Modeling the University Decision Process: The Effects of Faculty Participation in University Decision Making

Kathleen A. Carroll*, Lisa M. Dickson* and Jane E. Ruseski**

Abstract

This paper develops models of decision making in a university setting with and without faculty participation. The models predict values for the level of services or programs offered and the quality of those services in a university setting for either private nonprofit or public universities. These predictions indicate conditions under which outcomes are similar or differ with faculty participation in the decision process. The model predicts that without shared governance that universities may overinvest in non-academic quality (e.g. athletics, recreational activities). This would be exacerbated in for-profit forms of higher education. Notably, nonprofit and/or public institutions are not inefficient relative to for-profit institutions, which questions the rationale for subsidies to for-profit institutions. If academic quality provides positive externalities as has been suggested in the literature, then shared governance may be socially preferred to university decision making without faculty involvement.

Keywords: higher education, faculty governance, university decision making, incentives, nonprofit organization, public organization, organizational behavior

JEL classification: *D23,D73, I23,L31, L32*

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*Department of Economics, University of Maryland, Baltimore County (UMBC), 1000 Hilltop Circle, Baltimore, MD 21250, email: carroll@umbc.edu, ldickson@umbc.edu, respectively.
**Department of Economics, University of Alberta, HM Tory 9-24, Edmonton, AB T6G 2H4, Canada, email: ruseski@ualberta.ca.
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1. Introduction

Public and private nonprofit universities are currently experiencing serious budget problems. The budgetary problems stem in part from the current state of the economy that has negatively affected state appropriations, endowment values, and donations. In addition to the reductions in revenues from these sources, public and private nonprofit universities face increases in demand and increases in costs (Washburn, 2005; Zumeta, 1996). With increasingly scarce resources and greater demand for higher education services, each university must make critical decisions of how to accomplish its mission while making the best use of limited resources. In this study, we evaluate whether faculty involvement in university decision making (shared governance) affects a university's decisions over enrollment and investments in quality.

The university decision process involves either directly or indirectly multiple stakeholders and participants (See, for example, Morphew (1999); Davenport *et al* (2000); Birnbaum (2004); Pfeffer and Salancik, 2003; Hamilton, 2004; and Hermalin; 2004). External to an individual university are boards of trustees, donors and/or taxpayers, and governments; internal are the administration, faculty, students and staff. In this paper we focus on two parties relevant to internal decision making: the administration and the faculty. As mentioned in James (1990) and Tuckman and Chang (1990), faculty and administrators may have conflicting goals.[1] The faculty may wish to increase the academic quality of the university and may place this concern above all other concerns. The administration may be more focused on the revenue generating aspects of the university and in times of fiscal constraint may choose to focus on these aspects rather than potentially costly investments in academic quality. Given the different objectives of the faculty and the administration, it is possible that the university may make very different decisions according to the amount of influence the faculty has over university decisions concerning enrollment and investments.

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[1] For some discussion of differences in objectives, see Tuckman and Chang, 1990; Collis, 2004; Dudestadt, 2004; Birnbaum, 2004; Ehrenberg et al, 2004; Kaplan, 2004a; and Lohmann, 2004

In this study, we propose a model of university decision making that explicitly considers the individual objectives of administrators and faculty by assigning weights to each of the parties objective functions. The model explicitly considers decision making under three conditions: 1) sole administration decision making 2) shared governance with faculty participation in certain decisions and 3) equally shared governance. By analyzing the effects of faculty involvement in these three situations, we are able to isolate how investments in academic quality and nonacademic quality vary according to the level of faculty participation.

In the past few decades, college tuition has increased faster than inflation. This has led to concerns about why college costs are increasing and the types of investments that universities are currently making. Recently criticism has emerged that universities are spending large amounts of money on dormitories, athletic centers, and other amenities that are not directly related to the academic quality of the university (e.g. Hacker and Dreifus, 2010). This study demonstrates how faculty involvement in governance affects these types of investments in nonacademic quality. We also investigate how the current economic environment may affect university investments taking note of the fact that tight financial constraints tend to limit faculty governance (e,g, Morphew, 1999).

In section 2, we provide a review of the existing literature in both economics and education on university decision making. This review demonstrates the need for a behavioral theory that incorporates the interests of participants in the decision process. Following the literature review, we develop our models in section 3 and examine the theoretical predictions of the effects of faculty governance for university enrollment and quality. We develop theoretical policy implications in section 4 and policy implications in section 5. Concluding remarks are given in section 6.

2. Literature Review and Motivation

The economic literature on university decision making tends to focus on the university as an entity that maximizes a single institutional objective, such as the reputation of the university, rather than focusing on the objective functions of participants in the decision making process. While several

economic papers recognize that participants may have conflicting goals for the university, no formal behavioral model of shared governance currently exists in the literature. Within the education literature, most studies focus on the extent of shared governance exhibited at colleges and universities and methods to improve shared governance. While quantifying the extent of shared governance at colleges and universities is important, the current literature does not provide guidance as to how shared governance could affect university outcomes. Our paper fills the gap in both literatures by proposing a formal model of university decision making with and without shared governance. We then compare the outcomes for the university, such as levels of undergraduate or graduate enrollment or sponsored funding, under the different governance structures.

The education literature provides information on the extent of shared governance at universities and provides some reasons for why shared governance varies by institutions and over time. Three reasons given in the literature for why shared governance varies are: the support of the administration, the fiscal environment, and technological change. Miller (2001) finds that college presidents show some interest in shared governance but there seems to be a preference for limiting the role of faculty to certain issues, such as curriculum. The Center for Higher Education Policy Analysis (CHEPA) (2003) and Kaplan (2004a) both examine survey data and address questions on the functioning and effectiveness of shared governance, with similar results. Both CHEPA (2003) and Kaplan (2004a) find generally good faculty/administration relations. They also find, however, that to some degree faculty lacks confidence in the ability of the faculty senate to affect policy, particularly during times of fiscal constraint.

Morphew (1999) and Birnbaum (2004) focus on shared governance structures under changing environments. Morphew examines the implications of technological change and environmental change, particularly the fiscal environment, faced by colleges and universities. Both technological change and environmental change tend to limit the faculty's role in governance. Birnbaum's study expands on this idea by distinguishing between academic and market institutions, where "academic" refers to traditional not-for-profit educational institutions that may be either private or public, while "market" refers to institutions that are for-profit corporations. In the former, scholarship, inquiry, and learning are the focus,

whereas in the latter, offering training and earning profits are the focus. He states that speed and efficiency in decision making, of greater concern in the latter, may be reduced by faculty participation so that any increased emphasis on these due to external environmental pressure can serve to limit shared governance. Washburn (2005) and Zumeta (1996) support the view that technology and the fiscal environment can affect academic institutions' response to increasing demand and costs and imply a limit to shared governance, although somewhat differently than Morphew (1999) and Birnbaum (2004). Washburn demonstrates that the increasing role of university investment in laboratories to provide marketable patents through the participation of faculty research to this end, but not necessarily governance. Zumeta examines alternative policies for state higher education systems in the face of increased demand. He finds that a so-called market competitive policy where state policies incorporate the private sector and minimize regulation may be best suited to accommodate the higher demand for higher education. His work supports the implications of both Morphew (1999) and Birnbaum (2004) of limited faculty participation by focusing on producer's interests but his analysis differs in that its focus is on the role of the governing board.

The economics literature on universities typically assumes that universities are attempting to maximize the reputation of the university. This idea is developed in Garvin (1980). However, the university is made up of several different participants with possibly different goals. Tuckman and Chang (1990) provide a description of the participants at the university and for each of the participants their possible goals. Our study focuses on the interaction between two of the participants, faculty and administrators, and how that affects decision-making at a university. As mentioned in James (1990) and Tuckman and Chang (1990), faculty and administrators may have conflicting goals. Previously, Kaplan (2004b) focuses on the effects of shared governance on faculty workloads and pay. In our study, we focus on the effects of shared governance on university decisions over whether to invest in academic quality or nonacademic quality and on enrollment.

