

The effects of regulation on the work effort of researchers: Crowding in or crowding out?

Lotte Bøgh Andersen *
Department of Political Science
University of Aarhus
lotte@ps.au.dk

Christian Bøtcher Jacobsen
The municipality of Aarhus

&

Anne Line Möller
The municipality of Randers

Paper to be presented at the Danish Public Choice Workshop 2008, Aarhus School of Business, University of Aarhus, January 14th, 2008.

Abstract

According to the motivation crowding theory (MCT), external interventions such as regulation and payment reduce public employees' work effort if the employees see the interventions as controlling. If interventions are seen as supportive, MCT expects the work effort to increase. But when it comes to regulation, only few studies have tested the MCT proposition. This article investigates the relationship between work effort and regulation defined as the principal's directives, monitoring and sanctioning of the employees. Using survey and register data from 2000 and 2006 (n=101 individual researchers) and 19 semi-structured interviews, we examine how regulation affects the number of publications at Danish research institutions, when the researchers' perception of the regulation is taken into account. We find that if the researchers see the regulation as supportive, the number of publications grow rapidly. Regulation which the researchers perceive as controlling has no or even negative effect on the number of publications.

Introduction

Practitioners and scholars of public administration have long claimed that public service is a special calling (Perry, 1996: 5). If a special public sector motivation really exists (Rainey 1982; Perry and Wise 1990; Wright 2001), the utility of public employees depends on more than just their money income and work load. More regulation or stronger financial incentives do not necessarily improve the work effort of public employees who get utility from the task itself – if their initial intrinsic motivation is high. Following Le Grand (2003: 53), intrinsic factors “include interest in or enjoyment of the work for its own sake, while extrinsic ones include wages and salaries, promotion, the threat of losing one's job, and direct commands or orders”. Extrinsic motivation certainly exists in the public sector, but intrinsic motivation from the performance of work tasks also frequently occurs (Miller & Whitford, 2006: 229). Although few public employees work just for the enjoyment of the work itself, intrinsic factors can be important for the work effort. Intrinsic motivation is not, however, invariable; it can be crowded out (or in) by extrinsic factors.

The motivation crowding theory (Frey, 1997; Frey & Jegen, 2001) argues that the effects of external interventions on intrinsic motivation depend on the perception of these interventions, especially if the employees have a high initial level of intrinsic motivation. ‘Crowding out’ is when the introduction of an external intervention reduces the intrinsic motivation. If the introduced interventions are seen as supportive, the motivation crowding theory expects

‘crowding in’, that is, increased intrinsic motivation due to the external intervention. Most studies (e.g. Frey & Jegen, 2001; Bertelli, 2006; Andersen & Pallesen, forthcoming) have concentrated on monetary incentives. They indicate that payments perceived as controlling decrease intrinsic motivation and thereby reduce work effort, whereas payments perceived as supportive have the opposite effect. The motivation crowding theory does, however, apply to both payment and regulation. Frey (1997: 29-32) even argues that regulation can potentially crowd out more intrinsic motivation than monetary rewards, especially if the regulation is hard and uniform. But only few studies (Frey, 1991: 1524; Barkema, 1995) have tested the crowding proposition for regulation, and the knowledge about the relationship between regulation and intrinsic motivation of public employees is therefore insufficient (Grepperud and Pedersen, 2001).

If we define regulation as the principal’s use of directives, monitoring and sanctioning to make the employees comply, most public employees are governed more by regulation than by financial incentives (Kerwin, 1999: 7-22; James, 2000; Flynn, 2007; Miller & Whitford, 2007: 214-215). Not knowing how regulation affects the intrinsic motivation and thereby the work effort is therefore an important gap in the literature. This paper aims to begin to fill this gap by an investigation of the impact of regulation at Danish research institutions. We focus on the degree, which research institutions set up rules for the number of publications, monitor these rules and sanction noncompliance. Accordingly, we measure the targeted behavior as the actual number of published publications (before and after the introduction of the regulation). The paper thus asks *how the introduction of regulation at research institutions affects the number of publications, when the perception of the regulation is taken into account.*

Research institutions are very suitable for this test, because an important part of the output (publications) is measurable at the individual level. Knowing that publishing is not the only objective of most public research institutions, it is still at least a central part of it. Correspondingly, high quality of publications is the ultimate goal of most research institutions, but most of them only regulated the quantity – which is then the relevant performance measure in a test of the effect of regulation. Another reason for investigating research institutions is that researchers are expected to have a high initial level of intrinsic motivation (Frey & Osterloh, 2006). It is only possible to crowd out intrinsic motivation, if such a motivation is present initially. Further, we have been able to identify five very similar Danish research institutions, which have recently introduced different degrees of regulation, enabling us to use a longitudinal design. Using data from 2000 and 2006, the analysis includes 101 individual researchers from five research institutions, which introduced

varying degrees of regulation. Additionally, we have conducted 19 semi-structured interviews and done a comprehensive content analysis of existing documents to measure the degree of regulation.

