Can an academia reward system change publication habits? The case of University Carlos III of Madrid (UC3M)

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Introduction

◈ Traditional economic theory considers that financial incentives are important to determine the behavior of an individual and presume that make them respond positively, increasing their productivity at work.

◈ Positive effect: Many countries that have incorporated reward incentives have noticed an improvement of the quantity (Norway, Australia, South Korea, United States) and quality (China, Korea, Austria, Norway or UK) of scientific publications (Besir, 2018); other authors consider this incentives promote research productivity and the acquisition of other habits such as international collaboration.

◈ Negative effect: no impact on the publications (Good et al, 2015); irrelevant for some groups and even affect negatively, especially if it is perceived as a control / pressure (Andersen and Pallesen, 2008).

◈ At Spanish level: productivity incentive called Sexenios (six-year period evaluation) by National Assessment Commission on Research Activities (CNEAI).

◈ At University level, not all have incentives.

'Complementos' of University Carlos III of Madrid

◈ University Carlos III of Madrid (UC3M) has introduced a new university policy for research activities based on economic rewards in order to improve the scientific output and to promote recognition of excellence in research.

◈ There have been 5 calls of these incentives: 2007, 2009, 2011, 2014 and 2016.

◈ The evaluation criteria are based on:
   1) Teaching: teaching results, innovation, internationalization, etc.;
   2) Research: six-year period research, directed thesis, management and participation in research projects, publications (JCR in the last 5 years);

◈ The collectives that can apply for 'Complementos' are the following:
   1) Full Professor
   2) Professors
   3) Lecturer
   4) Permanent Associate Lecturer of Foreign Nationality
   5) Ph.D. students, Associate professors, Professor Emeritus (2016)

Objectives

◇ The main purpose of this work is to analyze if the introduction of new economic incentives to the researchers at the University Carlos III of Madrid affects the increase of the scientific production, impact and visibility of the research. The specific aims are the following:

◇ Detect the dynamic of scientific activity with the following metrics from 2000 to 2016:

Scientific output	- No. documents - Productivity: Teaching staff/documents
Visibility	- 1st quartile documents
Collaboration	- No. documents in international collaboration

◇ Establish possible scenarios and estimate its prediction (6 year-window) by using a State-Space (SS) model.

Methodology

◈ **Source of Data**:

   ◈ Scientific activity: Information from University Carlos III of Madrid from IUNE Observatory (Science Citation Index Expanded (SSCI) and Arts & Humanities Citation Index (AHCI) databases from Web of Science (WoS).

   ◈ Teaching staff: INE (Statistics National Institute) until 2011. Ministry of Education, Culture and Sports (SIIU) since 2012.

◈ **Period:** 2000-2016

◈ **Mathematical model used:** Matlab was used for its application and analysis.

   ◈ State space (SS) model

$$x_{k+1} = Gx_k + Hu_k$$
$$y_k = Cx_k$$

Where x_k is the input vector, y_k is the output vector and $G, H\ and\ C$ are matrices.
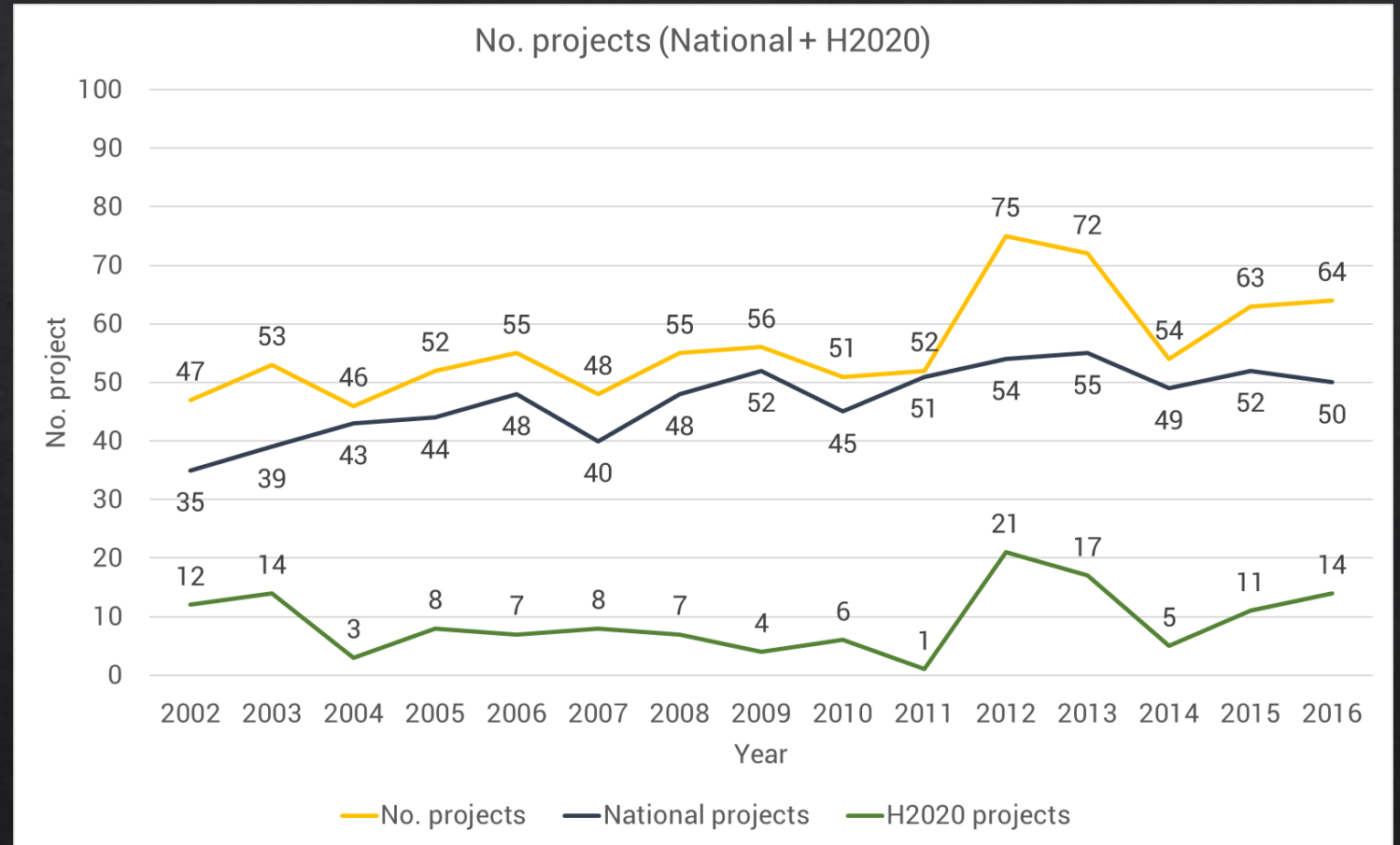
Results: 1) Scientific output UC3M vs SUE

- Uc3m is considered a 'highly specialized University': (Aldás *et al.*, 2016)

- 9,405 documents were detected during the period (2000-2016). UC3M output represents a 1.54% of Spanish University System (SUE).