While the literature on shared governance in universities is lacking a formal theoretical model, several theoretical models from organizational behavior outside of higher education as well as those that

model some aspect of university decisions have implications for the effects of shared governance on outcomes. Hammond (1986) examines the relationship between agendas and hierarchy in organizations. His model demonstrates that organizational structures are similar to agendas, and that those who control the structure/agenda will determine the policy decision outcome. Although his paper does not specifically focus on decision making in higher education, his model has implications for the relevance of shared governance (or lack thereof) and decision outcomes in colleges and universities. Hammond (2004) formally models the organization of academic units in higher education to promote scholarship but is not concerned with shared governance. Wilson (2004) analyzes the effects of decision structure by comparing central management and decentralized (departmental) decision structures in organizations of higher education. He finds that central budgeting is superior (that is, more efficient) to decentralization due to interdepartmental competition. He notes, however, that this result may be based on the assumed form of unit compensation and the problem of externalities, such as student majors' taking courses from other departments, and ignores information asymmetries. He also notes that there may be differential effects on research and teaching under centralized and decentralized decision structures.

Our review of the literature shows an absence of a behavioral theory of shared governance. We fill this gap by modeling university decision making both with and without shared governance by faculty. Building on the information in Tuckman and Chang (1990) and James (1990), we develop utility functions for administrators and faculty. We then analyze how choices about enrollment and investments vary according to whether faculty can influence the decision making process. Since the education literature stresses that the amount of shared governance may be limited under times of financial distress, we analyze the outcomes under a break-even constraint. The break-even constraint is also mentioned in James (1990). We also analyze the effects of shared governance under an academic quality constraint. Our models are developed fully below.

3. A Model of Decision Making in Institutions of Higher Education

The decision makers in our models are the university administrators (*AD*) and faculty (*F*); university enrollment (*E*) may consist of two possible student types, undergraduates (*UG*) and graduates (*G*), the latter includes those seeking either a masters degree or the Ph.D., where $E = UG + G$. Enrollment is assumed to depend on price (*P*) for each student type and institutional quality (*Q*), so that $E = E(P, Q)$. The price (*P*) to the student of educational services at any institution is tuition + fees + other costs – financial aid, where other costs may include residential and/or transportation costs, books and supplies, etc. Tuition, other costs, and financial aid may be determined outside of the university itself. For example, the university board or state legislatures may determine or explicitly affect the level of tuition. Therefore, for our purposes here price (*P*) is considered as exogenous in the decision process.

Quality (*Q*) of an institution of higher education is composed of two components, academic (*AQ*), reflected in the level and offerings of program, curriculum, faculty, etc., and/or nonacademic (*NQ*), such as the quality of athletic teams or student activity facilities; $Q = (AQ, NQ)$. We assume that undergraduate enrollment responds to its price and both academic and nonacademic quality: $UG = UG(P_U, Q)$. Graduate student enrollment responds to its price and the level of academic quality: $G = G(P_G, AQ)$. Sponsored funds (*S*) may be obtained through a number of sources, such as donations, grants, and/or appropriations. Sponsored funds are assumed to depend on institutional quality through the ability to obtain funding for academic research and programs, nonacademic programs, and capital (buildings). The ability to raise sponsored funds depends on sources from the public sector (government grants, appropriations) and the private sector (foundation grants, donations, such as from alumni). Therefore the ability to obtain sponsored funding for the institution is affected by both academic and nonacademic quality of the institution: $S = S(Q)$.

Optimal (efficient) values of enrollment (E_{opt}), quality (Q_{opt}), and sponsored funding (S_{opt}) are defined as the level of each that maximizes net social benefits, represented by net revenues to institutional stakeholders/principals. For example, the stakeholders/principals of a university may be the boards of trustees, acting on behalf of the contributors for private nonprofit institutions or the taxpayers for public institutions. There is a literature on shared governance with respect to external boards, such as through

board composition and representation, but this literature does not consider the internal decision process of the university (see, for example, Toma (1986, 1990), Zumeta (1996), Hermalin (2004), Heller (2004) and Hamilton (2004)).

We propose that the size of the institution is defined by student enrollment at all levels, and that university revenue is obtained through enrollment of all student types and through sponsored funds, such as donations, grants, and appropriations. Thus, while revenue is a direct function of student enrollment and sponsored funds, it is an indirect function of quality. The revenue function for a university is therefore given as

$$R = R[UG(P_{UG},Q), G(P_G, AQ), S(Q)] = R[E(P,Q), S(Q)]. \quad (1)$$

Cost to the institution is the cost of providing student related services, the cost of providing a given level of quality services, and the cost to obtain sponsored funds, such as marketing costs and faculty and staff time. Thus, cost is a direct function of student enrollment and generating sponsored funds. Quality, however, affects cost both directly and indirectly through its ability to affect enrollment and sponsored funds. The total cost function for a college or university is therefore given as

$$C = C[UG(P_{UG},Q), G(P_G, AQ), S(Q), Q] = C[E(P,Q), S(Q), Q], \quad (2)$$

where C = total cost and the other variables are as defined above.

Our model assumes homogeneous educational services per enrollment type and some given level of minimum required quality of educational service $(\overline{Q})$, such as that required for accreditation for nonprofit private and public institutions, as well as available physical capacity to meet enrollment goals. We assume the usual diminishing marginal revenue and diminishing marginal utility (U) with constant or increasing cost. Thus, for any function $R(E,Q,S)$, $U(E,Q,S)$, $C(E,Q,S)$, we assume: $R_i' > 0$, $U_i' > 0$, $C_i' > 0$, where prime notation denotes first derivatives, $i = E, Q, S$; and $R_i'' \leq 0$, $U_i'' \leq 0$, and $C_i'' \geq 0$, where double prime notation denotes second derivatives and the subscript i is as defined above. We assume an

imperfectly competitive market for the services of higher education, so that an individual institution has some market power and faces a downward sloping demand for its specific educational services.

A Model of Shared Governance in University Decision Making

For a university, the administrators or decision makers for the institution are taken here to be the president and provosts for academic and business affairs. The assumed institutional objective for our model of administrative decision making in a nonprofit university is the maximization of institutional revenue for a given required standard of quality and available sponsored funds, subject to the breakeven constraint that revenue at least cover cost of providing university services [(see, for example, Kaplan (2004a, 2004b, Keller, 2004, Washburn, 2005)].[2] Maximum revenue is obtained through enrollment at all levels and through sponsored funds, such as donations, grants, and appropriations. The administrators maximize their utility and are assumed to obtain utility from increased income, reputation, and social standing. These sources of satisfaction to administrators depend on the size and/or prestige of the institution, which depend on its success in achieving its educational and research mission and its public profile. Coates and Humphreys (2002) provide some evidence for this in their work. They empirically demonstrated the preferences of university presidents or academic provosts by examining the relationship between their tenure in office and changes in academic programs. As noted above, the literature on decision making in institutions of higher education indicate that to achieve their goals the primary focus of the administration is on revenue and the budget of the institution.

