ECONOMIC AND BUSINESS REVIEW

Volume 16 | Issue 3 Article 1

12-31-2014

Deaccessioning and Agency Costs of Free Cash Flow in Manager's Hands: A Formal Model

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DEACCESSIONING AND AGENCY COSTS OF FREE CASH FLOW IN MANAGER'S HANDS: A FORMAL MODEL[1]

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Received: 9 February 2013
Accepted: 11 February 2015

ABSTRACT: *The problem of agency costs of free cash flow in manager's hands has been firstly noted by Easterbrook and Jensen. We present one of the first attempts to formally model the problem in light of similar situation faced by managers of museums being allowed (or disallowed) to deaccession the artworks from their collections. We show that deaccessioning funds always lead to various forms of agency costs for the museum. This finding applies for any non-profit firm and its endowment. The task lying ahead is to formally prove the general conjecture also for the case of private for-profit firms.*

Keywords: *deaccessioning, agency costs, free cash flow, principal-agent problem, non-profit firms*

JEL Classification: G32, L14, Z11

1. INTRODUCTION

Deaccessioning is a problem which has been often discussed both in cultural economics as well as in the popular media and blogs, especially in recent years due to the rising economic crisis and attempts of deaccessioning the museum artworks by several American museums facing the crisis. Deaccessioning is sometimes proclaimed to be a possible panacea to financial problems of museums in economic crisis, as it still holds that museums have the larger part of their endowment in the form of artworks – highly valuable but also very often neglected and mostly unexhibited. So why shouldn't the museum's deaccession the redundant paintings, sculptures, photographs and other artworks in their collection if on the one hand they are left unused in the depos of the museums and on the other hand the museums are in dire need of additional financial resources? Some of the American museums (e.g. The Barnes Foundation, National Academy Museum, Brandeis University' Rose Art Museum) have tried to pursue the "deaccessioning path" yet have been mostly prevented by the rigorous action of the American Association of Museum Directors and American Association of Museums.

1 ACKNOWLEDGEMENTS: This research has been written with support from the Fulbright Scholarship Grant given to the author for the year 2011/12 and »Innovation scheme for financing of PhD studies, their cooperation with economy and solutions to societal challenges – generation 2010 University of Ljubljana« scholarship grant given to the corresponding author for the year 2010/11. The author thanks the Institute of International Education, School of Public and Environmental Affairs at Indiana University Bloomington and University of Ljubljana for their kind support. The author also thanks Prof. Michael J. Rushton and Prof. Liljana Ferbar Tratar for their great support during the research.

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The question obviously entails both strong legal and moral problems (summarized by e.g. Fincham (2011) and Rohner (2010)). In this article we will prove that there exists another pervasive and dire problem of deaccessioning practices: they lead to non-optimal museum management. We will prove that allowing deaccessioning leads to incentives for managers to excessively use the deaccessioning funds and that they are therefore demotivated to raise the revenues of the museum in the presence of deaccessioning possibilities.

Striking as this finding may appear, its message is simple and clear: allowing deaccessioning to substitute for museum revenues in times of economic crisis (or in any time) leads not only to legal and moral issues, but also entails excess economic, i.e. agency costs. The case for deaccessioning therefore appears to lose ground and one would question if there is any strong and sensible argument in favor of deaccessioning left over.

The article will be structured in the following way. The second section will provide a literature review and review of the most needed findings and concepts. In the third section we will present the model to be used for our purpose. In the fourth section we will present its solution and the main propositions for the case of risk-neutral principal. The proof of propositions for the risk-averse principal case will be presented in the fifth section. The final two sections will conclude with the discussion of the findings and their consequences.

2. LITERATURE REVIEW

Museums are a very special field of research in cultural economics, and they pose numerous microeconomic problems. These problems have been subject of research literature in past years. The research crystalized across several main topics: industrial organization of museums, superstar museums, charging for entrance to museums and deaccessioning practices.

One of the main facts from the literature in museum management and economics is that museums have been subject to change in their main characteristics and most of all in the mission they serve: they have come to be customer-oriented, and their main task has become education and not simply preserving the dedicated objects anymore (Whitting-Looze, 2010). This change is being reflected in theoretical considerations as well, and substantial literature has grown in the fields of museum management and marketing. The phenomenon of superstar museums has been researched a lot, following the rise of big museums and their franchises (e.g. Guggenheim, Tate). The topic of superstar museums is being explored in cultural economics as well (e.g. Frey & Pommerehne, 1989; Frey, 2003).

Charging for entrance to museums proved to be an extremely interesting topic for economists. According to welfare theoretical considerations, the appropriate charge for entrance should be zero, due to zero (or close to zero) marginal costs of every new entrant (Fernandez-Blanco & Prieto-Rodriguez, 2011). But the opinions vary because the fixed costs of museums should also be taken into consideration (as suggested by Frey & Meier, 2006) and most of all congestion costs should be accounted for, which accounts for marginal costs in the long run being possibly distinct from zero (Fernandez-Blanco & Prieto-

Rodriguez, 2011). A new proposal for museum pricing has been made by Bruno Frey and Lasse Steiner (Frey & Steiner, 2010) which proposes that the fee is charged when leaving the museum according to the time spent there (the so-called pay-as-you-go principle). In the article we will explore another interesting and often quoted phenomena in the economics of museums, namely the deaccessioning practices, which denote "the permanent removal or disposal of an object from the collection of the museum by virtue of its sale, exchange, donation or transfer by any means to any person" (McKinney, in: Range, 2004). Deaccessioning has become a topic not only in US museums, but is also being considered in German, Dutch, French and UK museums and in other European states. Deaccessioning can of course be done in two most general ways: either the funds are spent to finance new collections which have been a common and mostly undisputed practice for decades, or the funds are spent to finance daily operation costs of a museum. It is the latter form that will be of interest in this article.

