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Supporting Online Material for

Changing Incentives to Publish

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Corrected 9 August 2011: The Excel table link and the description of the Excel table in SOM Text have been added.

Supporting Online Material

Materials and Methods

1. Data

We received article-level data from *Science* for the period 1995–2009. Before 2000, submission data were recorded by country of corresponding author. Country of first author is missing in approximately 25% of the cases (*S1*). From 2000 on, country of first author is recorded. Because of missing data for country of first author prior to 2000 and because country of corresponding author may be biased towards U.S. authors before paper submissions were replaced by electronic submissions in 2000, we restricted our analysis to the period 2000–2009. The data set includes the date the article was submitted and an indication as to whether the article was eventually published in *Science* (*S1*).

1.1 Dependent variables

We used the data from *Science* to compute the annual number of submissions by country, annual number of publications by country and annual acceptance rate by country, calculated as the share of submitted articles that were accepted each year for publication.

During the time period studied, the number of articles published remained fairly stable, at around 800 per year. In total, 110,870 research articles were submitted by first authors from 144 different countries during the ten-year period; 8,138 of these submissions were accepted (7.3%), with first authors from 53 different countries. Unlike the number of articles published, submissions showed a sharp increase during the ten-year period, growing from 7,895 in 2000 to 12,564 in 2010. As a consequence, the acceptance rate steadily declined, going from 9.5% in 2000 to 5.4% in 2010.

We restrict our analysis to 27 Organization for Economic Cooperation and Development (OECD) countries and 3 OECD-monitored countries that overall make up 99% of the accepted items and 95% of submitted items. The 30 are: Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Singapore, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and USA.

In Figure S1, we show the trend in submissions (left) and in publications (right) by country or geographical areas for the 30 countries. The figure shows quite clearly an actual decrease in the relative position for the U.S. This trend is in sharp contrast with that of other countries, such as China and Australia and New Zealand which increased their submissions markedly and for which publications did not decline. Trends for Canada are also illustrated for comparison. European countries exhibit a moderate increase in both submissions and publications. Submissions from Japanese-first-authors remained relatively flat after 2003.

1.2 Explanatory variables

We screened university funding and reward policies for the 30 countries. We found 11 of the 30 countries to have introduced reforms and policies potentially affecting the incentives to publish in international journals during the ten years 2000 through 2009. For purposes of the present analysis, incentive polices must meet three criteria: (i) be government initiated; (ii) have a main or exclusive objective of stimulating the scientific productivity of academic scientists; (iii) be perceived as permanent. We exclude the establishment of prizes, the main aim of which is the awarding of recognition to the research achievements of a limited number of individuals, and the introduction of competitive research grants, the main aim of which is the distribution of money to "best ideas." The 11 countries where such policies were introduced during the period 2000 to 2009 are: Australia, Belgium, China, Denmark, Germany, Italy, Korea, New Zealand, Norway, Spain and Turkey. Other countries, like the UK, implemented similar policies but prior to 2000. Their implementation is outside our period of analysis.

A short description of these policies is in Table S1.

Country policies differ in a number of characteristics. To reflect these differences, we built a taxonomy, based on key features of incentive policies. As a first step we distinguished between policies that place incentives at the level of the institutions where scientists work (universities and research centers) and policies that target the individual scientists directly. Policies that target institutions have often been inspired by the UK Research Assessment Exercise and include the Australian Research Quality Framework, the Special Research Fund in Belgium, the New Zealand Performance-Based Research Fund, and similar schemas introduced in Denmark, Italy and Norway. These policies typically set in place large periodic programs to assess and score national institutions based on their performance. The ranking is then used as a criterion to share a national budget for research institutions. Universities that rank in better positions earn a larger share of the budget. Ranking formulas have various components and scoring methodologies vary from one country to another, but all rely to a considerable extent on the quantity and quality of scientific publications which appear in international journals. The rationale behind these policies is that, pressured by competition for funding, universities respond by asking for more productivity from their scientists and/or by actively seeking to hire highly productive scientists away from other institutions. The reaction of scientists to institutional incentives depends upon the degree to which institutions can provide individual incentives and the degree to which institutions can attract highly productive scholars, offering competitive salaries.

