	(0.703)	(0.640)
d_1910	19.502***	19.414***	17.738***	18.199***	16.583***	16.739***
	(1.339)	(1.817)	(1.308)	(1.314)	(0.546)	(0.576)
d_1920	18.500***	18.053***	16.743***	16.966***	16.194***	15.982***
	(1.159)	(1.787)	(1.073)	(1.173)	(0.601)	(0.708)
d_1930	19.802***	19.331***	18.206***	18.410***	16.582***	16.458***
	(1.200)	(1.607)	(1.387)	(1.324)	(0.692)	(0.709)
d_1940	19.001***	18.287***	17.714***	17.725***	16.672***	16.401***
	(1.572)	(1.752)	(1.827)	(1.874)	(0.760)	(0.779)
d_1950	19.428***	18.922***	17.611***	17.882***	17.684***	17.398***
	(1.505)	(1.821)	(1.421)	(1.541)	(1.120)	(1.052)
math	0.919	1.040	1.320	1.399*	1.113**	1.195**
	(0.707)	(0.703)	(0.826)	(0.806)	(0.533)	(0.545)
other	0.854	0.920	0.962	1.038	0.914*	0.951*
	(0.615)	(0.630)	(0.743)	(0.735)	(0.467)	(0.490)
phd_math	0.047	-0.263	0.132	-0.042	-0.124	-0.311
	(0.744)	(0.771)	(0.807)	(0.846)	(0.678)	(0.725)
phd_other	2.090***	2.152***	2.158**	2.166***	1.384**	1.591**
	(0.760)	(0.751)	(0.839)	(0.833)	(0.663)	(0.684)
namy	-2.516*	-2.044	-2.153**	-1.544	-0.391	-0.362
	(1.423)	(1.459)	(0.961)	(0.954)	(1.233)	(1.143)
se	-0.438*	-0.556**	-0.469	-0.594*	-0.251	-0.324*
	(0.253)	(0.241)	(0.341)	(0.340)	(0.162)	(0.177)
pages	0.150**	0.169***	0.193***	0.209***	0.075	0.083
	(0.059)	(0.060)	(0.069)	(0.064)	(0.048)	(0.051)
pp	-0.032	-0.049	-0.027	-0.037	-0.009	-0.010
	(0.037)	(0.035)	(0.033)	(0.033)	(0.023)	(0.025)
e_foot	0.020	0.026	0.017	0.023	-0.003	-0.001
	(0.023)	(0.023)	(0.023)	(0.023)	(0.020)	(0.020)
jbcm_d	5.708***	5.086***	7.311***	6.308***		
	(1.207)	(1.058)	(1.618)	(1.509)		
df_d	-3.135***	-3.189***	-3.030***	-3.092***		
	(0.845)	(0.839)	(0.903)	(0.904)		
fhm_d	-2.375***	-2.469***	-2.544***	-2.608***		
	(0.850)	(0.789)	(0.973)	(0.923)		
paea_d	-1.417*	-1.393	-1.077	-1.047		
	(0.844)	(0.875)	(0.832)	(0.853)		
rtel_d	-0.372	-0.297	-0.272	-0.216		
	(0.806)	(0.832)	(0.846)	(0.865)		
pes_d	0.521	0.455	0.729	0.760		
	(0.629)	(0.640)	(0.682)	(0.734)		
Constant	-75.334***	-71.272***	-83.000***	-78.233***	-48.879***	-48.607***
	(12.996)	(12.250)	(16.067)	(14.881)	(8.410)	(7.890)
Observations	240	240	234	234	234	234

