# Research Assessements by Synchronic and Diachronic Citation Impact: A Case Study of Carlos III University of Madrid

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## Abstract

Synchronic and diachronic indicators are used to measure the impact of a set of publications from Carlos III University of Madrid (UC3M), in order to verify if UC3M papers contribute to enhancing the impact and visibility of the journals in which they were published. Both Diachronic Journal Impact Factors and the Field Crown Indicator are used in the study.

The results reveal that although some analyzed departments publish highly (>50%) in first quartile journals, the impact values for UC3M production are not correspondingly high for all the parameters analyzed: the production not always contribute to the impact factors of their respective journals, and the visibility of that production are found to be lower in general than the patterns exhibited by all European countries as a whole for each subject area.

The results confirm the need to extend impact and visibility studies beyond the information provided by Journal Citation Reports (JCR), to reach a fuller understanding of all the data analyzed.

## Introduction

The value and utility of the synchronic journal impact factor (JCR-JIF) has been broadly discussed in the scientific literature (Ingwersen, Larsen & Wormell, 2000; Moed, 2005). Moreover, the accessibility of this indicator and its ease of interpretation have made this a very popular tool for evaluating scientific literature, researchers and institutions, mainly carried out by non-bibliometricians. Furthermore, articles published in a journal with a high JIF (i.e., appearing at the top of the JCR category lists) are assumed to constitute higher quality research. For that reason, a journal's IF rank within its category, has been used as a criterion for distinguishing quality research. Nonetheless, this indicator does not always provide a true and fair view of reality. Journal impact cannot be extrapolated to the *real* impact of all other scientific agents. Many authors have attempted to establish a relationship between the actual citations to an article and the citations received by the journal as a whole. Figueredo and Villalonga (2001) found that more than half of the papers in the anaesthesiology journals they analyzed were not cited even once in the first five years after publication; and their high JIFs were often the result of numerous citations to only a handful of articles. Aksnes (2006) confirmed their finding. In earlier evaluations of the scientific activity at Carlos III University of Madrid (UC3M) using *Web of Science* data (Iribarren-Maestro, Lascurain-Sánchez & Sanz-Casado, 2009) the JCR-JIF values and the publishing journals' position in the JCR (by quartiles) were used to measure production impact and visibility. However, the *actual* contribution of citations made by UC3M papers to the publishing journals was not analyzed and not compared to the diachronic JIF of those journals. To explore this second type of measurements, the present study purposes to analyze citations by combining synchronic and diachronic indicators, since the latter are particularly robust and therefore held in esteem (Ingwersen, Larsen & Wormell, 2000), despite their high cost (Adam, 2002).

The paper is structured as follows: First, the data collection and analysis methods are briefly outlined. This is followed by the result section, including the demonstration of the Journal

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Crown Indicator (JCI) and with the impact of the university's production seen in a European context in terms of Field Crown Indicator (FCI) analysis. The findings and their interpretation are discussed jointly.

## Methodology

As in the earlier studies (e.g. Iribarren-Maestro, Lascurain-Sánchez & Sanz-Casado, 2009), the articles analyzed in the present study were retrieved from the *Web of Science*. The present study is limited to articles published between 1997 and 2003, having at least one author affiliated with the UC3M. The identified papers were then grouped by departmental area. The ten areas selected were: *Materials Science, Engineering and Chemical Engineering* (MAT); *Economics* (ECO); *Business Economics* (BUS); *Statistics and Econometrics* (STAT); *Physics* (PHYS); *Computer Science* (COMP); *Electrical, Electronic and Robotic Engineering* (ELEC); *Mechanical Engineering* (MECH); *Mathematics* (MATH); and *Communications Technology* (COMM).

The following indicators were used to reach the objectives proposed in the study:

- *Diachronic Journal Crown Indicator (JCI)*, following the methodology proposed by Hjortgaard Christensen *et al.* (1997). An article's diachronic citation pattern is compared to the diachronic patterns of the citations to all the articles published in that journal. A selected set of the UC3M articles was analyzed, consisting of the articles published in the *first quartile* of the journals used, as defined by their JCR-JIF. This was done to observe the citation patterns of UC3M articles in potentially high-quality journals, assessed synchronically, and also to reduce the number of calculations from 463 journals to 176.
- *Field Crown Indicator (FCI).* This index-based indicator, developed by van Raan (1999), was used to rank the UC3M's scientific activity internationally. It is obtained by distributing each department's published papers by subject areas and then by identifying its publication profile and comparing this profile's number of citations to the same production profile and citation impact for a given baseline, here Europe.

## Results and Discussion

The obtained results are outlined below. Table 1 shows for each department 1) the volume of articles published, 2) the average percentage of articles published in the first JCR-JIF quartile journals, and 3) the average percentage of articles contributing to JCR-JIFs during the two years following their publication (acknowledging that a given year's production ($y_0$) may contribute to two different JIFs ($y_{0+1}$ and $y_{0+2}$), the number of citations to the production in each of these two years is compared to the respective JIFs).