Deaccessioning as a practice brought to light many controversies. In one of the first cultural economics' articles on this topic, J. M. Montias (1973) advocates for its usage: "If the Metropolitan resources are as depleted as Mr. Hoving (the director) makes them out to be, and if the exhibition space is fixed to the present wall capacities for the foreseeable future, then his decision – to sell essentially duplicate items to make room for paintings and sculptures that will fill serious gaps in the museum's collection – appears largely justified" (Montias, 1973). Later works often advocated for its usage as well (e.g. Weil, 1990; Borg, 1991). There has been and is to this day also a considerable opposition to deaccessioning in the museum world (Besterman, 1991, Cannon-Brookes, 1991). It has to be noted, first, that the subject is not well researched, especially in light of economic modeling of actual situations and problems it brings for museum management, and second, that it indeed brings controversies, which can be seen in the fierce debates in contemporary American intellectual and art scene (Rohner, 2010; Whitting-Looze, 2010; Fincham, 2011; Rosenbaum, 2009-2012; Zaretsky, 2009-2012; Muñoz-Sarmiento, 2009-2012).

Some basic reasons for the debate on deaccessioning have been summarized by O'Hagan (O'Hagan, 1998):

1) Many art museums have trustee status, which protects art works given in trust from being sold to satisfy creditors; however, by blocking the most efficient use and allocation of its available resources, donor restrictions can seriously hinder the attempt of museum trustees to keep the museum solvent;
2) Because collections demand space, protection, and maintenance, it seems sensible for the museum with precarious finances to deaccession artworks that are unable to be exhibited and unwanted;
3) Once allowing deaccessioning the politicians might insist on the sale of further works of art as the quid-pro-quo of further subsidy (although the opposite is more likely to apply, namely a large public outcry against the use of the money from the sale for anything other than the purchase of more art);
4) The issues concerning the process of deaccessioning: what conditions apply, who decides how it is to be disposed of, and how the proceeds are to be allocated.

Finally, article by Di Gaetano and Mazza (2014) is one of the first to explore deaccessioning from a formal modelling viewpoint. It explores the situation of deaccessioning from the viewpoint of donations (and donors) and uses tools from game theory to explore the situation of uncertainty about the museum's choice of deaccessioning. The authors' main results are that when deaccessioning is allowed, this may reduce private donations also to those museums which do not sale portion of their collections; and that a reduction in public grants may benefit museums committed not to deaccess, which contrasts with the common wisdom that budget cuts hurt especially museums that choose to discard the option of selling their collections.

For our article, the key observation has been stated already by Montias: "The purpose of this discussion is to determine whether a rule barring the sale of major works would cause museum managers to accomplish their mission more efficaciously" (Montias, 1973). The problem of deaccessioning when considered in light of economics deals with questions of efficacy of museum management and with (appropriate) incentives posed to the managers. We will claim that when making decisions on deaccessioning, it is not only donors who are affected, but the managers of museums have strong incentives for non-optimal (from the principals and societal viewpoint) behavior and efficacy, as seen from either the level of effort or motivation to raise the revenues of the museum.

We will evaluate this hypothesis in light of microeconomic theoretical models, formed on the basis of contract theory and modeling of principal-agent problem. The debate of principal-agent modeling has been started in the 1960's and 1970's with articles by Arrow (1963), Ross (1973) and Shavell (1979a; 1979b). The theory has been developed in works by Mirrlees (1975); Grossman and Hart (1983; 1986) Holmström (1979), Holmström and Milgrom (1987), Laffont and Martimort (2002) and Bolton and Dewatripont (2006). Principal-agent problem in most general summarizes the situation between one principal (e.g. person offering a contract) and one agent (e.g. person being offered a contract). Principal and agent most commonly have conflicting objectives and decentralized information which stress the importance of incentives in the relationship. The essential paradigm for the analysis of such behavior by economists is one where economic agents pursue, at least to some extent, their private interests. What is proposed by incentive theory is that this major assumption be maintained in the analysis of organizations, small markets, and any other kind of collective decision-making. In the principal-agent relationship the principal is therefore interested in performance of the firm and the proper incentives given to the agent so that the latter can provide the utmost level of effort to his task, while the agent is motivated by his payment and to provide the minimal amount of effort required (it is usually supposed that the agent has disutility of provided effort – the more effort he provides, the less satisfied he is, ceteris paribus).

Certain main findings were provided already by the first researchers in the field. It has been often claimed that if one of the parties is risk-neutral (and the other risk-averse), this party should be "charged" with all the risk in the relationship meaning that the other (the risk-averse) party is being fully secured of its payment i.e. benefit. The latter is usually done by securing the risk-averse party a constant payoff with the risk-neutral party been given the residual rights of ownership (see: Grossman & Hart, 1986). In the economics of principal-agent problem (and contract theory in general) one can have perfect and symmetrical information in which case usually the problem can be provided with an immediate, sometimes trivial solution. Most commonly though one encounters problems of asymmetrical information, either in the form of adverse selection, when the principal or the agent doesn't know the other party's type (this can lead to signaling models, where the informed and unobserved party is providing the signals of his type to the uninformed one, or to screening models where the uninformed party is providing the signals to the informed one) or in the form of moral hazard, when one of the party (most commonly the principal) cannot observe the actions of the other. It has been shown that both problems lead to inefficient equlibria and second-best or sometimes even worse solutions of the model (see: Laffont & Martimort, 2002; Bolton & Dewatripont, 2006).