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: The first two columns compare Nobel Laureates and Awarded scholars using their papers from their academic careers up through 2010. The last four columns only feature papers produced the year the scholars won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Nobel Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.013		-0.019	
	(0.016)		(0.012)	
e2		-2.067		-1.543
		(1.766)		(1.203)
d_1920	-0.670	-0.293	0.703	0.599
	(1.118)	(1.078)	(1.395)	(1.395)
d_1930	-1.508	-0.957	-0.611	-0.533
	(1.288)	(1.543)	(1.157)	(1.180)
d_1940	-2.552**	-2.553**	-1.491	-1.711*
	(1.219)	(1.261)	(0.930)	(1.004)
d_1950	-5.511***	-5.233***	-4.158***	-4.090***
	(1.683)	(1.573)	(1.362)	(1.291)
math	5.778***	6.161***	4.211***	4.163***
	(2.189)	(2.214)	(1.372)	(1.326)
other	1.587	1.423	1.547	1.301
	(1.243)	(1.110)	(0.995)	(0.898)
phd_math	0.301	-0.058	0.398	-0.063
	(1.276)	(0.964)	(0.939)	(0.933)
namy	-10.879***	-10.522***	-4.956***	-4.919***
	(2.978)	(3.039)	(1.274)	(1.884)
se	-1.001***	-1.098***	-1.022***	-1.000***
	(0.264)	(0.335)	(0.358)	(0.383)
pages	-0.005	-0.014	0.012	0.007
	(0.102)	(0.100)	(0.126)	(0.127)
pp	-0.260***	-0.277**	-0.144**	-0.134**
	(0.099)	(0.112)	(0.069)	(0.064)
e_foot	0.329***	0.332**	0.254**	0.215***
	(0.116)	(0.138)	(0.099)	(0.081)
Constant	7.779***	8.253***	4.814***	4.590***
	(2.449)	(2.670)	(1.637)	(1.573)
Observations	117	117	113	113

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: The first two columns compare Nobel Laureates and Non-Awarded scholars based on papers from their entier academic careers up through 2010. The last two columns reference only papers by Nobel Laureates produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Nobel Vs Awarded+Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.004		-0.003	
	(0.007)		(0.008)	
e3		-0.912		-1.204
		(0.680)		(0.756)
prize	-2.196***	-2.857***	-2.000***	-2.684***
	(0.600)	(0.650)	(0.608)	(0.638)
interaction	0.008		0.006	
	(0.007)		(0.007)	
interaction2		1.925**		1.921**
		(0.773)		(0.835)
gender	-1.666**	-1.713**	-1.481**	-1.571**
	(0.723)	(0.725)	(0.739)	(0.735)
d_1890	15.806***	15.783***	16.917***	16.739***
	(0.694)	(0.752)	(0.602)	(0.683)
d_1900	16.004***	16.222***	16.922***	16.940***
	(0.624)	(0.649)	(0.556)	(0.639)
d_1910	17.204***	17.341***	18.004***	17.962***
	(0.505)	(0.501)	(0.329)	(0.429)
d_1920	16.009***	15.940***	17.008***	16.856***
	(0.466)	(0.477)	(0.235)	(0.433)
d_1930	16.297***	16.199***	17.234***	17.033***
	(0.545)	(0.557)	(0.086)	(0.524)
d_1940	15.515***	15.365***	16.465***	16.219***
	(0.597)	(0.541)	(0.391)	(0.592)
d_1950	14.896***	14.751***	15.646***	15.475***
	(0.940)	(0.893)	(0.769)	(0.903)
math	1.018**	0.876*	1.055**	0.940**
	(0.449)	(0.473)	(0.435)	(0.453)
other	0.955**	0.763*	0.926**	0.815**
	(0.431)	(0.417)	(0.417)	(0.413)
phd_math	-0.211	-0.217	-0.192	-0.151
	(0.745)	(0.758)	(0.691)	(0.712)
phd_other	1.311**	1.536**	1.275**	1.364**
	(0.539)	(0.597)	(0.541)	(0.573)
namy	-2.156**	-1.879**	-0.992	-0.668
	(0.847)	(0.792)	(1.219)	(1.078)
se	-0.411*	-0.419**	-0.413*	-0.430*
	(0.213)	(0.206)	(0.220)	(0.225)
pages	0.068	0.071	0.017	0.019
	(0.048)	(0.046)	(0.047)	(0.047)
pp	-0.059***	-0.062***	-0.031	-0.035*
	(0.023)	(0.022)	(0.022)	(0.021)
e_foot	0.026	0.028	0.016	0.019
	(0.024)	(0.023)	(0.023)	(0.023)
Constant	-16.013***	-15.589***	-16.721***	-16.050***
	(1.031)	(0.978)	(0.866)	(0.860)
Observations	292	292	286	286