First, we present the motivation crowding theory and discuss the interaction between regulation, the perception of this regulation and work effort. Then we discuss our data (register data, a survey, interviews and existing documents) and the measures used in the analysis. After that, we present our empirical results which consist of a series of regression analyses. The paper ends with a discussion of the contribution of the paper in terms of beginning to close the gap concerning the regulation in the motivation crowding literature.

Theoretical framework

The motivation crowding theory (Frey, 1993; 1994; 1997; Frey & Jegen, 2001) draws perspectives both from the traditional principal agent (PA) theory (Alchian & Demsetz, 1972; Holmström, 1982; Fama & Jensen, 1983; Holmström & Milgrom 1991) and from cognitive and social psychology (Deci, 1971; Deci & Ryan, 1985; Deci, Koestner & Ryan, 1999). The central question in the PA theory is whether the principal can induce the agent to act like the principal intends him to. In the original formulation of PA theory, the focus was on the monetary incentives. The principal was expected to reward the wanted behaviour to minimize shirking and thus reduce the losses imposed on the principal by the inability to align the agent's self-interest with that of the principal (for a review, see Miller, 2005: 204). This perspective was later extended to include regulation (Mitnick 1975, 1980 & 1982; Weingast 1984). Regulation means that the principal sets up directives, which are then continuously monitored and sanctioned. Unwanted behaviour and the lack of wanted behaviour are punished instead of rewarding wanted behaviour, but the logic is the same as for rewards.

The PA theory expects the agents to maximize income and minimize work effort, that is, to be motivated by extrinsic factors alone. Social psychological research (Deci, 1971; Deci, 1972; Deci and Ryan, 1985; Deci, Koestner and Ryan, 1999) does, however, stress the importance of intrinsic motivation. Synthesizing these approaches, the Motivation Crowding Theory (MCT) holds that both extrinsic and intrinsic factors are important for behaviour. Frey (1994: 338) distinguishes between the disciplining effect and the crowding effect. The disciplining effect of an external intervention is the effect of imposing a higher cost on shirking or lowering the cost of performing. The crowding effect is the effect of an external intervention on intrinsic motivation. It is called crowding out, when the external intervention undermines the intrinsic motivation, and

crowding in if the external intervention raises intrinsic motivation. But under what circumstances do external interventions crowd intrinsic motivation in and out?

According to Frey (1994: 337), “[w]hen individuals perceive the external intervention to be controlling in the sense of reducing the extent to which they can determine actions by themselves, they substitute intrinsic for extrinsic control”. In this situation, MCT argues that the introduction of regulation and rewards actually counteracts the targeted behaviour. On the other hand, if the employees see an external intervention as supportive, that is, as an acknowledgement of their work effort and their high intrinsic motivation, crowding in is expected to happen. Frey thus generalizes the possible dual impact of external interventions by distinguishing between situations in which the interventions are perceived as controlling and situations in which the interventions are seen as supportive. Specifically, external interventions are expected to crowd out intrinsic motivation if the individuals affected perceive them as controlling. If the crowding out effect on behaviour is bigger than the disciplining effect, we might even see that the intervention reduces the targeted behaviour. If an intervention on the other hand is seen as supportive, both the crowding in effect and the disciplining effect be in the same direction, and the intervention will ‘over-perform’ in terms of increasing the targeted behaviour.

Whether the crowding effect works in the same direction as the disciplining effect (and increases the agents’ motivation to perform) depends on the perception of the incentive as either controlling or supportive (Frey and Jegen, 2001: 594-595). The perception does, among other things, depend on the type of intervention (Frey 1994: 345). Frey (1997: 11) distinguishes between regulation and money payment. Regulation is the principal’s use of directives, monitoring and sanctioning to impose a higher cost on shirking. The employees’ net cost of performing can be affected both by regulation via the potential costs of noncompliance (the punishment) and by money payments via the potential rewards of compliance (the financial payment). Although regulation and money payments can thus be seen as negative and positive incentives respectively, they might not have the same effect on behaviour due to the different messages implied by rewards and regulation.