A special subbranch of principal agent theory deals with agency costs of principal-agent relationship, most commonly related to financial theory. The main article is probably the contribution by Jensen & Meckling (1976) which started to talk about the concept of agency costs which could be attributed to monitoring expenditures by the principal, bonding costs of the agent and the residual loss (ibid.). Agency costs are therefore a special sort of transaction costs (being of course related to pioneering work of Coase and Williamson) which come out as a result of principal-agent relationship. A very special type of agency costs has been observed by Easterbrook (1984) and Jensen (1986): agency costs of free cash flow in hand of the managers of the firm. Jensen observes that free cash flow in the hands of the managers very often leads to poor management decisions either in the form of raising the perquisites of the managers beyond the optimal level or in the form of investing in project with negative net present value. Jensen sees debt as a device to discipline the managers in the presence of agency costs of this type (Jensen, 1986). Despite the thesis raising a lot of debate and econometric evidence (e.g. Crutchly & Hansen, 1989; Lang, Stulz & Walkling, 1991; Almeida, Campello & Weisbach, 2004; Fleming, Heaney & McCosker, 2005; Utami & Inanga, 2011) it has rarely been properly modeled and formally proved (for additional information see e.g. Tirole, 2006).

More or less the only attempt to model the problem of agency costs of free cash flow and its relationship to debt in firms is the article by Grossman and Hart (1982)[3]. In this article the authors observe and prove that debt can serve the role of bonding device in the relationship of principal and agent/manager in a firm and that including debt can be in the manager's interest as it can serve to increase the value of the firm, which is also in manager's interest (ibid.). Grossman and Hart prove that level of debt is beneficial to the level of investment and firm's profits and market value.

Several studies have explored the role of endowment and the economics and financing of non-profit firms in general. Papers by Hansmann (1980; 1990) and Fama and Jensen (1983a; 1983b) sketch some basic considerations regarding economics of non-profit organisations and role of non-profit endowments. First (lastingly more or less the only one so far) attempt on modeling the financial structure of non-profit organisations and their

3 The article was written before the Jensen's 1986 conjecture, therefore it does not address the Jensen's problem directly.

agency structure have been made by Wedig and colleagues (Wedig et al., 1988; Wedig et al., 1996) on the case of non-profit hospitals. In their 1996's paper their evaluate role of tax-exempt debt in non-profit hospitals and show some important results (e.g. that non-profit firms behave as if they were following a target ratio of tax-exempt debt). Capital structure of non-profit organisations has been also analysed by Bowman (2002), who tests whether capital structure of non-profit firms could be better analysed by refering to pecking-order theory (which states that different forms of capital always follow the same order of attractiveness and usage) or instead to a static trade-off theory which is more in accordance with mentioned Jensen's conjecture. Bowman (and several other authors, e.g. Fisman & Hubbard, 2003) finds evidence for the latter. Among the other contributions that would have to mentioned are studies on capital structure of non-profit hospitals by Calem and Rizzo (1995) and Brickley and van Horn (2002), econometric evaluation of agency costs of excess endowments by Core, Guay and Verdi (2006) and economic model of non-profit entrepreneur behavior by Glaeser and Shleifer (2001). Finally, in an influential article, Fisman and Hubbard (2003) observe the role of endowment and its similarity to debt in the contributions of Jensen (1986) and Grossman and Hart (1982). The general conclusion, confirmed by econometric evidence is that excess endowments lead to significant agency costs in the sense of Jensen and Easterbrook. Yet this conclusion has been so far supported only by econometric evidence and rarely by any formal modeling, similar to evaluation of Jensen's (and Easterbrook's) conjecture in general.

3. MODEL

In an important article in financial and principal-agent theory, Grossman and Hart (1982) show that debt can serve as a self-limitation device for a firm. Grossman and Hart analyze the model where there is no clearly defined principal and agent relationship - they are mainly interested in investment, its role in enhancing the market value of the firm and the impact on the expected utility function of the manager. On their account the manager optimizes the following function:

$$\max U(V-I)(1-F(D-g(I))) \qquad (1)$$

where U is the manager's utility function, V is the expected value of the firm, I is the investment itself, $g(I)$ is the expected profit from the investment, D are current debt obligations and F is the cumulative density function. This formula therefore describes the manager's expected utility in the presence of the danger of bankruptcy due to debt obligations of the firm – the manager's expected utility depends upon the utility from current consumption $V-I$, which depends on the market value of the firm less the investment needed for changing the value of the firm. The manager's utility also depends upon the probability of solvency $1-F(D-g(I))$ which is modeled as probability that the current debt obligations D don't surpass in value the revenues of the firm $g(I)$. The latter formula therefore measures the probability that the random variable s (which is defined as simply a random variable with mean 0) is greater than $D - g(I)$ (total revenues are equal to $g(I)$ plus this random variable) which is equivalent to solvency condition of the firm.

We therefore propose to model the deaccessioning process in the following way. The budget function of the museum is:

$$Budg = R - w - FC = R_T - w \qquad (2)$$

where R are total revenues of the museum, consisting of fundraising (including donations), ticket sales and public grants, w is wage of the manager and FC are remaining costs of the museum (including both fixed costs as well as costs depending upon the level of service, e.g. cleaning costs, costs of collection maintenance). R_T denotes the difference between R and FC.

