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Three Essays on Public Procurement

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Abstract

The following dissertation presents three essays on the theory and empirics of public procurement—the process by which government defines its needs for goods and services and acquires them using contracts. The objective of this dissertation is to address three unresolved questions in the literature regarding how the characteristics of products governments procure, and the environments in which they are bought and sold, shape government and non-governmental actors' decision making at different points in the procurement process.

The first essay develops an expanded theory of government's decision to directly deliver public services—social welfare, energy utilities, select forms of security provision, and other services for citizens—or contract out these responsibilities to third parties. The essay takes as its point departure that transaction cost economics—the theory that a product is "made" or "bought" based on the ease or difficulty with which it can be defined, produced, and exchanged via a contract—does not adequately account for the environmental context within which governments select among alternative service delivery modes. The essay rectifies this deficiency by drawing on resource dependence theory, a complementary theory arguing that the make-or-buy decision turns on the nature of the public service marketplace: the number of alternative sellers with which a government can do business, and the amount of revenue sellers derive from this government vis-à-vis their other customers. The argument is that combined, these factors shape the degree of power government can exercise in a contracting relationship, directly influencing the choice to make or buy a service as well as moderating the impact of service-specific characteristics. This argument is specified in a set of hypotheses and a model for testing in future empirical research.

The second essay examines how the characteristics of products government chooses to buy (rather than make) influence competition among sellers vying for its business. Drawing from transaction cost economics, the essay argues product complexity—defined and operationalized in terms of asset specificity, or the degree of relationship-specific physical and human capital investments required to produce and deliver a product—is a key determinant of competition. More specifically, the essay argues (i) at higher levels of complexity, and thus of asset specificity, sellers may deem the risks of doing business with the government as too high to warrant submitting a bid, but (ii) while lower levels of complexity may decrease these risks, they may also discourage competition by creating a collective action dilemma: for a simpler product, individual sellers may not submit a bid because they believe the competition will be too intense, and their probability of winning too low. This reasoning points to two effects—a *project risk effect* (simpler products invite more bids) and a *win probability effect* (simpler products invite less bids)—and implies competing hypotheses for how complexity influences competition. The essay presents an econometric test of these hypotheses using a sample of information technology procurements drawn from U.S. procurement federal data, finding that the effects mostly offset one another. The effects likely operate with greater force (in one direction or another) in larger, program-based procurements (e.g., of major weapons or information systems) that can span many years and involve multiple individual contracts for development, production, maintenance, and upgrades. Thus, a more complete theoretical story that links complexity and competition would likely need to make its propositions contingent on the depth and duration of the underlying business relationship, as well as the nature of the product being procured.

The third essay examines the conditions under which government adopts and implements alternative strategies to procure products after it has selected and awarded its business to one

from a competing set of sellers. Specifically, the essay examines the conditions under which government implements a knowledge-based procurement strategy predicated on incremental delivery of product capabilities and a sequential approach to product development and production (typically seen as a best practice), or a strategy predicated on delivering product capabilities in a single-step fashion and using a concurrent approach to development and production activities. The essay starts from the observation that procurements executed in accordance with knowledge-based principles consistently feature strong leadership—individuals purported to be pivotal in ensuring procurements adhere to a strategy anchored in knowledge—and posits that leader commitment influences adoption of the knowledge-based approach through a "credible commitment" mechanism. In essence, tenured leaders serve an advocacy role for the procurements they oversee, ensuring the procurements receive sufficient support and protecting them from policymakers wishing to commit resources to other projects (including those for which failure to follow a knowledge-based strategy could invite future problems, but, at least in the short-run, appear that they will take less time and provide more capability). In this way, sustained leadership provides teams tasked with managing procurements incentives to "stay the course," maintaining adherence to a knowledge-based strategy, pursuing modest capability objectives, and taking the time necessary for sequential development and production. The essay samples and examines a set of four successfully executed United States weapon system procurements to probe the plausibility of the credible commitment mechanism, finding and presenting evidence that leaders do influence employment of knowledge-based strategies in part through this channel.

THREE ESSAYS ON PUBLIC PROCUREMENT

by

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For Dad

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Chapter 1: Introduction

1.0 Introduction to the Essays

Public procurement—the process by which government defines its needs for goods and services and acquires them using contracts—accounts for approximately twenty percent of annual global GDP and large shares of government spending in both developed and developing countries (World Bank 2016). Governments procure a wide variety of products to accomplish their missions, ranging from office supplies and landscaping to information technology and complex weapon systems. They also use the procurement function to contract with actors like nonprofit and private for-profit organizations that deliver public services to citizens. Debates continue over whether these latter arrangements effectively harness market forces to reduce costs and improve upon government performance in public service delivery, but the sheer scale and complexity of responsibilities with which citizens entrust their governments often necessitates involvement of non-governmental actors in the service delivery process. Moreover, even when governments assume full responsibility for delivering services, they must still rely on hardware, software, and/or human capital support for which, as a matter of policy, the private sector may be the preferred (or in some cases the only feasible) provider. These realities make understanding whether, how, and with what consequences government utilizes procurement to achieve policy goals of ongoing importance to public administration scholarship and practice.

Treating this imperative as a point of departure, this dissertation presents three essays on the theory and empirics of public procurement. The unifying theme of the essays is their concern with strategic behavior: how actors anticipate one another's choices, evaluate consequences, and take alternative courses of action. In this vein, the essays consider how the characteristics of products governments procure and the economic, political, and organizational contexts of their procurement activities (i) incentivizes choices more or less likely to produce outcomes seen as

desirable in the procurement setting, and (ii) motivates alternative courses of action on the part of government and non-governmental actors. Each essay considers the implications of strategic behavior at a different point in the procurement process, with attention toward developing and testing theoretical arguments of how product characteristics and contexts shape actor incentives to engage in ostensibly desirable vs. undesirable behavior (e.g., resolving contract disputes on a cooperative basis vs. behaving opportunistically), and how these incentives shape action.

The first essay develops an expanded theory of government's decision to directly deliver public services—social welfare, energy utilities, select forms of security provision, and other services for citizens—or contract out these responsibilities to third parties. The essay argues transaction cost economics—the theory that a product is "made" or "bought" based on the ease or difficulty with which it can be defined, produced, and exchanged via a contract—does not adequately account for the environmental context within which governments select among alternative service delivery modes. The essay rectifies this deficiency by drawing on resource dependence theory, a complementary theory arguing that the make-or-buy decision turns on the nature of the service marketplace: the number of alternative sellers with which a government can do business, and the amount of revenue sellers derive from this government vis-à-vis their other customers. The argument is that combined, these factors shape the degree of power government can exercise in a contracting relationship (and, as such, the degree to which sellers can or cannot behave opportunistically), directly influencing the choice to make or buy a service as well as moderating the impact of service-specific characteristics. This argument is specified in a set of hypotheses and a model for testing in future empirical research.

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incremental delivery of product capabilities and a sequential approach to product development and production (typically seen as a best practice), or a strategy predicated on delivering product capabilities in a single-step fashion and using a concurrent approach to development and production activities. The essay takes as its point of departure that procurements executed in accordance with knowledge-based principles consistently feature strong leadership—individuals purported to be pivotal in ensuring procurements adhere to a strategy anchored in knowledge—and posits that leader commitment influences adoption of the knowledge-based approach through a "credible commitment" mechanism. In essence, tenured leaders serve an advocacy role for the procurements they oversee, ensuring the procurements receive sufficient support and protecting them from policymakers wishing to commit resources to other projects (including those for which failure to follow a knowledge-based strategy could invite future problems, but, at least in the short-run, appear that they will take less time and provide more capability). In this way, sustained leadership provides teams tasked with managing procurements incentives to "stay the course," maintaining adherence to a knowledge-based strategy, pursuing modest capability objectives, and taking the time necessary for sequential development and production. The essay samples and examines a set of four successfully executed United States weapon system procurements to probe the plausibility of the credible commitment mechanism, finding and presenting evidence that leaders do influence employment of knowledge-based strategies in part through this channel.

1.1 Implications for Scholarship and Practice

Through exploring how characteristics of products governments procure and the environments in which they are bought and sold shape government and non-governmental

actors' strategic behavior and decision making at different points in the procurement process, the essays presented in this dissertation make several contributions to scholarship and practice.

Through developing an extended theory of the government make-or-buy decision, essay one creates opportunities for researchers to conduct additional empirical analysis of patterns in government service delivery arrangements, as well as extend their analytical endeavors toward a deeper understanding of the *consequences* of arrangements of different kinds (e.g., impacts alternative arrangements have on cost efficiency, citizen satisfaction, and other outcomes). This work can aid practitioners by enhancing their understanding of what, exactly, their peers consider when choosing among different mechanisms to deliver public services—thus facilitating consideration of potentially important factors that may otherwise not be accounted for in determining how services should be delivered—as well as promote selection of delivery mechanisms more likely to result in achievement of performance and policy objectives.

Through positing and testing for competing effects of product complexity on competition, essay two sheds light on how choices over products with different characteristics shape and incentivize seller behavior—thereby providing researchers with further insight into how competition arises in the public procurement context, and practitioners with information on whether and to what extent choosing products of different types (e.g., a commercial product or a variant thereof) presents a trade-off between competition and procurement of a resource with greater functionality (and, potentially, greater ability to facilitate mission accomplishment).

Finally, through positing and probing the plausibility of a mechanism underpinning leadership and adoption of strategies deemed important to successful execution of procurements—including and especially large, complex projects that consume significant shares of budget resources—essay three begins to unpack the nature of the leader-strategy association;

lays groundwork for more in-depth research; and, accordingly, creates scope for informing practitioners about how best to manage relationships between leaders, managers, and policymakers for purposes of (i) incentivizing application of sound practice and (ii) promoting success in complex procurement endeavors.

Chapter 2: Transaction Costs, Resource Dependence, and Public Service Delivery Decisions—A Theoretical Expansion

2.0 Introduction

The prevalence of private actors in public service delivery has spawned a large literature examining why and how governments choose to deliver services directly or rely on third parties to carry out these responsibilities (see, e.g., Bel and Fegeda 2007; Brown 2008; Brown and Potoski 2003; Brown et al. 2008, 2016; Ferris and Graddy 1991; Hefetz and Warner 2004, 2012; Johnston and Girth 2012; Morgan and Hirlinger 1991).[1,2] Among other factors, this literature has emphasized the central role of transaction costs—"the comparative costs of planning, adapting, and monitoring task completion under alternative governance structures" (Williamson 1981: 552-553)—in driving government's decision to "make" or "buy" public services.[3] Transaction cost theory holds that governments choose to make or buy a service based on the ease or difficulty with which the service can be defined, produced, and exchanged via a contract (Williamson 1997).