At the other extreme are policies that target individual scientists directly, bypassing their institutions. We further distinguish two main classes of such individual incentive policies. The first class comprises incentive schemes that pay a one-time cash bonus for each article that a scholar publishes in certain specific classes of international journals. Journals worthy of bonuses are typically those listed by the Institute of Scientific Information (ISI). Sometimes the bonus relates to the Impact Factor of the journal. Such a policy, for example, has been introduced in China, Korea and Turkey. The second class of policies links productivity to salary or career progression. Reforms introduced by Germany, which allow universities to link salaries to research performance, and by Spain, where a national agency (ANECA) decides tenure and promotion, belong to this class. The monetary value of these incentives varies across countries. In Turkey, the value of the incentive for publishing in an ISI-ranked journal is equal to approximately 7.5% of salary; in Korea, the cash bonus awarded by the Ministry of Science and Technology equals 5% or more of salary; when bonuses awarded by the university are included, the value can easily exceed 20%. In China, the bonuses depend upon the institute but can be as high as 50% or more of salary.

We first examined the relationship between the introduction of any kind of incentive and submission and publication patterns. Second, we differentiated between incentives targeted at institutions and incentives targeted directly to individuals. Third, within the latter category we contrasted policies that provide cash bonuses to individuals in recognition of publication performance, and policies that link promotion and salary to publication performance.

In Figure S2, we show the trend in the submissions (left) and in the publications (right) of the 30 countries. We differentiated countries by type of incentive policy and contrast them with countries that did not change policies during the period. The figure shows that all classes experience a boost in submissions during the period. But countries that introduced either kind of incentive policy experienced a steeper trend of submissions than countries that did not introduce new incentive policies. The greatest increase came among those introducing cash bonuses. Trends of publications were more volatile, due to smaller numbers.

We took the introduction of incentive policies as an exogenous event and built country-year step variables to examine the relationship between the event and country counts of submissions and publications, as well as between the event and country acceptance rates.

1.3 Control variables

In order to account for variations in research inputs, we included in the analysis country-level data to measure the annual stock of R&D expenditures. These data were obtained from the 2010 release of OECD Main Science and Technology Indicators (*S2*). In particular, we used the "higher education research and development expenditures" expressed in constant 2000 prices and discounted for purchasing parity power (*S3*). From this we constructed a stock measure following a standard perpetual inventory methodology for each country included in our sample. We calculated the yearly stock of Higher Education (HE) spending as the sum of the previous year depreciated stock, plus current HE spending:

$$HEspending\_stock_t = (1 - \delta)\ HEspending\_stock_{t-1} + HEspending_t$$

where δ is the yearly R&D depreciation rate, assumed, conventionally as 10%. The initial value for the R&D stock has been computed according to the methodology proposed by Griliches (*S4*) that is based, for each country, on the average growth rate of HE spending (g) over the available years and the initial observation of HE spending (year 1999 in our case).

$$HEspending\_stock_0 = HEspending_0 / (g + \delta)$$

We are aware that this approach has potential limitations. For example, we are using a macro variable, the country-level R&D expenditure in HE, to explain variations in the number of papers submitted to a single scientific journal. Nevertheless, the level of HE spending represents a reliable proxy to capture differentials among countries' endowments of tangible and intangible research infrastructures. Alternative measures are used in the robustness check, as illustrated in section 3.

We included in our models country fixed effects and yearly time dummies to capture aggregated dynamics in submissions, which are unrelated to the country-specific incentive policies.
We provide definitions and summary statistics for all variables in Table S2.

2. Econometric models and results

We initially conducted a simple *t* test of the null hypothesis that the growth rates of submissions and published papers between the subsample of countries that introduced some type of incentive policy (11 countries) and the subsample that did not (19 countries) are equal. We found neither measure to be equal in means, and the difference between the two to be significant at the 5% level for both submissions and publications. See Table S3 and Table S4.

In order to investigate the effects exerted by different policies on the number of submitted articles by each country, we estimated a panel model. Since our dependent variables are integer positive, all specifications have been estimated using a fixed-effect Poisson panel model. In specification I, we regressed the number of submissions in a given year against the one-year-lagged *HEspending_stock*. We included country fixed effects.

In specification II, we introduced a dummy variable that takes a value equal to one in the year when a policy-event of either type occurred and in all subsequent years. Year dummies were added in specification III (Table S5). The estimates show a positive and significant impact of the introduction of an incentive policy on the submissions, even after accounting for year effects and research inputs. The estimated coefficient for the incentive covariate in model III amounts to an incidence rate ratio of 1.2189 (*S5*). Hence the introduction of the policy generates on average, all else equal, a 22% increase in the number of submissions.

Table S6 presents the results when the model is re-estimated to differentiate among incentive policies. All three types of incentives are positively and significantly related to submissions. In this specification, the estimated coefficient for the cash incentive variable is significantly larger than either the institutional incentive coefficient or the career incentive coefficient.

