

Capital Budgeting and Divisional Performance Measurement

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Foundations and Trends[®] in Accounting

Published, sold and distributed by:

now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:

now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is

N. B. Johnson and T. Pfeiffer. *Capital Budgeting and Divisional Performance Measurement*. Foundations and Trends[®] in Accounting, vol. 10, no. 1, pp. 1–100, 2015.

This Foundations and Trends[®] issue was typeset in L^AT_EX using a class file designed by Neal Parikh. Printed on acid-free paper.

ISBN: 978-1-68083-125-2

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Volume 10, Issue 1, 2015
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Foundations and Trends[®] in Accounting, 2015, Volume 10, 4 issues. ISSN paper version 1554-0642. ISSN online version 1554-0650. Also available as a combined paper and online subscription.

Foundations and Trends® in Accounting
Vol. 10, No. 1 (2015) 1–100
© 2016 N. B. Johnson and T. Pfeiffer
DOI: 10.1561/1400000038



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Abstract

This monograph synthesizes recent work on the use of capital budgeting mechanisms to coordinate decentralized investment decisions in multi-division firms, with a focus on two-stage investment problems. Divisional managers often have private information about investment profitability that evolves over time and divisional investments can create positive or negative externalities for other divisions at individual investment stages. We show that in these circumstances, formal capital budgeting mechanisms that allocate investment costs to divisions via capital charge rates, depreciation schedules, and inter-divisional cost-sharing rules (if the investment cost is shared), can yield divisional performance measures that provide proper two-stage investment incentives.

Several recurring themes arise in our analysis. First, positive and negative externalities that arise from divisional investment decisions can cause optimal capital charge rates to deviate substantially from the firm's cost of capital. Second, the optimal inter-divisional cost-sharing rules for shared investments can be approximated by simple rules frequently observed in practice, such as equal cost-sharing or sharing proportional to divisional performance, under sometimes counter-intuitive circumstances. Third, agency costs can change the divisions' investment decisions beyond the standard underinvestment rationing result in two-stage investment problems and can impact the first and second-stage cost charges quite differently. Finally, our analysis shows very broadly that the key components of a two-stage optimal budgeting mechanism, including capital charge rates and inter-divisional cost-sharing rules, can vary significantly across the two investment stages, even when the investment decisions appear to be similar at each stage.

1

Introduction

Many firms allocate resources for divisional projects through a formal capital budgeting process that uses divisional cost charges based on firm-wide or division-specific capital charge rates to hold divisions responsible for the resources they receive. Survey evidence reveals significant variation in observed capital charges rates and finds that they seem to substantially exceed the firm's cost of capital on average, although capital charge rates below the firm's cost of capital are observed as well (e.g., Mukherjee and Henderson 1987, Poterba and Summers 1995, Mukherjee and Hingorani 1999). An important theme of this monograph is to show how such variation can arise as an optimal response to multi-agent investment problems that involve resource constraints or shared investments, particularly when investments are made in multiple stages and can be abandoned if unfavorable information becomes available.

In multi-agent settings, individual divisions do not always internalize the full costs and benefits of the resources they receive. When the firm faces resource constraints, for example, individual divisions may not consider the opportunity costs associated with their own use of the scarce resource. Similarly, if a purchased resource can be shared among

divisions, the joint costs and benefits of the resource may not be apparent to each individual division. For each of these cases, we derive single-stage and two-stage mechanisms that induce truthful reporting and efficient investment decisions by making each division internalize the firm-wide costs and benefits associated with the investment.

Investment decisions are often made in multiple rounds as new information becomes available and profitability forecasts are updated. Research and development is a common example. When investments take place over multiple stages and externalities are present, different capital charge rates are generally required to induce efficient decision-making at each investment stage. The magnitude of the difference between the two capital charge rates depends on the specifics of the underlying problem and can be quite large. Thus, an important theme in this context is variation in capital charge rates applied to investments undertaken at different stages, which is not driven by differences in nominal investment costs across the two stages and can arise even if the investment decision in the second stage is simply an option to reinvest in the same resource that was purchased in the first stage.

When the firm invests in a resource that can be shared across divisions, the capital budgeting mechanism must also specify inter-divisional cost-sharing rules that allocate the joint investment cost among participating divisions. An interesting question in this case is whether optimal cost-sharing rules can be approximated by simple sharing rules frequently observed in practice, such as equal sharing of joint costs or cost sharing in proportion to divisional performance measured by revenue or gross margin (e.g., Horngren, Foster and Datar 2006). We show that simple inter-divisional cost-sharing rules can be optimal, but often under counter-intuitive circumstances. For example, equal cost sharing can be optimal even though the individual divisional projects do not contribute equally to overall firm profit (equal treatment of unequally profitable projects) and unequal cost sharing can be optimal when all divisional projects are equally profitable but exhibit different cash flow patterns (unequal treatment of equally profitable projects). In a two-stage shared investment problem, inter-divisional cost-sharing rules must be specified for each stage. As with the capital

charge rates, the optimal sharing rules can exhibit significant variation across investment stages even if the underlying resource cost does not change.