According to Frey, the message implied by an external intervention is central: The more strongly an external intervention implies an acknowledgement of the employee’s intrinsic motivation, the more does it foster intrinsic motivation (ibid: 33). It is difficult to make directives, monitoring, and sanctioning, which seem to be an acknowledgement, and Frey (1997: 31-32) therefore expects regulation to crowd out more intrinsic motivation than rewards. He also expects hard regulation (enforceable directives including convincing threats of punishments of non-

compliance) to crowd out more intrinsic motivation than soft regulation (non-enforceable directives implemented by agreement and without threats of punishments). This implies that regulation can be seen as a continuum from no regulation over very soft regulation (with weakly formulated directives and low degrees of monitoring and sanctioning) to hard regulation.

Regulation is only expected to affect behaviour if the sanctions involve cost for the employees. Most prominent among the sanctions in the public sector are the threat of losing one's job and the withdrawal of promotion. The cost of these sanctions is not, however, equally high for all employees. The threat of not being promoted is, of course, only relevant for persons who can still move upwards (in this study for associate and assistance professors compared to full professors). Not being promoted is more costly for young persons, because they have longer time left of their working life to enjoy the benefits of a promotion. It does, however, also depend on the alternative job options. The same applies to the costs of losing one's job. A young person loses more years of employment, if they are fired, but they might more easily find alternative employment. For the investigated researchers, we expect that the costs of losing more years of employment/more years in the career position dominate, which implies that dismissal and lost promotions is less costly at the end of the career (see also Dixit 2002: 703-704; Burgess & Ratto, 2003: 288).

If the same sanctions are less costly for old employees, we expect the same regulation (which is a package of directives, monitoring and sanctions) to matter less for these employees. We therefore expect that the higher age of the researcher, the weaker is the association between the degree of regulation and the work effort (that is, we expect a negative interaction effect between age and regulation).

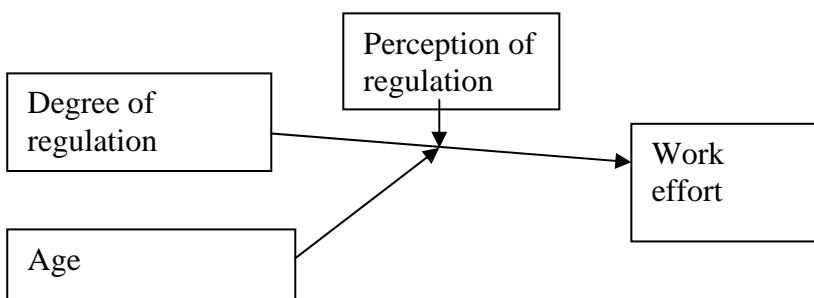
Additionally, both career step and age of researchers can have direct effects on work effort measured as publications. Positions are temporary at the lower career steps in the Danish research sector, and tenure is given for many high quality publications. The threat of losing one's job, unless one works hard, is thus build into the system for all researchers at the low career steps. This implies that researchers at the low career steps publish more than tenured researchers. On the other hand, researchers at the higher career steps have been selected according to their abilities, so we cannot determine if the direct effect of having reached a higher career step is positive or negative. Age can also have different direct effects. Young researchers benefit more from making publications (in terms of getting jobs which they can keep longer than older researchers), whereas older researchers are more experienced in writing publications. In sum, we have no clear

expectations about the direct effects of age and career step, but we have a very clear expectation about the interaction between age and regulation: The association between the degree of regulation and the number of publications is expected to be stronger, the younger the researchers are.

The most important determinant of the effect of regulation on work effort is, however, expected to be the perception of the regulation. Whereas the disciplining effect of regulation (the direct effect of imposing a higher cost on shirking) is always expected to increase the work effort, this is not the case for the crowding effect, which is effect of the extrinsic intervention on work effort via the intrinsic motivation. Regulation might crowd in more intrinsic motivation, or crowd out existing intrinsic motivation. As several studies indicate that intrinsic motivation is strong in the public sector (Rainey 1982; Perry and Wise 1990; Wright 2001; Le Grand 2003), we expect that there is something to crowd out. Only very few studies have analyzed the effects of regulation when the perception of the regulation is taken into account. This article aims to begin to close this gap, testing how the introduction of regulation at research institutions affects the number of publications when the perception of the regulation is taken into account.