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: The first two columns compare Nobel Laureates, Awarded Scholars and Non-Awarded Scholars based on all the papers from their entier academic career up trough 2010. The last two columns only reference papers by Nobel Laureates and Awarded Scholars produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

	Awarded Vs Non-Awarded			
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.012***		-0.006	
	(0.004)		(0.004)	
e4		-2.248***		-1.655***
		(0.599)		(0.534)
gender	-0.399	-0.504	-0.783	-0.851
	(0.787)	(0.775)	(0.717)	(0.735)
d_1920	1.240	1.789	2.842	3.777
	(1.125)	(1.096)	(3.127)	(5.088)
d_1930	0.172	0.370	0.804	0.862
	(0.818)	(0.850)	(0.908)	(0.873)
d_1940	-0.750	-0.359	-0.703	-0.392
	(0.540)	(0.596)	(0.505)	(0.535)
d_1950	-2.288***	-1.797**	-2.235***	-1.717***
	(0.700)	(0.718)	(0.606)	(0.636)
math	1.210*	1.319**	1.147*	1.228**
	(0.695)	(0.656)	(0.655)	(0.617)
other	-0.979	-1.018	-0.966*	-0.941
	(0.662)	(0.702)	(0.569)	(0.597)
phd_math	-1.351*	-1.367*	-1.417*	-1.244*
	(0.744)	(0.740)	(0.741)	(0.727)
namy	-0.199	-0.139	-0.491	-0.433
	(0.390)	(0.444)	(0.357)	(0.273)
se	-0.147**	-0.178**	-0.066	-0.090
	(0.072)	(0.079)	(0.060)	(0.061)
pages	-0.128***	-0.136***	-0.077*	-0.076*
	(0.049)	(0.050)	(0.044)	(0.039)
pp	-0.097***	-0.105***	-0.067**	-0.076**
	(0.032)	(0.033)	(0.028)	(0.032)
e_foot	0.081**	0.087**	0.037	0.050
	(0.039)	(0.036)	(0.034)	(0.034)
Constant	6.298***	6.824***	4.668***	5.025***
	(1.029)	(1.020)	(0.785)	(0.829)
Observations	229	229	227	227

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: The first two columns compare Awarded Scholars with Non-Awarded Scholars based on all of their papers from their entier academic careers up through 2010. The last two columns are based on only the papers by Awarded Scholars produced up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

Nobel+Awarded Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.014***		-0.007*	
	(0.004)		(0.004)	
e5		-1.969***		-1.451***
		(0.561)		(0.517)
gender	-0.553	-0.772	-0.929	-1.036
	(0.741)	(0.708)	(0.685)	(0.683)
d_1920	1.184	1.510	2.778	3.291
	(1.113)	(1.063)	(2.619)	(3.645)
d_1930	0.175	0.417	0.733	0.740
	(0.769)	(0.815)	(0.869)	(0.829)
d_1940	-0.919*	-0.621	-0.860*	-0.612
	(0.522)	(0.570)	(0.493)	(0.537)
d_1950	-2.461***	-2.091***	-2.306***	-1.925***
	(0.654)	(0.659)	(0.575)	(0.608)
math	1.502**	1.441**	1.377**	1.413**
	(0.727)	(0.661)	(0.669)	(0.610)
other	-0.534	-0.328	-0.562	-0.357
	(0.553)	(0.619)	(0.504)	(0.566)
phd_math	-0.840	-0.954	-0.916	-0.902
	(0.752)	(0.755)	(0.714)	(0.695)
namy	-0.257	-0.249	-0.584	-0.516
	(0.331)	(0.348)	(0.519)	(0.368)
se	-0.199***	-0.213***	-0.092	-0.108*
	(0.070)	(0.075)	(0.062)	(0.062)
pages	-0.096**	-0.090**	-0.071	-0.069*
	(0.039)	(0.037)	(0.044)	(0.038)
pp	-0.109***	-0.107***	-0.067***	-0.070***
	(0.030)	(0.029)	(0.024)	(0.026)
e_foot	0.103***	0.093***	0.042	0.047*
	(0.036)	(0.032)	(0.030)	(0.028)
Constant	6.225***	6.226***	4.831***	5.014***
	(0.934)	(0.817)	(0.746)	(0.731)
Observations	292	292	286	286