- By number of documents, UC3M is the 27th/50 (IUNE Observatory, 2018).

- The percentage that UC3M contributes to SUE has passed from 1.05% (2000) to 1.61% (2016).

- The cumulative average growth rate (CAGR) of SUE during the period is 7.03% vs 9.92% at UC3M.
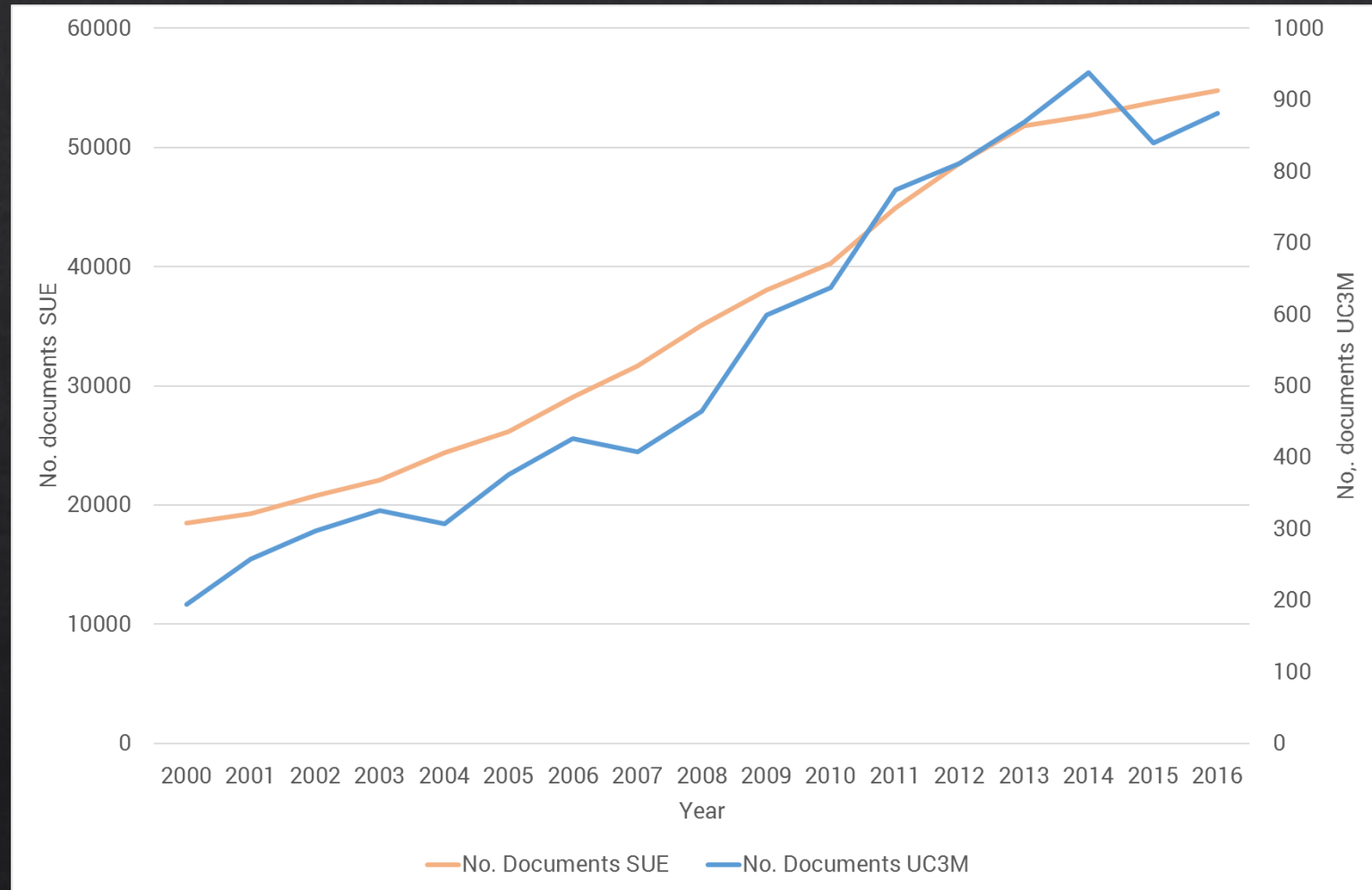
Results: 1) Scientific output: projects

Can this increase be related with an increase of projects?

◇ The number of projects (National and European) is 843 during the period 2002-2016. The CAGR is 2.23% during the period.