The main expectation follows the motivation crowding proposition: If researchers perceive regulation of publications to be supportive, the regulation increases the number of published articles, but if the researchers see the regulation as a control device, regulation decreases the number of published articles. Further, we expect the relationship between regulation and work effort to be stronger for young researchers. Figure 1 sums up the expected relationships between age, regulation, perception of the regulation and work effort. Age (and career step) might also have direct effects on work effort. The next section discusses how we test the expectations.

Figure 1: Theoretical model of the determinant of individual work effort



Data and methods

Testing the effect of regulation on work effort required a setting with comparable (and measurable) individual work effort and varying degree of regulation. As crowding out can only be expected for employees with some initial intrinsic motivation (Weibel et al., 2007), we needed to find a sector where this is the case. We investigated researchers for three reasons. First, the individual work effort can be quantified, using publications as an indicator. Second, researchers are expected to have high levels of intrinsic motivation (Frey & Osterloh, 2007). Third, it was possible to find quite similar research institutions, which only vary in their degree of regulation.

The first stage of the selection was based on telephone interviews with all the Danish universities to identify comparable research institutions with varying degrees of regulation. At the second stage, we interviewed the heads of the potential research institutions to select research institutions with maximum variation in the degree of regulation both over time and between research institutions. We succeeded in finding five university departments within the same scientific field, which had almost the same gender composition and remuneration system. Since 2001, the five research institutions had introduced very different degrees of regulation (none of the research institutions regulated the number of publications before 2001). To get access to the internal documents and to be allowed to interview researchers and leaders and send out questionnaires, we promised not to publish the names of the investigated research institutions. This gave us access to the internal documents of the departments and to more valid information in the interviews about the real degree of regulation.

Although we investigate ‘most similar’ research institutions, we cannot exclude the possibility that the research institutions differ in other respects than their introduced degree of regulation. We do, however, measure all the variables as differences between 2000 and 2006, and (except for the introduced degree of regulation) the variables are measured for each individual researcher. To do this, we combined several data sources, which are discussed in detail after the overview provided in table 1.

Table 1: Overview of concepts and operationalizations

Concept	Operationalizations	Data source
Work effort	Percentage change in the number of ISI-articles between 2000 and 2006	ISI-web of knowledge database
Organizational degree of regulation	Index for change in the organizational publication demands, monitoring and sanctioning between 2000 and 2006	19 semi-structured interviews and documentary material
Perception of incentives	Index of indicators of supportive/controlling perception of the regulation (measured in 2007)	Web based questionnaire
Age	Self-reported age and/or web page information on age	Web based questionnaire and web page
Control variables	Time to research, career step (assistant professor, associate professor, full professor) and temporary/non-temporary position	Web based questionnaire

The most important concept is the individual work effort. According to the interviews and the analyzed internal documents, only articles in ISI journals count at the investigated research institutions. Writing research articles is not the only task of public researchers, but it is a very important part, and as we wanted to see the effects of the regulation, we used the number of ISI-articles as an indicator of work effort. Following the measurement system in the investigated regulation, we measured the number of articles (co-)authored by each individual researcher. We know that making one really good article can involve a higher work effort than making three mundane articles, but we still used the number of articles, because we investigated the effects of the regulation (which only regulated the quantity of articles). In the discussing section, we return to the trade-offs between quality and quantity. As the regulation was introduced in 2001, we looked at the change in work effort (ISI-articles) between 2000 and 2006. To optimize validity, we coded the number of articles directly from the international ISI-web of knowledge database for each individual researcher. To make sure that different publication patterns did not interfere with the analysis and to control for different individual capacities, we calculated the relative publication growth as the percentage increase in the number of ISI-articles from 2000 to 2006.

Following Frey (1997: 31-32), we measured how hard the regulation was at the investigated research institutions. Hard regulation is defined as enforceable directives including convincing threats of punishments of non-compliance, whereas soft regulation consists of non-enforceable directives without threats of punishments. To measure this for the five investigated research institutions, we utilized both existing documents (action plans, annuals, and target and means) and 19 semi-structured interviewsⁱ with heads/vice-heads of research institution (n=5), middle-managers (n=5), union representatives (n=4) and ordinary researchers (n=5). These texts were theoretically codedⁱⁱ to find directives, monitoring and sanctioning mechanisms. According to these sources, the five investigated research institutions did not have any regulation of publications in year 2000. This changed in 2001, but the institutions introduced different degrees of regulation. Their ranks are similar for all three dimension of regulation (directives, monitoring and sanctioning), and they are categorized according to table 2.