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: The first two columns compare Nobel Laureates and Awarded scholars using papers from all their academic carrer up to 2010. The last two columns only use papers from the year when scholars won their first prize or before. Source: JSTOR. Calculations: authors.

The following tables (6-10) show the results of perfoming a linear regression instead of a probit one.

Nobel vs Awarded						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
equations	0.001*		0.001**		0.001	
	(0.001)		(0.000)		(0.001)	
e1		0.155**		0.152**		0.200***
		(0.064)		(0.064)		(0.073)
gender	-0.113	-0.053	-0.123	-0.072	-0.127	-0.055
	(0.094)	(0.094)	(0.093)	(0.093)	(0.093)	(0.094)
age_award	0.064***	0.065***	0.074***	0.070***	0.038**	0.039**
	(0.018)	(0.018)	(0.019)	(0.019)	(0.017)	(0.017)
age_square	-0.000**	-0.000**	-0.000***	-0.000**	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
d_1890	0.340***	0.333***	0.347***	0.354***	0.255***	0.271***
	(0.078)	(0.076)	(0.084)	(0.082)	(0.087)	(0.088)
d_1900	0.305***	0.295***	0.295***	0.287***	0.197*	0.193*
	(0.098)	(0.097)	(0.105)	(0.105)	(0.113)	(0.111)
d_1910	0.420***	0.402***	0.365***	0.354***	0.260***	0.236***
	(0.088)	(0.088)	(0.092)	(0.090)	(0.090)	(0.086)
d_1920	0.335***	0.292***	0.303***	0.264***	0.190**	0.125
	(0.073)	(0.076)	(0.076)	(0.080)	(0.074)	(0.078)
d_1930	0.381***	0.327***	0.357***	0.323***	0.274***	0.212**
	(0.082)	(0.080)	(0.087)	(0.084)	(0.081)	(0.082)
d_1940	0.306***	0.247***	0.299***	0.255***	0.219**	0.147
	(0.087)	(0.093)	(0.093)	(0.096)	(0.091)	(0.093)
d_1950	0.232**	0.176	0.246**	0.200	0.301**	0.216
	(0.117)	(0.124)	(0.118)	(0.127)	(0.135)	(0.138)
math	0.108	0.113	0.124	0.135*	0.162**	0.157**
	(0.073)	(0.071)	(0.075)	(0.074)	(0.078)	(0.077)
other	0.144**	0.138**	0.149**	0.154**	0.168**	0.165**
	(0.062)	(0.061)	(0.064)	(0.063)	(0.077)	(0.077)
phd_math	0.061	0.034	0.063	0.039	-0.004	-0.034
	(0.110)	(0.113)	(0.112)	(0.121)	(0.129)	(0.136)
phd_other	0.243**	0.258**	0.236*	0.246**	0.214*	0.239**
	(0.114)	(0.108)	(0.124)	(0.118)	(0.121)	(0.115)
namy	-0.012	-0.007	0.012	0.014	-0.008	-0.009
	(0.027)	(0.026)	(0.025)	(0.027)	(0.028)	(0.028)
se	-0.009	-0.011	-0.005	-0.007	-0.012*	-0.012*
	(0.007)	(0.008)	(0.005)	(0.006)	(0.006)	(0.006)
pages	0.008	0.008	0.006	0.006	0.006	0.006
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
pp	-0.005	-0.006*	-0.001	-0.002	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
e_foot	0.001	0.001	-0.001	-0.000	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
jbcm_d	0.449***	0.421***	0.492***	0.462***		
	(0.072)	(0.073)	(0.074)	(0.073)		
df_d	-0.328***	-0.331***	-0.279***	-0.284***		
	(0.076)	(0.074)	(0.079)	(0.077)		
fhm_d	-0.208**	-0.186**	-0.196**	-0.170**		
	(0.081)	(0.080)	(0.082)	(0.082)		
paea_d	-0.131*	-0.122	-0.091	-0.084		
	(0.076)	(0.076)	(0.078)	(0.078)		
rtel_d	-0.023	-0.017	-0.005	0.002		
	(0.072)	(0.071)	(0.072)	(0.071)		
pes_d	0.040	0.029	0.050	0.046		
	(0.058)	(0.058)	(0.060)	(0.060)		
Constant	-2.586***	-2.627***	-2.980***	-2.872***	-1.621***	-1.686***
	(0.514)	(0.514)	(0.552)	(0.531)	(0.482)	(0.492)
Observations	240	240	234	234	234	234
R-squared	0.427	0.435	0.410	0.414	0.219	0.239