We also analyzed the impact of the incentive policies on the number of published papers (Table S7). Again we used a fixed-effect Poisson panel model. The incentive variable remains positive, but when we differentiated among policies (specification II in Table S8,) we found that the incentive effect is limited to policies that link publication performance to career advancement, such as those introduced in Germany and Spain during the time frame.

In the final set of model specifications, we investigated whether the introduction of incentive policies had an effect on acceptance rates. For this purpose, we computed a new dependent variable defined for each country-year observation as the log of the ratio of the number of publications to the number of submitted articles (*S6*). The equations were estimated by using ordinary least squares (OLS). Results are reported in

Table S9. In models I and II, we found a negative, but not significant, coefficient for the incentive covariates, which suggested that on average incentive policies affect submissions and to a lesser extent publications, but not acceptance rates. When incentive policies are disaggregated (model III in

Table S9), we found acceptance rates to be negatively and significantly related to cash bonuses.

3. Robustness checks

In order to check the robustness of our estimates, we ran additional sets of model specifications. In these new sets of models, (i) we controlled for the potential impact on submissions, publications, and acceptance rates of the country-specific patterns of international scientific collaborations and of the country composition of the editorial board of *Science* and (ii) we substituted the *HEspending_stock* with the total number of scientific publications as a proxy for the country-specific level of development of the scientific system. Below we report the description of the procedure for the collection of the additional required data and comment on the results. We measured the total publication output as the log of total number of publications in the SCOPUS database, lagged one year, with at least one author located in country *i* in year *t* (*S7*).

In our dataset of submissions to and publications in *Science*, counts of submissions and publications are attributed to countries according to the first author affiliation. In order to control for the potential effect of changes in the degree to which authors from one country collaborate internationally, we included in the robustness-check estimate a variable (COLLABORATION) that represents the percent of each country's whole publication count that has one or more international co-authors. The data on international co-authorships are based on the SCOPUS database and were collected through the SCImago Journal & Country Rank database, which annually computes country indicators (*S7*).

We considered the possibility that the number of submissions and publications by country might reflect the composition of the editorial board of the journal *Science*. It might be the case, for example, that the presence within the editorial board of a scientist from a specific country encourages a larger number of submissions and/or publications by that country. In order to perform this analysis, we controlled for the country's share in the editorial board of *Science* (variable EDITORIAL BOARD). We collected data on the country affiliation of the editors of *Science* during the period 2000–2009. Data on the editorial board memberships of *Science* have been obtained from the paper edition of the journal, by using the first issue of the second and fourth volume of *Science* in each year. Editorial board members in charge of book reviews were omitted. The average annual number of editors during the relevant years is 123, with a significant increase from 84 in year 2000 to 160 in 2009. The share of U.S. affiliated editors declined from 70% in 2000 to 61% in 2009. A group of countries, including Australia, Austria, Belgium, China and Denmark, which did not have representation on the editorial board in 2000, gained representation by 2009.

The first set of robustness check estimates are shown in Table S10, Table S11 and Table S12. Here we added additional controls related to the extent of international collaborations and to each country's share in the editorial board of *Science*. We observed no significant alteration in the results discussed above. It is interesting to note that the editorial board composition is significantly related to the submission patterns, but it shows a weak significance in the publications model (Table S11) and it is not significantly related to acceptance rates (Table S12). Note that we are aware that the number of publications in one international journal by different countries and the international composition of the editorial board can exhibit endogeneity. We are not suggesting any causal effect between a country share in the editorial board and the submission and publication activity. In this respect, our measure of the composition of the *Science* editorial board is solely intended as an additional control to check the robustness of the estimated impact of incentive policies on submissions and publication patterns. Note that when we restricted the analysis to publications rather than submissions (Table S11), the intensity of international collaboration had a positive and significant effect. The new estimates for acceptance rates confirmed previous results (Table S12), with the exception that the cash bonus variable, while maintaining the negative sign, lost significance at traditional levels.

In the second set of robustness-check estimates, we replaced the *HEspending_stock* with the total number of scientific publications as a proxy for the country-specific level of development of the national scientific system. Results are reported in Table S13 and suggest that the estimated impacts of incentive policies on submissions also hold after accounting for the yearly overall country production of scientific publications apart from the fact that in model III of Table S13 the career incentive variable is no longer significantly related to the number of submissions.

