Faculty members' productivity and research funding: Intrinsic and/or extrinsic motivations

Ramzi Ben Slama [1, 2, *], Jamel Choukir [1, 3]

[1]Al-Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia
[2]University of Sousse, Sousse, Tunisia
[3]University of Sfax, Sfax, Tunisia

ABSTRACT

This paper investigates the publication activity and the value of research funding in Saudi institutions of higher education. Our main question was what is the relationship between the efficiency of chair research funding and the productivity of faculty members? This interdisciplinary paper consists of applying econometric modeling to determine the profile of a faculty member involved in research and the Return on investment (ROI) methodology to assess the value of the funding in the case of SABIC chair. A survey using a questionnaire on perceptions of academic research productivity and documentary analysis of the profile of funding recipients showed that research funding has a positive impact on faculty productivity (2.66 published papers more) when the count considered is the number of published papers. However, there is no significant relationship between grants and publications in peer-reviewed journals with an impact factor. Furthermore, the results revealed that the estimated ROI was 37.2% more.

1. Introduction

According to different studies (Abu-Orabi, 2012a; 2012b), research spending in Saudi Arabia represents only about 0.3% of the GDP, which is considered modest compared with the Asian R&D average (1.9% in 2014) and those of different other countries such as Israel, 3.93%; Germany, 2.92%; and USA, 2.79%.

Clarifying and better understanding spending on scientific research in Saudi Arabia in the Arabic context and in an absolute way is interesting. This research provides an overview of the efficiency of research expenditures through a faculty member's (FM) research productivity. Econometric and Return on investment (ROI) (Phillips and Phillips, 2010; 2012) methodologies have been adopted. The first, the econometric approach, will allow us to understand and determine the predictors of an FM's productivity (some individual characteristics essentially count for intrinsic motivation). The

second, the ROI approach, assesses the efficiency of research funding.

We aim to analyze how the funding environment of research could influence faculty members' productivity and whether a funding like the chair strategy is efficient in producing publications in peer-reviewed journals. The conceptual background is the well-known principal-agent dilemma and the new trend in management. The appropriate empirical methodology for predicting the probability of publishing papers, as a measure of productivity, conditional to financial supports is based on four econometric models (Poisson, zero-inflated Poisson, negative binomial, and zero-inflated negative binomial). Second, we determine the ROI funding research. Results will give answers to many questions about whether financial incentives boost publication productivity and whether decision makers should place greater emphasis on other factors relevant to high productivity.

The originality of this paper is obviously that it combines two approaches. The econometric approach based on probability model estimations to explain FM productivity and the managerial approach based on the ROI methodology to measure the benefit of the chair financing research.

The rest of this paper is organized as follows. Section 2 discusses the literature review on the relationship between faculty members' research productivity and funding from both econometric and

financial perspectives. Section 3 outlines the theoretical framework and the empirical methodology used in this research. Section 4 reports and discusses the results from the econometric analysis. Section 5 presents the ROI methodology; the data used and provides the results of this approach. Section 6 concludes and suggests new directions for future research.

2. Related literature

A range of studies in the literature reported that research is not a linear process that leads to knowledge and then to action or adoption of new practices (Carayol and Matt, 2004). Indeed, research outcomes are more than some papers, knowledge, new ideas, or principles but new procedures and ways to think and explain a phenomenon and manage it. Research is not neutral. It could be used in a direct or instrumental way (Buxton and Hannay, 1996).

Assessing the value outputs of social research is a complex but necessary process in legitimating the expenditures and research funding of any institution. Research in the social sciences differs from any research in the medical, physical, agriculture, and engineering fields and all the so-called experimental sciences; and in general, it differs from applied sciences. Research outcomes from social sciences in particular could be considered contingent goods similar to environmental goods (e.g., lake, forest, natural landscape, etc.) or public goods (e.g., street lighting, main trunk artery, etc.). Such investment could be valued through the contingent valuation method (Hausman, 1993) and the estimation method (Phillips and Phillips, 2010; 2012). Indeed, research will be considered an asset. However, the use of estimates has some limitations.

Contrary to pure or basic sciences (Locke and Dunnette, 1976), research value in the social sciences and in the behavioral or organizational fields is difficult to measure and quantify in terms of return on investment (ROI), returns, or paybacks. We can say that this situation is due to many reasons, such as social science rationality, difficulty of attributing the value of any social research (overlapping of many factors), field complexity, few interests, and marginalization of managerial evaluation research, particularly in the Arab context. A survey conducted in two big Saudi universities with a sample composed of 50 faculty members from the business department revealed that none of their own theses could be considered a research evaluation.

A few studies (DFID, 2005) have attempted to quantify the efficiency, productivity, or rates of return of social science research, which has used esoteric methods such as the Bayesian decision theory and has reached estimates that cannot be considered robust (Gardner, 1999; Schimmelpfennig and Norton, 2003). The investigation of some databases (Eco-Link, ProQuest, Ektaband EBSCO) that revealed the need to conduct further research to assess the benefits of research no doubt constitutes a serious challenge.

2.1. Faculty members' research productivity: An economic perspective

According to the literature (Jonker and Hicks, 2014), the research productivity of an FM can be quantified through publications: peer-reviewed articles, national and international conference presentations, and number of citations. Some researchers (Jonker and Hicks, 2014) distinguish between research volume and research impact and between research-active and research-non-active faculty members.

For finance, banking, economics, and management, only articles published in peer-reviewed journals have been included. We verify that these articles are published in the appropriate journals before they are included in the publication count using Google Scholar; that is, the factors influencing faculty members' research productivity have been studied for decades (Lotka, 1926). University-generated ideas based on research are important in promoting innovations for the economic growth and competitiveness of industrialized economies (Jaffe, 1989; Mansfield, 1991).

In the process of obtaining and disseminating knowledge, numerous characteristics affect faculty research productivity, but the academic strength of the faculty and the decision maker leadership characteristics were confirmed as necessary for high levels of research productivity (Bland et al., 2002; 2005). Teodorescu (2000) explained the positive influence of faculty research productivity and faculty involvement in discipline affiliations such as membership in professional societies and attendance at professional conferences.

Dundar and Lewis's (1998) study found that faculty research productivity is primarily associated with two attributes: (a) individual attributes that relate to personal traits and environmental experiences and (b) institutional and departmental attributes that entail variables related to leadership, culture, structure, and policies.