Existing evidence suggests governments do consider service-specific characteristics when selecting among delivery options—they tend to buy services more easily defined and delivered on a contract basis (Bel and Fegada 2007; Brown and Potoski 2003; Brown et al. 2008, 2016; Hefetz and Warner 2004; Lamothe et al. 2008; Levin and Tadelis 2010)—but transaction cost economics does not fully explain the make-or-buy decision in the public service context (Hefetz

[1] Unless otherwise specified, "private" references both private for-profit and nonprofit organizations.
[2] By "public service," this paper refers to a good, service, or combination thereof meant to directly impact and/or be consumed by the public. It does not refer to inputs into government's service delivery process, such as support services and equipment like landscaping, information technology (IT), or office supplies. However, as an avenue for future research, the theory proposed in the paper could be applied to government procurements of these products as well as public services themselves.
[3] For the purposes of this paper, "make" refers to government delivering a service entirely on its own—using its own employees, equipment, infrastructure, and other resources in the delivery process. "Buy" refers to government either sharing or fully delegating delivery responsibilities to third parties, including other governments, nonprofits, or private for-profit organizations.

and Warner 2012). Thus, observers have called for a "wider framework" (Hefetz and Warner 2012: 20) to understand how governments choose among alternative service delivery modes.

Building on existing research, this essay develops an expanded theory of government's service delivery decisions. The essay takes as its point of departure that transaction cost economics does not adequately account for the environmental context within which governments choose from alternative ways of delivering services (Granovetter 1985; Hefetz and Warner 2012), and rectifies this deficiency by drawing on resource dependence theory, a complementary theory stressing that (with respect to public services) government's make-or-buy decision turns on the nature of the service marketplace: the number of service providers with which a given government can do business, and the proportion of their total revenue providers receive from this government relative to others.[4] These factors, the essay argues, constitute key contextual conditions bearing on the make-or-buy decision because they shape the degree of power government can exercise in its relationships with third party providers of public services. The essay argues that all else equal, government will more likely buy rather than make services given markets with more, and more financially reliant, third party providers over whom greater power can be exercised in contracting relationships.[5]

Importantly, in addition to these direct effects, the essay also argues that market factors moderate the influence of transaction costs on the decision to make services or use a third party delivery approach. Whereas high transaction costs might make a government more likely to

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[4] This paper conceives of financial reliance as a service provider's total financial reliance on the potentially contracting government—including outside the context of a contract and associated revenue received for delivery of a particular public service. It does *not* reference a service provider's reliance on the public sector in general.

[5] Of course, sometimes government simply lacks the capacity to deliver services on its own, necessitating outside service delivery. The argument here pertains to situations in which government could in theory deliver a service itself, and is deciding whether, compared to direct delivery, it wishes to use an external delivery mode of some kind.

choose direct instead of third-party public service delivery—given challenges specifying a contract that accounts for all the relevant contingencies the government and a service provider could encounter in their relationship, and attendant risks the provider will behave opportunistically in unforeseen circumstances—a government actor could find itself in a sufficiently powerful position to mitigate opportunism risk and still be inclined to choose a form of external delivery despite challenges posed by an incomplete contract.[6] Alternatively, in cases where government finds itself in a weak position vis-à-vis third party providers, it may be more likely to choose direct delivery of services despite lower transaction costs and (at least on a relative basis) fewer issues attributable to incomplete contracting.[7] The essay specifies these arguments in a set of hypotheses and a model for testing in future empirical research.

The remainder of the essay is organized in five sections. Section one reviews alternative modes government can choose from to deliver public services. Section two presents the transaction cost theory of government's decision to make or buy services, specifies it in a set of testable hypotheses, and then lays out the argument that transaction cost economics neglects the context within which governments choose to make services or buy them using an external delivery mode. Section three presents resource dependence theory as a complementary theory of the make-or-buy decision, and specifies the main and moderating influences of resource dependence—as determined by market characteristics that shape government's power position relative to third party service providers—as testable hypotheses. Section four codifies the overall

[6] While the focus here is on the non-governmental actor's propensity for opportunistic behavior, government could also behave opportunistically (e.g., by exploiting contract ambiguities for purposes of imposing upon the provider costly good or service changes not required to meet the government's needs—see Brown et al. 2010).
[7] Given that most contracts are incomplete (Coase 1937; Grossman and Hart 1986; Klein et al. 1978; Williamson 1981), the assumption here is that, despite relatively low transaction costs, governments' contracts with outside providers of public services are sufficiently incomplete that they still afford service providers opportunities to behave opportunistically.

theoretical argument in a model for testing in future empirical research. Section five concludes by discussing the implications of the essay for future research and practice.

2.1 Government Service Delivery Modes

Modern governments take many approaches to delivering public services (Salamon 2002). Indeed, while observers have traditionally cast the selection of service delivery mode as an "all-or-nothing choice" (Brown et al. 2016: 242) between a government or a private sector organization providing a service, the contemporary landscape is considerably more nuanced. Governments do use direct delivery in many cases, and private nonprofit or for-profit organizations act as the focal delivery agent in others, but a government could also delegate its delivery responsibilities to another government, as well as share its responsibilities with organizations across the nonprofit, for-profit, and/or governmental sectors. Accordingly, existing studies of public service delivery tend to operationalize the make-or-buy decision in terms of multiple options, from a government assuming full responsibility to sharing or completely delegating responsibility in one of several different ways (Bel and Fegada 2007; Bel et al. 2010; Brown and Potoski 2003; Brown et al. 2006, 2016; Hefetz and Warner 2004, 2012; Warner and Hefetz 2008).

Following prior studies, this essay assumes government can arrange its delivery of services on a direct, shared, or delegated basis, and can work with other governments, nonprofits, or private for-profit organizations if it chooses a shared or a delegated approach. Specifically, the essay contemplates government selecting from one of eight delivery modes: direct delivery (1); delegated delivery using one other government (2), nonprofit (3), or private for-profit organization (4); shared bi-lateral delivery using one other government (5), nonprofit (6), or

private for-profit organization (7); or shared multi-lateral delivery using a mix of government, nonprofit, and/or private for-profit organizations (8).[8]

2.2. Transaction Cost Economics and Choice of Service Delivery Mode

Transaction cost economics is one of several theories that aim to explain the arrangement of productive activities within and across organizational boundaries (Coase 1937; Klein et al. 1978; Williamson 1981).[9] It originated with the notion that in deciding how to produce goods and services, organizations can take one of two approaches: make the good or service, or buy it from the market (Coase 1937). Out of this argument, the theory evolved to explain a variety of intermediate approaches that combine aspects of internal and market-based production modes (Williamson 1979, 1981, 1991).[10]

In choosing among these approaches, transaction cost theory argues organizations align the attributes of a good or service with the production mode that minimizes management- and relationship-related costs arising during the production process (Williamson 1979; 1981; 1991). Called transaction costs, these are costs the parties producing and consuming goods and services face from (ex ante) difficulty contemplating unforeseen contingencies that could contribute to "delays, breakdowns, or other malfunctions" after production begins (Williamson 1981: 552). Suppose, for example, that prior to starting production, a seller supplying a good or service and

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[8] Since multi-lateral delivery arrangements tend to have organizations of multiple types, this paper follows prior research (e.g., Brown et al. 2016) in counting it as a single delivery mode. Moreover, the paper does not consider an approach in which government delegates delivery responsibility completely to multiple organizations (what could be called "delegated multi-lateral delivery," where government removes itself completely from the delivery process). Thus, the paper considers eight modes in total.

[9] Others include agency theory (Jensen and Meckling 1976) and property rights theory (Grossman and Hart 1986). See Aghion and Holden (2011) and Williamson (2002) for reviews.

[10] For example, what Williamson (1979) refers to as a "bi-lateral monopoly" combining a mix of a formal contract and use of repeated interaction between the buyer and seller to craft mutual understanding between them and govern a set of shared production tasks.

its buyer lack full understanding as to the good's or service's required quality standards, performance expectations, and other properties—meaning they cannot clearly specify this information in a contract. This lack of clarity risks creating a collective action problem where, after production is initiated, the buyer and/or the seller may attempt to exploit the contract ambiguity "for their own gain and at the other's expense" (Brown et al 2010: 42). The seller could attempt to "gold plate the good or service with costly features that increase its profits, but for the buyer add little value and considerable expense" (Brown et al. 2010: 44). Likewise, the buyer could "force the seller to make changes to the good or service that raise costs above a negotiated price, even though the buyer well knows that a cheaper product would meet its needs almost as well" (Brown et al. 2010: 44). To the extent these opportunistic behaviors may yield a prolonged conflict and accompanying production disruptions, transaction cost economics prescribes that buyers take action to minimize the prospects of opportunism. Under conditions otherwise prone toward high opportunism risk, a buyer could seek sellers more prone to resolve problems on a cooperative basis. The buyer could also bring sellers partially or fully within the boundaries of its own organization—choosing (to one extent or another) to make rather than buy—for purposes of addressing unforeseen problems informally instead of with reference to a formal contract containing significant information gaps (Klein et al. 1978; Williamson 1971, 1981, 1991).

In contemplating how attributes of goods and services influence decisions to rely on internal production vis-à-vis outside sellers, the transaction cost approach emphasizes two attributes in particular: uncertainty and asset specificity (Brown and Potoski 2003; Brown et al. 2010; Williamson 1979, 1981, 1991). These, the theory argues, determine whether and to what extent a buyer and a seller will encounter incomplete contracting problems and opportunism risk

in their relationship with one another, and thus influence the selection of alternative production modes. The concepts were originally developed to explain private for-profit organizations' decisions about how they would arrange their systems of production and exchange, but can also be (and have been) applied to government's decisions regarding alternative means of delivering public services—of making services or buying them via different forms of external delivery.

2.2.1 Uncertainty

Uncertainty references difficulties encountered in specifying the nature of a good or service a buyer seeks, and the terms of exchange governing the buyer's relationship with a seller (Brown et al. 2010; Williamson 1981). Can a good's or service's cost, quality, performance characteristics, and terms of exchange be readily defined in a contract? Does this contract contemplate potential problems the buyer and the seller could encounter in the process of production and exchange, and provide guidance as to how the parties can resolve disputes? In this sense, does the contract serve as a comprehensive instrument for guiding and governing the buyer-seller relationship? Or, do its ambiguities make adaptation to ex-post problems more challenging?