Table 2: Regulation at the investigated research institutions. 2000 and 2006.

Categorization	Description	Number of research institutions	
		2000	2006
No regulation (0)	No regulation	5	0
Very soft regulation (1)	Only general statements of intent, but almost no directives, monitoring or sanctioning	0	2
Soft regulation (2)	Diffuse demands, loose control and ad hoc (soft) sanctions	0	1
Hard regulation (3)	Firm, but unspecific, demands, occasional control and moderate sanctions	0	1
Very hard regulation (4)	Firm and specific demands, frequent control and hard sanctions	0	1
Total		5	5

At the two institutions with very soft regulation, almost no directives concerning publications existed in 2006. One researcher said that “there is no pressure” and that “our head of department never orders anybody to publish more”. According to one of the heads of department, they look at the publication patterns, but only very little, because “the researchers must have their freedom”. The same head of department stated that “we avoid dismissals although we have weak persons”, and that

“we don’t control much here”. The other head of a department with very weak regulation said that “one cannot fire people for not publishing enough”.

At the other end of the spectrum, the department with very hard regulation has a very strict minimum number of articles, each researcher must publish per year, and it is rigidly monitored. According to the head of department they “just count the articles and hold yearly meetings with each researcher”. The department “dismisses or makes a retirement plan” for researchers who do not publish enough. The head of department stated that he “had fired persons, who had been at the department for 25-30 years, following their regulation system”. The last two departments are in-between these extremes.

To measure the age, the career step and the perception of the regulation, we conducted a web based surveyⁱⁱⁱ in the spring of 2007. 189 researchers received the questionnaire, and 133 researchers answered (response rate 70.4). To ensure that the researchers were comparable, 32 respondents were excluded from the analysis, since they were not assistant, associate or full professor in 2000. Career step is measured by dummy variables for (1) persons, who were assistant professors in 2000, and (2) persons, who were full professors in 2006. Besides, we included a dummy variable for temporary positions and asked the researchers to state, how much time they used to research.

The researchers’ perception of incentives was measured by five Likert format questions and three questions where the researchers should choose between statements expressing supportive or controlling perception of the regulation. Principal Component Analysis of these multiple measures of perception gives high, consistent loadings which indicates that supportive and controlling perceptions are ends at the same continuum (see table 3). An additive index was calculated and rescales so that 0 is maximum controlling perception, and 100 is maximum supportive perception. Cronbach’s Alpha for this index was 0.8, which is highly satisfactory.

Table 3: Principal Component Analyses of indicators of researchers' perception of the regulation.

Items	Loadings
Counting research publications makes the effort of the individual researcher visible	0.63
The measuring of publications is a stress factor (turned)	0.60
Increased focus on the number of publications lead to less innovative research (turned)	0.74
Counting research publication enables the leaders to give competent researchers a pat at on the back	0.55
I feel forced to downgrade the quality of my research to publish more (turned)	0.61
A: ISI is a good tool to measure whether you are a researcher. B: ISI is unnecessary and says nothing about research quality. (A coded as high)	0.72
A: Demands to publish in ISI is a management control device. B: Demanding publications in ISS journals, the leaders encourage me in a good way to public more. (B coded as high)	0.55
A: Demands to publish in ISI journals mean nothing to my freedom of research. B: Demands to publish in ISI journals encroach on my freedom of research. (A coded as high)	0.71

Note: The first five items are Likert format with the following response categories: Totally agree, partly agree, neither agree nor disagree, partly disagree, totally disagree. In the last questions, the researchers should state whether they agreed more with A than with B, or more with B than with A.

In sum, we measured the degree of regulation at the organizational level, using interviews and existing data. Information on the dependent variable (individual work effort) came directly from the ISI data base, while we used a questionnaire to measure the perception of the regulation, the age and the position (both in 2000 and 2006) of the individual researchers. The analyses of these data, which the next section will present, are a series of OLS regressions.