SOM Text

Alternative explanations

Our results are consistent with the hypothesis that increased competition has contributed to the relative decline in U.S. publications. There are alternative explanations regarding the decline in U.S. productivity that focus on changes primarily within the United States Mervis (*S8*), for example, suggests that the decline may be explained by the overall ageing of the U.S. science and engineering workforce, which may have become less productive as it nears retirement. The administrative burden argument attributes the decline to the fact that administrative responsibilities, especially with regard to grants, require sufficient time to detract from scientific research. A recent survey found that U.S. scientists spend 42% of their time filling out forms and going to meetings (*S9*). Another explanation relates to the alleged crisis of peer-review (*S10*). For instance, it is suggested that authors who have already established their name and position in top-rated institutions may obtain equally good citations by publishing in lower-ranked journals that are less demanding in terms of time and refinement of work. At the same time, new dissemination channels available to authors (such as Internet-based open-access publications) ensure a direct exchange between the author and the readers and may lower the perceived need to publish in traditional peer-reviewed journals (*S10*). Finally, the National Science Foundation offers a fourth alternative explanation: the steep learning curve associated with collaborative research, which has become an increasingly popular mode of operation (*S8*, *S11*, *S12*). Although these alternative explanations have merit, it is difficult to determine the degree to which they are specific to the United States vs. other countries. For example, increased administrative burden has likely been experienced by scientists working in other countries, and the learning curve regarding collaboration is unlikely to apply only to scientists in the United States.

Limitations and future work

Our work has limitations. First, we focused on one journal; second, we examined a limited ten-year period for a set of 30 countries; and third, we cannot test for causality. Fourth, the incentive schemes may have been accompanied by other changes that we have not controlled for. Finally, lack of data at the individual level precludes examining how individuals respond to incentives.

Our research suggests a number of possible avenues for future research. For example, it would be informative to repeat the analysis for other journals having various impact factors and to compare the degree to which the correlation between incentives and submissions, publications and acceptance rates depends upon the quality of the journal. Second, it would be beneficial to obtain data for a longer period of time. Third, the acquisition and analysis of data at the individual level would be useful. Such data could, for example, provide insight into whether incentives encourage "serial submitters," that is whether the same scientists repeatedly submit articles to highly ranked journals or whether incentives encourage more people to submit articles to top journals. Such data could also be used to analyze the degree to which incentives attract or retain highly productive researchers in a country (*23*).

Data sources and methodology for the econometric analysis

In the set of Excel tables, we report the data we used in the analyses.

The data on submissions and publications have been provided by *Science*. Note that publications are assigned to a specific year on the basis of the date of the initial submission to the journal.

The data on total number of publication by country have been collected through the Web site http://www.scimagojr.com/, which provides data based on the SCOPUS database. Slight variations in the data reported can be due to updates in the database.

The data on HERD have been taken from the OECD report "Main Science and Technology Indicators (2010).

All models have been estimated with the econometric software STATA 11.0. For the model based on count-data we have used the xtpoisson Stata routine with the fixed effect option. The models based on acceptance rates have been estimated with the xtreg Stata routine and the fixed effect option.

The step variables relating to the incentive policies have been generated according to the data reported in Table 1 of the SOM.

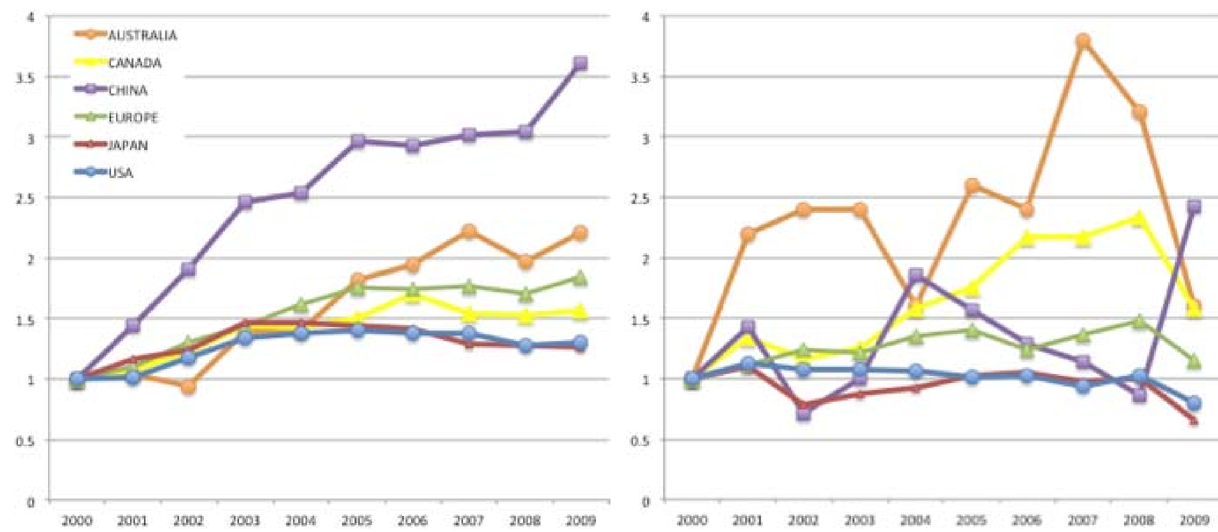

Fig. S1. (**Left**) Trend in number of submitted papers to *Science*, 30 countries by country or geographical areas (base year 2000 = 1). (**Right**) Trend in number of published papers in *Science,* 30 countries by country or geographical areas (base year 2000 = 1).