According to transaction cost theory, when buyers seek goods and services for which attributes such as desired functionality, successful performance, and/or expected conduct during the production and delivery process become harder to define, verify, and monitor, uncertainty increases and the prospects for specifying a comprehensive contract diminish. Consequently, the number of situations for which the contract does not provide clear guidance increases, as does the scope for opportunistic behavior and the likelihood of disruptions to production (Klein et al. 1978; Williamson 1971). Under these conditions, the theory argues a buyer will seek sellers more prone toward cooperative problem resolution, or either partially or fully internalize

production by bringing sellers within the buyer's own organization (thus substituting an employer-employee relationship for one otherwise requiring a hard-to-specify contract established across organizational boundaries—see Klein et al. 1978; Williamson 1971).

In the context of public services, uncertainty references whether and to what extent government can define what it seeks to achieve in delivering services, and the activities required to do so. A service for which government can easily specify what constitutes success and monitor performance relative to desired outcomes lends itself more readily to delivery via contracting, whereas a service for which goals and performance cannot be easily specified, monitored, and verified makes contracting more challenging. Were government to contract out under these latter circumstances, it could risk failing to detect "nonperformance or negligence" (Brown and Potoski 2003: 445) if its contract did not clearly define success and if it could not easily monitor the seller to which it delegated delivery responsibilities. In these circumstances, according to transaction cost theory, the government would therefore be more likely to deliver the service itself, or if not, would either retain a degree of responsibility through a mixed delivery arrangement or delegate delivery to other governments or nonprofits—so-called "mission-driven" organizations—less likely to trade-off meeting performance objectives for the sake of ensuring adequate profit (thus presenting less of a concern from a monitoring perspective—see Brown and Potoski 2003).[11] As such:

[11] The profit motive could compel a for-profit organization to focus strongly on performance, but the argument in the contracting literature is that this is most likely given high competition, clearly specified goals, and relatively simple tasks that can be easily monitored. With lower competition, less clear goals, and difficult to monitor performance, the profit-motive may compel an organization to adhere strictly to a narrow interpretation of contract terms in lieu of putting in effort commensurate with a broader interpretation of what the contract says (see, e.g., Brown and Potoski 2003).

> H_{1a}: *As public services become characterized by higher uncertainty, governments are more likely to choose direct delivery, mixed delivery, or delegated delivery to other governments or nonprofit organizations, and less likely to choose delegated delivery to private for-profit organizations.*

While hard to measure services may be amenable to mixed delivery or delegated delivery to mission-driven organizations, in some cases monitoring challenges become so acute as to make risk of non-performance or negligence by third parties unacceptable from government's point of view—making direct delivery the safest option (Brown and Potoski 2003). Accordingly:

> H_{1b}: *Once uncertainty reaches a sufficiently high level, governments are more likely to choose direct delivery, and less likely choose an external delivery mode.*

2.2.2 Asset Specificity

Asset specificity references the degree of relationship-specific physical and human capital investments required to produce and deliver a good or service, and the implications of these investments for how strongly intertwined a buyer and seller become in a transaction (Williamson 1979; 1981; 1991). How much must a seller tailor its physical and human resource investments for purposes of producing a good or service for a particular buyer? Given significant tailoring on the part of a seller, can the buyer readily part company with this seller and establish a new relationship? Or, will the buyer be "locked in?" Will lock-in problems encourage the seller to behave opportunistically?

According to transaction cost theory, when buyers seek goods and services requiring greater relationship-specific investments, they cannot readily part company with their incumbent sellers given the time and effort new sellers would need to meet relationship-specific investment requirements. The upshot is that incumbents become more difficult to replace with any

alternative sellers who remain in the market, thereby giving rise to lock-in and increasing the likelihood incumbents will behave opportunistically (on account of diminished risk of replacement; see Brown et al. 2010). As with uncertainty, under these conditions transaction cost theory argues buyers will more likely internalize production or delegate production responsibilities to organizations prone toward more cooperative resolution of problems (Klein et al. 1978; Williamson 1971).

In the context of public services, asset specificity references relationship-specific investments required for a seller to produce and deliver one or another type of public service on a government buyer's behalf. A service for which government requires fewer relationship-specific investments lends itself more readily to delivery via contracting, whereas a service for which more relationship-specific investments must be made makes contracting more challenging. Were government to contract out under these latter circumstances, it could face lock-in problems if alternative sellers (specifically, those still in the marketplace following award of a contract to a particular seller) cannot be leveraged to discipline an incumbent via a credible threat of replacement. In these circumstances, according to transaction cost theory, the government would be more likely to deliver the service itself, or if not, would either retain a degree of responsibility through a mixed delivery arrangement or delegate delivery to other governments or nonprofits (whose mission-driven orientations may make them less apt to take advantage of their incumbency position). Therefore:

> H_{2a}: *As public services become characterized by higher asset specificity, governments are more likely to choose direct delivery, mixed delivery, or delegated delivery to other governments or nonprofit organizations, and less likely to choose delegated delivery to private for-profit organizations.*

Despite its desire to avoid incurring lock-in risk and exposure to opportunistic behavior on the part of a seller who could abuse its incumbency advantages, in some cases government may be unable to raise sufficient revenue and capital required to cover the fixed costs of service delivery, such as in the case of energy utilities (Brown and Potoski 2003). Thus, while in these cases direct delivery may be preferable from a risk standpoint, government may be forced to rely more on external delivery mechanisms. As such:

> H_{2b}: *Once asset specificity reaches a sufficiently high level, governments are less likely choose direct delivery, and more likely to choose an external delivery mode.*

2.2.3 Transaction Cost Economics and Environmental Contexts

Existing evidence suggests government's choice of service delivery mode follows a transaction cost logic, with a series of studies demonstrating that governments are more likely to pursue direct vis-à-vis mixed or delegated delivery of public services characterized by higher uncertainty and/or higher asset specificity (and vice versa; see, e.g., Bel and Fegada 2007; Brown and Potoski 2003; Brown et al. 2008, 2016; Hefetz and Warner 2004; Lamothe et al. 2008; Levin and Tadelis 2010). However, transaction cost economics does not provide a full accounting of the decision to make or (through various external approaches) buy services, prompting calls for an expanded theoretical framework that incorporates the "broader objectives and constraints [government] managers must consider in their decisions on sourcing service delivery" (Hefetz and Warner 2012: 2).

Such calls echo the now long-standing argument that (among other deficiencies) the transaction cost approach provides an "under-socialized" explanation of why actors organize production and exchange the way they do (Granovetter 1985; Ghoshal and Moran 1996). In essence, this argument (sometimes referred to as the "embeddedness" critique) contends that by

emphasizing the attributes of goods and services and their implications for the costs of managing task execution under alternative organizational arrangements, transaction cost economics "disallows by hypothesis any impact of social structure and social relations on production, distribution, or consumption" (Granovetter 1985: 483). In other words, it ignores the setting—what organization theorists refer to as the "environmental context"—in place in advance of the transaction (Granovetter 1985; Hall 1999; Malatesta and Smith 2011). Arguments as to how uncertainty challenges contract specification and impedes ex-post adaptation of buyer-seller relationships make no reference to the ex-ante environment within which the buyer and the seller come together. Likewise, while arguments about asset specificity allude to the seller side of good and service markets, they do so strictly from an ex-post perspective—from the perspective of whether asset-specific investments and lock-in problems leave any alternative sellers a buyer could switch to *after* awarding a contract to one seller in particular. The number of alternative sellers in place *prior* to award of the contract is not referenced, nor are other ex-ante conditions unrelated to the nature of the good or service to be exchanged (Malatesta and Smith 2011).

These oversights imply that transaction cost theory makes no accommodation for the idea that the influence of uncertainty and asset specificity could be context-dependent, or that contextual factors could influence the make-or-buy decision independent of uncertainty or asset specificity per se. Accordingly, if "transaction cost economics should [be] used in addition to, rather than to the exclusion of, alternative [theoretical] approaches" (Williamson 1985: 18), the theory chosen to supplement transaction costs should account systematically for variation in the environmental contexts in which buyers and sellers structure their relationships.

In emphasizing the role conditions external to organizations play in shaping and constraining decision making, resource dependence theory provides this supplement (Pfeffer and

Salancik 1978, 2003). Indeed, the payoff of this theory is precisely in that it accounts for the environmental context "in place *before*" (Malatesta and Smith: 608) buyers and sellers engage with one another to exchange goods and services. In other words, with respect to the variety of make-or-buy decisions organizations make—including government decisions about modes through which to deliver public services—resource dependence theory fills the contextual gap otherwise left by the transaction cost approach.

2.3 Resource Dependence Theory and Choice of Service Delivery Mode

Like transaction cost economics, resource dependence theory aims to explain variation in the structure of production and exchange between buyers and sellers. However, in lieu of emphasizing how the attributes of goods and services (and their implications for transaction costs) influence choice of production mode, the resource dependence approach emphasizes the role of the environment in which production and exchange occur as key to how these activities are organized.

In contemplating specifically how environments influence production and exchange, resource dependence theory begins with the notion that "every organization occupies a social exchange position [which] can be characterized in terms of both dependence and its inverse, power" (Malatesta and Smith 2011: 610). From here, the theory argues that organizations align production modes with the position of power or dependence the exchange environment accords them (Emerson 1962; Pfeffer and Salancik 1978, 2003). Suppose, for example, that a particular environment accords a buyer less power than a candidate seller. Were the buyer to enter a contract relationship with this seller, its relatively weaker position could create a situation in which it lacks leverage useful for tempering the seller's incentives to behave opportunistically

(here on account of elements of the exchange context rather than attributes of the good or service and incomplete contracting risks per se). In such situations, resource dependence theory (like transaction cost theory) prescribes that buyers take action to minimize the prospects of opportunism, such as through internalizing production or delegating it to sellers less likely to engage in opportunistic behavior.

Regarding the choice of internal versus various forms of external production, the resource dependence approach emphasizes two attributes of environments in particular: the number of alternative sellers of what an organization needs, and the extent to which sellers rely on this organization vis-à-vis others to "absorb" (consume, purchase, or otherwise take possession of) their output (Emerson 1962; Malatesta and Smith 2011; Pfeffer and Salancik 1978, 2003). The theory argues these factors are key in shaping the degree of power buyers and sellers may exercise in contract relationships—and therefore in determining their scope to behave opportunistically, which in turn influences their selection of alternative production modes. While widely applied to explain private for-profit organizations' choices over making versus buying goods and services, these concepts have also been used to understand the make-or-buy-decision in both the nonprofit and government sectors.