Results

In this section, we first discuss the bivariate relationships, followed by a multivariate analysis of the factors concerning the researchers' background. After that, we include first the regulation together with age and then the perception of the regulation and its interaction with the degree of regulation. Finally, we present the full model.

The left column in table 4 shows the bivariate associations between the independent variables and the growth in number of ISI-articles in percentages for the 101 investigated researchers. The degree of regulation is positively associated with the growth in journal articles, meaning that when other variables are ignored, the harder regulation, the research institutions introduced in 2001, the more have the individual researchers increased the number of published ISI-articles between 2000 and 2006. The bivariate relationship between the perception of the incentive and the ISI-article growth is also positive. Neither the proportion of research time, having a

temporary position nor two dummies for career step has any effect. These findings should not, however, be overinterpreted as the researchers have been selected as having been employed at the departments in both 2000 and 2006. There is also very limited variation in the time to research. The research design of this article is not, in other words, optimized to test the effect of these variables, but they are still included as control to detect spurious relationships (they have been included in all multivariate analyses and do not change anything, except that the power of the analysis decreases due to fewer degrees of freedom). The bivariate association between the age of the researchers and the growth in number of journal articles is negative. This means that the increase in publications is smaller for old researchers than for young ones, but before we conclude anything final, we need to look at the multivariate models. Model 1 analyzes all the background variables and finds exactly the same as the bivariate analyses.

Table 4: Regressions of the percentage growth in the number of ISI journal articles. 2000-2006. Unstandardized regression coefficient.

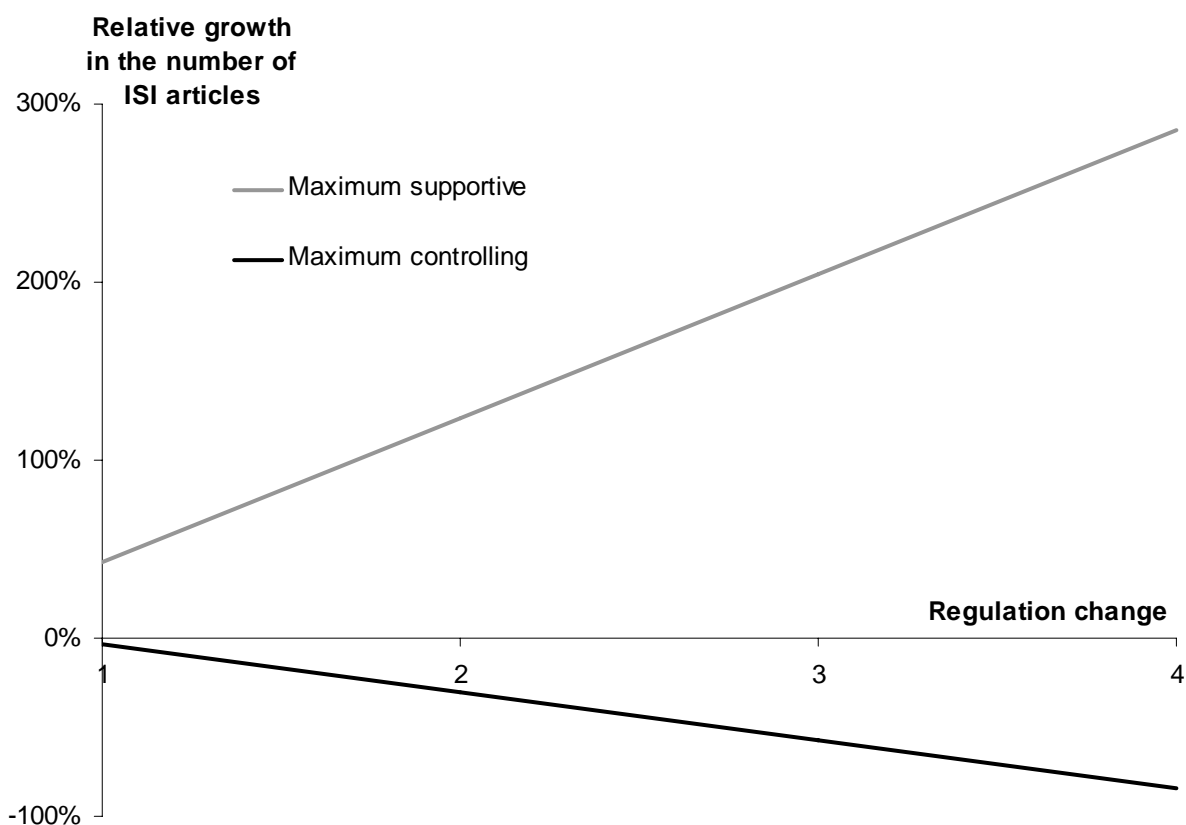
	Bivariate regression	Model 1 Background variables	Model 2 Regulation and age	Model 3 Regulation, age and perception	Model 4 Full model
Intercept		2.4 **	1.8 **	2.2 **	-1.2
Proportion research time	0.01	0.008			
Assistant professor, 2000	0.5	0.2			
Full professor, 2006	0.3	0.4			
Temporary position	0.6	0.2			
Age	-0.04 **	-0.03 **	-0.04 **	-0.04 **	0.02
Regulation growth (1-4)	0.3 **		0.3 **	-0.27	1.3 *
Perception of regulation (0-100)	0.02 **			-0.006	-0.004
Regulation * perception				0.011 **	0.009 *
Age * regulation					-0.03 **
Adj. R ²		0.05	0.10	0.17	0.21