◇ 2012 and 2013 were the period with the highest number of projects (75 and 72 projects), especially caused by an increase of European projects.
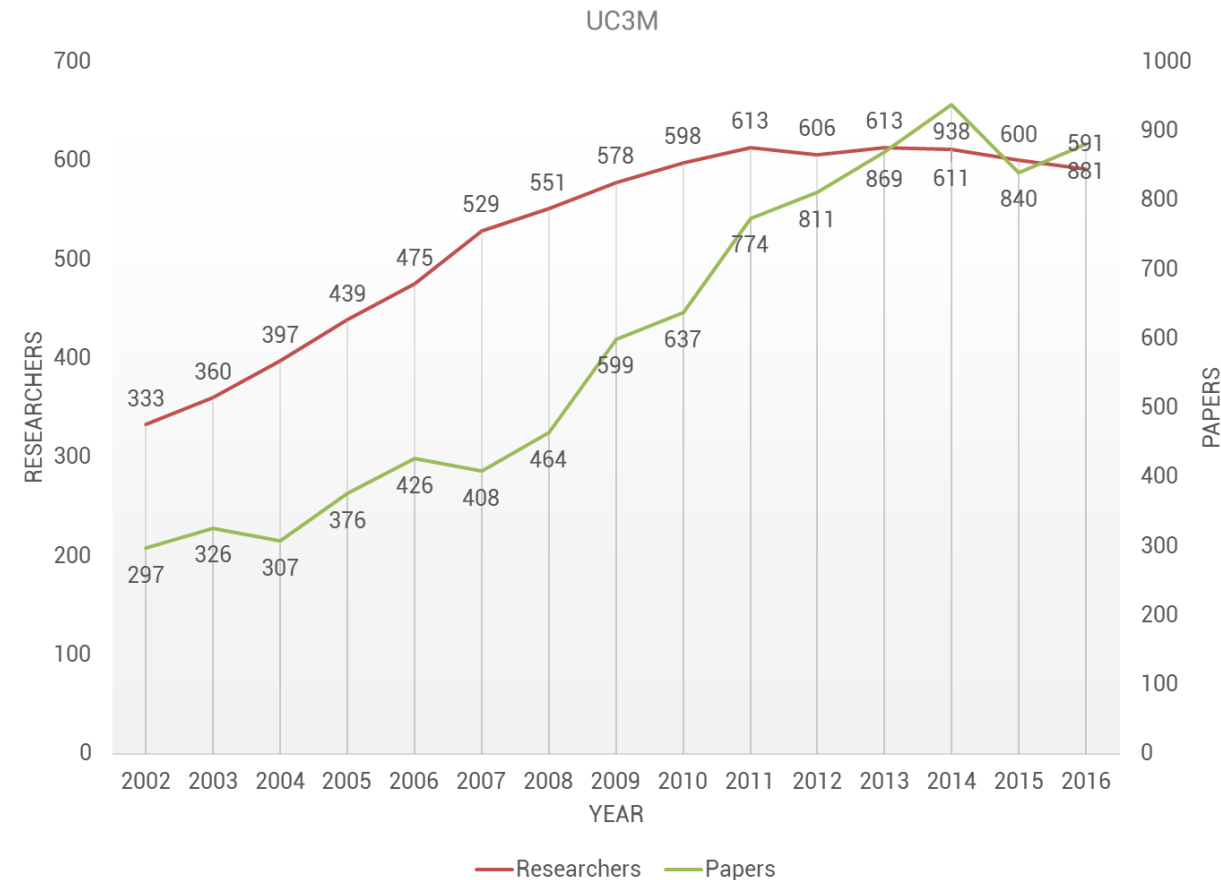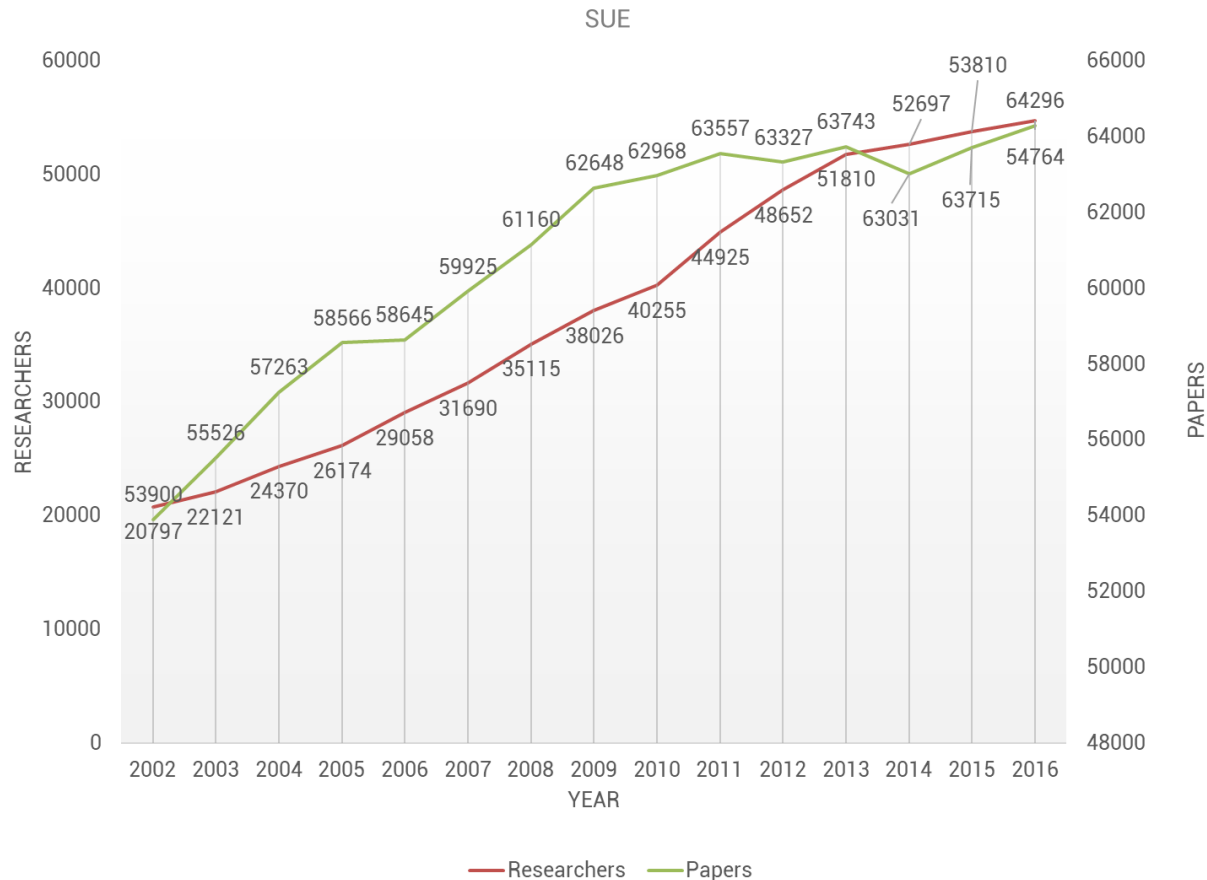