We propose here that the measure of revenue reflects the sources of utility to the administration. Accordingly, the objective of the administration in higher education in our model to maximize utility is consistent with the institutional objective of maximizing institutional revenue, where undergraduate and graduate enrollment, institutional academic and nonacademic quality, and sponsored funding are now variable. The administration's utility function is therefore given as:

[2] Zemsky, Wegner and Massy (2005) assert that universities seek "to maximize mission attainment," which they define as the production of high quality education, research and public service (p. 59). We propose that seeking maximum revenue is consistent with this and has the advantage of measurability.

$$\max U_{AD} = \max U_{AD}\{R[E(P,Q), S(Q)]\} = \max R[E(P,Q), S(Q)]$$

$$= \max R[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ)] \quad (3)$$

We propose that faculty obtain utility from income and academic reputation and prestige, primarily through publishable research. These are assumed to increase with having graduate programs that provide teaching and research assistants, academic quality that promotes this enrollment, sponsored funding and other sources of support for research. The role of faculty in shared governance has been primarily concerned with the academic aspects of the university rather than with its financial aspects, and in particular, with workload (see, for example, Kaplan, 2004a and Dudestadt, 2004). Accordingly, the assumed objective of faculty is to maximize utility, U_F, given as

$$\max U_F, = U_F[G(P_G, AQ), AQ, S(AQ, NQ)]. \quad (4)$$

Both the administration and faculty face an institutional breakeven constraint and constraints on quality; assuming that class sizes can be increased and facilities uses altered over time, no long run capacity constraint is imposed. The decision constraints are therefore stated as:

$$R[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ)]$$

$$- C[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ), AQ, NQ] - k_1 \geq 0,$$

$$Q_j \geq \overline{Q}, \text{ or } Q_j - \overline{Q} - k_2 = 0, \; j = AQ, NQ, \text{ and}$$

$$k_\gamma \text{ is a slack variable, } k_\gamma \geq 0, \; \gamma = 1, 2. \quad (5)$$

The levels of undergraduate and graduate enrollment, *UG*, and *G*, the levels of academic and nonacademic quality, *AQ*, and *NQ*, and sponsored funding, *S*, that likely would result depend on the relative weights of the objectives of the university administration and the faculty.[3] The relative weight

[3] Birnbaum (2004, p. 5) and Collis (2004, p. 37) specifically note the existence and weights of multiple objectives of participants in the decision process within the university. Zemsky, Wegner and Massy (2005, p. 63) note that different weights may be applied by single or multiple decision makers on the attributes of a decision.

indicates the ability of faculty to influence the allocation of resources toward those that promote faculty interests, such as opportunities to increase publishable research. This suggests that the amount of shared governance at a university directly affects university investments.

Formally, the decision process can be modeled as a multiple objective optimization problem using a weighting method, where w_{AD} = weight on the administrative objective and w_F = weight on the faculty's objective. As noted in the literature, the relative weights vary by institution. For example, for an institution with essentially no shared governance, $w_F = 0$; the value of w_F increases as faculty have a greater role in the decision process. The objective function for the multiobjective decision problem is given as:

$$\max Z(UG, G, AQ, NQ, S,) = \max [U_{AD}, U_F]$$

$$= \max [R(UG, G, AQ, NQ, S), U_F(G, AQ, S)]. \quad (6)$$

When weighted, Z becomes a function of the variables and the weights, so that (6) becomes

$$\max Z(UG, G, AQ, NQ, S, w_i) = \max [w_{AD}U_{AD}, w_F U_F], \quad i = AD, F$$

$$= \max \{R(UG, G, AQ, NQ, S) + w[U_F(G, AQ, S)]\},$$

where $w = \frac{w_F}{w_{AD}}$, so that when written out in full, this is given as

$$\max Z(UG, G, AQ, NQ, S, w)$$

$$= \max \{R[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ)]$$

$$+ w[U_F(G(P_G, AQ), AQ, S(AQ ,NQ)]\} \quad (6a)$$

subject to

$$R[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ)]$$

$$- C[UG(P_{UG},AQ, NQ), G(P_G,AQ), S(AQ, NQ), AQ, NQ] - k_1 \geq 0,$$

$Q_j \geq \overline{Q}$, or $Q_j - \overline{Q} - k_2 = 0$, $j = AQ, NQ$, and

$k_\gamma \geq 0$, $\gamma = 1, 2$. (6b)

The corresponding Lagrangian to be maximized is

$$\max \psi(UG, G, AQ, NQ, S, w)$$

$$= \max \{R[UG(P_{UG}, AQ, NQ), G(P_G, AQ), S(AQ, NQ)]$$

$$+ w[U_F(G(P_G, AQ), AQ, S(Q_{AQ}, Q_{NQ})]\}$$

$$- \lambda_1(R[UG(P_{UG}, AQ, NQ), G(P_G, AQ), S(AQ, NQ)]$$

$$- C[UG(P_{UG}, AQ, NQ), G(P_G, AQ), S(AQ, NQ), AQ, NQ] - k_1)$$

$$- \lambda_2(AQ - \overline{AQ} - k_2)$$

$$- \lambda_3(NQ - \overline{NQ} - k_3)\} \quad (7)$$

where λ_1, λ_2 and λ_3 are Lagrange multipliers. The first order conditions for the Lagrangian with respect to the choice variables are:

$$\frac{\partial \psi}{\partial UG} = R'_{UG} - \lambda_1(R'_{UG} - C'_{UG}) = 0 \quad (7a)$$

$$\frac{\partial \psi}{\partial G} = R'_G + wU'_{FG} - \lambda_1(R'_G - C'_G) = 0 \quad (7b)$$

$$\frac{\partial \psi}{\partial AQ} = R'_{UG}UG'_{AQ} + R'_G G'_{AQ} + R'_S S'_{AQ} + wU'_{FG}G'_{AQ} + wU'_{FAQ} + wU'_{FS}S'_{AQ}$$

$$- \lambda_1\left(R'_{UG}UG'_{AQ} + R'_G G'_{AQ} + R'_S S'_{AQ} - C'_{UG}UG'_{AQ} - C'_G G'_{AQ} - C'_S S'_{AQ} - C'_{AQ}\right)$$

$$- \lambda_2 = 0 \quad (7c)$$

$$\frac{\partial \psi}{\partial NQ} = R'_{UG}UG'_{NQ} + R'_S S'_{NQ} + wU'_{FS}S'_{NQ}$$

$$-\lambda_1\left(R_{UG}^{'}UG_{NQ}^{'}+R_S^{'}S_{NQ}^{'}-C_{UG}^{'}UG_{NQ}^{'}-C_S^{'}S_{NQ}^{'}-C_{NQ}^{'}\right)-\lambda_3=0 \quad (7d)$$

$$\frac{\partial\psi}{\partial S}=R_S^{'}+wU_{FS}^{'}-\lambda_1\left(R_S^{'}-C_S^{'}\right)=0 \quad (7e)$$

These yield behavioral predictions for different levels of shared governance, that is, different values of *w*. We derive predictions in each case for two scenarios: binding fiscal and quality constraints and when those constraints are not binding. Constraints may be externally imposed for a number of reasons. These include those that may originate as a result of market or macroeconomic conditions or political conditions, such as by state legislatures. In some cases private contributors may also impose conditions that may serve to act as constraints on choices in the university.

Predictions developed below are summarized in Table 1. Proofs of derivations are provided in the appendix.

Administration control: No shared governance (w = 0)

The weight takes on a value of zero when decisions are made exclusively by the administration, with no role in the decision process by faculty. This is consistent with Hammond (2004), which does not focus on shared governance, but instead has the role of faculty as "employees" or "subordinates," that is, agents who carry out the policies of the administration, something completely at odds with faculty participation in decision making.

I. Binding breakeven constraint (tight financial constraints)

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): Under required breakeven conditions, when the utility (revenue) maximizing administration is the sole decision maker, administrators are unable to influence or increase these beyond the socially optimal level that maximizes institutional net benefits (as measured by net revenue): $UG = UG_{opt}$, $G = G_{opt}$, and $S = S_{opt}$.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that decisions made solely by administration result in the revenue maximizing level and consequent overinvestment in both *AQ* and *NQ*, that is, $AQ_R > AQ_{opt} \geq \overline{AQ}$ and $NQ_R > NQ_{opt} \geq \overline{NQ}$. We note also that while the revenue from additional quality has only an *implicit* component, the cost of additional quality has both an *implicit* and *explicit* component. The implicit cost component reflects the forms of academic (or nonacademic) quality which are more visible and which serve to promote enrollment (both *UG* and *G*) and sponsored funding, *S*. The explicit cost component reflects other forms of academic (or nonacademic) quality which are less visible and therefore tend not to affect either enrollment or sponsored funding levels. When both the breakeven and quality constraints are binding, the level of investment in implicit *AQ* depends on the level of the marginal cost of explicit quality. *AQ* is optimal when marginal explicit cost has a value of 1, above optimal when the marginal explicit cost of quality is less than 1, and below optimal when marginal explicit cost exceeds a value of 1. Thus, for the most likely case of a value greater than 1, the model predicts that revenue maximization by the administration results in underinvestment in implicit *AQ*: $AQ_{UG,G,S} < AQ_{opt}$. In this case, investment in academic quality specifically to increase undergraduate or graduate enrollment or sponsored funding is below optimal levels.