2.3.1 Number of Alternative Sellers

Number of alternative sellers references the degree of choice a buyer can exercise in deciding from whom it will procure goods and services. Can a buyer choose from many sellers of a good or service it seeks, or only a few? What implications does the number of sellers pose for competition? How does competition influence the power of buyers vis-à-vis sellers in contracting relationships, and by extension, risks of opportunistic behavior?

According to resource dependence theory, a greater number of sellers enhances the credibility of threats that any one seller could be replaced by its competitors, and thereby bolsters the power a buyer can exercise in contracting relationships. In accordance with enhanced buyer power, the likelihood an incumbent seller will behave opportunistically decreases, and the buyer faces less risk from contracting. With fewer sellers, however, threats of replacement become less credible, meaning a buyer exercises less power and incurs more risk from using a contracting approach. Under these conditions, the theory argues a buyer will more likely internalize production, share it, or delegate it to organizations less prone toward behaving in an opportunistic fashion.

In the context of public services, the number of alternative sellers references how many organizations (whether public, nonprofit, or private for-profit) a government can choose from for purposes of delivering services on either a mixed or delegated basis. Given more organizations from which a government can buy service delivery, its power to leverage the benefits of competition grows in accordance with enhanced credibility of threats to substitute an alternative seller for an incumbent. With fewer organizations selling services, however, the power of the government buyer diminishes—competition decreases, the threat of replacement becomes less credible, and the ability to leverage this threat for purposes disciplining an incumbent seller goes down. Accordingly:

> H_3: *As the number of sellers of public services decreases, governments are more likely to choose direct delivery, mixed delivery, or delegated delivery to other governments or nonprofit organizations, and less likely to choose delegated delivery to private for-profit organizations.*

In addition to this direct effect, the number of alternative sellers may also reduce lock-in risks arising from asset specificity. Here, the idea is that with larger numbers of sellers present

before a government awards one of them a contract, issues stemming from seller exit following contract award—from the propensity of sellers who lose a contract competition to exit the market place given the strength of the winner's incumbency advantage—may be mitigated to some extent. While substitution of an alternative seller for an incumbent could still be costly, the presence of a larger number of sellers ex ante raises the likelihood that one or more of them will remain in the market ex-post—that is, after government has awarded a contract and established its relationship with one in a set of sellers competing for its business. Therefore:

> H_4: *The number of sellers of public services moderates the relationship between asset specificity and choice of service delivery mode.*

2.3.2 Seller Dependence

Seller dependence references the proportion of a seller's output "absorbed"—consumed, purchased, or otherwise procured through a process of exchange—by one organization relative to others. What proportion of a seller's output does it depend on one organization or another to absorb? Do a large number of organizations absorb the seller's output, or is its dependence concentrated in one or a few organizations? How does the concentration of a seller's dependence shape the balance of power between itself and an organization that absorbs its output? What implications does dependence have for opportunistic behavior?

According to resource dependence theory, higher concentration of seller dependence on a single buyer elevates the importance of this buyer to the seller's sustainability and continued survival, and thus elevates the buyer's power in the context of a contracting relationship with the seller. As in the case of an increased number of alternative sellers, enhanced buyer power stemming from higher seller dependence reduces the likelihood the seller will engage in opportunistic behavior, and therefore reduces risks associated with contracting. By contrast,

decreased dependence raises contracting risks, since the seller depends less on the buyer and may suffer fewer consequences from behaving opportunistically (e.g., while it may lose its relationship with the buyer, its dependence could be distributed broadly enough to prevent such a loss from driving it out of business).[12] Under these conditions, resource dependence theory argues a buyer will more likely internalize production, share it, or delegate it to organizations less prone toward behaving opportunistically.

In the context of public services, seller dependence references the amount of revenue a seller of public services receives from a given government relative to other governments or non-governmental actors. To the extent a seller otherwise depends more heavily on a particular government buyer (e.g., by having multiple other contracts with it), this buyer can exercise more power over the seller in the context of a new contract. With lesser seller dependence, however, the power of the government buyer diminishes—its proportion of total seller revenue decreases and its power to use revenue dependence as a disciplinary tool diminishes (inviting greater risk of opportunism). As such:

> H_5: *As seller revenue dependence decreases, governments are more likely to choose direct delivery, mixed delivery, or delegated delivery to other governments or nonprofit organizations, and less likely to choose delegated delivery to private for-profit organizations.*

In addition to this direct effect, seller dependence may also reduce incomplete contract risks stemming from uncertainty. If a seller's dependence is concentrated more heavily in a particular government buyer, it may be less prone to exploit contract ambiguities attributable to the buyer's difficulty defining and verifying successful performance. To the extent this is the

[12] Impacts on the seller's reputation could discourage malfeasance in relationships with organizations upon which it is not overly dependent, but these effects would turn on the specific distribution of dependence and how importantly organizations on whom the seller depends most treat reputation.

case, the buyer may be less concerned with opportunistic behavior arising from a lack of clear contract specification (and attendant challenges monitoring the seller and determining whether it is behaving appropriately). Accordingly:

> $\underline{H_6}$: *The percentage of revenue sellers receive from government moderates the relationship between uncertainty and choice of service delivery mode.*

2.4 Theoretical Model

For purposes of testing in future empirical research, the theoretical argument advanced in this essay can expressed in model form as follows:

(1) $$Y = \beta_0 + \beta_1(UNCERTAINTY) + \beta_2(UNCERTAINTY)^2 + \beta_3(ASSET\ SPECIFICITY) + \beta_4(ASSET\ SPECIFICITY)^2 + \beta_5(SELLERS) + \beta_6(DEPENDENCE) + \beta_7(\text{ASSET SPECIFICITY})*(\text{SELLERS}) + \beta_8(\text{ASSET SPECIFICITY})^2*(\text{SELLERS}) \beta_9(UNCERTAINTY)*(DEPENDENCE) + \beta_{10}(UNCERTAINTY)^2*(DEPENDENCE) + \varepsilon$$

Where the β's represent estimable parameters and the rest of the elements are as follows:

Y = government's choice of service delivery mode

UNCERTAINTY = degree of uncertainty characterizing a public service

ASSET SPECIFICITY = degree of asset specificity characterizing a public service

SELLERS = number of alternative sellers

DEPENDENCE = degree of seller dependence

$ASSET\ SPECIFICITY^2$ = square of asset specificity

$UNCERTAINTY^2$ = square of uncertainty

ε = error term

This model is specified in a manner that permits testing each of the theory's hypotheses. It features the main effects of uncertainty (H_{1a}), asset specificity (H_{2a}), number of alternative sellers (H_3), and seller dependence (H_5); the square of asset specificity (H_{1b}) and the square of uncertainty (H_{2b}); and the moderating effects of, respectively, asset specificity and number of alternative sellers (H_4), and uncertainty and seller dependence (H_6).[13]

In addition to these primary variables, the model could be augmented with a series of control variables to account for additional influences on selection of delivery mode, including, following prior work (e.g., Brown and Potoski 2003; Brown et al. 2016; Hefetz and Warner 2012), geography (e.g., urban vs. rural location); demographics (e.g., population); institutions (e.g., structure of and relationships between legislative and executive bodies of government); taxes and spending (e.g., amount of annual tax collections or budget size); economic conditions (e.g., per capita income); and variables to account for the political context of decision making (e.g., citizen ideology or party affiliations). Building on prior research, the model could be tested using a sample of government source selection decisions and accompanying information on services and service characteristics, market characteristics, and the set of control variables. Given the nature of the dependent variable—a dummy variable indicating selection of one in a set of alternative approaches to service production—testing would require use of a discrete choice model that accommodates a nominal outcome inclusive of more than two categories (i.e., an outcome indicating one in a set of choices for which there is no natural underlying order), such as a multinomial logistic regression model.

[13] The data used for empirical analysis would be at the level of the individual service delivery mechanism chosen by a given government, for a given service, at a given time period, as a function of (i) individual service characteristics; and (ii) market-level variables measuring the number of alternative sellers and a composite measure of overall seller dependence (such as the average or median proportion of revenue the relevant sellers receive from the government buyer).

2.5 Conclusion

In the context of modern governance, private actors play a prominent role in public service delivery, making the conditions under which governments choose to make or (through a variety of external arrangements) buy public services an important question for both scholarship and practice.

To date, research on the make-or-buy decision has relied heavily on transaction cost economics, emphasizing the role of public service characteristics and their implications for the ease or difficulty of production and exchange through contracts as key determinants of the choice to internally produce services or rely (in part or wholly) on third party production. Existing studies suggest service-specific characteristics and transaction costs stemming therefrom do influence government's choice of service delivery mode, but these decisions do not follow a strict transaction cost logic. Accordingly, better framing and motivating future empirical analysis of variation in the mechanics of public service production warrants additional research—specifically, a more fully specified theory of the make-or-buy decision in the public service context.

Building on past research, this essay sets government's decision over direct, shared, or fully delegated public service delivery within a larger environmental context for which the transaction cost approach does not account, and draws on resource dependence theory—which puts explicit emphasis on contextual conditions shaping and constraining organizations' decision making—to develop a richer argument as to why governments deliver services via different arrangements. With respect to public services, the thrust of resource dependence is that two factors—the number of alternative sellers from which governments can buy services, and seller financial dependence on the government buyer—shape the balance of power of government vis-

à-vis a third party seller in a contracting relationship. Such power, the essay argues, both directly influences government's choice of service delivery mode and moderates the influence of transaction costs.

Through advancing this argument, a key contribution of the essay is thus to provide a theoretical justification for why, in practice, governments sometimes make what transaction cost economics prescribes buying, and buy what transaction cost economics prescribes making. By extension, the essay creates opportunities for additional empirical analysis of service delivery choices, and in doing so, contributes to the process by which knowledge is accumulated through development, testing, and further development of theory. Moreover, by refining and sharpening knowledge about the factors that influence selection of direct vis-à-vis various forms of external delivery, the essay may also afford researchers opportunities to address questions such as how choice of a given delivery mode influences performance (as measured, for example, by variables like cost efficiency, citizen satisfaction, or other performance indicators). In combination, these advances in research can aid practitioners by helping them understand how to choose methods for delivering public services that lower costs, raise the likelihood of accomplishing missions, and promote stronger realization of policy goals.