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 19: The first two columns compare Nobel Laureates and Awarded scholars using their papers from their academic careers up through 2010. The last four columns only feature papers produced the year the scholars won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Nobel Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.001		-0.001	
	(0.001)		(0.001)	
e2		-0.133		-0.110
		(0.081)		(0.094)
d_1920	0.043	0.068	0.110	0.107
	(0.093)	(0.089)	(0.108)	(0.105)
d_1930	0.028	0.033	0.033	0.024
	(0.106)	(0.103)	(0.114)	(0.110)
d_1940	-0.171*	-0.169*	-0.156	-0.166
	(0.095)	(0.095)	(0.108)	(0.108)
d_1950	-0.261***	-0.250***	-0.289***	-0.290***
	(0.089)	(0.084)	(0.091)	(0.090)
math	0.199**	0.207***	0.244***	0.238***
	(0.078)	(0.077)	(0.088)	(0.085)
other	0.085	0.086	0.083	0.082
	(0.086)	(0.086)	(0.092)	(0.094)
phd_math	-0.031	-0.028	-0.014	-0.033
	(0.093)	(0.094)	(0.111)	(0.111)
namy	-0.561***	-0.538***	-0.446***	-0.441***
	(0.124)	(0.125)	(0.124)	(0.130)
se	-0.090***	-0.092***	-0.090***	-0.089***
	(0.022)	(0.022)	(0.022)	(0.023)
pages	0.001	0.001	-0.002	-0.004
	(0.005)	(0.005)	(0.010)	(0.010)
pp	-0.014***	-0.015***	-0.011**	-0.011***
	(0.003)	(0.003)	(0.004)	(0.004)
e_foot	0.022***	0.021***	0.019***	0.017***
	(0.004)	(0.004)	(0.006)	(0.005)
Constant	0.984***	0.985***	0.985***	0.996***
	(0.086)	(0.085)	(0.135)	(0.137)
Observations	117	117	113	113
R-squared	0.671	0.676	0.611	0.608