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): The model predicts that under no shared governance a revenue maximizing administration results in optimal investment in *AQ* or *NQ*. There is, however, investment in the implicit forms of both *AQ* and *NQ* is optimal only if the marginal cost of explicit quality is zero; otherwise implicit *AQ* and *NQ* are below optimal levels. Thus the model predicts that investment in these forms of quality are likely too low under administration decision control.

II. Nonbinding breakeven constraint (potential deficit conditions)

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): If the university operates at a deficit for any period of time, then the model predicts that with administration control, undergraduate enrollment (*UG*), graduate enrollment (*G*), and sponsored funding (*S*) are at the revenue

maximizing levels. Therefore, each component of enrollment and the level of sponsored funding all exceed the socially optimal levels: $UG = UG_R > UG_{opt}$, $G = G_R > G_{opt}$ and $S = S_R > S_{opt}$. The above optimal enrollments and sponsored funding may be a strategy to move the university toward a breakeven level. Alternatively, above optimal enrollment may contribute to the university deficit situation by increasing costs. In this situation fiscal constraint may move the university closer to socially optimal undergraduate and graduate enrollment as well as sponsored funding levels by limiting upward pressure on costs.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that decisions made solely by the administration yield the minimum required standards of academic quality and nonacademic quality: $AQ = \overline{AQ}$ and $NQ = \overline{NQ}$. The administration therefore has no ability to influence the level of *AQ* under a binding quality constraint even under deficit conditions.

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): When both the breakeven and quality constraints are not binding, administration decision control ($w = 0$) yields the revenue maximizing levels and consequent overinvestment in both *AQ* and *NQ*. This implies that the minimum quality standard is below optimal ($\overline{AQ} < AQ_{opt} < AQ_R$) and the nonbinding quality constraint may be used by the administration to seek additional funding (implicitly through increased enrollment, both *UG* and *G*, and increased sponsored funding, *S*) in order to meet its revenue maximizing objective.

Equally shared governance (w = 1)

I. *Binding breakeven constraint (tight financial constraints)*

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): Under required breakeven conditions, when the revenue maximizing administration and utility maximizing faculty equally participate in the decision process, neither can influence or increase these above the socially

optimal level that maximizes institutional net benefits (as measured by net revenue) $UG = UG_{opt}$, $G = G_{opt}$, and $S = S_{opt}$.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that decisions made with equal participation by the administration and the faculty in shared governance yield the same results as if there were no faculty participation ($w = 0$). Thus equally shared governance results in revenue maximizing levels, that is, overinvestment in both *AQ* and *NQ*, where $AQ > AQ_{opt} \geq \overline{AQ}$ and $NQ > NQ_{opt} \geq \overline{NQ}$. As before, the distinction between implicit quality and explicit quality play a role in the predicted investment levels of academic quality (*AQ*). When both the breakeven and quality constraints are binding, the level of investment in implicit *AQ* depends on the level of the marginal cost of explicit quality. The model predicts that when the additional cost of explicit quality exceeds a value of 1, equally shared governance of the administration with the faculty results in underinvestment in implicit *AQ*: $AQ_{UG,G,S} < AQ_{opt}$. Investment in academic quality designed specifically to promote undergraduate or graduate enrollment or sponsored funding is below optimal levels.

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): The model predicts that under conditions of equally shared governance a revenue maximizing administration together with a utility maximizing faculty together choose optimal investment in *AQ* or *NQ*. As with sole administration control, in this case as well investment in the implicit forms of both *AQ* and *NQ* is optimal only if the marginal cost of explicit quality is zero; otherwise implicit *AQ* and *NQ* are below optimal levels. Thus the model predicts that $AQ < AQ_{opt}$ and $NQ < NQ_{opt}$, i.e., the levels of investment in both academic and nonacademic quality are likely to too low under equally shared governance.

II. Nonbinding breakeven constraint (potential deficit conditions)

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): The model predicts that if the university need not break even, with decision control equally shared by the

administration and faculty, undergraduate enrollment (*UG*) is above optimal and at the revenue maximizing level, while graduate enrollment (*G*), and sponsored funding (*S*) are above optimal but below the revenue maximizing levels. Thus, $UG = UG_R > UG_{opt}$, $G = G_R > G_{opt}$ and $S = S_R > S_{opt}$. As with sole administration decision control, the above optimal enrollments and sponsored funding may be a strategy to move the university toward a breakeven level. Alternatively, above optimal enrollment may contribute to the university deficit situation. We predict two possible effects. One is that fiscal constraint may move the university closer to socially optimal undergraduate and graduate enrollment as well as sponsored funding levels. The other is that even without imposed fiscal constraints, participation of faculty in the decision process through equally shared governance can correct at least some of the overinvestment by the administration in graduate enrollment and sponsored funding.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that decisions under equally shared governance of the administration and faculty result in the minimum acceptable standard levels of academic and nonacademic quality, that is, $AQ = \overline{AQ}$ and $NQ = \overline{NQ}$. The model predicts, therefore, that partial and even equal participation of faculty with the administration in the decision process has no influence on the level of *AQ* or *NQ* under a binding quality constraint even under deficit conditions.

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): Decision making related to *AQ* or *NQ* that is shared by faculty and the administration is more complex with no binding quality constraint. In the case of equal weights in the decision process ($w = 1$) we find different effects for *AQ* and *NQ*. For academic quality, the model predicts that the level of investment in implicit forms of *AQ* chosen by the administration to increase enrollment (*UG* and *G*) and sponsored funding (*S*) is smaller than either the level that would be chosen by faculty to increase only *G* and *S* or the level that would generate explicit benefits for faculty. Therefore, our model predicts that when faculty have equal weight in the decision

process with the administration, faculty participation increases investment for either of these purposes relative to the level that the administration would choose

For nonacademic quality, the model predicts the reverse. With equal participation by faculty and the administration in decision making, the model yields the result that for implicit forms of nonacademic quality designed to increase both *UG* and *S* for the interests of the administration, $NQ = NQ_R > NQ_{opt}$ and $NQ_R > NQ_F$. This indicates that for purposes of expanding revenue from undergraduate enrollment (sponsored funding), the administration invests in a greater level of *NQ* than would be chosen by the faculty. Because revenue maximizing administrators overinvest in *NQ*, the model predicts that an equal weight in faculty participation serves to reduce this overinvestment and move *NQ* closer to the optimal level.

Faculty control (w = ∞)

I. *Binding breakeven constraint (tight financial constraints)*

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): Even when the utility maximizing faculty control the decision process, a requirement to at least break even indicates that faculty cannot influence or increase these above the socially optimal level that maximizes institutional net benefits (as measured by net revenue) $UG = UG_{opt}$, $G = G_{opt}$, and $S = S_{opt}$.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that when decisions on quality are controlled by the faculty, the level of investment in *AQ* depends on the value of the faculty's marginal utility of *AQ (or* NQ*)*. Either form of quality is optimal if marginal utility takes on a value of 1; it is below optimal if marginal utility exceeds a value of 1. However, with faculty in full control neither of these is likely. Alternatively, *AQ* (or *NQ*) is above optimal for marginal utility less than 1. Thus, at the faculty's utility maximizing level of academic quality where marginal utility is 0, $AQ_{Umax} > AQ_{opt}$ and $NQ_{Umax} > NQ_{opt}$

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): The model predicts that with faculty in control of decisions on academic or nonacademic quality, utility maximization by faculty, when marginal utility is 0, results in optimal *AQ* and *NQ*. Thus, even with a binding breakeven constraint, if there is no binding quality constraint faculty preferences reflect social preferences for academic quality. We note, however, that in the situation of a binding breakeven constraint, regardless of whether or not the quality constraints are binding, faculty cannot influence the level of either academic or nonacademic quality unless they have full control of decision making over that component of quality.