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Chapter 3: Product Complexity and Competition in Public Procurement—Theory and Evidence from United States Federal Information Technology (IT) Procurement

3.0 Introduction

Competition is argued to be a fundamental source of value in public procurement. Indeed, perhaps no other force is purported to be as powerful at incentivizing sellers to deliver goods and services of lower cost and higher quality. This essay asks: how does product complexity affect competition for government's procurement business?

While not available in all circumstances—the number of alternative sellers varies widely across both geography and product types, and may be especially low in markets for some public services (Kettl 1993; Van Slyke 2003)—we would expect government's procurements of more commonly sold products to be subject to stronger competitive forces. At the U.S. federal level, "buying commercial" has been the preferred method for meeting the government's material needs since the mid-1990s,[14] and the Federal Acquisition Regulation (FAR) calls for "maximizing the use of commercial products and services."[15] The products agencies buy, however, can vary in the extent to which they are either commercial or modified for a more government-specific purpose (Serbu 2012a, 2012b).[16]

From a theoretical perspective, variation in the degree to which a product is either purely commercial or modified for government reflects variation in *asset specificity*: the degree of relationship-specific investments required to execute a transaction by producing and delivering a product (Williamson 1981). Asset specificity is a key concept in the transaction cost theory of organization, and along with uncertainty, is one of the two major dimensions along which public administration research distinguishes government's procurements of *simple products* from

[14] The preference for acquiring commercial items and using more commercial-like purchasing practices stems primarily from two 1990s laws: the Federal Acquisition Streamlining Act (FASA) of 1994 and the Federal Acquisition Reform Act (FARA) of 1996 (a.k.a., the "Clinger-Cohen Act").

[15] See FAR 1.102. The Federal Acquisition Regulation (FAR) is the primary set of regulations governing acquisition at the US federal level. For further details, see Manuel et al. (2015).

[16] Unless otherwise indicated, this paper uses the word "product" for either a good or a service.

complex products (Brown et al. 2015). Simple products are those for which government can easily define a product's cost, quality, and terms of exchange, and that do not entail lock-in risks stemming from asset-specific investments; complex products are those for which government is more uncertain about what it wants to procure, and that entail greater risk of lock-in (Brown et al. 2010).

Of course, these are ideal types. A product could, for example, be complex in that its design includes many constituent subparts—meaning it exhibits high uncertainty—but at the same time exhibit little or no asset specificity if it is sold to both commercial and government customers. That said, complexity often implies some degree of asset specificity. Thus, while "product complexity" is conceptualized along multiple dimensions by researchers working in areas like economics, engineering, and operations research (Orfi et al. 2011), this essay emphasizes the asset specificity dimension.

The question of how complexity (i.e., asset specificity) influences competition is important because in theory it is a choice variable over which government exercises control. The ability to choose will vary from case to case—some missions necessitate procuring more than a basic, commercially available product—but for many of its purposes government can elect to procure a simpler or a more complex product, with potentially important implications for competition.[17]

This essay develops competing hypotheses for how product complexity influences competition and tests them on a sample of information technology (IT) procurements drawn from US federal procurement data. The US federal government spends approximately $50

[17] In principle, complexity is driven by requirements of the mission for which the product is purchased. Of course, however, it could be that competition is often a partial driver of government's choice to buy a simpler or a more complex product—it could be that complexity is endogenous to competition. This issue is further addressed in the methods section.

billion per year on IT, making it the second largest category of procurement spending government-wide (Rung 2014). Moreover, IT figures importantly in the performance of nearly every federal mission and, insofar as it offers government the opportunity to choose one level of complexity versus another, it offers a potentially useful source of variation for hypothesis testing purposes. The essay operationalizes the asset specificity dimension of complexity using a categorical variable indicating whether a procurement is for (i) a purely commercial product (*commercial*), (ii) a modified commercial product (*modified*), or (iii) a product developed exclusively for government use (*government*). It operationalizes competition as the number of bids offered in response to solicitations for individual procurements. Its primary argument is two-fold.

First, at higher levels of complexity, and thus of asset specificity, sellers may deem the risks of doing business with the government as too high to warrant submitting a bid. Second, however, while lower levels of complexity may decrease these risks, they may also discourage competition by creating a collective action dilemma: for a simpler product, individual sellers may not submit a bid because they believe the competition will be too intense, and their probability of winning too low. This reasoning points to two effects—a *project risk effect* (simpler products invite more bids) and a *win probability effect* (simpler products invite less bids)—and implies competing hypotheses for how complexity influences competition.

Evidence from count variable regressions suggests that for the type of procurements the essay considers—recurring procurements of commercial commodities and variants thereof—the effects mostly offset one another: across several models and sub-samples, increases in complexity are associated with less competition, but the reduction is small. The project risk effect and the win probability effect likely operate with greater force (in one direction or another)

in larger, program-based procurements (e.g., procurements of major weapons or information systems) that can span many years and involve multiple individual contracts for development, production, maintenance, and upgrades. Thus, a more complete theoretical story that links complexity and competition would likely need to make its propositions contingent on the depth and duration of the underlying business relationship, as well as the nature of the product being procured.

The remainder of this essay is organized in six sections. Section one further discusses competition in public procurement. Section two reviews existing literature on product complexity as a theoretical construct and discusses its dimensions (including asset specificity). Section three develops the logic underlying the relationship between product complexity and competition, and derives competing hypotheses for how complexity affects competition. Section four discusses data and methods. Section five presents and discusses results. Section six concludes by discussing the implications of the essay for future research and practice.

3.1 Competition in Public Procurement

Governments are among the world's largest consumers of goods and services. The United States federal government procures nearly half a trillion dollars of goods and services every year, or roughly 16 percent of annual federal expenditures (Brown et al. 2015). Historically, procurement spending has been even higher as a percentage of total budgets at the US state and local level (Kelman 2002), and is also significant internationally (accounting for approximately 12% of GDP among OECD countries and even higher percentages among developing countries—see Brown et al. 2015).

But procurement is about more than money. The sheer scale and scope of responsibilities with which governments are entrusted mean they cannot possibly produce all the goods and services required to accomplish their missions. While debates continue over whether government should buy delivery of certain public services—prison operations, social services, and security provision are notable examples—one would be hard pressed to argue the public sector should produce its own pens, pencils, or office furniture. Indeed, whereas external procurement of public services may present a "thin markets" problem—where government can work with only a few sellers, and risks lock-in to the one with whom it establishes a relationship if others exit the marketplace when they are not chosen (Williamson 1985; Kettl 1993; Van Slyke 2003; Brown et al. 2010)—competitive forces tend to be more intense in markets for products that support public service delivery, and government more able to harness competition's benefits.

Proponents point to several benefits of competition, including the promise of higher quality products at lower prices, as well as ancillary benefits like accountability, fraud prevention, and better stewardship of taxpayer resources (Manuel 2011). These benefits are important, but it should be noted that competition is only a means to an end, not an end in itself. There are both good and bad forms of competition. By mandating competition—for example, requiring sellers to bid for every order of goods or services placed against an indefinite delivery contract (an umbrella contract awarded via a two-step process where sellers first compete for award of a master contract and then compete for individual orders)—government often discourages the very behavior it seeks to encourage. Rather than preventing one seller from gaining an incumbency advantage that reduces its motivation to minimize costs and maximize performance, a mandate more often raises each seller's bid proposal expenses and results in more

overhead costs passed on to the government (Gansler and Lucyshyn 2013). Mandates may also discourage sellers from offering innovative solutions, since they cannot focus exclusively on winning business that aligns with their capabilities and expertise (Gansler and Lucyshyn 2013). Creating a competitive environment where sellers can choose whether or not to bid allows them to pursue business for which they deem themselves a best fit, thus harnessing (rather than suppressing) seller incentives to be efficient and innovative while preserving government's option to either maintain or change business relationships depending on a seller's historical track record. This discretion is key to tapping competition's benefits without preventing public managers from using their "common sense and good judgment in ways that promote better [seller] performance" (Kelman 1990, p. 1).

3.2 Product Complexity

The wide range of products governments procure significantly complicates research on procurement- and contracting-related issues. As such, gaining traction on these topics requires a theoretical construct allowing for parsimonious description and differentiation of what government buys.

"Complexity" is one such construct, albeit one with multiple meanings across different areas of inquiry. Indeed, as an idea, complexity and the accompanying notion of a "complex system" are subjects of a large, eclectic intellectual enterprise cutting across the physical and social sciences. A comprehensive review of the literature is far beyond the scope of this essay (see Johnson 2009), and even with respect to products, there is no widely accepted definition or measurement of the complexity construct. Definitions and measurements instead vary "based on the objective of the analysis, scope of the research, and the available data" (Orfi et al. 2011, p.

60), and are conceptualized along numerous different dimensions. In the context of the private sector, for example, many studies have conceived of product complexity in terms of *variety*, which they operationalize by measuring characteristics like a product's number of unique parts or production processes, or performance-based attributes like diversity of functions offered to end users (see, e.g., Ameri et al. 2008; Barclay and Dunn 2000; Pahl and Beitz 1996).

Research in the public sector context maps product complexity along two dimensions—*uncertainty* and *asset specificity*—and uses them to distinguish *simple products* from *complex products* (Brown et al. 2010, 2015). A simple product is one for which uncertainty, or difficulty defining a product's cost, quality, and/or terms of exchange is low, and there is little or no need for asset specific investments—investments in relationship-specific physical and human capital required to produce the product and deliver it. A complex product, by contrast, is one where uncertainty is higher and there is more need for asset-specific investments (Brown et al. 2010).

Of course, these are ideal types. In practice a product may not fit neatly in the "simple" or "complex" category. Moreover, complexity *per se* need not imply the presence of both high uncertainty and high asset specificity. A product could, for example, exhibit high uncertainty on account of having a design that includes many constituent subparts, but at the same time be sold to both commercial and government customers (thus posing little in the way of asset specific investment requirements). In fact, to the extent new or innovative products useful to government agencies are increasingly developed by and for the private sector, buying the "cutting edge" can mean buying commercial (Kendall 2015). That said, relationship-specific investments often underpin the exchange of a product modified or newly created to meet a particular buyer's needs, including a government buyer. In other words, complexity usually implies some degree of asset

specificity. Insofar as this is frequently the case with government, this essay conceives of product complexity along the asset specificity dimension.