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 20: The first two columns compare Nobel Laureates and Non-Awarded scholars based on papers from their entier academic careers up through 2010. The last two columns reference only papers by Nobel Laureates produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Nobel Vs Awarded+Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.001		-0.001	
	(0.001)		(0.001)	
e3		-0.206**		-0.203**
		(0.091)		(0.094)
prize	-0.315***	-0.411***	-0.288***	-0.392***
	(0.089)	(0.083)	(0.087)	(0.086)
interaction	0.001		0.001	
	(0.001)		(0.001)	
interaction2		0.326***		0.308***
		(0.098)		(0.102)
gender	-0.077	-0.077	-0.075	-0.077*
	(0.048)	(0.048)	(0.048)	(0.046)
d_1890	0.245***	0.235***	0.278***	0.269***
	(0.077)	(0.074)	(0.079)	(0.075)
d_1900	0.259**	0.272**	0.250**	0.257**
	(0.106)	(0.106)	(0.109)	(0.109)
d_1910	0.434***	0.437***	0.413***	0.419***
	(0.076)	(0.074)	(0.080)	(0.079)
d_1920	0.244***	0.231***	0.261***	0.255***
	(0.064)	(0.065)	(0.065)	(0.066)
d_1930	0.243***	0.231***	0.259***	0.252***
	(0.072)	(0.072)	(0.071)	(0.072)
d_1940	0.117**	0.104*	0.141**	0.131**
	(0.060)	(0.058)	(0.061)	(0.059)
d_1950	0.020	0.012	0.041	0.038
	(0.072)	(0.074)	(0.071)	(0.075)
math	0.126**	0.110*	0.130**	0.121*
	(0.063)	(0.064)	(0.065)	(0.064)
other	0.129**	0.115**	0.130**	0.120**
	(0.061)	(0.058)	(0.062)	(0.060)
phd_math	0.039	0.041	0.008	0.014
	(0.123)	(0.123)	(0.128)	(0.128)
phd_other	0.277**	0.286***	0.265**	0.263**
	(0.110)	(0.109)	(0.115)	(0.113)
namy	-0.046*	-0.040**	-0.052	-0.040
	(0.023)	(0.020)	(0.035)	(0.028)
se	-0.015*	-0.015*	-0.014**	-0.014**
	(0.009)	(0.008)	(0.006)	(0.006)
pages	0.003	0.004	-0.001	-0.000
	(0.006)	(0.006)	(0.004)	(0.004)
pp	-0.006**	-0.007**	-0.004	-0.005*
	(0.003)	(0.003)	(0.003)	(0.002)
e_foot	0.007	0.007*	0.005	0.005
	(0.005)	(0.004)	(0.004)	(0.003)
Constant	0.220	0.303**	0.227**	0.321***
	(0.136)	(0.122)	(0.110)	(0.103)
Observations	292	292	286	286
R-squared	0.226	0.246	0.195	0.212

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 21: The first two columns compare Nobel Laureates, Awarded Scholars and Non-Awarded Scholars based on all the papers from their entier academic career up trough 2010. The last two columns only reference papers by Nobel Laureates and Awarded Scholars produced the year they won their first prize or prior to it. Source: JSTOR. Calculations: authors.

Awarded Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.001		-0.000	
	(0.001)		(0.000)	
e4		-0.183***		-0.148**
		(0.060)		(0.064)
gender	-0.105	-0.116	-0.143	-0.149
	(0.126)	(0.120)	(0.125)	(0.120)
d_1920	0.080*	0.111**	0.105**	0.136**
	(0.045)	(0.047)	(0.052)	(0.053)
d_1930	0.054	0.078	0.093	0.114
	(0.070)	(0.071)	(0.075)	(0.074)
d_1940	-0.099	-0.056	-0.118	-0.079
	(0.084)	(0.085)	(0.086)	(0.088)
d_1950	-0.355***	-0.299***	-0.398***	-0.337***
	(0.107)	(0.108)	(0.104)	(0.109)
math	0.132**	0.156***	0.135**	0.152***
	(0.057)	(0.058)	(0.058)	(0.057)
other	-0.087	-0.082	-0.096	-0.090
	(0.067)	(0.067)	(0.066)	(0.067)
phd_math	-0.154	-0.144	-0.182*	-0.157
	(0.107)	(0.105)	(0.101)	(0.099)
namy	-0.032	-0.027	-0.087	-0.073
	(0.042)	(0.038)	(0.081)	(0.072)
se	-0.018	-0.019*	-0.009	-0.011
	(0.011)	(0.011)	(0.010)	(0.010)
pages	-0.016***	-0.016***	-0.010*	-0.009*
	(0.005)	(0.005)	(0.005)	(0.005)
pp	-0.008***	-0.008***	-0.007***	-0.007**
	(0.003)	(0.002)	(0.003)	(0.003)
e_foot	0.005*	0.005*	0.002	0.002
	(0.003)	(0.002)	(0.003)	(0.003)
Constant	1.249***	1.257***	1.133***	1.138***
	(0.067)	(0.065)	(0.069)	(0.067)
Observations	229	229	227	227
R-squared	0.398	0.419	0.364	0.381