Gomez-Mejia and Balkin (1992) described peer recognition or career advancement as the primary motivation behind research publications. However, researchers have debated whether the intrinsic motivation for research and/or the innate urge toward solving research puzzles are crowded out by extrinsic motivations such as career advancement or financial gains. Several frameworks have been used to assess ROR, such as the International Food Policy Research Institute model (Fan and Hazell, 2000; Fan et al., 2005; Buxton and Hannay, 1996).

2.2. Faculty members' research productivity: A managerial perspective

A few studies (Aubyn et al., 2009; DFID, 2005) have examined the efficiency and value of different

public and private spending types in social science research (in R&D, estimated at 30%; in education, around 13%–14%). This observation confirmed that further research is needed.

Most studies using the ROI methodology were applied in contexts such as distance learning program, academic libraries (Tenopir, 2010) and expenditure in the software development environment (Dinesh and Moinuddin, 2012). That is, research questions tend to focus more on financial and economic value.

A few studies also triedto examine the scholarly outcomes of projects receiving research grants such as Bawden et al. (2010), who explored research grants from the Canadian Association of Emergency Physicians (CAEP) during the first 10 years of national funding (i.e., between 1996 and 2005).Overall, the CAEP Research Grants Competition has produced impressive results. Despite the small sums available, the grants have been important for ensuring study completion and for securing additional funding. CAEP and similar organizations need to develop a more robust funding approach so that larger grant awards can be given and more researchers can be supported on an annual basis.

Among the existing researches focusing on ROI we could cite a research realized on the preparatory program value by applying ROI at the College of Economics and Administrative Sciences: CEAS (Choukir, 2014). This research consists of applying the ROI methodology in order to assess the efficiency of the preparatory program launched at Al-Imam Muhammad ibn Saud Islamic University (IMSIU) in 2010–2011.

These kinds of research, integrating the ROI methodology and learning, training, among others, are relatively numerous. However, a few studies investigate the link between research chair expenditure and the ROI translated in money terms but also intangible returns.

In the Arab context, we explored different databases (Ektab, Eco-Link, ProQuest, EBESCO). It seemed that research expenditures, efficiency, and FM productivity were not investigated in terms of both individual (demographics) and institutional (incentives) perspectives. The governmental and nongovernmental institutions continued to invest big funds without knowing their own contributions. This research legitimacy involves understanding academic expenditures' efficiency, the ROI of any research chair, and the profile of productive faculty members.

3. Theoretical framework and empirical methodology

3.1. Theoretical model

Beyond these issues, both research chair value and research productivity of faculty members seemed to be neglected by investigation particularly through the ROI methodology. This research builds on existing research evaluation and examines the chair value from both economic and managerial perspectives.

According to the literature review on research value and returns from both economic and managerial perspective, we observe that research value particularly in social fields obey a specific rationale and process. Through a few social studies on ROI, we observe a consensus about the use of estimates and quantification tool, which is seen as most appropriate. The use of estimates could be credible if we respect two conditions: the process and the method limitations. Aware about these constraints, we launched the following research questions in order to highlight some or even a little ambiguity.

What is the profile of the productive faculty member? What is the research value? To investigate these questions, we adopt both the econometric and the ROI methodologies. The last one takes into account quantitative and qualitative sides and financial and nonfinancial measures and determines both sides' tangible and intangible aspects and opens a perspective for evaluation or action research. This research seeks to identify metrics for demonstrating the ROI in research funding (Fig. 1).

3.2. The empirical strategy

3.2.1. Data and variables description

Data are obtained from a survey questionnaire addressed to the FMs. The set of variables used in all estimations is inspired from Hesli and Lee (2011). Variables used in this study are as follows:

- Outcome variable y_i
  - The number of published or accepted papers in international journals per author *i*
  - The number of published or accepted papers in international journals with impact factor per author *i*
- Covariates x_i (individual characteristics, department characteristics, SABIC Chair incentives, funding, research grants, …)
  - Age: The age of the researcher *i* at the beginning of the program (SABIC chair)
  - Marital status: Dummy variables (married; single)
  - gender: Dummy variables (Male, Female)
  - Nationality
  - Rank:
    - Full professor: Dummy variable = 1 if the researcher *i* is a full professor
    - Associate professor: Dummy variable = 1 if the researcher *i* is associate professor
    - Assistant professor: Dummy variable = 1 if the researcher iis assistant professor
  - Publications record y_i^{-1} The number of published papers in international journals

per author *i* before joining the department (intrinsic motivations)
- Number of years in academics (experience)
- Teaching load: The number of teaching hours per week
- PhD Diploma: dummy variables (local university; foreign university)

- Specialization: A set of dummy variables (Finance, Insurance and risk management, Banking, Accounting, Business administration and, Economics)
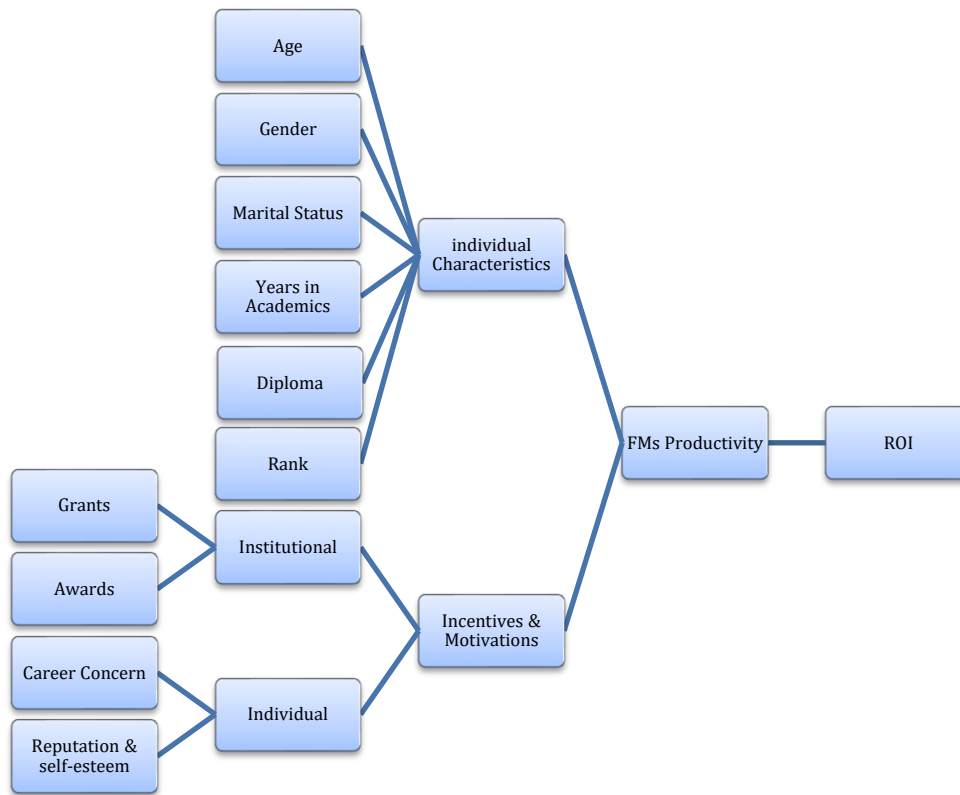- Monetary incentives: financial supports & research grants (extrinsic motivations)