We model possible role of deaccessioning as having a preventing function over possible bankruptcy of the museum, following the model by Grossman and Hart. If the museum should remain solvent, the following inequality has to be satisfied:

$$dE \leq R_T - w + s \qquad (3)$$

where s is, again, a random variable with mean 0 and is simply denoting the random factors influencing the revenues of the museum and dE is the amount of endowment allowed for deaccessioning. Deaccessioning in this equation serves in the role of "reserve funds" available to prevent the possible bankruptcy of the museum (therefore if the budget is negative it has to be less in absolute value than the deaccessioning "reserve funds").

In our case, we use their model and extend it for a principal-agent situation. Our principal is the board of trustees of the museum, which hires the manager (the agent) to work for the benefit of the museum. Following Grossman and Hart, the following should be the specification of our principal-agent deaccessioning' problem in the risk-neutral principal case (if we assume that the main objective of the principal is the maximization of the expected budget in line with considerations of e.g. Niskanen, 1968; 1971):

$$\max\ (R_T - w)[1 - F(w - R_T - dE)] \qquad (4)$$

$$s.t. \qquad u(w)[1 - F(w - R_T - dE)] - \psi(e) \geq \underline{u} \qquad (5)$$

where $R_T - w$ is the net total budget, F is the cumulative distribution function, u is the manager's utility function, ψ is the manager's disutility from effort function and $\underline{u}$ is the minimal guaranteed level of manager's utility. The optimization problem is therefore to maximize the expected benefit of the principal (net revenues times the probability of no bankruptcy) such that the agent's expected utility is bigger than some guaranteed value. This problem doesn't include deaccessioning funds among revenues of the museum yet takes them into account in their role as a »buffer« against insolvency of the museum, in accordance with findings by Fisman and Hubbard (2003).

The above discussion also shows two important considerations:

1) From the inequality (3) and from the model (4) & (5) we see that deaccessioning acts in exactly the opposite manner as debt in the model of Grossman and Hart. Is therefore serves as a sort of »negative debt«: as reserves that are a »buffer« against possible insolvency of the museum.

2) From the above it is also apparent that if we are able to prove that deaccessioning leads to non-optimal museum manager's/agent's decisions, this would be sufficient to show the Jensen's conjecture on agency costs of free cash flow in firms, if the free cash flow behaves in a similar manner as deaccessioning funds: it is not included in the budget function of the firm, yet can serve to cover the possible firm's insolvency.

In the following we also make the following assumptions on marginal effects:

$$\frac{\partial R_T}{\partial e} > 0, \frac{\partial^2 R_T}{\partial e^2} \leq 0, \frac{\partial w}{\partial e} > 0, \frac{\partial^2 w}{\partial e^2} \leq 0, \frac{\partial u}{\partial w} > 0, \frac{\partial^2 u}{\partial w^2} \leq 0, \frac{\partial \psi}{\partial e} > 0, \frac{\partial^2 \psi}{\partial e^2} \geq 0 \qquad (6)$$

We therefore assume that additional effort raises net non-labor revenues and that the net non-labor revenue function is concave in effort; that additional effort raises manager's wage and that the wage function is concave in effort; that the utility function of the manager is concave in wage; and that the manager's disutility function of effort is convex. All of the assumptions are common in principal-agent problems and will not be discussed here.

In our propositions, we will explore two possible relationships between deaccessioning and effort. Firstly, deaccessioning will be assumed as fixed and independent of the level of provided effort. In this case, museum manager takes the level of deaccessioning as predetermined by rules of the museum. Second case if when deaccessioning can be left to vary and is dependent on the invested effort from the manager. It is logical to assume that the higher the provided effort, the lower will be the need for deaccessioning to act as a buffer to remedy for financial problems of the museum.

4. THE RISK-NEUTRAL PRINCIPAL CASE

Solving the model leads to the following first order conditions and Lagrangian function:

$$\mathcal{L} = (R_T - w)(1 - F) + \lambda u(1 - F) - \lambda \psi(e) - \lambda \underline{u} \qquad (7)$$

where we write F and u as short terms for $F(w - R_T - dE)$ and $u(w)$.

F.O.C.:

$$\frac{\partial \mathcal{L}}{\partial w} = -(1-F) - (R_T - w)f + \lambda u'(1-F) - \lambda u f = 0 \qquad (8)$$

where f is the probability density function of the distribution with cumulative distribution function $F(w - R_T - dE)$.

Proposition 1: The constraint in (5) is binding or relying on funds from deaccessioning instead of on the raised revenues is optimal.

Proof.
We can express the value of λ from (8) as:

$$\lambda = \frac{(1-F) + (R_T - w)f}{u'(1-F) - uf} \geq 0 \qquad (9)$$

where the last inequality of course holds because λ is the Lagrange multiplier and therefore non-negative.

There are two possibilities: either $\lambda = 0$ or $\lambda > 0$.

In the first case, it should hold that:

$$(1-F) + (R_T - w)f = 0 \qquad (10)$$

and therefore

$$-\frac{f}{1-F} = \frac{1}{R_T - w} \qquad (11)$$

Because $0 \leq f, F \leq 1$, this would mean that the optimal value of the net revenues ($R_T - w$) is negative which means that in this case relying on deaccessioning is optimal for the manager which contradicts the basic supposition of optimality of the behavior of the manager. This shows that in order for the manager to act optimally, the constraint in (5) should be binding (i.e. $\lambda > 0$).

Q.E.D.

The F.O.C. over effort states that:

$$\frac{\partial \mathcal{L}}{\partial e} = \left(\frac{\partial R_T}{\partial e}\right)(1-F) + (R_T - w)\left(\frac{\partial R_T}{\partial e}\right)f + \lambda u\left(\frac{\partial R_T}{\partial e}\right)f - \lambda\psi'(e) = 0 \qquad (12)$$

Proposition 2: If the principal is risk-neutral and we make deaccessioning depend upon effort, the provided effort by the agent will be suboptimal.