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 22: The first two columns compare Awarded Scholars with Non-Awarded Scholars based on all of their papers from their entier academic careers up through 2010. The last two columns are based on only the papers by Awarded Scholars produced up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

Nobel+Awarded Vs Non-Awarded				
	(1)	(2)	(3)	(4)
VARIABLES				
equations	-0.001		-0.000	
	(0.000)		(0.000)	
e5		-0.139***		-0.117**
		(0.049)		(0.051)
gender	-0.118	-0.132	-0.146	-0.154
	(0.116)	(0.112)	(0.116)	(0.112)
d_1920	0.066*	0.086**	0.088**	0.108***
	(0.036)	(0.037)	(0.041)	(0.041)
d_1930	0.061	0.078	0.078	0.091
	(0.054)	(0.055)	(0.058)	(0.057)
d_1940	-0.095	-0.065	-0.108	-0.077
	(0.072)	(0.073)	(0.074)	(0.076)
d_1950	-0.351***	-0.319***	-0.375***	-0.334***
	(0.095)	(0.095)	(0.095)	(0.097)
math	0.112**	0.125***	0.118**	0.135***
	(0.047)	(0.046)	(0.047)	(0.047)
other	-0.035	-0.020	-0.043	-0.030
	(0.050)	(0.050)	(0.050)	(0.051)
phd_math	-0.092	-0.092	-0.115	-0.103
	(0.080)	(0.079)	(0.083)	(0.082)
namy	-0.041	-0.036	-0.098	-0.085
	(0.046)	(0.042)	(0.082)	(0.075)
se	-0.022**	-0.023**	-0.013	-0.015
	(0.011)	(0.011)	(0.010)	(0.010)
pages	-0.010**	-0.010**	-0.008*	-0.007*
	(0.004)	(0.004)	(0.005)	(0.004)
pp	-0.009***	-0.009***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)
e_foot	0.006**	0.005**	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.183***	1.181***	1.117***	1.119***
	(0.052)	(0.051)	(0.060)	(0.057)
Observations	292	292	286	286
R-squared	0.371	0.386	0.345	0.358

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 23: The first two columns compare Nobel Laureates, Awarded Scholars with Non-Awarded Scholars based on all the papers from their entier academic careers up through 2010. The last two columns are based on only the papers by Nobel Laureates and Awarded Scholars produced up to and including the year when they won their first prize. Source: JSTOR. Calculations: authors.

PSM Nearest Neighbor Matching					
	(1)	(2)	(3)	(4)	(5)
VARIABLES					
.					
Coeficient Ex. 1	17.91	-27.49	-4.246	-34.66***	-30.16**
	(14.29)	(18.80)	(14.07)	(13.23)	(12.71)
Coeficient Ex. 2	5.130	-24.65	3.545	-18.73	-17.16
	(16.87)	(31.36)	(16.12)	(15.49)	(14.76)
Observations	234	111	286	227	286

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 24: First column: Nobel Laureates versus Awarded Scholars; second column: Nobel Laureates versus Non-Awarded Scholars; third column: Nobel versus Awarded Scholars + Non-Awarded Scholars; fourth column: Awarded Scholars versus Non-Awarded Scholars; and fifth column: Nobel Laureates + Awarded Scholars versus Non-Awarded Scholars. Mean number of equations comparison using nearest neighbor matching. The first exercise (first row) uses only *se* and *pp* in the matching equation. The second exercise (second row) uses *namy*, *se*, *pages*, *pp* and e_foot in the matching equation. Source: JSTOR. Calculations: authors.