II. Nonbinding breakeven constraint (potential deficit conditions)

Undergraduate enrollment (*UG*), Graduate enrollment (*G*) and Sponsored funding (*S*): If the university may operate at a deficit for any period of time, then undergraduate enrollment (*UG*), graduate enrollment (*G*), and sponsored funding (*S*) are each greater than the optimal levels. In a university setting where graduate students are the primary contributors to faculty research, the utility maximizing faculty will not influence undergraduate enrollment, and the level will be determined by administration policy (i.e., the revenue maximizing level). However, when faculty has influence with control in decision making, both graduate enrollment (*G*) and sponsored funding (*S*) are affected. In particular, two effects are predicted. When faculty control decisions related to graduate enrollment (*G*) or investment in academic quality for the purpose of increased sponsored funding (*S*), then the number of graduate students and the level of sponsored funding are greater than their corresponding revenue maximizing levels. The faculty choose the levels that maximize faculty utility. In this situation $G = G_F > G_R > G_{opt}$ and $S = S_F > S_R > S_{opt}$.

Academic and Nonacademic quality (*AQ*) and (*NQ*):

Binding quality constraint ($AQ \geq \overline{AQ}$ or $NQ \geq \overline{NQ}$): The model predicts that with a binding quality constraint faculty that have decision control choose the revenue maximizing levels of academic and nonacademic quality, where $AQ_R > AQ_{opt}$ and $NQ_R > NQ_{opt}$. While this may seem counterintuitive, it seems that with full faculty control, this result indicates that faculty preferences can be consistent with

revenue maximization under some circumstances, such as when a quality constraint is enforced. There are some differences, however, in these predictions. This outcome under a binding quality constraint differs from that when the administration is solely in control, which led to the minimum acceptable standard of quality ($AQ_R = \overline{AQ}$ or $NQ_R \geq \overline{NQ}$), i.e., the lower level of the imposed constraint. Faculty, on the other hand, will choose levels of quality above the minimum acceptable level ($AQ_F \geq \overline{AQ}$ or $NQ_F \geq \overline{NQ}$), those that at the same time would increase revenue to the university when the breakeven constraint is not binding.

Nonbinding quality constraint ($AQ < \overline{AQ}$ or $NQ < \overline{NQ}$): With faculty decision control, faculty will choose the levels of academic and nonacademic quality that maximize their utility. In this situation, the predicted outcome is utility maximizing levels of quality that exceed both the optimal level and the revenue maximizing level. Thus, the model predicts $AQ_F > AQ_R > AQ_{opt}$ and $NQ_F > NQ_R > NQ_{opt}$.

4. Behavioral Implications

Our model is based on a decision process that involves objectives of revenue and utility maximization, and yield testable predictions. Even under these objectives, the model indicates that when universities are required to at least cover their costs, that the decisions on undergraduate and graduate enrollments, academic and nonacademic quality, and sponsored funding yield socially optimal outcomes except under certain specific conditions that yield implications for investment of university resources. In addition, in a university setting faculty involvement in the decision process can affect the levels of graduate enrollments (G), academic quality (AQ) and nonacademic quality (NQ), and sponsored funding (S), while decisions that affect undergraduate enrollments (UG) are based on revenue considerations by the administration. In addition, our model shows that the effects on AQ and on NQ are quite different when decision making involves the faculty than when it does not.

One implication of our model concerns the level of investment in academic quality (AQ) and nonacademic quality (NQ) under sole administration decision making ($w = 0$) or equally shared

governance ($w = 1$) when both breakeven and quality constraints are binding. In these cases, there is overinvestment in *AQ* and *NQ*. Optimal investment in academic and nonacademic quality designed to enhance enrollment and sponsored funding (i.e., implicit *AQ* and *NQ*) results under only one specific condition. This condition requires that the marginal cost of increasing quality for purposes *other than* increasing enrollment and sponsored funding (i.e., explicit marginal cost of quality $C'_{\exp}$, has a value of 1).

Explicit cost most likely reflects forms of academic or nonacademic quality that are less visible forms than those promoted to increase enrollment or sponsored funding. Examples of these explicit costs of quality are investments in roofing, increased energy efficiency measures, certain aspects of faculty quality, etc., that is, intangibles that may improve the campus life and environment as well as the educational experience. Investments of these forms of quality may go unnoticed by either potential students or donors, and therefore not increase either enrollment or sponsored funding. We find that when budgets must be balanced or there are tight financial concerns with a deficit, if the cost of quality has both implicit and explicit components, then only if the additional cost of the latter equals a value of 1 will investment in the implicit forms of *AQ* and *NQ* to generate enrollment and funding be optimal. Otherwise, when the administration controls decisions, there is too little investment in these forms of quality.

A second implication of our model of shared governance concerns the level of investment in academic quality (*AQ*) and nonacademic quality (*NQ*) also when both breakeven and quality constraints are binding. The model shows that the overinvestment in *AQ* or *NQ* results more from decisions made by the administration ($w = 0$) than from those made by faculty ($w = \infty$).

We note that this result can occur when the breakeven constraint is not in effect; however, the level of overinvestment by both parties in this case depends on the relative roles of administration ($w \to 0$) and faculty ($w \to \infty$) in the decision process and the strength of the quality constraint. For example, our findings show that in the case when neither the breakeven nor the quality constraint is

binding, investment in AQ is higher when the decision process is driven by faculty ($w \geq 1$); alternatively, NQ investment is higher when the administration exerts greater control in the decision process ($w = 0$).

These results suggest that with shared governance of a utility (revenue) maximizing administration and utility maximizing faculty, both *AQ* and *NQ* take on additional importance in the decision making process. However, this would occur for nonacademic quality (*NQ*) to different degrees by the administration and by faculty, whose interest in *NQ* is primarily to increase the potential for sponsored funding for their research, so it is much smaller. In particular, an implication of our findings is that for *NQ*, aspects of universities such as facilities available for student extracurricular activities, or athletic resources and facilities, or investment in physical plant and grounds will be increased relative to those resources that would be used for academic quality (*AQ*). The result of above optimal investment in *NQ* suggests that administrators who seek maximum revenue focus more on the nonacademic component of quality. We find that with neither breakeven nor binding constraints faculty participation (either equally or in full) in the decision process reduces overinvestment in NQ and by doing so increases efficiency in resource allocation within the university.

A third behavioral implication of administration decision control ($w = 0$) is that under investment in *AQ* and *NQ* results under deficit conditions with a binding quality constraint. Moving from breakeven even to deficit therefore reverses the investment behavior of the administration with respect to both types of quality. In this case the deficit condition may drive *AQ* or *NQ* from the efficient level to the minimum acceptable standard. This result may reflect a cost saving strategy by the administration. Alternatively, if faculty control quality decisions, investment in either *AQ* or *NQ* is above the minimum standard and is the level that maximizes university revenue. This indicates that faculty in deficit situations, in seeking to satisfy their own preferences, can choose an outcome that is consistent with preferences of a revenue maximizing administration.

In a possible deficit situation but with no quality constraint, a fourth implication of our model is that under either sole administration control ($w = 0$) or equally shared control with faculty ($w = 1$), that

neither faculty nor the administration have an ability to affect investment in *AQ* or *NQ* above the minimum acceptable standard, so that $AQ = \overline{AQ}$ and $NQ = \overline{NQ}$. The one exception occurs in implicit *AQ* and *NQ*, the forms that are designed specifically to increase enrollment and sponsored funding. In this case the administration, with or without equally shared governance, underinvests in implicit *AQ* relative to the socially optimal level. However, faculty control ($w = \infty$) of the decisions on *AQ* serves to correct that and move investment in *AQ* toward the socially optimal level.