3.3 Product Complexity and Competition

The question of how complexity (as defined by asset specificity) affects competition is important because, in theory, it is a choice over which government can exercise control. For many of its purposes, government can procure a simpler or a more complex product without jeopardizing mission accomplishment. How does variation in complexity impact seller decisions to compete for government procurement business?

3.3.1 Project Risk

To the extent increasing complexity entails greater need for asset specific investments, a seller could deem the risks of doing business with the government as too high to warrant submitting a bid. In particular, increasing asset specificity makes accurately estimating project costs more difficult because of requirements to use relatively unique physical and human capital with which the seller may not have much experience, and not as much historical information about costs. Absent this information, a seller may risk making an offer that fails to reflect the full extent of resources needed to complete a project. If the seller wins a bid contest on the basis of this offer, it could end up incurring cost overruns for which the government does not provide additional compensation—as in the case of fixed price projects, where government pays a set price not adjusted for unforeseen production expenses.[18] Since uncompensated expenses reduce

[18] Depending on the contracting mechanism, government could provide some degree of compensation for unforeseen cost increases, which may create a moral hazard problem where sellers are more (not less) inclined to pursue complex procurements by systematically underestimating costs out of a belief that the government will inevitably provide them with financial "bail outs." As noted in section four, however, for purposes of this paper the focus is exclusively on fixed price procurements.

profits, sellers may elect not to bid for projects characterized by higher asset specificity—higher complexity—because they are more likely to incur cost overruns the government will not cover. Call this product complexity's *project risk effect*, which implies the following:

> H_{1a}: *As product complexity increases, the risk of uncompensated cost overruns (i.e., project risk) increases, and discourages competition for public procurements. Accordingly, simpler (more complex) products invite more (fewer) bids.*

3.3.2 Win Probability

Project risk may suppress seller motivation to compete for procurement business, but it could be that competition does not automatically increase in the absence of this risk. Indeed, while we would expect more bids in cases where a commercial product is sufficient to meet the government's requirements, the prospect of a larger competitor pool could negatively impact any one seller's beliefs about their ability to win a bid contest. That is, a larger number of potential competitors may compel each individual seller to lower their estimate of the likelihood they can secure the government's business. The implication could be that an individual seller "stays on the sidelines" because they deem their odds of winning as too low to warrant submitting a bid.[19]

To the extent each seller evaluates the situation similarly, the upshot could be that multiple sellers simultaneously elect *not* to vie for the government's business. From the government's perspective, this outcome represents a collective action dilemma—a "tragedy of the commons" in which value-enhancing competition succumbs to the strategic behavior of actors on the supply side of the marketplace.

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[19] While it could be that the cost of submitting a bid in any given case of a simple product is not that high, recall (from section I) that accumulating bid and proposal expenses can drive up overhead costs, which can possibly make a seller's bids less competitive over time.

To be sure, in practice we do not observe wholesale disappearance of seller interest whenever government seeks to buy a simpler product, but reflections from stakeholders with extensive experience and background in public procurement do accord with a collective action argument. As one observer argues,

> *"[B]idders will try harder to be innovative in a limited competition (where they think they have a strong chance of winning) than in a competition with many others. In fact, many firms will not bid unless they think they have a good chance of winning the business…*" *(Gansler 2011, p. 283).*

Accordingly, it could be that in choosing to support its missions with simpler products, government inadvertently discourages competition among sellers convinced they do not have a meaningful chance of garnering its business. Call this product complexity's *win probability effect*, which implies the following:

> $\underline{H_{1b}}$: *As product complexity decreases, the pool of potential competitors grows, prompting individual sellers to lower their estimated probability of winning and discouraging competition for public procurements. Accordingly, simpler (more complex) products invite fewer (more) bids.*

3.4 Data and Methods

For hypothesis testing purposes, this essay draws on a sample of information technology (IT) procurements drawn from US federal procurement data. US federal agencies make extensive use of IT products to perform their missions. Moreover, insofar as IT affords federal buyers an opportunity to choose one level of product complexity versus another, IT procurement provides a potentially useful source of variation for testing hypotheses about project risk and win probability effects. Among federal agencies, the Department of Defense (DOD) is by far the

largest procurement entity, accounting for roughly seven of every 10 cents in annual federal procurement expenditures.[20] The analysis focuses on DOD's IT procurements.[21]

Data are drawn from the Federal Procurement Data System – Next Generation (FPDS-NG), a database recording information on non-classified federal procurement activities.[22] The FPDS records a variety of information pertaining to individual procurements, including procurement identification numbers, dates, and dollar values, as well as information on the agency buyer, the seller, the product bought, and the nature of the transaction (including the number of offers received in response to agency bid solicitations). For analysis purposes, the essay examines procurements from FY 2012.[23] All the procurements were executed on a fixed price basis.[24]

Federal agencies (DOD included) procure IT products predominately through indefinite delivery contracts (Kelman 2002). Accordingly, the sample focuses on procurements made through these contracting vehicles, and the unit of analysis is thus the master contract-procurement (or "purchase") order. For analysis purposes, the sample specifically includes two types of master contracts through which DOD procures IT: government-wide acquisition contracts (GWACs)—contracts through which multiple departments and agencies can make

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[20] For example, for FY 2014 (10/1/2013 – 9/30/2014), federal contract spending totaled $462.5 billion. Of this amount, DOD contract spending amounted to $308.6 billion, or around two thirds of total federal contract spending. See USAspending.gov for additional information. Similar patterns held in FY 2015 (10/1/2014 – 9/30/2015) and FY 2016 (10/1/2015 – 9/30/2016).

[21] While DOD buys a number of products unique to its warfighting mission, the IT procurements with which this paper is concerned are made across federal agencies. Thus, focusing on DOD does not significantly reduce generalizability.

[22] See FPDS.gov.

[23] Thus, the data are cross-sectional in nature, but they are also grouped.

[24] Fixed price is compensation method in which the seller is paid for output. This is contrasted with cost-reimbursement, in which the seller is paid based on inputs. Sellers generally prefer cost plus contracts as they shift financial risk to the government. Accordingly, the compensation method government indicates in its bid solicitation information likely influences seller bidding decisions. Restricting the focus to fixed-price procurements eliminates the need to account for compensation-driven differences in bidding across individual procurement transactions.

different types of IT procurements—and agency-specific master contracts, which for the purposes of this essay are referred to as "multiple award contracts" (MACs), a type of vehicle set up for DOD's use.

To ensure variation in the dependent variable (defined below), the sample is restricted to procurements made against master contracts where sellers can elect whether or not to bid for an individual order (where competition is not "mandatory").[25] The sample is further restricted to procurements listed under North American Industry Classification System (NAICS) code 334, which denotes "Computers and Electronic Products." The final sample is 3,411 orders across 34 master contracts. All procurements were executed in the United States (none were made to support overseas activities).

3.4.1 Dependent Variable

The dependent variable, *bid count*, is the number of offers received in response to solicitations for each procurement. Bid counts indicate seller interest in supplying a government agency with goods or services (Malatesta and Smith 2011). Thus, higher observed numbers of offers indicate a greater degree of competition for individual procurement transactions.

3.4.2 Measure of Complexity

The primary explanatory variable operationalizes product complexity with a categorical measure indicating whether a procurement is for (i) a commercial product (*commercial*), (ii) a modified commercial product (*modified*), or (iii) a product developed exclusively for government use (*government*). In classifying products as commercial, modified, or government-specific, this

[25] This determination was made based on observed variation in bid counts within each master contract. It could be that higher bid counts reflect an increase in the number of qualified sellers rather than flexibility to bid or not bid for any given order. However, sellers are not typically added to master contracts on an ongoing basis, and this analysis assumes the number of sellers within each contract does not change over the time period considered.

indicator variable effectively operationalizes the asset specificity dimension of the product complexity construct. A commercial product requires essentially no asset specific investments (since it is sold to both commercial and government customers), while modified and government-specific products require some degree of investment in relationship-specific physical and human capital (in the physical infrastructure and/or knowledge necessary to create something more customized to government needs).

3.4.3 Control Variables

Control variables aid in distinguishing complexity from other factors that may influence competition. In attempting to account for these factors, like the dollar value and the term of the procurement agreement, the ideal approach would be to gather information directly from the solicitation notice. For orders placed against indefinite delivery vehicles, however, solicitation information is typically not recorded in a publicly accessible source. Thus, while the FPDS records data on factors such as transaction size and period of performance, these are ultimately *procurement data* associated with an award. They may correspond to information on the initial solicitation for bids, but they are not *the same* as this latter form of data. Therefore, for variables like transaction size—for which the solicitation may contain an approximate figure, but for which the figure recorded in the procurement data follows from competitive bidding—direct measurement is not appropriate.

A second-best approach is to incorporate a logically constructed indicator variable that provides some control for the factor in question, but is not likely to be endogenous. Accordingly, while procurement size is a key factor for which to account—competition may, for example, be stronger for larger procurements that require an agency to give sellers more information about what exactly they wish to buy, as well as more time to vet bidding decisions

and prepare offers (or, alternatively, may discourage competition if larger procurements require what sellers deem an undue amount of bid preparation work)—for the purposes of this analysis it is not measured directly. Instead, it is measured indirectly using a set of dummy variables that indicate value thresholds at which federal acquisition regulations require agencies to make increasingly greater efforts to afford each seller a "fair opportunity" to compete.[26] Fair opportunity requirements apply with differing levels of specificity to procurements starting above $3,000 (below which agencies are only required to distribute procurements equally, but above which fair opportunity requirements begin to kick-in[27]). For any procurement above $3,000 but below $150,000, agencies must ensure each qualified seller under an indefinite delivery contract has a fair opportunity to compete, but can otherwise exercise considerable flexibility in how they solicit competing proposals (including via oral presentations).[28] Above the $150,000 threshold, federal acquisition regulations specify that agencies must issue a formal notice of intent to make a procurement, describe what they seek to buy, and explain the basis for how they will select a winning seller.[29] Above $5 million, agencies must meet additional requirements, like offering to debrief losing sellers.[30] Based on these requirements, the dummy variables for procurement size captures (i) procurements greater than $3,000 but less than $150,000 (*<$150k*), (ii) procurements greater than or equal to $150,000 but below $5 million (*$<5Mil*), and (iii) procurements of $5 million or more (*$5Mil+*—for estimation purposes, the excluded reference category).