Fig. 1: Theoretical model

3.2.2. The econometric model

The statistical model depends on the outcome variable y_i, which is a count variable. Four models can be estimated to predict the probability of publishing papers conditional to financial supports or research grants (monetary incentives):

i.) Poisson regression model (PRM)
ii.) Zero-inflated Poisson model (ZIP)
iii.) Negative binomial model (NB)
iv.) Zero-inflated negative binomial (ZINB)

The basic model:

$$E[y_i^*] = \beta' x_i + \varepsilon_i = ln\lambda_i + lnu_i \qquad (1)$$

where y_i^* is a latent variable such as $y_i = z_i \times y_i^*$ and where

$$z_i = \begin{cases} 1 \text{ if the research conducted is published} \\ 0 \qquad\qquad\qquad\qquad\qquad otherwise \end{cases}$$

z_i is assumed to be determined by the vector of covariates w_i according to a given distribution function defined as follows:

$$Pr[z_i = 0|w_i] = F(\gamma' w_i) = exp(\gamma' w_i)/(1 + exp(\gamma' w_i)).$$

The distribution of y_i^* conditioned on x_i and u_i is given by the following density function:

$$f(y_i^*|x_i) = \int_0^\infty f(y_i^*|x_i)g(u_i)\,du_i = \int_0^\infty \frac{e^{-\lambda_i(\lambda_i u_i)}}{y_i^*!}g(u_i)du_i \qquad (2)$$

which is standard Poisson and where $g(u_i)$ is assumed to be a gamma density. Eq. 2 is normalized in order to have $E[u_i] = 1$. Giving $g(u_i) = \frac{\theta^\theta}{\Gamma(\theta)}e^{-\theta u_i}u_i^{\theta-1}$ Eq. 2 can be rewritten as follows:

$$Pr[y_i^* = j|x_i] = f(j|x_i) = \frac{\Gamma(\theta+j)}{\Gamma(j+1)\Gamma(\theta)}r_i^j(1-r_i)^\theta \qquad (3)$$

where $r_i = \frac{\lambda_i}{\lambda_i+\theta}$, which is the form of the negative binomial distribution. So instead of having a constant mean equal to the variance λ_i of the standard Poisson distribution, we now have $E[y_i^*] = \lambda_i$ and

$$\frac{var[y_i^*]}{E[y_i^*]} = 1 + \frac{1}{\theta}E[y_i^*].$$

The non-conditional probability of the observed number of publications is thus given by

$$Pr[y_i = j | x_i, w_i] = Pr[z_i = 0 | w_i] \times (1 - min\{j, 1\}) + Pr[z_i = 1 | w_i] \times Pr[y_i = j | x_i, z_i = 1] \tag{4}$$

with $j = 0, 1, 2, \dots$

$$L = \sum_{i \in S} ln\left[F(\gamma'w_i) + (1 - F(\gamma'w_i))\left(\frac{(1 + \exp(\beta'x_i))}{\theta}\right)^{-\theta} \right] + \sum_{i \in S} \left[\begin{array}{l} ln(1 - F(\gamma'w_i)) + ln\Gamma(\theta + y_i) - ln\,\Gamma(y_i + 1) - ln\Gamma(\theta) \\ -\theta\,ln(1 + \exp(\beta'x_i)/\theta) + y_i ln(1 - (1 + \exp(\beta'x_i)/\theta)^{-1}) \end{array} \right]$$

with S the set of individuals (faculty members) i having a nonnull number of publications

$y_i > 0, \ \forall i \in S.$

4. Estimation results

4.1. Faculty members' demographic and research productivity

The response rate of the questionnaire intended for faculty members is 95/170 = 56%, which seems normally comparative to research in the academic world.

Table 1 shows some descriptive statistics of individual characteristics. Age and years in academics are continuous predictors of the probability to publish research papers. Rank (professor, associate professor, and assistant professor), gender, and university are discrete covariates. Each variable has valid 95 observations, and their distribution seems quite reasonable. The unconditional means and variances are not extremely different except for age and years in academics. What emerges is that the mean age of faculty members is about 42, which can be considered normal, and the average of years in

3.2.3. Estimation methodology

The estimation method is based on optimization algorithm of the following log-likelihood function:

academics is approximately 8 years, which is rather interesting as a factor of publishing productivity.

Table 2 highlights some descriptive statistics of the main variables representing the faculty members' productivity. What emerges here is the weakness of published papers with impact factor (1.12 in average).

The Table 3 reports the incidence rate ratio (IRR). The likelihood ratio (LR) test provides a comparison between a Poisson regression model (PRM) and a negative binomial model (NB). The LR test statistics is not significantly different from zero. We conclude no issue of over dispersion. The PRM is preferred. The Vuong test compares a PRM with a zero-inflated Poisson model (ZIP). The Vuong test statistics is positive, which favors the ZIP model, but it is not significant, so this favors the PRM. The Pearson goodness-of-fit test is weakly statistically significant (10% level). Thus, the PRM fits reasonably well the data. There are probably no omitted predictor variables. The results suggest no significant effect of demographics, human capital, and opportunity cost variables. However, publication record and monetary incentives positively affect the probability to publish research papers.