Proof.
Let's firstly observe the case when deaccessioning is fixed and doesn't depend upon the effort in the model. By inserting the value of λ from (9) into (12) we get:

$$\left(\frac{\partial R_T}{\partial e}\right)(1-F) + (R_T - w)\left(\frac{\partial R_T}{\partial e}\right)f + \frac{(1-F)+(R_T-w)f}{u'(1-F)-uf}u\left(\frac{\partial R_T}{\partial e}\right)f - \frac{(1-F)+(R_T-w)f}{u'(1-F)-uf}\psi'(e) = 0 \qquad (13)$$

and finally after simplification:

$$\frac{\partial R_T}{\partial e} = \frac{\psi'(e)}{u'(1-F)} \qquad (14)$$

On the other hand, if deaccessioning depends upon effort (and we assume that $\frac{\partial dE}{\partial e}$<0, which simply means that higher effort, invested into work for the museum, leads to lower need to rely on deaccessioning, which seems a logical assumption), (12) transforms into:

$$\frac{\partial \mathcal{L}}{\partial e} = \left(\frac{\partial R_T}{\partial e}\right)(1-F) + (R_T - w)\left(\frac{\partial R_T}{\partial e}\right)f + (R_T - w)\left(\frac{\partial dE}{\partial e}\right)f + \lambda u\left(\frac{\partial R_T}{\partial e}\right)f + \lambda u\left(\frac{\partial dE}{\partial e}\right)f - \lambda\psi'(e) = 0 \qquad (15)$$

which after inserting the value of of λ from (9) can be simplified into:

$$u'(1-F)^2\frac{\partial R_T}{\partial e} + (1-F)f\frac{\partial dE}{\partial e}(u-u'w) - \psi'(e)(1-F) + u'(1-F)\frac{\partial R_T}{\partial e}(R_T-w)f - (R_T-w)f\psi'(e) = -u'(1-F)\frac{\partial dE}{\partial e}fR_T \qquad (16)$$

Again, some simplification yields:

$$\begin{aligned}
0 = u'(1-F)\frac{\partial R_T}{\partial e}[(1-F)+(R_T-w)f] - \psi'(e)[(1-F)+(R_T-w)f] \\
+ (1-F)\frac{\partial dE}{\partial e} f u'(R_T-w) + (1-F)\frac{\partial dE}{\partial e} f u \\
\leq u'(1-F)\frac{\partial R_T}{\partial e}[(1-F)+(R_T-w)f] - \psi'(e)[(1-F)+(R_T-w)f] \\
- (1-F)\frac{\partial dE}{\partial e} f u \\
< u'(1-F)\frac{\partial R_T}{\partial e}[(1-F)+(R_T-w)f] \\
- \psi'(e)[(1-F)+(R_T-w)f] \qquad (17)
\end{aligned}$$

where the first inequality is due to negativity of $(1-F)\frac{\partial dE}{\partial e} f u'(R_T-w)$ (due to previously made suppositions) and the second is due to positivity of $u(w)$ in equilibrium – if it would be otherwise the signs of derivatives of (4) and (5) would be opposite and one would be able to increase (4) by going in the direction of its derivative while still being in the region of the constraint (5) which would contradict Proposition 1 that the constraint in (5) is binding.

From (17) and due to positivity of $(1-F)+(R_T-w)f$ we are finally able to conclude:

$$\frac{\partial R_T}{\partial e} > \frac{\psi'(e)}{u'(1-F)} \qquad (18)$$

Comparing (14) and (18) and taking into account our initial supposition that $\frac{\partial^2 R_T}{\partial e^2} \leq 0$, we conclude that the effort in (18) is lower than the effort in (14) which concludes our proof.

Q.E.D.

Let's shortly explain the intuition behind Proposition 2. Our main hypothesis of the article is that deaccessioning leads to worse performance of museum management. In Proposition 2 we therefore showed that if we allow effort to vary and have the influence on the level of deaccessioning funds (used as a buffer to remedy for financial problems of the museum), the invested effort will be lower than optimal (the marginal effect of effort to net revenues in equilibrium is higher when allowing deaccessioning to vary with effort and marginal effect of effort to net revenues is a monotonously decreasing function). This shows that usage of deaccessioning funds and invested effort are indeed inversely related and is the effect of including the (negative by assumption) marginal effect of effort to deaccessioning which has a negative marginal effect to derivatives of both (4) and (5) in the first order condition (15). In the following proposition we show another adverse effect of deaccessioning funds for performance of museum management.

Proposition 3: In the risk-neutral principal' equilibrium the marginal effect of deaccessioning to wage is greater than the marginal effect of additional net revenues to wage. Also the marginal effect of deaccessioning to net revenues in the equlibrium is negative and greater than minus one.