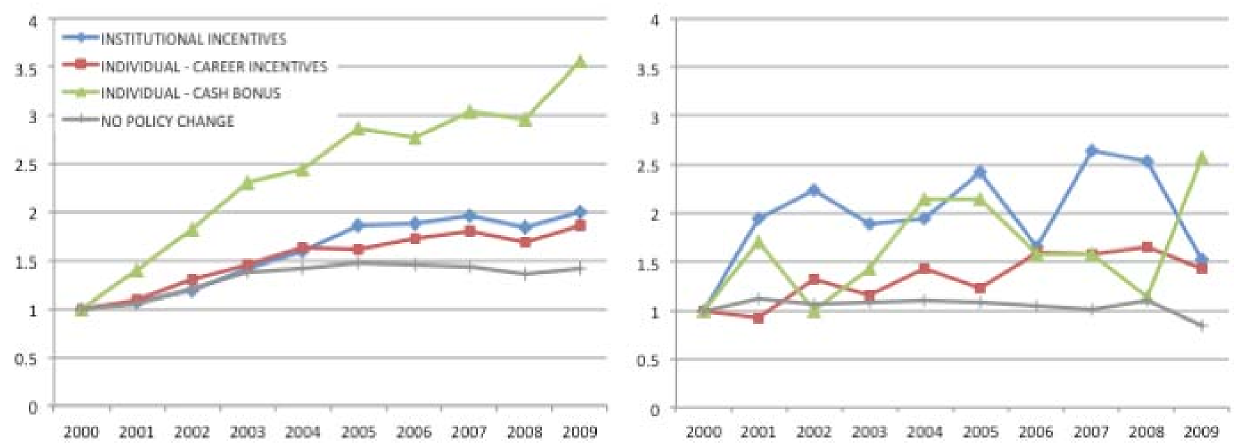

Fig. S2. (**Left**) Trend in number of submitted papers to *Science*, 30 countries by policy class (base year 2000 = 1). (**Right**) Trend in number of published papers in *Science,* 30 countries by policy class (base year 2000 = 1).

Table S1
Description of policy reforms

Country	Date	Policy	Impact	Description	References
Policies introduced during 2000–2009 that link publications performance to institutional funding					
Australia	2006	Research Quality Framework (RQF)	Decides the allocation of government institutional funding	The RQF program links both quantity and impact of publications to university funding. In 2008 the Excellence in Research for Australia (ERA) initiative was launched. It assesses research quality within Australia's higher education institutions using a combination of bibliometric indicators and expert review.	(*S13*, *S14*)
Belgium[1]	2006	Special Research Funds (BOF) allocation	Decides the allocation of government institutional funding	Bibliometric measures become a component of the formula that decides the allocation of BOF, which accounts for 30% of total budget to universities.	(*S15*)
Denmark	2008	Globalization Strategy	Decides the allocation of government institutional funding	Bibliometric indicators are included in the formula that decides the allocation of funds to institutions. By 2012, the component will account for 25% of the formula. The other components are the amount of competitive funding raised (20%), the number of PhD graduated (10%) and the number of students in bachelor and master degree courses (45%).	
Italy	2009	University Programming and Evaluation	Decides the allocation of government institutional funding	Based on the assessments of university publications introduced since 2003 and various other components, 10% of the total budget has been split based on the university ranking.	
New Zealand	2002	Performance Based Research Fund	Decides the allocation of government institutional funding	Institutional performance assessment is used to allocate government funding. A large component of the formula depends on quantity and quality of publications.	(*S16*)
Norway	2006	New funding model for Higher Education	Decides the allocation of government institutional funding	Publications become a component of the formula that decides the allocation of 15% of total budget to universities.	(*S17*)
Policies introduced during 2000–2009 that link publications performance to cash bonuses to individuals					
China	2001	Knowledge Innovation Project	Assigns cash bonuses to researchers that publish in elite journals	The Institutes of the Chinese Academy of Sciences began implementing the 10-year government plan by introducing cash bonuses for publications in ISI journals. Bonuses vary by institutions and assign a higher prize either to *Science* and *Nature* publications or to journals having an Impact Factor above a certain threshold.	(*S18*, *S19*)

[1]This reform relates to Flanders.