Table 1: Demographic FM data: Descriptive statistics of faculty members' characteristics

Variable	Mean	Std. dev.	Min	Max
Age	41.92982	5.912637	31	57
Gender	0.0454115	.2083036	0	1
Years in academics	7.561404	4.832988	0	22
University – foreign	.350772	.4814868	0	1
Professor	0.0028382	.0532245	0	1
Associate professor	0.0094607	.096851	0	1
Assistant professor	0.0416272	.1998304	0	1
Teaching load	0.6842105	0.4689614	0	1
Publication record	2.947368	2.415878	0	10

Table 2: Faculty members' research productivity: Descriptive statistics

	Mean	Standard Deviation	Min	Max
Impact factor papers	1.12	1.55	0	8
Rewarded papers	2.95	2.41	0	10
Published papers	3.58	2.46	0	10

The Table 4 reports the marginal effects (*dy/dx*) calculated at the mean of the number of publications during the last 5 years after the estimations reported in Table 3.

Table 5 reports the incidence rate ratio (IRR) when the count is the number of published papers with an impact factor (IF). The LR test performs a comparison between a Poisson regression model (PRM) and a negative binomial model (NB). The LR test statistics is significantly different from zero. The PRM would seem to have a problem with over dispersion. The NB model is preferred. The Vuong

test compares an NB model with a zero-inflated NB model (ZINB). The Vuong test statistics is positive, which favors the ZINB model, but it is not significant, so this favors the NB model. The Pearson goodness-of-fit test is weakly statistically significant (10% level). Thus, the NB fits reasonably well the data.

There are probably no omitted predictor variables. The results suggest some significant effects of demographics, human capital, and opportunity cost variables. However, publication record and monetary incentives positively affect the probability to publish research papers.

Table 3: Incidence rate ratio (IRR) on the FM's research productivity (count: published papers during the last 5 years)

Dependent Variable: Number of Publications		Poisson Model		ZIP Model	
Variables Set	Variable Name	*IRR*	*z-stat*	*IRR*	*z-stat*
Demographics/Family Variables					
	Age	1.033	1.31	1.033	1.29
Gender (ref. female)	Male	0.887	–0.50	0.887	–0.46
Marital status (ref. single)	Married	0.702	–1.38	0.702	–1.02
Human Capital Variables					
PhD diploma (ref. from local university)	From foreign university	1.042	0.19	1.042	0.19
	Years in academics	0.924***	–2.40	0.924***	–2.70
Professional Variables	Associate professor	1.217	0.82	1.217	0.82
Rank (ref. assistant professor)	Full professor	1.359	0.66	1.359	0.62
Specialization (ref. accounting)	Finance	0.788	–0.78	0.787	–0.76
	Insurance and risk ma.	1.023	0.07	1.023	0.06
	Banking	0.723	–0.71	0.723	–0.68
	Business administration	1.121	0.41	1.121	0.43
	Economics	0.734	–0.98	0.734	–0.96
	Publication record	1.069*	1.76	1.069*	1.94
Financial Incentive Variables	Monetary incentives	1.935***	2.63	1.935***	2.61
	Grants (inflation factor)			–10.361***	–9.75
Opportunity Cost Variables	Teaching load	0.875	–0.76	0.875	–0.68
Likelihood ratio test		LR chi2(1) =–0.00 (*p*-value = 1)			
Pearson goodness-of-fit		Chi2(86) =53.37(*p*-value = 0.0932)			
Vuong test		z = 0.79 (*p*-value= 0.2149)			
N		95		95	

Notes: IRR values are equal to exponentiated coefficients. *Z*-values, calculated using robust standard errors, are reported in columns. ***, **, * denote statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively

Table 4: Average marginal effect (count: published papers during the last 5 years)

Dependent Variable: Number of Publications		Poisson Model		ZIP Model	
Variables Set	Variable Name	*dy/dx*	*z-stat*	*dy/dx*	*z-stat*
Demographics/Family Variables					
	Age	0.102	1.10	0.118	1.29
Gender (ref. female)	Male	–0.194	–0.21	–0.427	–0.50
Marital status (ref. single)	Married	–1.230	–0.99	–1.262	–1.39
Human Capital Variable					
PhD diploma (ref. from local university)	From foreign university	0.035	0.05	0.147	0.19
	Years in academics	–0.302***	–2.85	–0.279***	–2.38
Professional Variables					
Rank (ref. assistant professor)	Associate professor	1.433*	1.83	0.703	0.83
	Full professor	2.564	1.60	1.098	0.67
Specialization (ref. accounting)	Finance	–0.690	–0.63	–0.852	–0.77
	Insurance and risk ma.	0.396	0.29	0.084	0.07
	Banking	–1.532	–0.90	–1.157	–0.70
	Business administration	0.403	0.43	0.409	0.42
	Economics	–1.112	–0.97	–1.104	–0.97
	Publication record	1.137*	1.94	0.241*	1.80
Financial Incentive Variables	Monetary incentives	2.662***	2.89	2.362***	2.49
Opportunity Cost Variables	Teaching load	–.708	–1.03	–0.473	–0.75
N		95		95	

Note: ***, **, * denote statistically distinct from 0at the 1%, 5%, and 10% levels, respectively

Finally, Table 6 reports the marginal effects (*dy/dx*) calculated at the mean of the number of publications during the last 5 years after the estimations reported in Table 5.

4.2. Discussion

We proposed to test the effect of financial support as monetary incentives (extrinsic motivation) on the probability to publish. We have two counts: the number of published papers in peer-reviewed journals during the last 5 years (model 1) and the number of published papers in academic journals with an impact factor (model 2).

We first discuss the results of the PRM estimations with robust standard errors (Table 3). To avoid estimate bias and inefficiency, we estimate a negative binomial model (results are not reported and may be requested) and perform a likelihood

ratio test to compare with the PRM. The test concludes that the PRM is preferred to the NB model.