A fifth implication of our findings is that, in general, when the university is not breaking even, investment is greater than optimal in enrollment (*UG* and *G*), quality (*AQ* and *NQ*), and sponsored funding (*S*), although the effects vary with and without faculty participation. With no faculty participation ($w = 0$), when the breakeven requirement does not hold the administration's investment in *UG* and *G*, *AQ* and *NQ*, and *S* are each greater than optimal. Faculty participation in the decision process may increase graduate enrollment (*G*) and academic quality (*AQ*). However, the extent of these effects depends on the degree of faculty participation, and, for *AQ* in particular, the degree of the quality constraint and motivation. For example, overinvestment in AQ could result from an emphasis by the administration on academic quality that is primarily limited to undergraduates which may have the unintended consequence of adversely affecting research levels. Alternatively, faculty, having a personal as well as institutional interest in research, may focus more on the benefits of academic quality of the institution in and of itself as a way to promote this. And as noted earlier, faculty participation in university decision making may serve to reduce the inefficient effects of overinvestment in nonacademic quality (*NQ*) by the administration.

These findings suggest that in periods of not breaking even, overinvestment in sponsored funding (*S*) may be a response by the administration, and possibly by faculty due to pressure from the administration, to solve the deficit problem. The causal relationship between deficit situations and both enrollment and quality is less clear. It is possible that overinvestment in enrollment, particularly graduate enrollment, and quality may be a response like that in the case of sponsored funding, that is, a way to

increase revenues to help close the deficit. This could be the case if university revenues are in some way tied to enrollment levels, for example, or if the increased quality is a means to increase sponsored funding as a revenue source. Our findings could explain situations where university administrators put increasing pressure on faculty to seek external funding and to develop graduate programs and increase graduate enrollment with its associated higher revenues. Alternatively, it is possible that the overinvestment in both enrollment and quality may be a source of the deficit situation rather than a strategy to reduce it. In this case, faculty participation that may reduce overinvestment in nonacademic quality may help to reduce any potential deficit.

Thus, faculty participation in decision making has some influence that may increase graduate enrollment and sponsored funding. This suggests that both graduate enrollment and sponsored funding may provide revenue sources that may offset revenue shortfalls, through higher graduate tuition and the increased sponsored funding that may also underwrite some increased graduate enrollment. Participation of faculty through shared governance therefore suggests that even in periods of fiscal restraint, quality may be increased. This may be true in part due to faculty effects on graduate enrollment and sponsored funding which may be sources of providing or funding higher quality, unless there is an exogenously imposed quality constraint.

5. Policy Implications

Our model yields implications for both internal university policy and public policy that relate the participation of faculty in university decisions to the efficiency of investments choices and specific conditions that may affect these choices. First, while we examine only the private nonprofit or public universities where the goal is to maximize revenue and/or utility rather than profit, we find that under the breakeven condition, the model predicts optimal results in most cases. This questions the notion that these organizational forms are inherently inefficient, particularly in times of fiscal restraint. There are two points to consider in this respect. One is that the divergence of these forms from the for-profit form may be a source of efficiency. Recall Birnbaum's (2004) findings that nonprofit and public forms of

higher education focus on scholarship, while for-profit forms focus on training. Our findings that in certain circumstances revenue-maximizing decisions underinvest in forms of academic quality and overinvest in forms of nonacademic quality are consistent with his findings. In particular, for-profit institutions of higher education typically employ faculty who have primary positions elsewhere and most certainly put a low, if any, weight on faculty participation in internal decisions on resource allocation, which suggests that their investments in academic quality may be below optimal.

The second point on organizational form is that the relative efficiency of nonprofit and public versus for-profit forms of organization can take the opposite tack and focus on the possible convergence of these forms. The issue of convergence has become increasingly important in higher education and other services. Much of the literature suggests that convergencemay be due to increasing competition from for-profit institutions or from change in the technology of providing university services (Levy (1987); Powell and Friedkin (1987); Munitz, 2000; Rosenau, P. V. (2003); Pusser and Turner, 2004; and Kaplan, 2004a). An exception to this reasoning is Carroll and Ruseski (forthcoming) who demonstrate that in hospitals, when the internal decision process is considered, an alternative rationale for observed convergence may be for-profits becoming more like nonprofits.

Our findings of efficiency in both nonprofit and public institutions of higher education call into question the efficiency rationale policies that promote homogeneity across organizational form. This may apply to both internal university policies as well as public policy. Internal policies of nonprofit and public university administrations that attempt to promote a business or corporate model that views students and parents as customers and focuses on increased mass-production of university educational services may be ignoring or devaluing the social benefits of divergence in institutional form (see Washburn (2005) and Zemsky, Wegner and Massy (2005) for example). For public policy, it would be useful to examine the extent to which state and federal subsidies to for-profit institutions of higher education promote social preferences and efficiency across different models of higher education in the public and nonprofit sectors, for example, the traditional versus corporate models.

Second, our findings that in some circumstances the revenue enhancing aspects of quality, and in particular, nonacademic quality, in institutions of higher education may be optimal, while other less visible forms or purposes of quality may be subject to underinvestment, suggests one of two things. Either these other forms or purposes are more socially desirable to those who value university services (i.e., students and sponsors), or they are less socially desirable but fulfill the objectives of the decision makers and are emphasized in the decision process. If the former case is correct, investment in nonacademic quality could be promoted and incentives could be put in place to do so. If the latter case is correct, however, this would reflect a situation where resources are diverted from meeting society's preferences to meeting those of the administrators to enhance revenue. This would be consistent with Lindsay's (1976) theory that focusing on so-called visible attributes of providing a service is a strategy for increasing revenue and budgets. In this case investment in nonacademic forms of quality should not be promoted, or at least promoted less heavily. Tax or subsidy policies could be targeted to limit these applications.

Third, our findings on the effects of shared governance with respect to quality are twofold. We find that in periods of tight financial constraints with an additionally imposed quality constraint administration decision making results in overinvestment in total academic quality but underinvestment in those forms of *AQ* that increase enrollment and sponsored funding. Faculty participation works in two ways in this case. It may increase or maintain the overinvestment in total academic quality; and it may correct the underinvestment by the administration in forms of *AQ* that increase graduate enrollment and sponsored funding. Faculty preferences may therefore contribute to this result, although for different reasons than increasing revenues. Alternatively, when some periods of deficit operation are permitted and there is a binding quality constraint faculty decision control can lead to a higher level of overinvestment in academic quality that maximizes both faculty utility and university revenue. This indicates that consistency between faculty and administration goals is possible. Policies could be developed to encourage shared governance in these situations. If, however, when faculty decisions result in overinvestment, faculty preferences overvalue social preferences for academic quality, or if the

administration drives overinvestment in academic quality and overvalues social preferences for academic quality, then alternative policies to alter incentives would be warranted.

Our findings suggest that faculty participation can have mixed effects on quality. Shared decision control works differently for academic quality and nonacademic quality. For *AQ*, the administration tends to underinvest in implicit forms designed to promote enrollment and sponsored funding; faculty participation corrects this underinvestment. For *NQ*, the administration tends to overinvest; faculty participation corrects this overinvestment. Thus, shared governance results in the reallocation of resources away from *NQ* and toward *AQ*. If there are positive externalities associated with academic quality so that *AQ* is considered to be more socially valuable than *NQ*, then policies to promote faculty participation in university decision making would be socially optimal, even though they also promote private utility maximizing goals for faculty. For example, Hanushek and Kimko (2000) demonstrate that differences in academic quality (as measured by test scores of students) across countries can help to explain differences in economic growth rates. Therefore, the potential positive effects of investments in academic quality on the economic growth rate of the United States may provide a rationale for increases in the amount of shared governance at universities.

We also note that the effects of faculty participation on the outcomes for graduate enrollment (*G*), sponsored funding (*S*), and both *AQ* and *NQ* depend on the degree of faculty participation involved. We find in a number of cases that even equally shared governance ($w = 1$) will yield outcomes that are the same as those under sole administration decision control ($w = 0$). In areas where faculty participation promote social preferences and efficiency, it may be especially important to have university policies and public policies that encourage greater faculty participation and control in the decision process.