[26] For federal procurement purposes, "fair opportunity" means giving every seller qualified to bid for orders placed against a master contract an equal opportunity to do so. See FAR 16.505(b).
[27] See FAR 16.505(b)(1)(i).
[28] See FAR 16.505(b)(1)(ii).
[29] See FAR 16.505(b)(1)(iii)(B)(1)-(2).
[30] See FAR 16.505(b)(iv)-(v).

Other controls include (i) dummy variables for period of performance (length of time given to deliver a product), each of which indicates a time period measured in range of months (e.g., less than one month—here the excluded reference category, between one month and three months, and so on—another indirect measure used for the same reason as the dummies for procurement size and defined fully in Table 1); as well as (ii) dummy variables for the identity of the component (or "sub-agency") making the procurement (in DOD's case, one of the three military departments, plus a fourth category if the component is one of the Pentagon's civilian agencies, which for estimation purposes is the excluded reference category).[31] These latter variables are "nuisance variables" intended to account for unobserved heterogeneity in procurement policies and practices across DOD (e.g., unobserved differences in how each component's procurement officers solicit competing business for transactions that are small enough to afford flexibility in solicitation processes).[32] These variables also help account for tendencies of components to select a level of complexity based on expected degree of competition (thus mitigating concerns about endogeneity of the key explanatory variable to the outcome).[33]

Table 3-1 presents summary statistics for the dependent variable, the primary explanatory variables, and the control variables.

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[31] Civilian agencies in DOD include the Defense Logistics Agency (DLA), Defense Information Systems Agency (DISA), and other agencies that are not located within a particular military department.

[32] In addition to the models for which results are presented in Section V, other models were run that included controls for situations in which a purchase is subject to limited competition stemming from socioeconomic preferences, as well as situations in which a purchase could be made using simplified solicitation and ordering procedures. Since these are both a function of size, however, they were dropped on account of multicollinearity. Accordingly, models corresponding to the reported results do not include these variables.

[33] For the dummy variables to aid in this way, the tendency to select complexity based on expected competition must be time invariant. Since the data are cross-sectional, this is a defensible assumption.

3.4.4 Method

Number of offers is an event count, making econometric methods suitable for count data appropriate here. A count data model is a type of limited dependent variable model used when the outcome takes on non-negative integer values (Wooldridge 2009). The outcome can be zero as well as non-zero positive integers, but here the sample is truncated above zero because the FPDS data only include information on procurements where DOD received at least one offer in response to the corresponding solicitation. Accordingly, for estimation purposes the essay uses zero-truncated count data models accounting for failure to observe a portion of the population from which the sample is drawn (Allison and Waterman 2002; Wooldridge 2009).[34]

Since individual observations are grouped by master contract, the models include "master contract fixed effects" to control for unobserved invariant heterogeneity in characteristics of master contracts that may bear on competition. Key among these is number of sellers qualified to bid on orders. Size of the qualified seller pool is a seemingly obvious source of variation in bid counts, meaning failure to control for it would create a serious omitted variable bias problem. Since it is not directly observable, however, fixed effects are necessary to eliminate differences in competition from seller pools of varying sizes.[35] This strategy also differences out any other unobserved, within-group invariant heterogeneity across master contracts, meaning it provides control for all other relevant influences on competition set at the master contract level.[36,37]

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[34] While to the author's knowledge no publicly accessible data exists on the extent to which solicitations for individual task or delivery orders receive no bids, available information suggests the problem is not significant. Accordingly, there are at least currently no grounds for concluding that this type of sample truncation introduces a serious issue with selection bias.

[35] All regression models were estimated with standard errors clustered by master contract.

[36] Since fixed effects approaches rely on variation within groups, however, measuring discernable effects of key explanatory variables can be difficult when they vary little within each group. This is a fundamental trade-off using fixed techniques.

[37] For analysis purposes, standard errors are clustered by master contract.

The analysis uses two common types of count data regression models: Poisson regression and negative binomial regression. The Poisson model is a "natural first step" for analyzing count data (Wooldridge 2009: 597), but its conditional mean-variance equality assumption rarely holds. Count data more often exhibit "overdispersion"—the variance of the data exceeds the mean. Here Poisson regression underestimates standard errors, overstating measurement precision of individual coefficients.[38] Negative binomial regression addresses this problem by relaxing the assumption of conditional mean-variance equality, preventing underestimation of standard errors otherwise attributable to overdispersion (Cameron and Travedi 1999).

Both regression models are based on the Poisson probability distribution:

$$P(Y = y) = \frac{e^{-\mu}\,\mu^{y}}{y!}$$

Each method models the mean outcome as an exponential function, which can also be expressed in terms of logarithms:

(1) Exponential: $E(Y_{ij}|X_{ij1}\ldots X_{ijk}, \delta_j) = e^{\beta_0 + \beta_1 X_{ij1} + \beta_2 X_{ij2} + \ldots + \beta_k X_{ijk} + \delta_j}$

(2) Logarithmic: $\ln[E(Y_{ij}| X_{ij1}\ldots X_{ijk}, \delta_j)] = \beta_0 + \beta_1 X_{ij1} + \beta_2 X_{ij2} + \ldots + \beta_k X_{ijk} + \delta_j$

In each equation, Y_{ij} corresponds to the bid count for procurement *i* within master contract *j*; β_0 represents an intercept; β_1 through β_k represent coefficients on *k* explanatory variables indicating product complexity, transaction size, period of performance, and agency component; and δ_j represents a fixed effect for each master contract *j*.

[38] This problem can be addressed (at least in part) via use of robust standard errors. For the purposes of this essay, all Poisson regressions were run using robust standard errors.

3.5 Results

Tables 3-2 through 3-7 present results from a set of count variable regressions estimated using Poisson and negative binomial regression methods. For each model, the tables present results from regressions on the full sample and two-sub samples that focus on MACs and GWACs.[39] To aid in interpreting magnitudes, each table presents the average number of offers received for the relevant sample or sub-sample. Recall that the regression models account for sample truncation (here, for the fact that the bid count is never zero) and feature a master contract fixed effect (to account for variation in the size of qualified seller pools). Each table reports the number of master contract groups, i.e., "fixed effects," in the corresponding regression. Also recall from equation (2) that the outcomes can be expressed in terms of logarithms (and are reported as such in the tables).

Overall, the results show that competition is decreasing in complexity by a relatively small magnitude. Estimates from the full sample Poisson regression (presented in Table 3-2) show that moving from a purely commercial to a modified commercial product is associated with an approximately 18 percent reduction in the number of offers received, a figure statistically significant at the 1 percent level.[40] Based on an average bid count of three, the 18 percent figure implies roughly one less bid on average for a change from a commercial product to a modified

[39] Breaking out the samples affords an opportunity to examine differences *between* the master contract types—to determine, generally, whether there is something different about the complexity-competition relationship between the two types of purchasing vehicles.

[40] Since regression results correspond to the log-linear form of the model in equation (2), the value of each reported coefficient can be interpreted as the approximate percentage change in bid count for a unit change in the corresponding explanatory variable (that is, for a unit change in X, 100*β would give an approximate percentage change in the number of offers received). Wooldridge (2009) notes that the most accurate percentage estimates are obtained by first exponentiating the coefficient, subtracting 1 from this result, and then multiplying by 100, although here the more basic calculation provides a result that corresponds closely to that produced by this more involved procedure (e.g., in Table 2—Poisson regression on the full sample—moving from a commercial product to a modified product is associated with an 18 percent decrease in the number of offers received, as $(e^{-0.198} - 1)*100 = -18$.

one. The corresponding result in Table 3-3—from a negative binomial regression on the full sample—is similar, showing that a shift from purely commercial to modified is associated with a roughly 16 percent reduction in bids (significant at the 5 percent level). A comparable pattern shows up in results from regressions on the sub-samples. For example, in Table 3-4—a Poisson regression on the MAC sub-sample—a shift from a purely commercial to a modified commercial product is associated with a reduction in offers of around 16 percent (significant at the 1 percent level).[41]

Results corresponding to the shift from a commercial to a government-specific product do not show a discernable influence on competition, although as shown in the summary statistics in Table 3-1, purely commercial procurements account for a very large majority of the sample compared to procurements of modified or government-specific products per se. Thus, while degree of complexity is a choice over which government exercises control—meaning that, in principle, it does offer a source of variation for hypothesis testing purposes—there is little *observed* variation in the sample itself. Moreover, the small number of observations corresponding to modified commercial and government-specific products are strongly partitioned by master contract.[42] This means there is also little of the "within-group" variation that the fixed effects approach relies on for estimation purposes. Given more variation in the

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[41] Results from regressions on the GWAC sub-sample (Tables 6 and 7) offer less for which substantive comment can be made, although in the negative binomial regression (Table 7), the estimate on the modified commercial dummy is larger than in either the full or MAC subsamples—suggesting an approximately roughly 50 percent reduction in number of offers ((e-0.691 – 1)*100 = -50). By conventional standards (p value = 0.05), however, this estimate is still somewhat noisy (p-value = approx. 0.09), and is based on a much smaller sample.

[42] For example, while over half the master contracts include variation in the complexity indicator, a tabulation by master contract ID of the dummy variable indicating a modified commercial product shows that of all the master contracts, roughly half (101 of 203) the observations corresponding to a modified commercial product are in just two master contract groups. These two groups comprise 1,480 observations in total, and all the observations except the 101 corresponding to modified commercial products are for purely commercial product procurements. Thus, again, observations corresponding to products that are not purely commercial in nature are heavily concentrated in a few groups for which overall variation in the complexity indicator is low.

complexity dummies, both overall and within master contracts, the regressions would likely show a more discernable influence of, for example, procuring a government-specific product on competition.

The relatively small (but well measured) influence on competition of a shift from commercial to modified products suggests the project risk and win probability effects operate in a largely offsetting fashion in these cases. That is, at least with respect to procurement of commercial products and variants thereof, it appears from the results that sellers view procurement of products modified from their purely commercial form as something of a "wash." Project risk and win probability considerations weigh roughly evenly on the bidding decision, with project risk appearing to play a slightly more predominate role. It may be that both the project risk and win probability effects operate with greater force, in one direction or another, in a different procurement context. Indeed, when procuring particularly complex products—such as major weapons or information systems that can span many years and involve multiple contracts for development, production, maintenance, and upgrades—losing a bid contest could have much more significant consequences (e.g., forgoing long periods of steady and predictable business). In these cases, individual sellers may be more prone to stay on the sidelines when the nature of the product (such as one modeled off a product also sold in commercial markets) affords a larger pool of competitors the opportunity to vie for the government's business. Likewise, individual sellers may be much more prone to compete when the nature of the product limits the pool of potential competitors, and also affords the winning seller a meaningful degree of incumbency advantage.