# Results: 1) Scientific output forecast
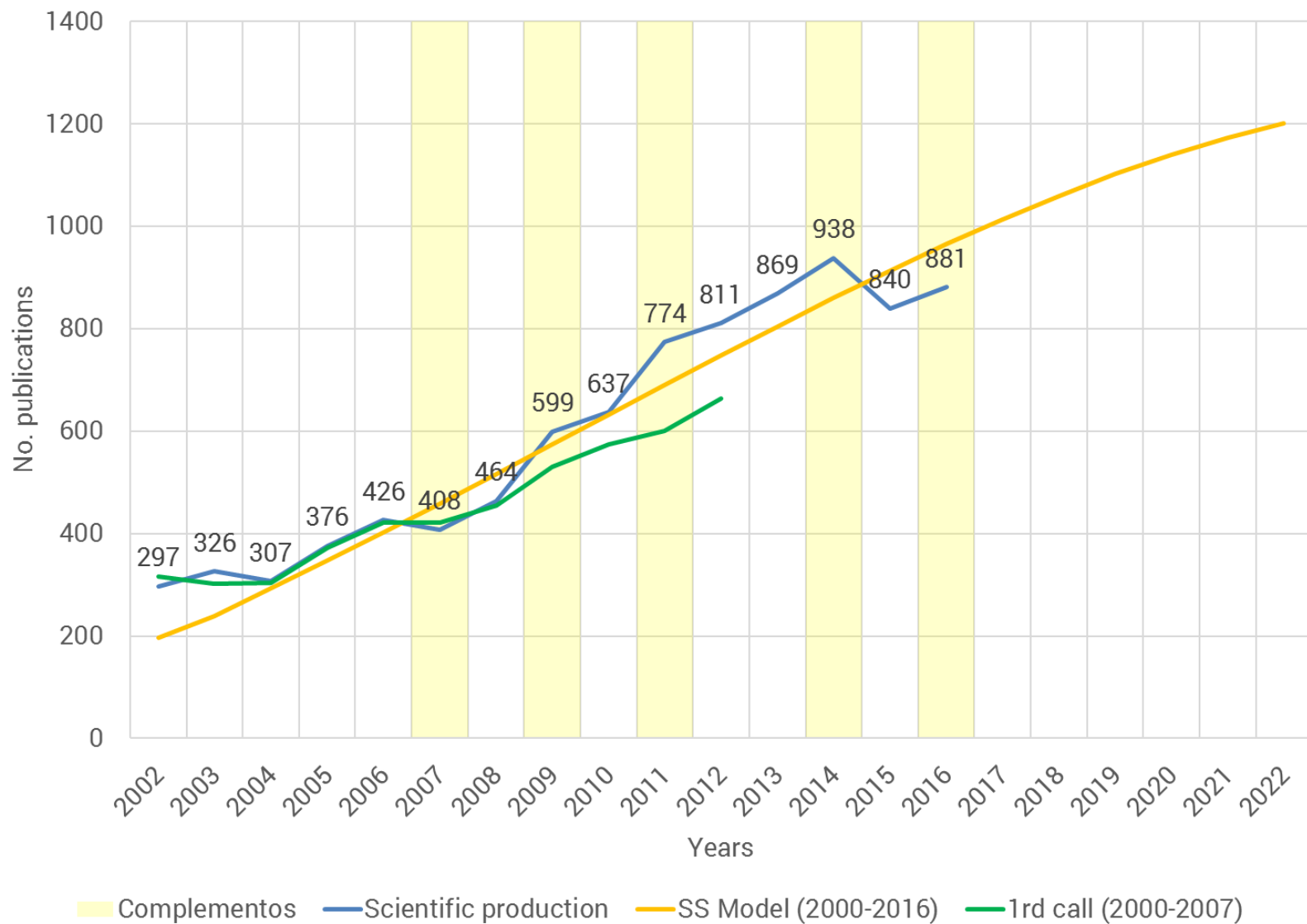
- The SS model to the 1rst call (2000-2007) shows a tendency 12.35% percentage of difference and variance of 0.014).