**Table 1. Total production per department, percentage of papers in the first quartile, and percentage of papers contributing to the respective JIFs, 1997-03 (WoS).**

| DEPARTMENT | NUMBER OF PUBLICATIONS (1997-2003) | AVERAGE PERCENTAGE IN 1ST QUARTUILE (1997-2003) | AVERAGE PERCENTAGE CONTRIBUTING TO JIF (1997-2003) |
|---|---|---|---|
| ECO | 167 | 25.97 | 21.25 |
| STAT | 144 | 31.11 | 20.13 |
| BUS | 62 | 11.67 | 18.54 |
| COMP | 122 | 24.66 | 9.42 |
| PHYS | 211 | 75.49 | 21.79 |
| MAT | 163 | 29.25 | 16.86 |
| ELEC | 86 | 35.44 | 13.95 |
| MECH | 86 | 51.81 | 27.90 |
| COMM | 102 | 33.33 | 11.27 |
| MATH | 334 | 53.40 | 25.89 |

The data given in table 1 reveals a wide inter-departmental variation in output, quite low proportions of papers published in the first quartile journals (with the exception of the Physics department - PHYS) and low ratios of the actual contribution made by the papers to the JCR-JIFs to which they could have contributed regardless the size of JIF score.

*Journal Crown Indicator (JCI) assessment*

The results in Table 2 show JCR scores with a three-year citation window, as an index value. Many of the cells in the table are empty because the ratios, having been obtained for a very low number of articles, were not regarded to be sufficiently representative.

The last column gives each department's mean diachronic JCI, while the bottom row provides the mean value in each period analyzed for the university as a whole. These data refer to only that part of the university's output that was published in 1st quartile of the journals used by the departments (see Table 1). Effectively, this implies that, e.g., for $ECO_{1997\text{-}99}$ the department's impact for publications in 1997 was null over the citation window 1997-99, although it published articles in 1st quartile journals.

**Table 2. JCI for UC3M (Source: Dialog – Thomson-Reuters). Bold figures > index 1.0**

| | JCI 1997-1999 | JCI 1998-2000 | JCI 1999-2001 | JCI 2000-2002 | JCI 2001-2003 | JCI 2002-2004 | JCI 2003-2004 | AVG |
|---|---|---|---|---|---|---|---|---|
| ECO | - | 0.16 | - | - | - | **1.22** | - | 0.51 |
| STAT | 0.14 | 0.17 | 0.29 | 0.46 | **1.61** | 0.28 | 0.93 | 0.43 |
| BUS | - | - | - | - | - | - | - | - |
| COMP | - | - | - | - | - | - | - | - |
| PHYS | 0.41 | **1.41** | 0.63 | 0.97 | **1.18** | 0.51 | 0.73 | 0.82 |
| MAT | 0.71 | - | - | **1.73** | 0.73 | 0.23 | **1.01** | 0.81 |
| ELEC | **1.01** | - | 0.39 | - | 0.08 | 0.31 | - | 0.36 |
| MECH | 0.5 | 0.67 | **2.86** | 0.81 | **2.7** | 0.63 | **1.45** | **1.25** |
| COMM | *1.3* | 0.5 | **1.37** | **2.56** | 0.36 | - | **2.24** | **1.08** |
| MATH | 0.99 | 0.84 | **1.03** | **1.8** | **2.62** | 0.75 | 0.58 | **1.30** |
| **UC3M AVG** | 0.78 | 0.86 | 0.86 | **1.27** | **1.77** | 0.59 | 0.80 | |

The scores in Table 2 show that the 1st quartile production had more impact than expected in only three departments, with three-year citation windows: Mechanical Engineering (MECH), Mathematics (MATH) and Communications Technology (COMM). Comparing to Table 1, we observe that in the cases of MECH and MATH more than 50 % of their articles were published in 1st quartile journals, thus probably contributing to their high JCI scores. The lowest JCI scores were found for the Business and Computer Science Departments (BUS &

COMP) with zero JCI. A Pearson correlation test carried out between the JCI scores (Table 2) and contributions to 1st quartile journals and to JCR-JIFs (Table 1) demonstrates per UC3M departments mean coefficients of $r$ = .65 and $r$ = .55, respectively. Some few disparate correlations exist, but they are statistically very weak over the entire period, given only 10 pairs of values (CV= .576 at p = .05; and CV= .708 at p= .01).

*Field Crown Indicator (FCI) assessment*

Figure 1 shows the field crown indicator obtained for each department in each year. The seven points plotted for each department represent the annual values, in chronological order, from 1997 to 2003. The horizontal line running across the graph at the FCI index value of 1 represents the overall mean number of citations per article for the European production in similar areas, as constituted by the ten departments. The first three departments shown are divisions of the Faculty of Social and Legal Science, while the other seven form part of the Polytechnic School. The graph shows that most of the UC3M's scientific production exhibited lower values for this indicator than expected from the European average. This means that its research cannot be regarded as ranking highly internationally. Only Business Economics (BUS) (in 2001), Physics (PHYS) (in 1998 and 2000), Mechanical Engineering (MECH) (in 2001) and Mathematics (MATH) (in 1997, 2000 and 2001) demonstrate values above the European averages. These findings, which can be used to roughly rank the institution analyzed, may owe to the university's relative youth and that its departments are still in the consolidation phase. Another relevant finding is that the Computer Science (COMP) and Electrical, Electronic and Robotic Engineering (ELEC) Departments exhibited very low values for FCI as well as JCI.