On this point we note that Johnston (2003) and Gaff (2007) provide examples of two studies that seek to promote shared governance at universities and highlight some of the methods to increase shared governance. Johnston (2003) examines the issues faced by faculty in participating in governance activities. She provides suggestions to promote better faculty participation, such as providing an overview of governance structures in the institution and a governance mentor to new faculty. Like

Johnston, Gaff (2007) provides recommendations designed to strengthen faculty participation in shared governance. Some recommendations are structural, such as linking departments with issues that are institutional so that faculty take a broader view of university issues, or simplifying committee structures. Other recommendations are behavioral, such as providing academic leadership for interdepartmental and institutional programs and developing better working relationships with administrators. He also suggests defining and rewarding faculty activities, which is both a structural and behavioral reform.

Finally, the results of our model indicate that governance goes beyond issues of workload and salaries, as much of current literature suggests (see CHEPA (2003) and Kaplan (2004a), for example). Our behavioral model shows that faculty may affect levels of graduate enrollment, academic and nonacademic quality, and sponsored funds. These additional effects have not been previously demonstrated but are important as they can have an impact on the costs of higher education as well as the ability to meet increasing demand. Nonacademic quality effects, such as for athletic facilities and housing, may contribute to the increased costs of higher education by increasing student fees for housing, recreation facilities, and other forms. Our model shows that faculty participation in governance, by diminishing the potential of administrators to increase some forms of nonacademic quality, may in this way either shift the emphasis to academic quality or contribute to reducing costs.

6. Concluding Remarks

Decisions on allocating resources in institutions of higher education will have both short term and long term effects. The number of programs, the faculty and staff, and the quality of the faculty and staff that provide them affect the ability of the university to serve its students effectively in both time frames. Additionally in the longer term, the ability to recruit more students and faculty will be affected as well. In particular, in periods of fiscal constraint when the administration and faculty are both constrained in the decision process, the participation of faculty in governance may affect enrollment, especially graduate enrollment, sponsored funding and levels of academic and nonacademic quality. In some instances faculty and the administration may have consistent and shared goals, and shared governance can increase the efficiency of university resource allocation, particularly in the area of quality. The model we develop

here provides a general framework for examining the behavioral process of making these decisions, and testable implications for potential policy applications.

Table 1. Levels of Enrollment, Sponsored Funding, and Quality under Alternative Governance Systems

Governance Decision Control:		Administration $w = 0$	Equally shared $w = 1$	Faculty $w = \infty$
Constraints	Variables			
Binding breakeven				
Binding quality	UG	UG_{opt}	UG_{opt}	----
	G	G_{opt}	G_{opt}	G_{opt}
	S	S_{opt}	S_{opt}	S_{opt}
	AQ	$AQ_R > AQ_{opt}$[1]	$AQ_R > AQ_{opt}$[1]	$AQ_R > AQ_{opt}$[1]
	NQ	$NQ_R > NQ_{opt}$[2]	$NQ_R > NQ_{opt}$[2]	$NQ_R > NQ_F > NQ_{opt}$[2]
Binding breakeven				
Nonbinding quality	UG	UG_{opt}	UG_{opt}	----
	G	G_{opt}	G_{opt}	G_{opt}
	S	S_{opt}	S_{opt}	S_{opt}
	AQ	AQ_{opt}[1]	AQ_{opt}[1]	AQ_{opt}
	NQ	NQ_{opt}[2]	NQ_{opt}[2]	NQ_{opt}
Nonbinding breakeven				
Binding quality	UG	$UG > UG_{opt}$	$UG > UG_{opt}$	----
	G	$G_R > G_{opt}$	$G_R = G_F > G_{opt}$	$G_F > G_R > G_{opt}$
	S	$S_R > S_{opt}$	$S_R = S_F > S_{opt}$	$S_F > S_R > S_{opt}$
	AQ	$AQ = \overline{AQ}$	$AQ = \overline{AQ}$	$AQ_R > AQ_{opt}$
	NQ	$NQ = \overline{NQ}$	$NQ = \overline{NQ}$	$NQ_R > NQ_{opt}$
Nonbinding breakeven				
Nonbinding quality	UG	$UG > UG_{opt}$	$UG > UG_{opt}$	----
	G	$G_R > G_{opt}$	$G_R = G_F > G_{opt}$	$G_F > G_R > G_{opt}$
	S	$S_R > S_{opt}$	$S_R = S_F > S_{opt}$	$S_F > S_R > S_{opt}$
	AQ	$AQ_R > AQ_{opt}$	$AQ_F > AQ_R > AQ_{opt}$[3]	$AQ_F > AQ_R > AQ_{opt}$
	NQ	$NQ_R > NQ_{opt}$	$NQ_R > NQ_{opt} > NQ_F$[4]	$NQ_F > NQ_R > NQ_{opt}$

[1]In the most likely cost scenario, implicit AQ is below optimal implicit AQ, that is, $AQ_{imp} < AQ_E$, where implicit AQ is academic quality designed specifically to promote enrollment and sponsored funding.
[2]In the most likely cost scenario, implicit NQ is below optimal implicit NQ, that is, $NQ_{imp} < NQ_E$, where implicit NQ is academic quality designed specifically to promote enrollment and sponsored funding.
[3]With equally shared governance ($w = 1$) implicit AQ chosen by the administration is below the level of implicit AQ chosen by faculty. This outcome is corrected with greater faculty control in the decision process.
[4]With equally shared governance ($w = 1$) implicit NQ chosen by the administration is above both the optimal level and the level of implicit NQ chosen by faculty. Greater faculty control in the decision process corrects this.

Appendix: Proofs of Predictions

Proof of predictions for undergraduate enrollment (UG) under binding and nonbinding breakeven conditions:

Let UG_B be defined as the breakeven level where $R = C$ of undergraduate enrollment; UG_{opt} the optimal level, and UG_R the revenue maximizing level. From (10a), $R'_{UG} = \left(\frac{-\lambda_1}{1-\lambda_1}\right) C'_{UG}$. For a binding breakeven constraint $\lambda_1 > 0$ and as $\lambda_1 \to \infty, \frac{-\lambda_1}{1-\lambda_1} \to 1 \Rightarrow R'_{UG} = C'_{UG}$, so that $UG = UG_\pi < UG_R$ for any revenue function $R(UG, G, AQ, NQ, S)$, and cost function $C(UG, G, AQ, NQ, S)$.

For a nonbinding breakeven constraint $\lambda_1 = 0, \left(\frac{-\lambda_1}{1-\lambda_1}\right) = 0 \Rightarrow R'_E = 0$, so that $UG = UG_R > UG_{opt}$ for any revenue and cost functions.

Proof of predictions for Graduate enrollment (G) and Sponsored funding (S) under breakeven and deficit conditions:

Let G_B and S_B be defined as the breakeven levels where $R = C$ of graduate enrollment and sponsored funding, respectively; G_{opt} and S_{opt} the socially optimal levels of each, G_R and S_R the revenue maximizing levels of each, and G_F and S_F the levels of each that maximize faculty utility. From (7b), $R'_G = \left(\frac{-w}{1-\lambda_1}\right) U'_{F_G} - \left(\frac{\lambda_1}{1-\lambda_1}\right) C'_G$ and from (7e), $R'_S = \left(\frac{-w}{1-\lambda_1}\right) U'_{F_S} - \left(\frac{\lambda_1}{1-\lambda_1}\right) C'_S$ For a binding breakeven constraint $\lambda_1 > 0$ and as $\lambda_1 \to \infty, \frac{-w}{1-\lambda_1} \to 0$ and $\frac{-\lambda_1}{1-\lambda_1} \to 1$, which imply that $R'_G = C'_G$, and $R'_S = C'_S$, so that $G = G_{opt} < G_R$ and $S = S_{opt} < S_R$ for any $R(UG, G, AQ, NQ, S)$, $C(UG, G, AQ, NQ, S)$, and $U_F(G, AQ, S)$.