- The prediction with a 6-year window presents an increase of 3.46%.

Legend: Complementos — Scientific production — SS Model (2000-2016) — 1rd call (2000-2007)
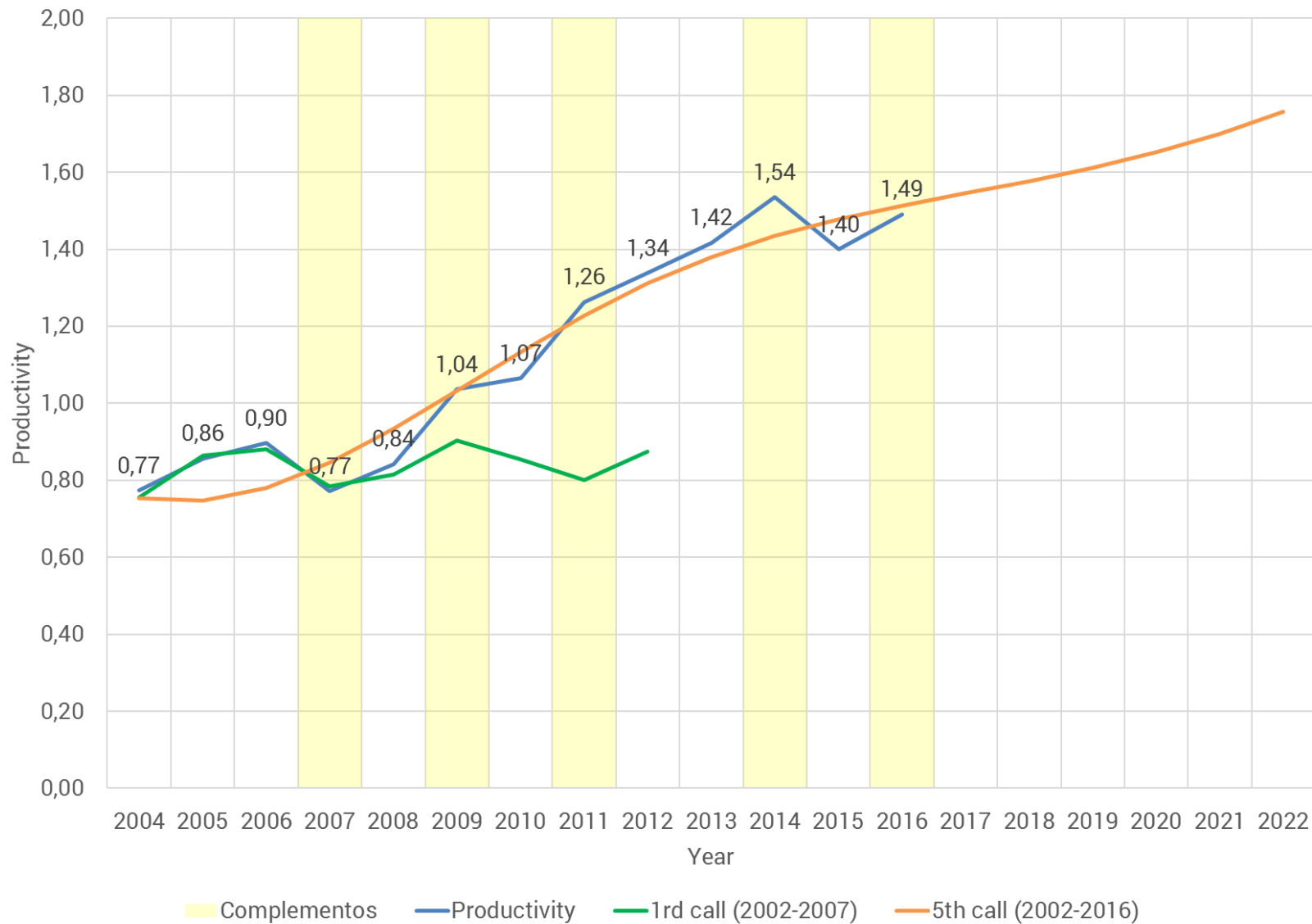
Results: 2) Researchers and Productivity

◇ 60.818 **researchers** were identified in the period 2002-2016 at SUE. From this, an average of 526 researchers (0.86%) were from UC3M.

◇ UC3M presents a stagnation of the researchers since 2009.

Results: 2) Researchers and Productivity
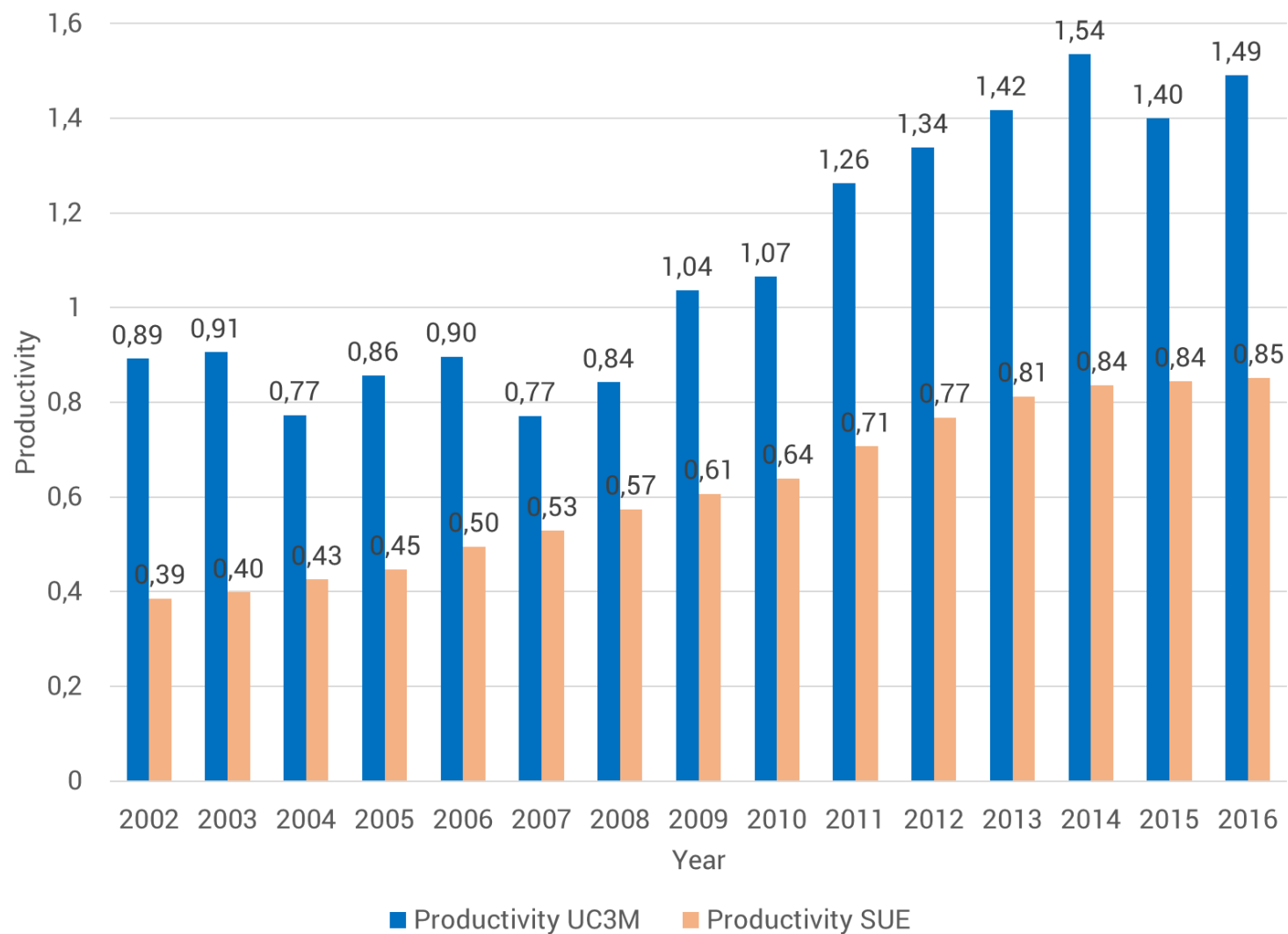
- ◇ **Productivity** average: 1.1 UC3M vs 0.62 SUE. The highest productivity value was at 2014 at Uc3m (1.54) and 2016 at SUE (0.85).