Table 5: Incidence rate ratio (IRR) on the FM's research productivity (published papers with IF)

Dependent Variable: Number of Publications with IF		NB Model		ZINB Model	
Variable Set	Variable Name	IRR	z-stat	IRR	z-stat
Demographics/Family Variables	Age	1.110*	1.94	1.103***	3.18
Gender (ref. female)	Male	0.624	−0.91	0.608	−1.04
Marital status (ref. single)	Married	0.181***	−4.51	0.310	−2.52
Human Capital Variables	From foreign university	1.051	0.12	1.717	0.79
PhD diploma (ref. from local university)	Years in academics	0.842**	−2.54	0.794***	−2.83
Professional Variables	Associate professor	1.050	0.09	1.298	0.49
Rank (ref. assistant professor)	Full professor	1.196	0.18	1.391	0.44
Specialization (ref. accounting)	Finance	0.973	−0.04	1.039	0.06
	Insurance and risk ma.	0.760	−0.075	0.939	−0.17
	banking	2.9e−7***	−15.55	5.3e−15***	−36.18
	Business administration	1.358	0.80	2.177**	2.05
	economics	0.664	−0.73	0.731	−0.60
	Publication record	1.137*	1.89	1.079	1.10
Financial Incentive Variables	Monetary incentives	1.090	0.80	1.211	0.380
	grants(inflation factor)			−14.307	−0.00
Opportunity Cost Variables	Teaching load	0.716	−0.90	0.763	−0.62
Likelihood ratio test		LR chi2(14) = 33.14 (*p*-value= 0.0028)			
Pearson goodness-of-fit		Chi2(86) =50.40712 (*p*-value=0.1489)			
Vuong test		*z* = 0.89 (*p*-value= 0. 1429)			
N		95	95		

Notes: IRR values are equal to exponentiated coefficients. *Z*-values, calculated using robust standard errors, are reported in columns. ***, **, * denote statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively

Table 6: Average marginal effect (count: published papers with IF)

Dependent Variable: Number of Publications with IF		NB Model		ZINB Model	
Variable Set	Variable Name	dy/dx	z-stat	dy/dx	z-stat
Demographics/Family Variables	Age	0.114**	2.09	0.119**	2.0
Gender (ref. female)	Male	−0.441	−0.78	−0.604	−0.91
Marital status (ref. single)	Married	−1.882***	−2.56	−1.424*	−1.76
Human Capital Variable	From foreign university	−0.009	−0.02	0.659	0.82
PhD diploma (ref. from local university)	Years in academics	−0.193***	−2.87	−0.279**	−2.27
Professional Variables	Associate professor	0.081	0.16	0.318	0.47
Rank (ref. assistant professor)	Full professor	0.339	0.29	0.402	0.32
Specialization (ref. accounting)	Finance	0.127	0.18	0.047	0.06
	Insurance and risk ma.	−0.287	−0.37	−0.075	−0.09
	Banking	−17.023	−0.02	−19.764	−0.01
	Business administration	0.356	0.62	−0.947	1.24
	Economics	−0.410	−0.57	−0.381	−0.47
	Publication record	0.144*	1.88	0.092	0.95
Financial Incentive Variables	Monetary incentives	0.094	0.16	0.233	0.34
Opportunity Cost Variables	Teaching load	−0.375	−0.87	−0.328	−0.59
N		95		95	

Note: ***, **, * denote statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively

This latter condition avoids the over dispersion of data. Also, we perform a ZIP model, which is divided in two parts: the Poisson part, when FMs were in the publication process (number of published papers different from zero), and a logit zero inflation part, when FMs did not have any grant (grant=0) to explain the switch between the publication and the non-publication process. The tests performed and discussed above confirm that the Poisson model is appropriate. The results suggest that only years in academics, publication record, and the monetary incentives influence the probability to publish.

Referring to Table 4, the main conclusion is that monetary incentives are associated with 2.66 additional published papers and publication record, which can be considered that an intrinsic motivation

is associated with 1.14 additional published papers. However, 1 more year in academics is associated with −0.3 papers, and being in the rank of associate professor increases the number of published papers by 1.4 times. We conclude that monetary incentives and publication record are effective. Therefore, a publication activity is the result of a combination of extrinsic motivations (grants) and intrinsic motivations (self-esteem, career concerns, reputation, etc.).

Fig. 2 gives the difference between the actual sample frequencies, the PRM, and the ZIP model predicted probabilities to publish research papers. The Poisson model performs better than the ZIP model but overestimates the probability mass at low counts (fewer than four papers). However, at high counts (more than five), there are no real differences. The Poisson model fits the sample data as well. We focus now on the results of model 2 presented in Table 5. PRM estimates are biased and inefficient because of over dispersion. So we estimate a negative binomial model (results of the PRM are not presented and may be requested) and perform a likelihood ratio test to compare with the PRM. The test concludes that the NB model is preferred to the PRM. Also, we perform a ZINB model, which is divided in two parts: the NB part, when FMs were in the publication in journals with an impact factor process (number of published papers with IF different from zero), and a logit zero inflation part, when FMs did not have any grant (grant=0) to explain the switch between the publication in journals with IF and the no publication in journals with an IF process. The tests performed and discussed above confirm that the NB model is appropriate. The results suggest that demographic variables (age and marital status) and professional variables (years in academics, fields: banking and publication record) influence the probability to publish. Monetary incentives are not effective.

Referring to Table 6, the main conclusion is that monetary incentives have no real effect on publishing research papers in academic journals with an impact factor. Therefore, publication record has a weak effect. It is associated with 0.14 additional published paper in academic journals with an impact factor. Indeed, the chair for financial support imposes conditions and constraints that discourage FMs from publishing high-quality papers in academic journals with an impact factor. FMs are constrained by time (about 6 months) to finish the project with financial support. If we refer to the theory of incentives based on the principal-agent model (Laffont and Martimort, 2009), we can state that by a selection process (screening) based on FMs curricula, the chair can fix the problem of adverse selection, but we think that the chair failed to find incentives for high-quality research by imposing a short deadline for the project papers. So the moral hazard problem remains unsolved.
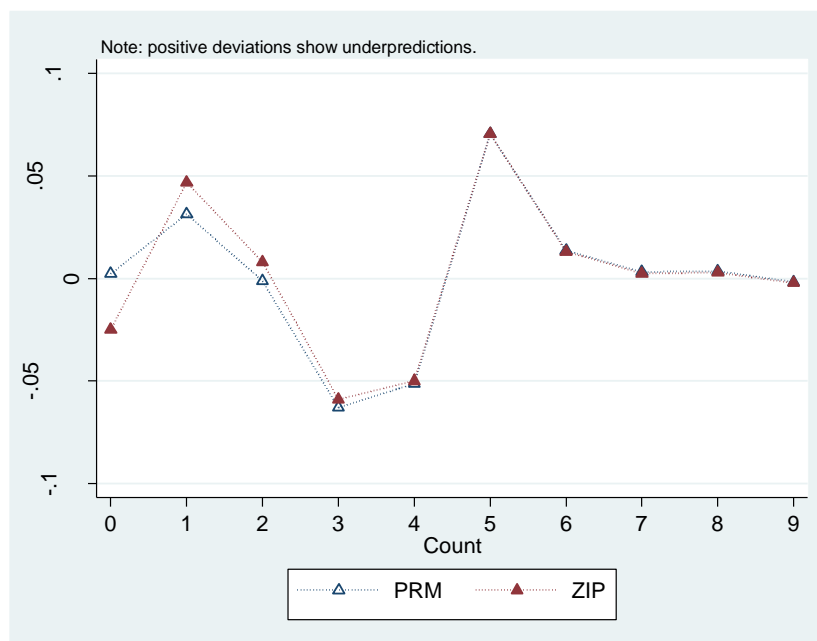