For a nonbinding breakeven constraint $\lambda_1 = 0$, $\left(\frac{-\lambda_1}{1-\lambda_1}\right) = 0 \Rightarrow R_G^{'} = -wU'_{F_G}$ and

$R_S^{'} = -wU'_{F_S}$, or alternatively, $\frac{-R_G^{'}}{U'_{F_G}} = w$ and $\frac{-R_S^{'}}{U'_{F_S}} = w$. As $w \to \infty$, $R_G^{'} > U'_{F_G}$ so that $G = G_F > G_R > G_{opt}$ and $S = S_F > S_R > S_{opt}$. Alternatively, $G = G_R > G_{opt}$ and $S = S_R > S_{opt}$ for any revenue and cost functions only if $w = 0$.

Proof of predictions for Academic quality (AQ) and Nonacademic quality (NQ) under binding and nonbinding breakeven conditions:

<u>*Binding breakeven constraint and binding quality constraints*</u>: Let Q_{jB} be defined as the breakeven level of investment in academic quality where $R_{Qj} = C_{Qj}$ and $j = AQ, NQ$; Q_{jopt} the optimal level; Q_{jR} the revenue maximizing level, and Q_{jF} the utility maximizing level of academic quality. From (7c) or (7d), we see that $R_{Qj}^{'} = \left(\frac{-w}{1-\lambda_1}\right)U_{Qj}^{'} - \left(\frac{\lambda_1}{1-\lambda_1}\right)C_{Qj}^{'} + \frac{\lambda_2}{1-\lambda_1}$. For $\lambda_1 > 0$ and $\lambda_2 > 0$. In addition, for $w \to 0$ and as $\lambda_1 \to \infty, \lambda_2 \to \infty, \frac{-w}{1-\lambda_1} \to 0$, $\frac{\lambda_2}{1-\lambda_1} \to -1$ and $\frac{-\lambda_1}{1-\lambda_1} \to 1$, which together imply $R'_{Qj} = C'_{Qj} - 1$.

This yields $Q_j > Q_{jopt} \geq \overline{Q_j}$. Consider the distinction between implicit Q_j ($=Q_{jUG,G,S}$) and explicit Q_j (Q_{jexp}). Revenue is an implicit function of academic quality, $R_{Qjimp}^{'}$, but cost has both an implicit cost, $C_{UG}^{'}UG_{F_{Qj}}^{'} + C_S^{'}S_{Qj}^{'}$ and explicit cost, $C_{Qj}^{'}$. Therefore $Q_{jUG,G,S} = Q_{jopt}$ only if $C_{Qj\exp}^{'} = 1$. If $C_{Qj\exp}^{'} > 1$, $R_{Qjimp}^{'} < C_{Qjimp}^{'}$ so that $Q_{jUG,G,S} < Q_{jopt}$. Alternatively, if $C_{\exp}^{'} < 1$, $Q_{jUG,G,S} > Q_{jopt}$. These results hold for any $0 \leq w < \infty$, $\frac{-w}{1-\lambda_1} \to 0$ as $\lambda_1 \to \infty$.

For $w \to \infty$ and $\frac{-w}{1-\lambda_1} \to 1$, so that $R_{Qj}^{'} = U_{Qj}^{'} + C_{Qj}^{'} - 1$. $Q_{jUmax} = Q_{jopt}$ only if $U_{Qj}^{'} = 1$. For $U_{Qj}^{'} > 1$, $Q_{jUmax} < Q_{jopt}$ and for $U_{Qj}^{'} < 1$, $Q_{jUmax} > Q_{jopt}$. Where $U_{Qj}^{'} = 0$, $Q_{jUmax} > Q_{jopt}$.

Binding breakeven and Nonbinding quality constraints: From (7c) or (7d), as $\lambda_1 \to \infty$ and $\lambda_2 \to 0$, for any $0 \le \lambda_2 < \infty$, $\frac{\lambda_2}{1-\lambda_1} \to 0$ (or $\lambda_3 \to 0$, for any $0 \le \lambda_3 < \infty$, $\frac{\lambda_3}{1-\lambda_1} \to 0$). For $w \to 0$, $R'_{Qj} = C'_{Qj}$, so that $Q_j = Q_{jopt}$. In addition, given $R'_{Qjimp} = C'_{UG} UG'_{F_{Qj}} + C'_S S'_{Qj} + C'_{Qj}$, $Q_{jUG,G,S} = Q_{jopt}$ only if $C'_{j\exp} = 0$; $Q_{jUG,G,S} > Q_{jopt}$ for $C'_{j\exp} > 0$. For $w \to \infty$ and $\frac{-w}{1-\lambda_1} \to 1$, $R'_{Qj} = U'_{Qj} + C'_{Qj}$. $R'_{Qj} = C'_{Qj}$ only if $U'_{Qj} =$ 0 which yields $Q_j = Q_{jopt}$; $Q_j > Q_{jopt}$ for $U'_{Qj} > 0$.

Nonbinding breakeven and Binding quality constraints: From (7c) or (7d), for $\lambda_1 = 0$, $\left(\frac{-\lambda_1}{1-\lambda_1}\right) = 0 \Rightarrow \frac{R'_{Qj}}{U'_{Qj}} = -w + \frac{\lambda_2}{U'_{Qj}}$ (or $\frac{R'_{Qj}}{U'_{Qj}} = -w + \frac{\lambda_3}{U'_{Qj}}$). Thus $\frac{R'_{Qj}}{U'_{Qj}}$ depends on the relative values of w and $\frac{\lambda_2}{U'_{Qj}}$ (or $\frac{\lambda_3}{U'_{Qj}}$). For $\lambda_2 > 0$ (or $\lambda_3 > 0$) and as $\lambda_2 \to \infty$ (or $\lambda_3 \to \infty$), for $w \to 0$ and for any $0 \le w < \infty$, $\frac{R'_{Qj}}{U'_{Qj}} \to \infty$ and $Q_j \to \overline{Q_j}$. For $w \to \infty$, $\frac{R'_{Qj}}{U'_{Qj}} = 0$, which yields $Q_j = Q_{jR} > Q_{jopt}$. For any $0 \le w < \infty$, $\frac{-w}{1-\lambda_1} \to -1$ as $\lambda_1 = 0$, and as $\lambda_2 \to \infty$ (or $\lambda_3 \to \infty$), $\frac{R'_{Qj}}{U'_{Qj}} = -1 + \infty$ or $\frac{R'_{Qj}}{U'_{Qj}} \to \infty$, again yielding $Q_j \to \overline{Q_j}$.

Nonbinding breakeven and Nonbinding quality constraints: From (7c) or (7d), for $\lambda_2 = 0$ (or $\lambda_3 = 0$), $\frac{R'_{Qj}}{U'_{Qj}} = -w$. For $w = 0$, $\frac{R'_{Qj}}{U'_{Qj}} = 0$ so that $Q_j = Q_{jR} > Q_{jopt} \Rightarrow \overline{Q_j} < Q_{jopt} < Q_{jR}$. For $w \to \infty$, $\frac{R'_{Qj}}{U'_{Qj}} \to \infty$, so that $Q_j = Q_{jF} > Q_{jR} > Q_{jopt}$.

From (7c) for $w = 1$ and $\frac{R'_{AQ}}{U'_{AQ}} = -1$, or, alternatively, $\frac{R'_{AQ}}{U'_{AQimp} + U'_{AQ\exp}} = -1$. Consider the case $R'_{AQ} > 0$ and $U'_{AQ} > 0$. For $w = 1$, $R'_{AQ} > U'_{AQimp}$ and $R'_{AQ} > U'_{AQ\exp} \Rightarrow AQ_{R_{UG,G,S}} < AQ_{F_{G,S}}$.

From (7d), for $w = 1$, $\frac{R'_{NQ}}{U'_{NQ}} = -1$ or, alternatively, $\frac{R'_{UG}UG'_{NQ} + R'_S S'_{NQ}}{U'_S S'_{NQ}} = -1$. From this we see that $R'_{UG}UG'_{NQ} < U'_S S'_{NQ}$ and $R'_S S'_{NQ} < U'_S S'_{NQ}$. These yield $NQ = NQ_{R_{UG,S}} > NQ_{opt}$ and $NQ_{R_{UG,S}} > NQ_{F_S}$.

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