- ◇ UC3M presents a higher CAGR (5.82% vs 3.74%).
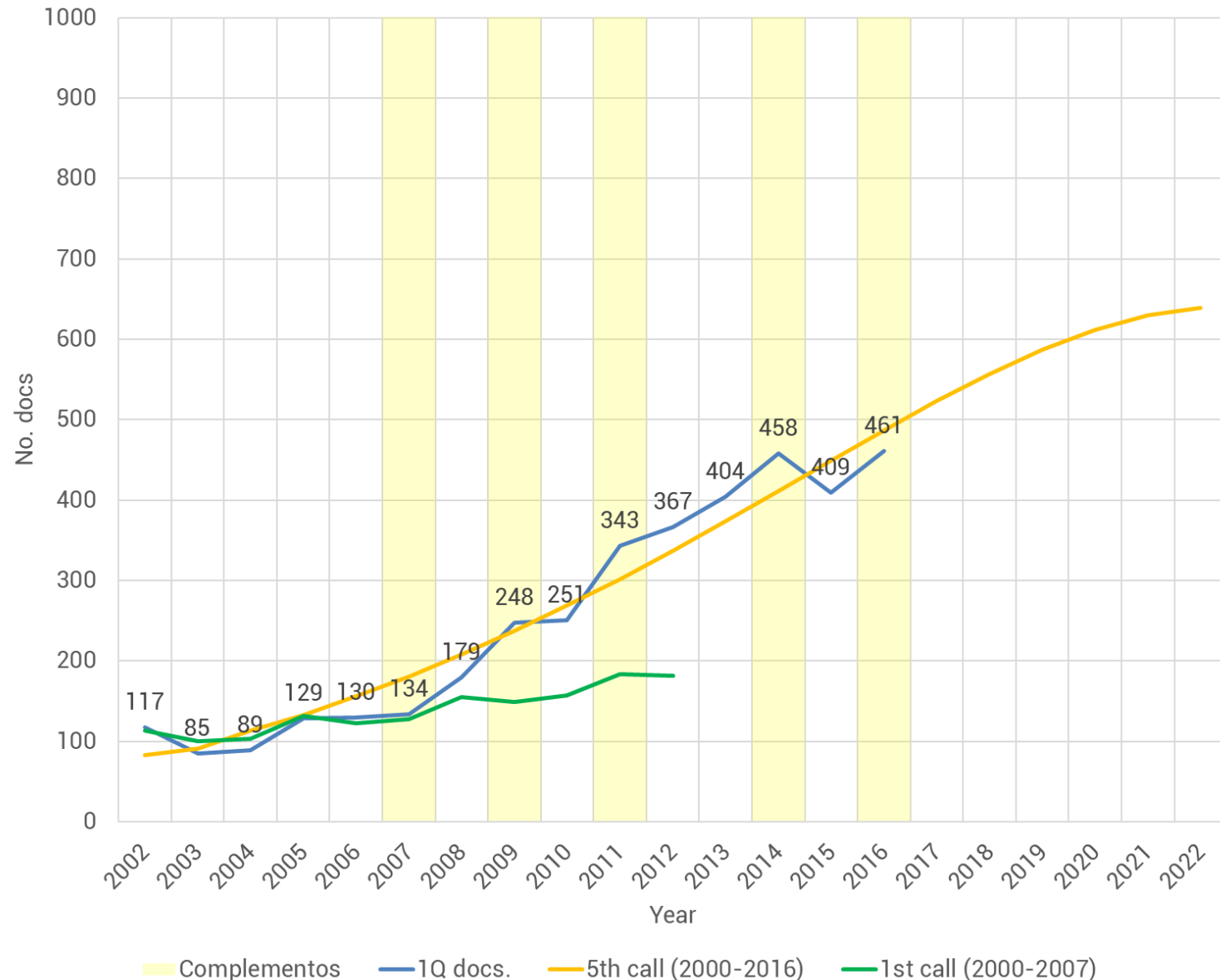
Results: 2) Productivity forecast

- The model aplied until the first call shows lower tendency (82.45% of difference and variance of 0.02).

- The prediction with a 6-year window presents an increase of 2.60%.