Note: **: p<0.05 *: p<0.1. N=101 individual researchers.

Model 2 includes the age of the researcher and the degree of regulation. It shows the same patterns as the bivariate analyses; the introduction of high degrees of regulation seems to increase the growth in ISI-articles, and young researchers have experienced a higher growth than older ones. Still, we need to include the perception of the regulation to test the MCT proposition.

The MTC expects that if researchers perceive regulation of publications to be supportive, the regulation will increase the number of published articles, but if the researchers see the regulation as a control device, regulation will decrease the number of published articles. This implies that the interaction between the degree of regulation and the perception of the regulation as supportive should be positive. This is exactly what the results show. The effect of regulation is higher the more supportive the researchers see the regulations. As figure 2 (below) illustrates, the introduction of hard regulation is estimated to have a strong positive effect on the growth in the number of ISI-articles in percentages, if the researchers see the regulation as maximum supportive. If they see the regulation as maximum controlling, it has no effect or a small negative effect on the growth in the number of ISI-articles.

Figure 2: The crowding effect

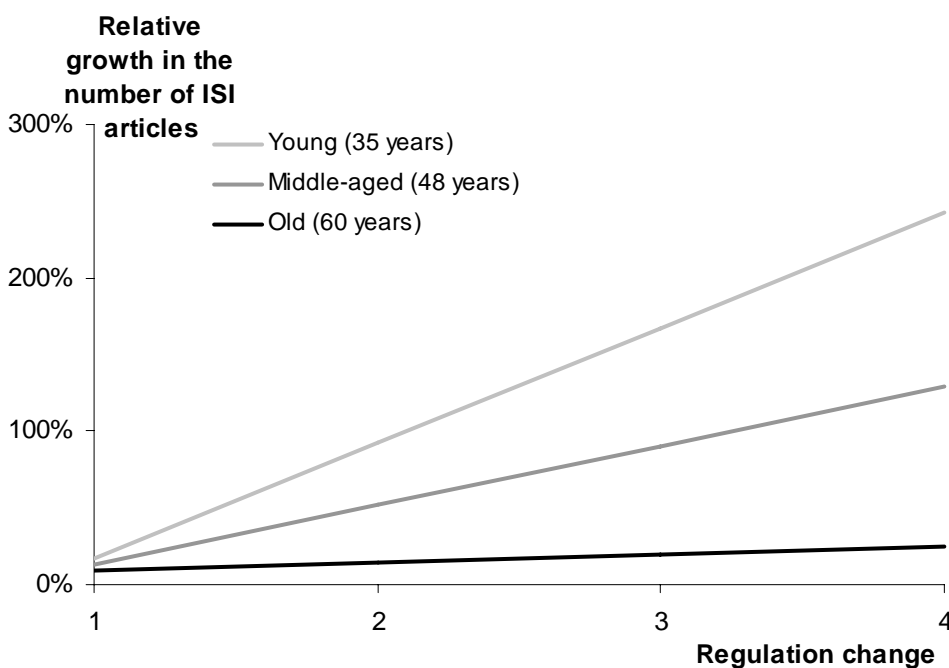


Note: Illustration of the regression lines for maximum supportive (perception index = 100) and maximum controlling (perception index = 0). Empirical variation is from 3 to 94. The figure illustrates model 3 in table 4.