Proof.To calculate the marginal effect of deaccessioning over wage, we can use the second derivatives of the Lagrangian (using the implicit function theorem):

$$\frac{\partial w}{\partial dE} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} \qquad (19)$$

Similarly we can calculate:

$$\frac{\partial w}{\partial R_T} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} \qquad (20)$$

$$\frac{\partial R_T}{\partial dE} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}}{\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}} \qquad (21)$$

The second order derivatives are:

$$\frac{\partial^2 \mathcal{L}}{\partial w^2} = 2f + wf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf' < 0 \qquad (22)$$

where the inequality holds because the Lagrangian is maximized at w,

$$\frac{\partial^2 \mathcal{L}}{\partial w \partial dE} = -f + (R_T - w)f' + \lambda u'f + \lambda uf' \qquad (23)$$

$$\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T} = -2f + (R_T - w)f' + \lambda u'f + \lambda uf' \qquad (24)$$

From equations (20), (22) and (24) we have:

$$\frac{\partial w}{\partial R_T} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} = \frac{2f - (R_T - w)f' - \lambda u'f - \lambda uf'}{2f + wf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf'} \qquad (25)$$

and from equations (19), (22) and (23) we have similarly:

$$\frac{\partial w}{\partial dE} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} = \frac{f - (R_T - w)f' - \lambda u' f - \lambda u f'}{2f + wf' + \lambda u''(1 - F) - 2\lambda u' f - \lambda u f'} \qquad (26)$$

Therefore:

$$\frac{\partial w}{\partial R_T} = \frac{\partial w}{\partial dE} + \frac{f}{2f + wf' + \lambda u''(1 - F) - 2\lambda u' f - \lambda u f'} \qquad (27)$$

Because of the inequality (22) the denominator in both (25) and (26) is strictly negative. This means that the last term on the right hand side of (27) is strictly negative (f – the probability density function – is of course strictly positive by assumption), which shows:

$$\frac{\partial w}{\partial R_T} < \frac{\partial w}{\partial dE} \qquad (28)$$

This proves the first part of the proposition. The second part is shown similarly using (21), (23) and (24):

$$\frac{\partial R_T}{\partial dE} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}}{\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}} = -\frac{f - (R_T - w)f' - \lambda u' f - \lambda u f'}{2f - (R_T - w)f' - \lambda u' f - \lambda u f'} > -1 \qquad (29)$$

Now let's observe the signs of $\frac{\partial w}{\partial dE}$, $\frac{\partial w}{\partial R_T}$ and $\frac{\partial R_T}{\partial dE}$. It is natural to assume that the marginal effect of additional net revenues less wage to wage is positive otherwise the manager wouldn't be motivated for the benefit of the firm at all. Therefore it is natural to assume:

$$\frac{\partial w}{\partial R_T} > 0 \qquad (30)$$

From (28) we also gain:

$$\frac{\partial w}{\partial dE} > \frac{\partial w}{\partial R_T} > 0 \qquad (31)$$

which means that the signs of both $\frac{\partial w}{\partial dE}$ and $\frac{\partial w}{\partial R_T}$ are positive. From equations (19) and (20) and the fact that $\frac{\partial^2 \mathcal{L}}{\partial w^2}$ is negative (as explained before) we gain:

$$sgn\left(\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}\right) = sgn\left(\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}\right) = +1 \qquad (32)$$

and therefore:

$$sgn\left(\frac{\partial R_T}{\partial dE}\right) = -1 \qquad (33)$$

But this means that deaccessioning funds have negative marginal effect on the total revenues, therefore on the success of the firm. This proves that allowing deaccessioning leads to decisions leading to lower revenues than optimal. This also proves our proposition.

Q.E.D.

Again, let's shortly explain the intuition behind Proposition 3. We showed that deaccessioning is more tempting for the manager not merely due to its adverse effect on effort (allowing managers to be more "lazy"), which we showed in Proposition 2, but also because it raises the manager's perquisites in the form of manager's wage, as claimed in the original article by Jensen (see Jensen, 1986). We, therefore, showed that the effect of deaccessioning on the level of equilibrium wage is higher than the effect of revenues to equilibrium wage which clearly demonstrates adverse effect of deaccessioning to manager's perquisites (deaccessioning funds are more tempting for the manager than raising of the revenues because he secures higher wage by using deaccessioning). Furthemore, we showed that deaccessioning and net revenues are negatively related also when observed in a direct relationship.

5. THE RISK-AVERSE PRINCIPAL CASE

We next observe our model in the case of principal being risk-averse and prove the validity of our two main propositions also for this case. In this case, the model in (4) and (5) changes to:

$$\max\ B(R_T - w)[1 - F(w - R_T - dE)] \qquad (34)$$

$$s.t. \qquad u(w)[1 - F(w - R_T - dE)] - \psi(e) \geq \underline{u} \qquad (35)$$

where $B(R_T - w)$ (we will write it shortly as B) is the benefit function of the principal and we assume $B' > 0, B'' < 0$.

Solving the model in (34) and (35) leads to the following Lagrangian function:

$$\mathcal{L} = B(1-F) + \lambda u(1-F) - \lambda\psi(e) - \lambda \underline{u} \qquad (36)$$

The first order conditions over wage and effort are:

$$\frac{\partial \mathcal{L}}{\partial w} = -B'(1-F) - Bf + \lambda u'[1-F] - \lambda uf = 0 \qquad (37)$$

$$\frac{\partial \mathcal{L}}{\partial e} = B'\left(\frac{\partial R_T}{\partial e}\right)(1-F) + B\left(\frac{\partial R_T}{\partial e}\right)f + \lambda u\left(\frac{\partial R_T}{\partial e}\right)f - \lambda\psi'(e) = 0 \qquad (38)$$

From (37) we get:

$$\lambda = \frac{B'(1-F) + Bf}{u'(1-F) - uf} \geq 0 \qquad (39)$$

Again, due to $B' > 0$ we see that for $\lambda = 0$ (i.e. constraint in (35) to be non-binding), B would have to be negative in equilibrium and relying on deaccessioning would be an optimal strategy.

We next prove our Propositions 2 and 3 also in the case of risk-averse principal.