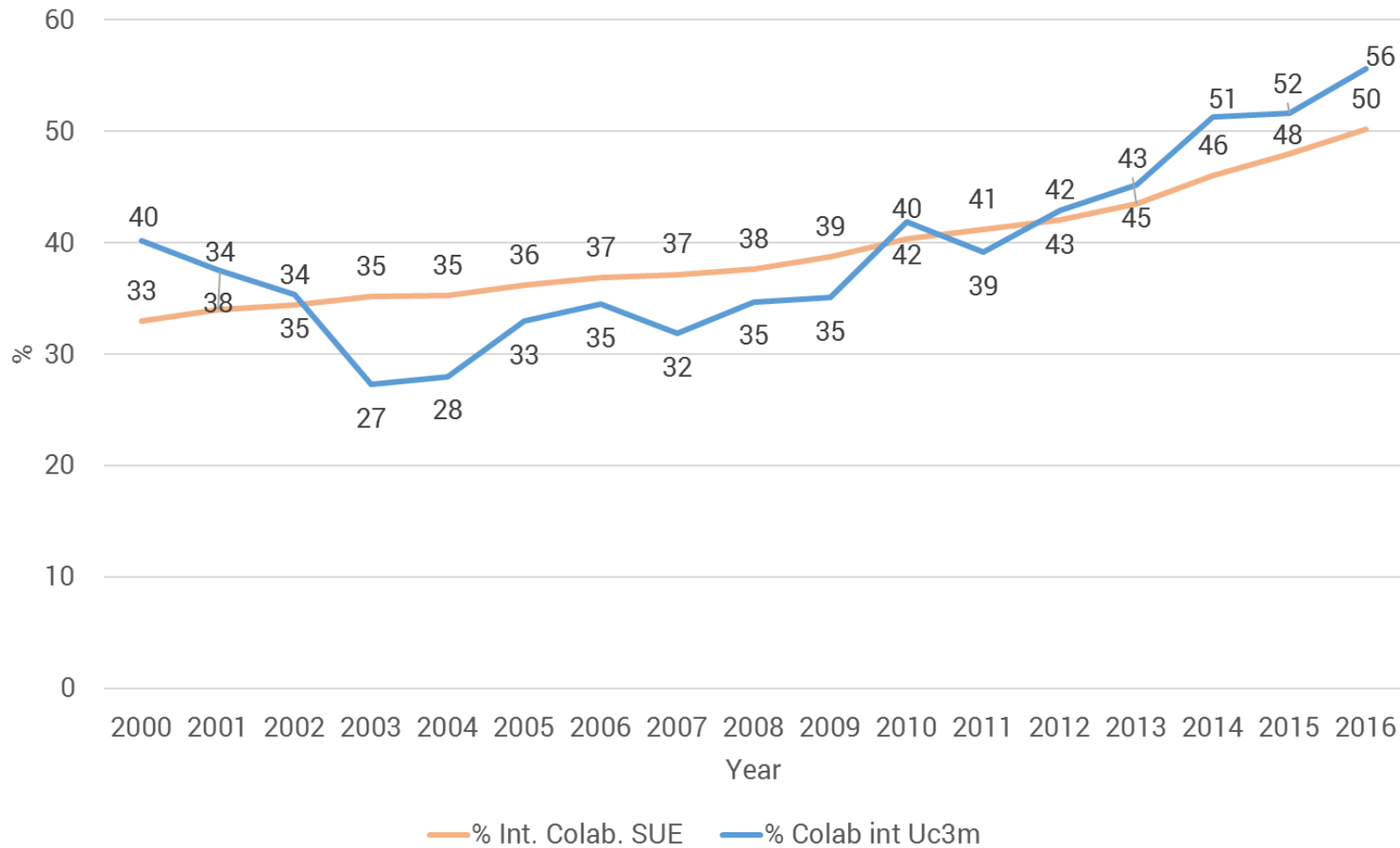# Results: 3) - First-quartile publications: SUE vs UC3M
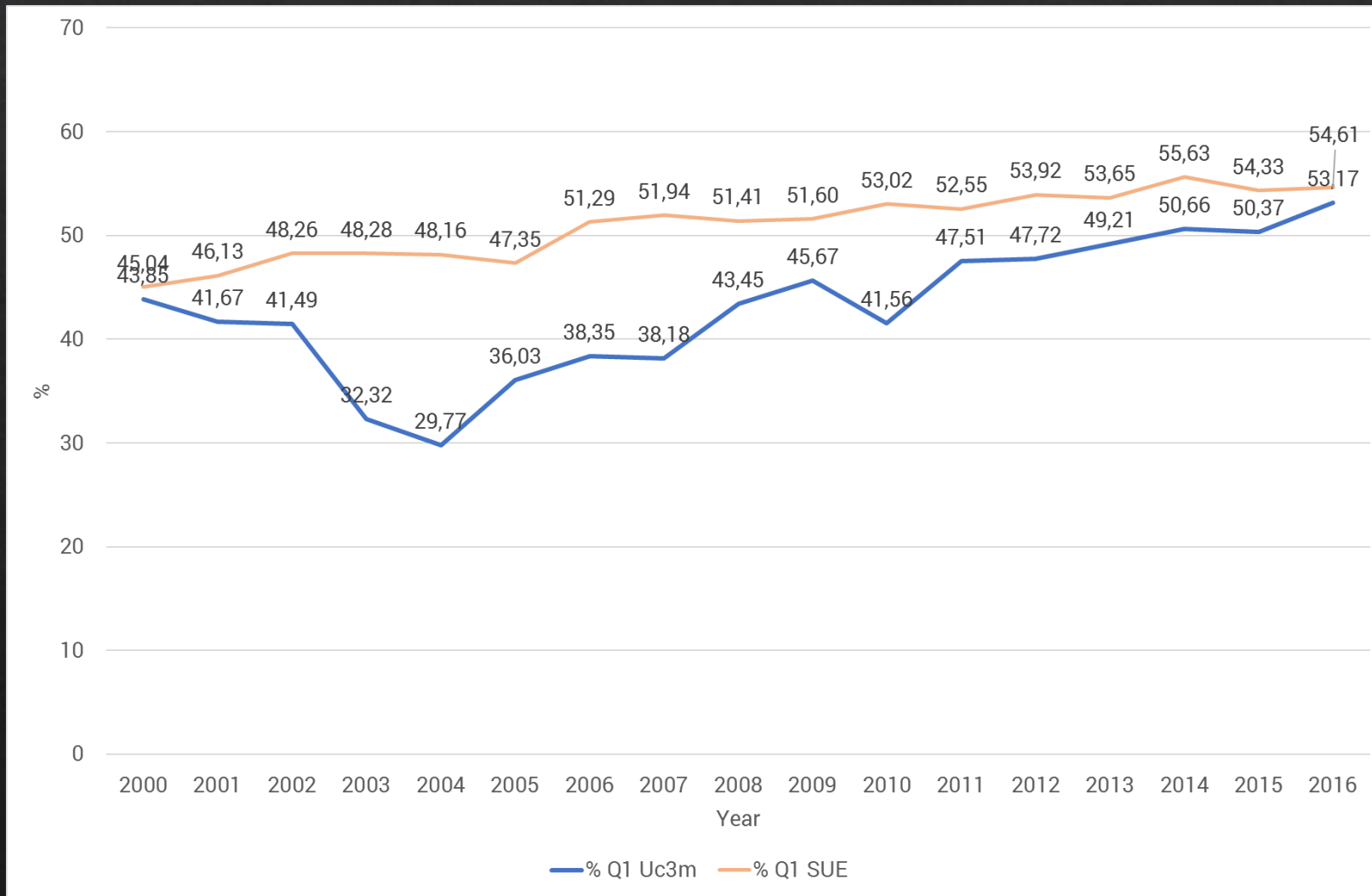
- 301,211 documents (51%) were detected in the first-quartile documents at SUE vs 3,986 (43%) at UC3M on the period.

- CAGR is 8.40% at SUE and 11.40% at UC3M.