Including the interaction between age and the degree of regulation (model 4 in table 4) does not substantially change the pattern shown in figure 2, except that the interaction term is not, however,

as highly significant in model 4, due to the fewer degrees of freedom. The analysis of age, regulation and ISI-article growth (model 4 in table) implies that age only matters for certain degrees of regulation. The negative regression coefficient for the interaction term between age and regulation indicates that a high degree of regulation primarily matters for young and middle-aged researchers. Figure 3 shows that for a neutral perception (perception = 50), regulation has a strong impact on the percentage growth in the number of ISI-articles for young researchers (35 years), but only a very limited effect for old researchers (60 years).

Figure 3: The age effect



Note: Illustration of the regression lines for different ages. Empirical variation is from 34 years to 66 years. The figure illustrates model 4 in table 4 for a neutral perception (perception index = 50).

In sum, the results indicate that the introduction of high degrees of regulation affects the number of ISI-articles positively if the individual researchers see the regulation as supportive – especially if the researchers are young.

Conclusion

At the investigated research institutions, the effects of regulation depend on the perception of this regulation. Supportive regulation seemingly leads to crowding in; the number of publications increases very much, whereas the small or even negative effect of controlling regulation is seen as a

sign of crowding out of intrinsic motivation. Our interpretation is that the perception of the regulation determines whether the introduction of the regulation leads to crowding in or crowding out. If researchers perceive regulation of publications to be supportive, such regulation increases the number of published articles, but if the researchers see the regulation as a control device, regulation can decrease the number of articles. The results thus support the MCT.

At the investigated research institutions, it seems to be essential what message the regulation sends to the individual researcher: Is it seen as an acknowledgement or a control device? These findings indicate that similar mechanisms are at work for regulation of publications as for bonuses for publication (e.g. Andersen & Pallesen, forthcoming). This implies that research institutions should pay attention to the message implied by both regulation and financial incentives before the introduction.

The next question is how far the findings in this paper can be generalized. Existing studies indicate that researchers from other countries do not differ much from the Danish (e.g. Ferris 1993), and the literature also warns us about unintended side effects from regulation. Frey and Osterloh (2006: 1) agree against introducing performance evaluations in research, because they fear that intrinsic work motivation will be crowded out, and that the evaluated persons and institutions will systematically change their behaviour and develop counter strategies. In an Australian study, Butler (2003) finds that publication practices change in response to funding based on evaluations. This indicates that it is problematic for the investigated research institutions to regulate only the *number* of publications. The researchers might slice their publications to make as many articles as possible, and cheating, biased registration and goal displacement are also relevant risks. Like Merton put it (1940), the instrument values soon become the terminal values. One should accordingly be very careful when formulating regulation, and we should not forget that the number of articles is not the ultimate (or only) objective of research. At least two dangers exist when regulation is introduced: Goal replacement and – as shown in this article – crowding out effects due to reduced intrinsic motivation.

While we argue that the relationship between the degree of regulation, the perception of this regulation and the work effort can be generalized to researchers in other countries, the generalization to other kinds of public employees is more questionably. We investigated researchers, because they have a high initial intrinsic motivation, and because the individual outlet (publications) can be measured. Similar results can be expected for employees who share these features, but it remains an open question how regulation affect employees with lower initial levels

of intrinsic motivation. Additionally, we do not know whether the perception also matters for team regulation.

There is still work to do on the application of the motivation crowding theory to the public sector, but this paper has begun to fill the gap concerning crowding effects of regulation. Regulation seemingly *does* affect the work effort of public employees, in this case the publications of public researchers, but the effect depends on how the regulation is perceived. If the employees see the regulation as a support to their initial intrinsic motivation, regulation increases work effort, whereas controlling regulation does not increase work effort.

Considering whether new regulation in the public sector is a good idea, we should therefore take the perception of it into account. Especially for public employees with high initial levels of intrinsic motivation, a regulation, which implies an acknowledgement of an employee's intrinsic motivation, is expected to foster intrinsic motivations and increase work effort, whereas we should avoid introducing external interventions which are purely control devices. The message implied by the regulation seems to be vital: Does the regulation signal support to the initial intrinsic motivation of the employees, or will they see it as a control device?

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ⁱ The interview guide is available at #web page to added after review#

ⁱⁱ The coding criteria can be seen at ##web page to be added after review#

ⁱⁱⁱ The questionnaire can be seen at #web page to be added after review#