Fig. 2: The PRM versus the ZIP model predicted probabilities (count: published papers in the last 5 years)

5. ROI process: Data collection strategy and results

5.1. SABIC chair description

SABIC Chair for Islamic Finance Market Studies has been established in November 2010 at Al-Imam Muhammad Ibn Saud Islamic University in line with the company's efforts to develop and find innovative financial and investment channels that apply Islamic principles. The chair aims to enhance research in Islamic finance to support the continuous development of Saudi Arabia. It also seeks to develop a knowledge-based economy, perform academic research based on the needs of the community, and deepen understanding of Islamic finance (global issue: many countries are concerned about this topic, such as USA, UK, France, Japan, etc.) (SABIC, 2015).

The available facilities such as the funding, the awareness, and the partnership could contribute to reach research quality, research performance, and volume measured through some indicators. Many reports and studies (Abu-Orabi, 2012a; 2012b) revealed the scarcity of research in the Islamic world, the facilities and investment in research (less than 1% in GDP), and the teaching domination loading universities. The objectives of the SABIC Chair are presented in the Table 7.

Table 7: The SABIC Chair outcomes

Financial support research and studies	66.4 %
Financial support graduate students	15.2%
Financial support specialized scientific knowledge	10.4%
Participation in scientific and research activities	0%
Cooperation and scientific communication	0%
Other activities (such as organizing conferences)	0%
Total	100 %

According to different SABIC (2015) reports, there are no expenditures and spending on the last three items during the last five years. The SABIC Chair outcomes are multiples from papers to syllabus. We will focus on the publication outcomes, which represent 66.4% of the funding (Table 7).

We consider that these expenditures allowed SABIC to reach many objectives, such as certain visibility (reputation, acknowledgments, etc.) and legitimacy (understanding issues related to Islamic financing). This mechanism of funding, according to the accounting perspective, could be considered a kind of corporate social responsibility activities, which is not a simple philanthropic act but a public relations one.

The biggest part of the funding (about 1.6 million Saudi riyals plus management costs) was invested in producing papers, which is the core business of any chair. The SABIC Chair has been funding more than 60 research projects for five years (2011–2015), with about 90% of achievements. The average funding for each paper was about 27,000 Saudi riyals (about US$ 7,200). The topics of these projects were mostly treated financial issues, such as financial market from the Islamic point of view: *sukuk*, stock market, and Islamic financial products.

5.2. Reaction and satisfaction

Reactions to the SABIC Chair Funding (SCF) have been collected from the FMs' point of view (current and previous). In others words, we investigated how the FMs perceive the funding. According to best practices, the SCF needs to reach a 4 out of 5 rating on appropriateness of the funding program. Reaction measurements were formal. According to the results of our survey (Table 8), we obtained less than 4, which represented best practices. Many improvements need to be done regarding incentives for research but, essentially, the link between FM salary structure and research.

Table 8: Issue and average rating for reaction and satisfaction

Issue	Average rating
The SABIC Chair Research Funding is an interesting motivator.	4.04
The SABIC Chair meets the needs of faculty members.	3.11
The SABIC Chair meets the needs of the sponsor.	2.46
The SABIC Chair meets the needs of the community.	3.51
The SABIC chair incentives are efficient.	3.16
Average	3.07

5.3. Learning

A formal questionnaire given to current faculty members provided an opportunity to collect information about their understanding of how the SCF works and their role in making the funding program successful. We determined the extent to which the FMs acquired knowledge and skills. How confident were the FMs in using or applying their acquired knowledge and skills? Learning was primarily measured through the test results obtained by SCF and FMs. The grade objective for the overall program was to maintain a 3.0 grade point average out of a possible 4.0. In 5 years, the SCF obtained an average of 3.23, which means that the program reached its objectives from learning perspective (Table 9).

Table 9: Issue and average rating for learning

Issue	Average rating
I extend my knowledge after my involvement in research through SABIC Chair	2.81
I extend my skills through research financed by SABIC Chair.	2.6
I acquire more confidence in teaching and research.	2.63
I acquire more skills and knowledge.	3.95
I maintain my knowledge and skills.	3.33
I become more expert in my major field.	3.5
I enlarge my expertise to other interest fields.	3.77
Average	3.23

5.4. Application and implementation

A questionnaire was distributed where the FMs indicated the success of the SCF in two areas: the extent to which the FM were using their acquired knowledge and skills in their studies, pursuit of their degree, and maybe their work, and the effectiveness in the use of knowledge and skills related to the

research process. In addition, several questions focused on progress with the application of the funding program (barriers). SCF statistics were collected, including publication, impact factor, and reward papers. A follow-up questionnaire was administrated to two populations: FM who were pursuing the SCF and FMs who were not. Several topics were covered on the questionnaire, such as the relevance of the SC funding. We obtained an average of 3.27 out of 5 (Table 10), which could be considered lower than the best practices and the required performance.

The results in Table 11 show the enablers and barriers to research productivity from the point of view of FMs. It reveals that the FMs' motivations to do research oscillate between reputations, career concern, and grant amount. It seems that the majority of FMs are more concerned about grant amount, which, according to them, has more impact on their research productivity, confirmed by econometric estimations, than career concern. These results seem rational, according to the persistence of many obstacles to research, such as a higher course number and teaching overload. OCUA (1994), advanced that the best practice is as follow: 40% teaching + 30% research +15% service +15% administration duties. Alshayea's (2013) recent study showed that the scientific and technological communities in universities in the Gulf area have hefty a teaching load. As a result, research activities account for no more than 5% of the FMs' workload. Research funding could be used by some FMs more in the financial perspective, as a salary supplement, than in the development one (achievement, fulfillment).