Country	Date	Policy	Impact	Description	References
Korea	2006	Initiative to foster university excellence	Assigns cash bonuses to researchers that publish in elite journals	A three million won (US$3,000) bonus is assigned by the Ministry of Science and Technology to the first and the corresponding author on papers in key journals, such as *Science*, *Nature*, and *Cell*.	(*S19*)
Turkey	2008	Turkish Institute for Scientific Research (TUBIKAK)	Assigns cash bonuses to researchers that publish in elite journals	Based on a 6-scale ranking of all ISI journals, TUBIKAK pays about $800 for an article in hard sciences (or $1600 for a social science article) placed in a top-ranked journal, and about $130 ($260 for a social sciences article) placed in a bottom-ranked journal. This registry has existed since 2004.	(*S20*)
Policies introduced during 2000–2009 that link publications performance to promotion and salary					
Germany	2004	Professor salary reform law	Affects personnel promotion	The law passed in 2002 and was implemented in 2004. It enables institutions to more freely negotiate professors' salaries and to link salary to performance	(*S21*)
Spain	2001	Agencia National de evaluacion de la Calidad (ANECA)	Affects personnel promotion	ANECA began to evaluate tenures and academic promotions. Publications account for a large share of the evaluation and can affect salary.	(*S22*)

Table S2
Description of variables and summary statistics

Variable	Description	Mean	St. dev	Min	Max
$SUBM_{it}$	Number of articles submitted to *Science* by country *i* in year *t*	352.466	859.177	1	5485
$PUBL_{it}$	Number of articles published in *Science* by country *i* in year *t*	26.746	89.052	0	550
$LOG\_ACC\_RATE_{it}$	$\text{Log}[(PUBL_{it} + 1)/SUBM_{it}]$	−2.745	0.684	−4.689	0
$HEspending\_stock_{it}$	Log of the stock of HERD expenditures of country *i* in year *t*	9.275	1.440	5.275	12.665
$COLLABORATION_{it}$	Percent of whole counted publications by country *i* in year *t* with one or more international coauthor	0.392	0.121	0.117	0.739
$TOTPUBL_{it}$	Log of the total number of scientific articles published by country *i* in year *t*.	9.930	1.256	5.793	12.836
$EDITORIAL\_BOARD_{it}$	Average share of *Science*'s editors affiliated to an institution in country *i* in year *t*	0.033	0.112	0	0.702
$INCENTIVE_{it}$	Step variable which equals one in year any type of incentive policy was introduced and in all subsequent years	0.176	0.382	0	1
$INST\_INCENTIVE_{it}$	Step variable which equals one in year of introduction of a policy linking publication performance to institutional funding and in all subsequent years	0.076	0.266	0	1
$INDIV\_INCENTIVE_{it}$	Step variable which equals one in year of introduction of incentive policies that operate at the individual level (either cash bonuses or promotion and salary) and in all subsequent years	0.100	0.300	0	1
$CASH\_INCENTIVE_{it}$	Step variable which equals one in year of introduction of a policy linking publication performance to individual cash bonuses and in all subsequent years	0.043	0.203	0	1
$CAREER\_INCENTIVE_{it}$	Step variable which equals one in year of introduction of a policy that links publication performance to promotion and salary and in all subsequent years	0.050	0.218	0	1

Table S3
***t* test for equality of means: Logarithmic growth rate of number of submitted papers to *Science* between year 2000 and year 2009.**

	Number of Countries	Mean	Std Err	95% confidence intervals	
1) No incentive policy	19	0.481	0.084	0.304	0.659
2) Incentive policy	11	0.885	0.103	0.656	1.115
3) Combined	30	0.629	0.074	0.478	0.780
Diff. in means [1] – [2]		–0.404	0.133	–0.680	–0.128

Table S4
***t* test for equality of means: Logarithmic growth rate of the number of published papers in *Science* between year 2000 and year 2009.**

	Number of Countries	Mean	Std Err	95% confidence intervals	
1) No incentive policy	19	0.077	0.106	–0.146	0.300
2) Incentive policy	11	0.467	0.099	0.247	0.687
3) Combined	30	0.220	0.083	0.050	0.390
Diff. in means [1] – [2]		–0.390	0.145	–0.687	–0.092

Table S5
Testing the effects of incentive policies on submissions

Poisson fixed-effects. Dependent variable: number of submissions to *Science* by country *i* in year *t*. Baseline model with stepwise procedure.