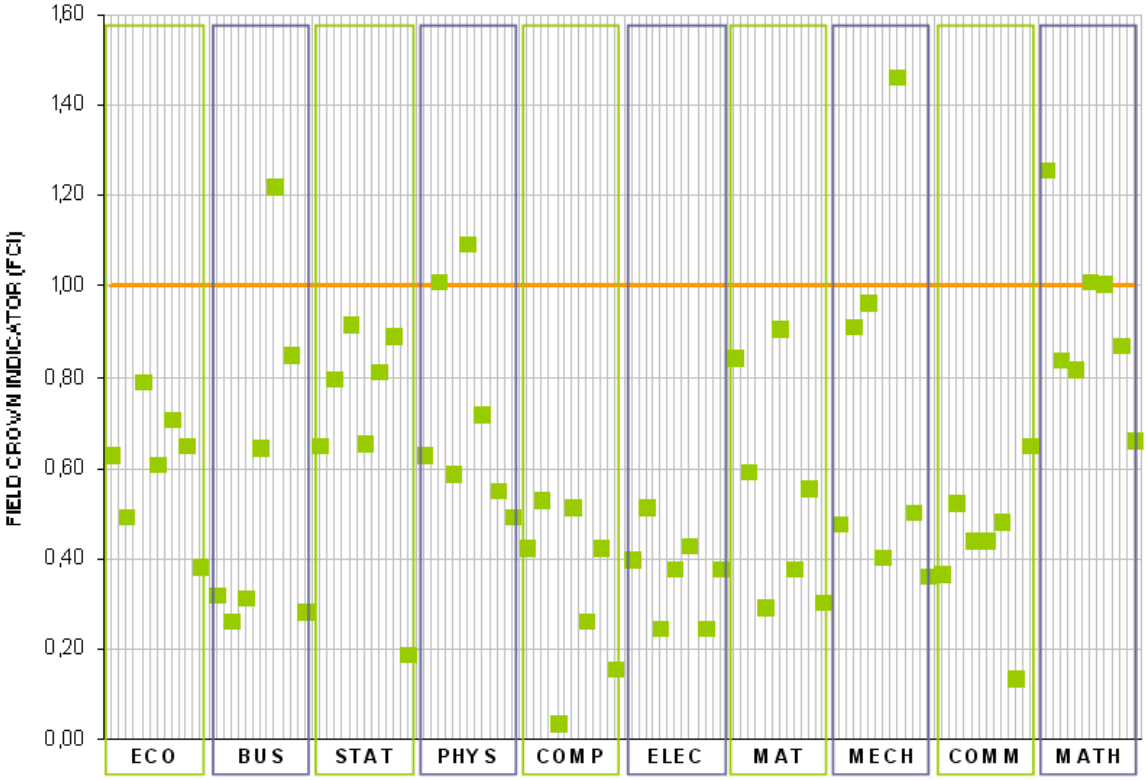


**Figure 1. Field Crown Indicator for UC3M departments (Source: NSI, 2006)**

## Conclusions

Several of the departments analyzed proved to be highly skilful in publishing their findings in first quartile journals. Nonetheless, their production did not, as a rule, contribute positively to

the JCI scores. Publication in journals holding the top JCR-JIFs in their respective categories has often been used as a measure of quality. In the present study, however, no correlation was found between publishing in high impact journals and receiving a large number of citations. Applying the JCR-JIF as a stand-alone research assessment tool seems hence to be an invalid option – as also demonstrated by previous studies (Seglen, 1997; Moed, 2005; Aksnes, 2006).

The diachronic JCI proved to be useful to ascertain the *actual* impact of publications. The findings based on departmental articles published in high impact journals supplemented the information furnished by the first indicator. They showed that three departments' first quartile production received more citations than expected over the entire period of 1997-2004 with three-year citation windows, even though their overall production failed to contribute to the JCR-JIF (Table 1, with much shorter citation windows). The only department consistently with the highest impact values, regardless evaluation mode, was Mechanical Engineering (MECH).

In general only very weak correlations were found between the synchronic indicators (Table 1) and the diachronic JCR scores (Table 2) across all ten UC3M departments over the seven year analysis period. With few exceptions, the impact of UC3M departments' production was found to be lower in general than the patterns exhibited by all European countries as a whole for each subject area. Although this conclusion concurs with the findings obtained for the same sample in the earlier studies cited above, it also confirms the need to extend impact and visibility studies beyond the information provided by *Journal Citation Reports* (JCR) into the diachronically based analyses, to reach a fuller understanding of all the data analyzed.

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