Table 10: Issue and average rating for application and implementation

Issue	Average Rating
I use the acquired knowledge and skills in my teaching process.	4.35
The SABIC Chair increased my ability to pursuit my academic career.	2.63
Career concerns support the use of knowledge and skills acquired through the SABIC Chair.	2.15
I found that the SABIC Chair research funding is efficient.	2.5
The financial support of the SABIC Chair gives me better ability to conduct research.	2,95
The support of SABIC gives better ability to produce interesting papers.	2.95
Publication has improved my knowledge and skills.	4.45
Publication has added value to my career.	4.05
I consider myself lucky to get funding for my research.	3.5
Average	3.27

Table 11: Faculty members' perception of the enablers and barriers to research

Factors directly related to FMs' research productivity	Max % of improvement
Grant amount	60
Teaching overload	25
Course number	35
Career concern	40
Reputation, self-esteem	25

While many other data collection methods could have been used, it is important to understand the rationale for using a questionnaire. With limited resources and a shortage of institutional data on the SCF, we develop an appropriate approach to draw a real picture of the SCF application.

5.5. Business impact

Because the SCF was implemented to increase the research production rate, the primary business measure was publication rate. The SCF would have influenced a variety business measures, including the following:

1. Enable FMs to conduct studies
2. Increase the visibility of the chair
3. Increase research expenditures
4. Improve the research funding efficiency

Although business data were monitored in several ways, the annual reports and the follow-up questionnaire obtained an input on the perceived link with impact measures. Some categories of data provided an opportunity for FMs to determine the extent to which the SCF influences several impact measures, such as the following:

- Improvements/accomplishments due to the funding
- Management support for the SCF
- Recommendations for improvement

In order to validate these data, a questionnaire was intended for different executive academics (chair professor and board members, FMs receiving funding compared with FMs without funding). The results showed that the performance of FMs with chair funding was better that those who did not get funding from the chair (2.66 papers more). Incentives could play a better role in improving research productivity if they are related to FMs' remuneration.

5.6. Benefit-cost ratio and return on investment

Benefit-cost ratio (BCR) compares the benefits of any program with its costs using a simple ratio in formula form. The ratio is BCR= program benefits (the value of paper)/ program costs (grant+ management fees) as follows:

$$BCR = (number\ of\ paper\ \times\ paper\ value)\ /\ number\ of\ paper\ \times\ grant\ amount$$

Paper value was determined according to the estimate method from the chair board members of different chairs (SABIC, Macroeconomic Forecasting Chair, UNESCO, Islamic Banking Studies Chair: 32 members) with confidence value. We choose the pessimistic value, which is 55,000 Saudi riyals for each paper as follows

$$55000 \times 60 = 3.300.000/1591.000 + (1215000 \times 66.4\%) = 1.37$$

For every riyal ($ 0.266) invested in research, one riyal and more benefits were returned. Unfortunately, no standards exist that constitute an acceptable BCR from the stakeholders' perspective:

$$ROI\ (\%) = net\ program\ benefits/\ program\ costs \times 100.$$

Net benefits are program benefits minus costs. The ROI value is related to the BCR by a factor of 1. Subtract 1 from the BCR and multiply by 100 to get the ROI percentage:

$$ROI = (3300.000 – 1591.000 + (814000)\ /\ 2671.000 = 37.2\%.$$

A BCR of 1.37 is the same as an ROI value of 37.2%. For each SAR invested, SABIC received 0.372 SAR (US$1= 3.75 SAR) in return after the costs of the consulting program had been recovered. The ROI calculation is easily understood by key management, which is familiar with other investments. Profits can be created by increasing the benefits or saving costs. In practice, more opportunities for saving costs occur than for profits. Creating value can be generated through several mechanisms: improvement in productivity, quality, and time.

5.7. Intangible benefits

The intangible benefits were not included in the monetary analysis but were considered important and were included in the final report. According to FMs, chair professors, and academic board members, several intangibles such as satisfaction degree, self-confidence, self-accomplishment, increasing competencies, teaching content enhancement, autonomy, and social involvement were linked to the SCF. According to the results of a survey (FMs and a control group), FMs engaging in the research process confirmed that the SCF represents an added value for them. FMs who did not benefit from the SCF considered it a missed opportunity.

Visibility is not free, it has value: each affected paper contributes to the visibility of the sponsor, the university, and the college and department contributing to create a positive mental image. The value of FMs' performance, competencies, attractiveness, and mobility compared with nonproductive ones increased and represent an intangible asset.

6. Conclusion

This paper combines two approaches: econometric and managerial. We adopted econometric probabilistic methods when we apprehended FMs' research productivity instead of linear ones. We applied The ROI methodology to measure the chair funding efficiency.

Our main findings diverge from previous findings regarding to academic research productivity. First, a FM does research without funding, and funding can enhance a FM's research productivity (2.66 published papers more during five years). Second, the FM's CEAS profile appropriate for research holds some characteristics related to rank and publications record before joining IMSIU. Third, the research funding has a positive ROI and intangible benefits.

There are several limitations to this research that should be considered. We investigate only one research chair. Indeed, this research is limited on publication in disciplines such as economics, finance, management, and accounting, which do not have the highest proportion of faculty publishing. The sample is limited to CEAS FMs and not necessarily those benefiting from the SABIC funding (60 papers in 5 years) against other chairs or research deanships or those without funding. Second, some question remained without answer: why FMs in finance are more productive than other in CEAS? Thirdly, we will explore deeply the relationship between FMs' research productivity and human capital variables particularly tenure, teaching load and discipline.

As to further research in this area a continued focus on university chairs and different disciplines and departments (natural, applied, social sciences and humanities, etc.) to draw FMs' profile and explain the link between FMs' research productivity and chair funding in Saudi institutions of higher education. Despite the above-mentioned limitations, our research has important implications for research funding especially concerning improving FMs' research productivity and chair efficiency. This target involves several things. First, the focus must be on the chair's core business, which means publication. Second, grant amount adjustment with respect to quality should be measured through more than the impact factor (Hitt and Greer, 2012). Third, higher education institutions need to rethink about FM salary and compensation and teaching load structures. Fourth, the chair's research priorities need to be aligned with the macro and social issues. The efficiency of the chair funding can be also improved by indexing and linking the grant to different parameters.