VARIABLES	(I)	(II)	(III) Specification A model 1 in article
HE spending stock$_{t-1}$	0.581***	0.517***	0.259***
	(0.015)	(0.016)	(0.022)
INCENTIVE$_t$		0.258***	0.198***
		(0.018)	(0.018)
Year Dummies	No	No	Yes
Observations	300	300	300
Number of id	30	30	30
Wald chi^2	1462***	1659***	2500***
LogLikelihood	−1715	−1609	−1145

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S6
Testing the effects of different incentive policies on submissions.
Poisson Fixed-effects. Dependent variable: number of submissions to *Science* by country *i* in year *t*.

VARIABLES	(I)	(II) Specification B model 1 in article
HE spending stock$_{t-1}$	0.259***	0.220***
	(0.022)	(0.023)
INST_INCENTIVE$_t$	0.215***	0.217***
	(0.029)	(0.029)
INDIV_INCENTIVE$_t$	0.188***	
	(0.023)	
CASH_INCENTIVE$_t$		0.379***
		(0.042)
CAREER_INCENTIVE$_t$		0.111***
		(0.026)
Year Dummies	Yes	Yes
Observations	300	300
Number of id	30	30
Wald Chi2	2502***	2514***
LogLikelihood	–1144	–1129

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S7
Testing the effects of incentive policies on publications.

Poisson Fixed-effects. Dependent variable: number of publications in *Science* by country *i* in year *t*.

VARIABLES	Specification A model 2 in article
HE spending stock$_{t-1}$	0.148
	(0.123)
INCENTIVES$_t$	0.240***
	(0.076)
Year Dummies	Yes
Observations	300
Number of id	30
Wald Chi2	47.61***
LogLikelihood	–517.3

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S8
Testing the effects of different incentive policies on publications.

Poisson Fixed-effects. Dependent variable: number of publications in *Science* by country *i* in year *t*.

VARIABLES	(I)	(II) Specification B model 2 in article
HE spending stock$_{t-1}$	0.154	0.190
	(0.124)	(0.130)
INST_INCENTIVE$_t$	0.193	0.190
	(0.129)	(0.130)
INDIV_INCENTIVES$_t$	0.264***	
	(0.093)	
CASH_INCENTIVE$_t$		–0.02
		(0.303)
CAREER_INCENTIVE$_t$		0.296***
		(0.099)
Year Dummies	Yes	Yes
Observations	300	300
Number of id	30	30
Wald chi^2	47.75***	48.80***
LogLikelihood	–517.23	–516.74

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S9
Testing the effects of incentive policies on acceptance rates.

OLS Fixed-effects. Dependent variable: log[(published papers+1)/submitted papers] by country *i* in year *t*.

VARIABLES	(I) Specification A model 3 in article	(II)	(III) Specification B model 3 in article
HE spending stock$_{t-1}$	0.116	0.121	0.147
	(0.097)	(0.098)	(0.099)
INCENTIVES$_t$	–0.122		
	(0.098)		
INST_INCENTIVE$_t$		–0.074	–0.076
		(0.123)	(0.124)
INDIV_INCENTIVE$_t$		–0.187	
		(0.142)	
CAREER_INCENTIVE$_t$			0.102
			(0.217)
CASH_INCENTIVE$_t$			–0.389**
			(0.182)
Year Dummies	Yes	Yes	Yes
Constant	–4.035***	–4.091***	–4.336***
	(0.938)	(0.944)	(0.950)
Observations	300	300	300
Number of id	30	30	30
Rsq	0.184	0.186	0.195
F test	5.33***	4.91***	4.81***

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

ESTIMATES FOR ROBUSTNESS CONTROLS

Table S10
Robustness controls. Testing the robustness of results to the inclusion among regressors of the level of international collaboration and the country composition of the editorial board of *Science*.

Poisson fixed-effects. Dependent variable: number of submissions by country *i* in year *t*.