Proposition 4: If the principal is risk-averse and we make deaccessioning depend upon effort, the provided effort by the agent will be suboptimal.

Proof.
Again, firstly observe the case when deaccessioning is fixed and doesn't depend upon the effort in the model. By inserting the value of λ from (39) into (38) we get:

$$B'\left(\frac{\partial R_T}{\partial e}\right)(1-F) + B\left(\frac{\partial R_T}{\partial e}\right)f + \frac{B'(1-F) + Bf}{u'(1-F) - uf}u\left(\frac{\partial R_T}{\partial e}\right)f - \frac{B'(1-F) + Bf}{u'(1-F) - uf}\psi'(e) = 0 \qquad (40)$$

and finally after simplification:

$$\frac{\partial R_T}{\partial e} = \frac{\psi'(e)}{u'(1-F)} \qquad (40)$$

On the other hand, if deaccessioning depends upon effort (again, we assume that $\frac{\partial dE}{\partial e}$<0), (38) transforms into:

$$\frac{\partial \mathcal{L}}{\partial e} = B'\left(\frac{\partial R_T}{\partial e}\right)(1-F) + B\left(\frac{\partial R_T}{\partial e}\right)f + B\left(\frac{\partial dE}{\partial e}\right)f + \lambda u\left(\frac{\partial R_T}{\partial e}\right)f + \lambda u\left(\frac{\partial dE}{\partial e}\right)f - \lambda\psi'(e) = 0 \qquad (41)$$

which after inserting the value of of λ from (39) can be simplified into:

$$B'u'(1-F)^2\frac{\partial R_T}{\partial e} + B'u(1-F)f\frac{\partial dE}{\partial e} + Bu'(1-F)f\frac{\partial R_T}{\partial e} - \psi'(e)B'(1-F) - \psi'(e)Bf = -Bu'(1-F)f\frac{\partial dE}{\partial e} \qquad (42)$$

Again, some additional simplification yields:

$$0 = [B'(1-F) + Bf]\left[u'\frac{\partial R_T}{\partial e}(1-F) - \psi'(e)\right] + [B'u + Bu'](1-F)f\frac{\partial dE}{\partial e} < [B'(1-F) + Bf]\left[u'\frac{\partial R_T}{\partial e}(1-F) - \psi'(e)\right] \qquad (43)$$

where the final inequality is due to term $B'u + Bu'$ being positive, as B' and u' are positive by initial assumptions, B is positive by previous reasoning at the start of this section, and u is positive by the same reasoning as in proof of Proposition 2.

From (43) it is easily deduced that:

$$\frac{\partial R_T}{\partial e} > \frac{\psi'(e)}{u'(1-F)} \qquad (44)$$

Again, Comparing (40) and (44) and taking into account our initial supposition that $\frac{\partial^2 R_T}{\partial e^2} \leq 0$, we conclude that the effort in (44) is lower than the effort in (40) which concludes our proof.

Q.E.D.

Proposition 5: Proposition 3 holds also in the case of risk-neutral principal with the additional assumption

$$\frac{f}{1-F} = r > -\frac{B''}{B'} = ARA \qquad (45)$$

Proof.
The inequality in (45) can be interpreted in the following way. According to Pratt (1964), the Arrow-Pratt coefficient of absolute risk aversion (ARA) can be interpreted as willingness-to-pay the insurance (risk premium), i.e. willingness-to-pay to avoid risk. On

the other hand as interpreted by Grossman and Hart (1982) the hazard rate (r) in the model described by equation (1) can be interpreted as marginal cost of avoiding bankruptcy, therefore marginal cost of avoiding risk in our model. Inequality (45) therefore only means that the principal's willingness to pay the risk premium to avoid risk is smaller than the cost of avoiding risk, which is a necessary condition for the principal to be willing to take the risk of bankruptcy and therefore to participate in the game described by the model (34) and (35). Inequality (45) is therefore nothing else than the participation condition for the principal.

Calculating the second order derivatives and implicit function quotients in this case gives:

$$\frac{\partial^2 \mathcal{L}}{\partial w^2} = B''(1-F) + 2B'f - Bf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf' < 0 \qquad (46)$$

$$\frac{\partial^2 \mathcal{L}}{\partial w \partial dE} = -B'f + Bf' + \lambda u'f + \lambda uf' \qquad (47)$$

$$\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T} = -B''(1-F) - 2B'f + Bf' + \lambda u'f + \lambda uf' \qquad (48)$$

$$\frac{\partial w}{\partial R_T} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial R_T}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} = \frac{B''(1-F) + 2B'f - Bf' - \lambda u'f - \lambda uf'}{B''(1-F) + 2B'f - Bf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf'} \qquad (49)$$

$$\frac{\partial w}{\partial dE} = -\frac{\frac{\partial^2 \mathcal{L}}{\partial w \partial dE}}{\frac{\partial^2 \mathcal{L}}{\partial w^2}} = \frac{B'f - Bf' - \lambda u'f - \lambda uf'}{B''(1-F) + 2B'f - Bf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf'} \qquad (50)$$

$$\frac{\partial w}{\partial R_T} = \frac{\partial w}{\partial dE} + \frac{B''(1-F) + B'f}{B''(1-F) + 2B'f - Bf' + \lambda u''(1-F) - 2\lambda u'f - \lambda uf'} \qquad (51)$$

Because of inequality (45) it holds:

$$B''(1-F) + B'f > 0 \qquad (52)$$

And therefore again (as in the risk-neutral principal case) it holds:

$$\frac{\partial w}{\partial R_T} < \frac{\partial w}{\partial dE} \qquad (53)$$

All the other steps in proving the analogue of proposition 3 are the same.