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Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

References

Abu-Orabi ST (2012a). Scientific research and higher education in the Arab world: Reality and outlook. Scientific Research Society, Secretary General of the Association of Arab Universities, Amman, Jordan.

Abu-Orabi ST (2012b). Scientific research and higher education in the Islamic world. In the Conference on the Future of Ranking? Cooperation or/and Competition, University of Bucharest, Romania.

Alshayea A (2013). Scientific research in the Kingdom of Saudi Arabia: Potential for excellence and indicators of underdevelopment. Higher Education Studies, 3(5): 47-51. https://doi.org/10.5539/hes.v3n5p47

Aubyn MS, Garcia F, and Pais J (2009). Study on the efficiency and effectiveness of public spending on tertiary education. No. 390, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission, ISEG, Lisboan, Portugal.
PMCid:PMC2778747

Bawden J, Manouchehri N, Villa-Roel C, Grafstein E, and Rowe BH (2010). Important returns on investment: An evaluation of a national research grants competition in emergency medicine. Canadian Journal of Emergency Medicine, 12(1): 33-38. https://doi.org/10.1017/S1481803500011994
PMid:20078916

Bland CJ, Center BA, Finstad DA, Risbey KR, and Staples JG (2005). A theoretical, practical, predictive model of faculty and department research productivity. Academic Medicine, 80(3): 225-237. https://doi.org/10.1097/00001888-200503000-00006
PMid:15734804

Bland CJ, Seaquist E, Pacala JT, Center B, and Finstad D (2002). One school's strategy to assess and improve the vitality of its faculty. Academic Medicine, 77(5): 368-376. https://doi.org/10.1097/00001888-200205000-00004
PMid:12010690

Buxton M and Hanney S (1996). How can payback from health services research be assessed?. Journal of Health Services Research and Policy, 1(1): 35-43. https://doi.org/10.1177/135581969600100107
PMid:10180843

Carayol N and Matt M (2004). Does research organization influence academic production?: Laboratory level evidence from a large European university. Research Policy, 33(8): 1081-1102. https://doi.org/10.1016/j.respol.2004.03.004

Choukir J (2014). Preparatory program return on investment: Case of college of economics and administrative sciences. Workings Papers, Al-Imam University, Riyadh, Saudi Arabia.

DFID (2005). Rates of return on research: A literature review and critique. Department for International Development, London, UK.

Dinesh KS and Moinuddin A (2012). Return on investment and effort expenditure in the software development environment. International Journal of Applied Information Systems, 4(7): 35-41. https://doi.org/10.5120/ijais12-450813

Dundar H and Lewis DR (1998). Determinants of research productivity in higher education. Research in Higher Education, 39(6): 607-631. https://doi.org/10.1023/A:1018705823763

Fan S and Hazell P (2000). Should developing countries invest more in less-favoured areas? An empirical analysis of rural India. Economic and Political Weekly, 35(17): 1455-1464.

Fan S, Nyange D, and Rao N (2005). Public investment and poverty reduction in Tanzania. DSGD Discussion Papers No. 18, International Food Policy Research Institute, Washington, D.C., USA.

Gardner BL (1999). Returns to policy-related social science research in agriculture. International Food Policy Research Institute, Washington, D.C., USA.

Gomez-Mejia LR and Balkin DB (1992). Determinants of faculty pay: An agency theory perspective. Academy of Management Journal, 35(5): 921-955.

Hausman JA (1993). Contingent valuation: A Critical Assessment. North-Holland, Amsterdam, Netherlands. https://doi.org/10.1108/S0573-8555(1993)220

Hesli VL and Lee JM (2011). Faculty research productivity: Why do some of our colleagues publish more than others?. PS: Political Science and Politics, 44(2): 393-408. https://doi.org/10.1017/S1049096511000242

Hitt MA and Greer CR (2012). The value of research and its evaluation in business schools: Killing the goose that laid the golden egg?. Journal of Management Inquiry, 21(2): 236-240. https://doi.org/10.1177/1056492611428721

Jaffe AB (1989). Real effects of academic research. The American Economic Review, 79(5): 957-970.

Jonker L and Hicks M (2014). Teaching loads and research outputs of Ontario university faculty members: Implications for productivity and differentiation. Higher Education Quality Council of Ontario, Toronto, Canada.

Laffont JJ and Martimort D (2009). The theory of incentives: The principal-agent model. Princeton University Press, Princeton, New Jersey, USA. https://doi.org/10.2307/j.ctv7h0rwr

Locke EA and Dunnette MD (1976). Handbook of industrial and organizational psychology. In: Locke EA (Ed.), The nature and causes of job satisfaction: 1297-1349. Rand McNally, Chicago, USA.

Lotka AJ (1926). The frequency distribution of scientific productivity. Journal of the Washington Academy of Sciences, 16(12): 317-323.

Mansfield E (1991). Academic research and industrial innovation. Research Policy, 20(1): 1-12. https://doi.org/10.1016/0048-7333(91)90080-A

OCUA (1994). The structure of academic work. Task Force on Resource Allocation, Ontario Council on University Affairs, Toronto, Canada.

Phillips JJ and Phillips PP (2010). Proving the value of HR: ROI cases study. 2nd Edition, ROI Institute, Birmingham, UK.

Phillips JJ and Phillips PP (2012). Measuring ROI in learning and development: Case studies from global organizations. American Society for Training and Development, Alexandria, Virginia, USA.

SABIC (2015). Chair reports 2010-2014. Saudi Arabian Basic Industries Corporation Petrochemical Manufacturing Company, Riyadh, Saudi Arabia.

Schimmelpfennig DE and Norton GW (2003). What is the value of agricultural economics research?. American Journal of Agricultural Economics, 85(1): 81-94. https://doi.org/10.1111/1467-8276.00104

Tenopir C (2010). Measuring the value of the academic library: Return on investment and other value measures. The Serials Librarian, 58(1-4): 39-48. https://doi.org/10.1080/03615261003623005

Teodorescu D (2000). Correlates of faculty publication productivity: A cross-national analysis. Higher Education,

39(2): 201-222.   https://doi.org/10.1023/A:1003901018634