VARIABLES	(I)	(II)	(III)
HE spending stock$_{t-1}$	0.223***	0.223***	0.208***
	(0.026)	(0.026)	(0.026)
INCENTIVE$_t$	0.182***		
	(0.019)		
INST_INCENTIVE$_t$		0.197***	0.194***
		(0.030)	(0.029)
INDIV_INCENTIVE$_t$		0.173***	
		(0.023)	
CASH_INCENTIVE$_t$			0.350***
			(0.043)
CAREER_INCENTIVE$_t$			0.099***
			(0.027)
COLLABORATION$_{t-1}$	–0.296	–0.297	–0.010
	(0.209)	(0.209)	(0.217)
EDITORIAL BOARD$_t$	1.433***	1.431***	1.378***
	(0.187)	(0.187)	(0.187)
Year Dummies	Yes	Yes	Yes
Observations	300	300	300
Number of id	30	30	30
Wald chi^2	2539***	2541***	2548***
LogLikelihood	–1114	–1113	–1102

Standard errors in parentheses: ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S11
Robustness controls. Testing the robustness of results to the inclusion among regressors of the level of international collaboration and the country composition of the editorial board of *Science*.

Poisson fixed-effects. Dependent variable: number of publications by country *i* in year *t*.

VARIABLES	(I)	(II)	(III)
HE spending stock$_{t-1}$	0.232*	0.235*	0.248*
	(0.132)	(0.132)	(0.135)
INCENTIVE$_t$	0.173**		
	(0.080)		
INST_INCENTIVE$_t$		0.137	0.137
		(0.130)	(0.131)
INDIV_INCENTIVE$_t$		0.193**	
		(0.097)	
CASH_INCENTIVE$_t$			0.043
			(0.310)
CAREER_INCENTIVE$_t$			0.212**
			(0.105)
COLLABORATION$_{t-1}$	2.370**	2.344**	2.201**
	(1.039)	(1.041)	(1.080)
EDITORIAL BOARD$_t$	1.162*	1.168*	1.192*
	(0.621)	(0.621)	(0.623)
Year Dummies	Yes	Yes	Yes
Observations	300	300	300
Number of id	30	30	30
Wald chi^2	56.98***	57.06***	57.30***
LogLikelihood	–512.5	–512.4	–512.3

Standard errors in parentheses: ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S12

Robustness controls. Testing the robustness of results to the inclusion among regressors of the level of international collaboration and the country composition of the editorial board of *Science*.

OLS Fixed-effects. Dependent variable: log[(published papers+1)/submitted papers] by country *i* in year *t*.

VARIABLES	(I)	(II)	(III)
HE spending stock$_{t-1}$	0.169*	0.169	0.178*
	(0.100)	(0.100)	(0.100)
INCENTIVE$_t$	−0.130		
	(0.098)		
INST_INCENTIVE$_t$		−0.118	−0.113
		(0.126)	(0.126)
INDIV_INCENTIVE$_t$		−0.144	
		(0.143)	
CASH_INCENTIVE$_t$			−0.285
			(0.190)
CAREER_INCENTIVE$_t$			0.042
			(0.219)
COLLABORATION$_{t-1}$	2.394**	2.359**	1.991*
	(1.014)	(1.044)	(1.094)
EDITORIAL BOARD$_t$	−1.042	−1.081	−0.883
	(2.379)	(2.400)	(2.405)
Year Dummies	Yes	Yes	Yes
Constant	−4.720***	−5.584	−5.515***
	(1.001)	(1.150)	(1.151)
Observations	300	300	300
Number of id	30	30	30
Rsq	0.202	0.203	0.206
F test	5.01***	4.63***	4.41***

Standard errors in parentheses: ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

Table S13

Robustness controls. Testing the effects of incentive policies using as a proxy of the national research system the total number of publications.

Poisson fixed-effects. Dependent variable: number of submissions to *Science* by country *i* in year *t*.

VARIABLES	(I)	(II)	(III)
$TOTPUBL_{t-1}$	0.426***	0.534***	0.524***
	(0.023)	(0.032)	(0.032)
$INCENTIVE_t$	0.136***	0.090***	
	(0.019)	(0.020)	
$INST\_INCENTIVE_t$			0.117***
			(0.030)
$INDIV\_INCENTIVE_t$			
$CASH\_INCENTIVE_t$			0.243***
			(0.045)
$CAREER\_INCENTIVE_t$			0.004
			(0.028)
$COLLABORATION_{t-1}$		1.462***	1.752***
		(0.243)	(0.251)
EDITORIAL $BOARD_t$		0.829***	0.781***
		(0.192)	(0.191)
Year Dummies	Yes	Yes	Yes
Observations	300	300	300
Number of id	30	30	30
Wald chi^2	2672***	2721***	2727***
LogLikelihood	−1046	−1015	−1003

Standard errors in parentheses ***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

References and Notes

S1. Data were provided by *Science*, To ensure confidentiality, *Science* did not include article title, author name, author institutions, or other identifying information. *Science* publishes three kinds of original research papers: Reports, Research Articles, and Brevia. Here we use the term "article" to refer to the three. All data used in this study are published as supplementary material to this article.

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