Q.E.D.

6. DISCUSSION

It is apparent that we just showed several adverse effects of allowing deaccessioning funds. Firstly, deaccessioning has negative effects on the effort of the managers in equilibrium – managers will tend to work less in the presence of deaccessioning funds, being able to cover for the possible deficit of the museum, if we allow their effort to provide funds for the museum which could lower the need for deaccessioning. This finding was demonstrated in Propositions 2 and 4 for both risk-neutral as well as risk-averse case.

Secondly, using deaccessioning funds is more tempting for the manager than raising revenues. This shows that in the presence of deaccessioning the manager has less motivation to work for the benefit of the museum, but will be more tempted to rely on deaccessioning funds, leaving the work for the benefit of the museum (i.e. raising revenues of the museum) for others to come. This is finally and once more confirmed by the negative sign of marginal effect of deaccessioning to the revenues – the more we allow deaccessioning possibilities to cover the possible deficit of the museum, the lower will be the total revenues.

One would be tempted of course to generalize this finding to behavior of managers in non-profit as well as for-profit firms. For the non-profit firms the result is immediate: allowing firms to rely on endowment funds for covering their possible deficit is economically detrimental to the incentives of a non-profit firm. This goes in line with the econometric findings in the literature (e.g. Fisman & Hubbard, 2003; Core, Guay & Verdi, 2006) yet goes of course a step further by formally proving the detrimental effects of large endowment funds for the incentives in non-profit firms.

So how about the for-profit firms? In Section 2 we presented the conjecture by Jensen and Easterbrook which says that excess free cash flow in hands of the managers entails agency costs in the form of excessive perquisites and investments in negative net present value projects. We are unfortunately at this point not able to prove that free cash flow acts exactly like deaccessioning (and/or endowment) funds in non-profit firms. We hadn't addressed all the different forms of negative effects of deaccessioning: do they lead to more perquisites on the side of managers (that appears to be the case) or do they lead to investments in negative net-present value projects, or perhaps even both? To account for this one would need to have a more specified basic model, including separate measures for all these effects. Yet we are able to say that if the free cash flow in for-profit firms acts in a manner as deaccessioning funds in our case, therefore if it is not included among the firm-value raising funds, yet could be spent to finance the possible deficit of the firm, then we are able to formally show (and have shown in this article) that this leads to adverse effects in terms of the agency costs.

7. EXTENSIONS OF THE MODEL

The model describes the situation in which there is a clearly specified relationship between principal and agent. In this way it improves on the model of Grossman and Hart who only use the optimization for the agent. Yet we specify manager's utility only in terms of his expected benefits from wage and disutility from effort. One could of course follow Grossman and Hart's logic further in specifying that the manager's utility depends also on bonding actions and value of the museum. In this way one would have to include in the manager's utility function also the utility from the value of museum (its revenues and most of all its endowment). As Grossman and Hart clearly state, the firm's market value is in the manager's own interest and therefore his utility function could (or should) be made dependent on the value of the museum. This would complicate the model further, yet would be more in line with original model and findings by Grossman and Hart.

Secondly, an apparent extension of the model would be to include the possibility of asymmetric information. One would expect that in the presence of deaccessioning, moral hazard problems would be extended and managers would tend to shirk to the expense of the principals and museum in general.

There are many other extensions that could be made to the specification of the principal-agent problem in our model. One could firstly argue about the choice of principal and agent. In one of the rare existing articles on principal-agent modeling in cultural economics Prieto-Rodriguez and Fernandez-Blanco (2006) consider the public agency (providing subsidies) to be the principal and the museum (or its board) to be the agent in museum financing decisions. One could also argue that museum has multiple principals: both the board of trustees as well as the donors can serve the role of principals. It would be interesting to include multiple principals (or even multiple agents) in our principal-agent problem following work of e.g. Bernheim & Whinston (1986), Li (1993), Martimort (1996), Waterman & Meier (1998) and Gailmard (2002), taking into account the externalities of one principal-agent relation for another principal-agent relation. One could furthermore argue that museums follow versatile objectives beside revenue maximization and are motivated by educational, aesthetic and other purposes as well. To this task, the extensions following Holmström and Milgrom's 1991 multitasking model would be most appropriate. One could also speculate that principal can follow a more general utility function and is not risk neutral as presupposed in our article. Yet we consider this observation would change nothing in the results of this paper which is demonstrated in the appendix.

One further extension of course concerns econometric evidence. Unfortunately the data on deaccessioning are not available presently in 990' non-profit organizations' forms, therefore an econometric study would be of only limited scope. One could of course try to gather the data by using questionnaires sent to museums. Still we consider that deaccessioning is considered as "barely legal" practice in American (and even more-so in other) museums, therefore the answers to questionnaires would be probably prone to a large non-response bias. Nevertheless, one would be able to show that excess endowment of museums in general contributes adversely to the benefit of the museum and positively to the perquisites of museum managers.

Another extension considers the solutions to the problems shown in the model. We were able to show the negative effects of deaccessioning to the incentives for managers in museums. One would be obliged to further explore if (and how) this problem could be prevented and if there is any mechanism to reduce the agency costs of allowing for deaccessioning. One would be tempted to use the literature in mechanism design theory to resolve this problem.

Finally, the proof in our article is still insufficient to prove the Jensen's agency costs of free cash flow conjecture for the case of for-profit firms. This question, therefore, remains open for future research, yet we believe the methods in our article should provide sufficient research directions for final solution to this problem in financial theory and theory of the firm.

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