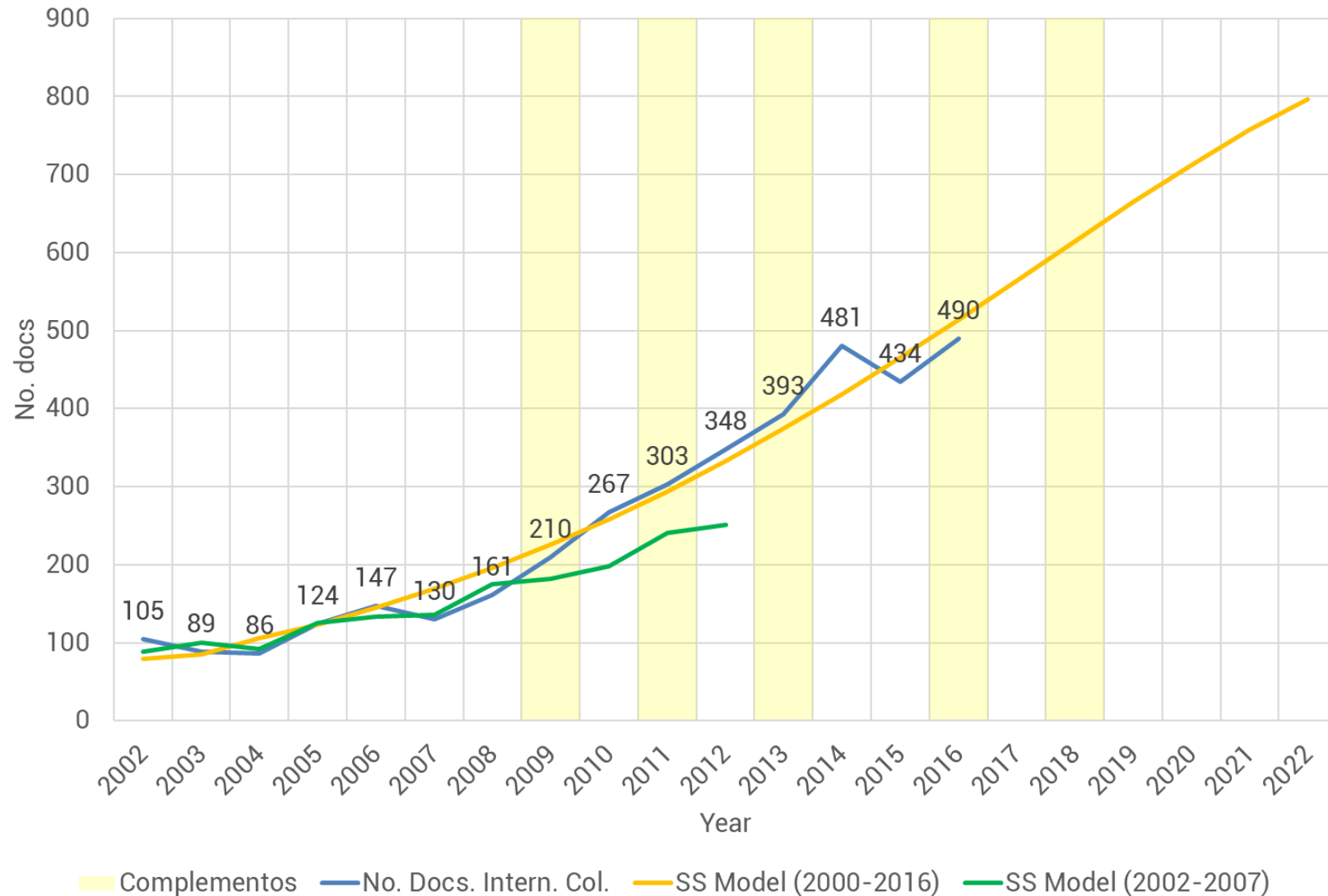# Results: 3) First-quartile publications forecast

- The model applied until the first call shows lower tendency (68% difference; variance: 0.03).

- The prediction with a 6-year window presents an increase of 4.09%.

Results: 4) International collaboration: SUE vs UC3M

- 251,459 documents (41.1%) were detected with International collaboration at SUE vs 3,943 (42%) at UC3M (1.56% of SUE).

- CAGR is 9.88% at SUE and 12.17% at UC3M.

Results: 4) International collaboration forecast

- The model aplied until the first call (88% of difference and variance of 0.02).

- The prediction with a 6-year window presents an increase of 7.14%.

Some considerations

◈ Monitoring the evolution of different dimensions at UC3M can provide interesting information about the trends of scientific production at this University.

Scientific output

◈ From the 1st call of 'Complementos', the scientific output has increased a 115.93 (2007-2016). The forecasted by the model would have been 58% (2007-2012), slightly lower on this simulated scenario without incentives. This increase cannot be associated with the researchers, which has witnessed a stagnation on the period. Neither with the number of projects, which has remained stable over the period and has presented a major increase over the last 5-year period (2012-2016).

◈ However, productivity at UC3M is higher than SUE: researchers of this University are publishing more papers. The forecasted increase by the model would have been 12% (2007-2012) (vs 74% real). This denotes the effect of these incentives on scientific production.

-Visibility and collaboration
- The papers published in the first quartile have considerably grown (244%) since the first call, denoting that publish journals with a greater impact, thus improving its visibility. Documents with international collaboration have also increased (276%). Besides, real increase is higher than the one simulated without incentives (84% vs 167% at international collaboration and 42% vs 174% at 1Q documents). This denotes that the effect of 'Complementos' is not only quantitative (nº docs, productivity) but qualitative (Q1, Int. Colab.).

Mathematical model:
-State space (SS) model could be a good methodological approach for estimating the behavior and forecast of an indicator in order to analyze the effects in scientific production caused by incentive rewards.
-The analysis with the different scenarios has determined that these incentives have real positive effects and has lead into a publication habits change of the researchers in this University.

Some limitations of the model must be highlighted:
- Not enough input data for time series evolution analysis: poor prediction reliability.
- In future studies, it is intended to analyze a longer period of time with multiple indicators, as well as to compare with other incentive reward policies in other regions or countries.

Any question?

Thanks for your attention!

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