Our analysis proceeds in two steps. We first apply the so-called goal-congruence approach to identify how budgeting mechanisms must be designed in order to properly account for the externalities that arise when multiple divisional managers participate in the budgeting process and each manager has private information about the profitability of his proposed project. A budgeting mechanism is considered to be robust goal congruent if it induces divisional managers to make firm-value-maximizing decisions regardless of the intertemporal weights the individual managers assign to their multi-period performance measures. One interpretation for this approach is that the budgeting mechanism must induce efficient decision making even if the managers' planning horizons or intertemporal discount rates are private information. Focusing on robust goal-congruent mechanisms allows us to identify unique budgeting mechanisms and to concentrate attention on the key properties of the budgeting mechanism components that emerge in each scenario, such as capital charge rates and inter-divisional cost-sharing rules.

In a second step, we extend the analysis to a second-best setting with moral hazard problems between the firm and the divisions, which introduce explicit divisional agency costs that are not present in the goal-congruence framework. This allows us to focus separately on how divisional agency costs change the optimal investment decisions relative to the goal-congruence case, and on the design of key elements of the budgeting mechanism.

Prior literature has emphasized that second-best budgeting mechanisms can mitigate agency costs by providing resources at a level below first best, i.e., it can be optimal to set capital charge rates above the cost of capital in order to implement capital rationing in response to an agency conflict (e.g., Antle and Eppen 1985, Antle and Fellingham 1997). When divisions invest jointly in a shared resource, agency costs reduce the overall profitability of the shared project and rationing emerges in both single-stage and two-stage problems. Rationing also

emerges in a single-stage investment problem with a resource constraint. A well-established result from the literature on socialistic internal capital markets is that a more severe agency conflict between a division and the firm increases the cost of providing resources to that division, which reduces the likelihood that it will receive funding relative to other divisions even if it has a nominally more profitable project (e.g., Bernardo, Luo and Wang 2006). In a two-stage setting, however, higher agency costs in a particular division can increase the likelihood that it will receive resources at the second stage. The key to this result is that higher agency costs in a particular division can lead to more project initiation at the first investment stage, which can change the composition of the group of competing divisions at the second stage.

Finally, agency conflicts can introduce substantial variation in capital charge rates and inter-divisional cost-sharing rules that is incremental to variation caused by other factors. In particular, the optimal two-stage budgeting mechanism in both the constrained and shared resource investment problems incorporates agency costs into only the second-stage divisional cost charges. Since the first-stage capital charge rate and inter-divisional cost-sharing rules are unaffected by the agency conflict, the divisional cost charges at the two investment stages can be quite different.

This monograph focuses on the themes outlined above using a basic modelling framework introduced in §2.1 and §2.2. The remainder of Section 2 and all of Section 3 focus on the design of capital budgeting mechanisms for investment problems in which divisions require the exclusive use of purchased assets in order to carry out divisional projects. Section 4 focuses on capital budgeting mechanisms for shared resources that benefit multiple divisions. The monograph is organized so that readers interested in the analyses of the goal-congruence cases can proceed directly from Section 2 to Section 4, skipping Section 3. The analysis of the agency problem in Section 3 is related to the analysis in Section 2, but can be read as a stand-alone piece.

Each section includes a brief introduction that discusses the relevant themes in more detail and closes with a brief discussion of related work. This monograph focuses on providing the reader with the

tools necessary to develop an understanding of the major results and themes in the multi-divisional capital budgeting literature and to access related literature, but does not provide a comprehensive survey of the extant capital budgeting literature. The discussion that follows draws on Reichelstein (1997), Rogerson (1997), Dutta and Reichelstein (2005), Baldenius, Dutta and Reichelstein (2007), Pfeiffer and Schneider (2007), Johnson, Pfeiffer and Schneider (2013), Bernardo, Luo and Wang (2006), and Johnson, Pfeiffer and Schneider (2015). At the beginning of each section of the monograph, we acknowledge the source paper for the underlying model and results. In most cases, we have adapted notation and minor details from the original paper in order to maintain consistent modeling assumptions throughout the monograph. The text outlines the parts of the proofs that are necessary to provide insight into particular properties of the budgeting mechanisms. Complete proofs for the formal results in each section can be found in the original papers.

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