In this sense, a more complete theoretical story that links complexity and competition would likely need to make its propositions contingent on the depth and duration of the

underlying business relationship, as well as the nature of the product being procured. In essence, incumbency advantage could moderate the complexity-competition relationship. For example, while complexity may increase project risk, the degree of risk depends on whether and to what extent a seller can capitalize on relationship-specific investments required to produce a more complex product. To the extent opportunity for lock-in is greater, it may (at least to some extent) reduce a seller's hesitation to compete for a more complex product.

3.6 Conclusion

Competition is a fundamental source of value in public procurement. While not available for all the goods and services government buys, we would expect procurements of more commonly sold products to be subject to stronger competitive forces. That said, product complexity—defined and operationalized here in terms of asset specificity—is theoretically a choice variable over which government exercises some degree of control (depending on mission requirements). While in the case of complex products sellers may deem the risks of doing business with the government as too high to warrant submitting a bid, for simpler products they might also deem their individual odds of winning as too low to warrant bidding. This reasoning points two effects—a project risk effect (simpler products invite more bids) and a win probability effect (simpler products invite less bids)—and implies competing hypotheses for how product complexity influences competition.

Evidence from count variable regressions run on a sample of US federal IT procurements suggests the effects mostly offset one another. In the case of IT—the federal government's second-largest procurement spending category and an area in which agencies have meaningful flexibility to choose one level of product complexity versus another—moving from a purely

commercial to a modified commercial product is associated with a well measured reduction in bids, but the reduction is small (implying the posited effects operate in an offsetting fashion). That regression results show no discernable association between competition (as measured in bid counts) and complexity at a higher level likely stems the fact that for procurements of individual IT supplies (i.e., for items not purchased as part of a larger product, such as a weapon system), agencies predominately buy commercial (as illustrated by the composition of the sample). Thus, there is little *observed* variation in complexity at this level of procurement. Greater variation could reveal a more pronounced effect of procuring a product more modified for government's purposes.

Ultimately, both the project risk effect and the win probability effect likely operate with greater force in larger, program-based procurements that can span many years and involve numerous contracts for various types of product development, production, and other activities. In these cases, losing a bid contest could have much more significant consequences (e.g., forgoing long periods of steady and predictable business). Thus, a more complete theoretical story that links complexity and competition would likely need to make its propositions contingent on the depth and duration of the underlying business relationship, as well as the nature of the product being procured. It could be, for example, that the nature of the business relationship is such that sellers can realize incumbency advantages from their investments in relationship-specific physical and human capital. Thus, while in these cases the product government seeks may be more complex, the opportunity for lock-in may actually encourage rather than depress competition. In seeking to buy individual services and supplies like IT, however, the results suggest variation in complexity does not strongly influence competition in a particular direction. Accordingly, at this level of procurement, competition and acquisition of

resources with greater functionality (and, potentially, greater ability to influence mission accomplishment) may not be subject to as strong a trade-off. As mentioned, from a research perspective this raises the question of whether and how the complexity-competition relationship is moderated by the procurement context—an issue ripe for additional theoretical and empirical analysis. From the standpoint of practice, it suggests that for recurring procurements of commercial-type products and their variants, competition need not come at the expense of acquiring products that best suit mission needs, but that, in general, decisions to procure one product type or another need to made with careful attention to context.

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Table 3-1 – Summary Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Bid Count	3,411	2.966	2.641	1	38
Commercial	3,411	0.932	0.251	0	1
Modified	3,411	0.059	0.237	0	1
Government	3,411	0.008	0.090	0	1
Month1	3,411	0.841	0.366	0	1
Month3	3,411	0.106	0.308	0	1
Month6	3,411	0.005	0.070	0	1
Month12	3,411	0.026	0.159	0	1
Month24	3,411	0.011	0.105	0	1
Month48	3,411	0.006	0.080	0	1
Month60	3,411	0.002	0.042	0	1
Month60Plus	3,411	0.003	0.054	0	1
Army	3,411	0.764	0.424	0	1
Navy	3,411	0.136	0.343	0	1
Air Force	3,411	0.057	0.232	0	1
Civil	3,411	0.043	0.203	0	1
<$150k	3,411	0.871	0.335	0	1
<$5Mil	3,411	0.127	0.333	0	1
$5Mil+	3,411	0.002	0.045	0	1

Notes:

Month1 represents term length <1 Month,
Month3 represents term length >1 Month & ≤ 3 Months
Month6 represents term length > 3 Months & ≤ 6 Months
Month12 represents term length > 6 Months and ≤ 12 Months
Month24 represents term length > 12 months and ≤ 24 months
Month48 represents term length > 24 months and ≤ 48 months
Month60 represents term length > 48 months and ≤ 60 months
Month60Plus represents term length > 60 months

For estimation purposes, Commercial, Month60Plus, Civil, and 5Mil+ are excluded as reference categories.

Table 3-2 – Poisson Regression Results, Full Sample

VARIABLES	(1) Offers
Modified	-0.198***
	(0.0664)
Government	0.00974
	(0.721)
Month1	0.139
	(0.161)
Month3	0.291*
	(0.167)
Month6	-0.727**
	(0.327)
Month12	0.167
	(0.188)
Month24	0.00191
	(0.210)
Month48	0.400*
	(0.231)
Month60	-0.0912
	(0.376)
Army	0.287***
	(0.106)
Navy	-0.103
	(0.0786)
Air Force	0.361***
	(0.0904)
<$150k	-0.413**
	(0.189)
<$5Mil	-0.283
	(0.193)
Constant	0.381
	(0.297)
Observations	3,411

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Number of Master Contract Groups = 34 (including 1 as an excluded reference category)

Average bid count = 2.97

Table 3-3 – Negative Binomial Regression Results, Full Sample

VARIABLES	(1) Offers
Modified	-0.185**
	(0.0823)
Government	0.0696
	(0.820)
Month1	0.211
	(0.210)
Month3	0.408*
	(0.217)
Month6	-0.782**
	(0.382)
Month12	0.269
	(0.245)
Month24	0.0711
	(0.268)
Month48	0.535*
	(0.286)
Month60	-0.00554
	(0.463)
Army	0.314***
	(0.106)
Navy	-0.123
	(0.0900)
Air Force	0.470***
	(0.106)
<$150k	-0.422*
	(0.224)
<$5M	-0.283
	(0.229)
Constant	-0.0735
	(0.366)
Observations	3,411

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Number of Master Contract Groups = 34 (including 1 as an excluded reference category)

Average Bid Count = 2.97

Table 3-4 – Poisson Regression Results, MAC Sub-Sample

VARIABLES	(1) Offers
Modified	-0.176***
	(0.0676)
Government	0.234
	(0.723)
Month1	0.150
	(0.229)
Month3	0.371
	(0.233)
Month6	-0.921*
	(0.500)
Month12	0.218
	(0.301)
Month24	-0.282
	(0.349)
Month48	0.260
	(0.279)
Month60	-0.0776
	(0.405)
Army	0.0619
	(0.117)
Navy	-0.392***
	(0.133)
Air Force	0.426***
	(0.156)
<$150k	-0.402**
	(0.190)
<$5Mil	-0.242
	(0.194)
Constant	0.320
	(0.346)
Observations	2,960

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Number of Master Contract Groups = 26 (including one as an excluded reference category)

Average Bid Count = 2.88

Table 3-5 – Negative Binomial Regression Results, MAC Sub-Sample

VARIABLES	(1) Offers
Modified	-0.159*
	(0.0858)
Government	0.339
	(0.849)
Month1	0.238
	(0.283)
Month3	0.506*
	(0.289)
Month6	-0.968*
	(0.576)
Month12	0.324
	(0.377)
Month24	-0.262
	(0.445)
Month48	0.349
	(0.341)
Month60	0.00710
	(0.498)
Army	0.0514
	(0.146)
Navy	-0.467***
	(0.164)
Air Force	0.515***
	(0.195)
<$150k	-0.419*
	(0.229)
<$5Mil	-0.245
	(0.234)
Constant	-0.191
	(0.432)
Observations	2,960

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Number of Master Contract Groups = 26 (including one as an excluded reference category)

Average Bid Count = 2.88

Table 3-6 – Poisson Regression Results, GWAC Sub-Sample

VARIABLES	(1) Offers
Modified	-0.623
	(0.401)
Government	-
Month1	0.266
	(0.266)
Month3	-0.137
	(0.272)
Month6	-0.348
	(0.319)
Month12	0.262
	(0.257)
Month24	0.239
	(0.299)
Month48	1.145*
	(0.587)
Month60	-
Army	0.562*
	(0.308)
Navy	-0.0142
	(0.0995)
Air Force	0.340***
	(0.109)
<$150k	0.0602
	(0.0970)
<$5Mil	-
Constant	0.947***
	(0.236)
Observations	451

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Government, Month60, <$5Mil dropped due to collinearity

Number of Master Contract Groups = 8 (including one as an excluded reference category)

Average Bid Count = 3.5

Table 3-7 – Negative Binomial Regression Results, GWAC Sub-Sample

VARIABLES	(1) Offers
Modified	-0.691*
	(0.409)
Government	-
Month1	0.270
	(0.245)
Month3	-0.148
	(0.257)
Month6	-0.372
	(0.325)
Month12	0.283
	(0.246)
Month24	0.252
	(0.287)
Month48	1.307**
	(0.652)
Month60	-
Army	0.571*
	(0.308)
Navy	-0.00961
	(0.101)
Air Force	0.366***
	(0.112)
<$150k	0.0567
	(0.101)
<$5Mil	-
Constant	0.902***
	(0.240)
Observations	451

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Government, Month60, <$5Mil dropped due to collinearity

Number of Master Contract Groups = 8 (including one as an excluded reference category)

Average Bid Count = 3.5

Chapter 4: Leader Commitment and Implementation of Knowledge-Based Strategies in Public Procurement—Theory and Evidence from United States Weapon System Programs

4.0 Introduction

Governments often experience challenges procuring goods and services difficult to describe, produce, and exchange through contracts with the private sector, but limitations on internal production may necessitate buying rather than making these "complex products" (Brown et al. 2010, 2013, 2015; Kettl 1993; Kelman 1990). Political overseers may compel a government to procure rather than internally produce a product, or the government may simply lack the capacity necessary for in-house production (Brown et al. 2015; Hefetz and Warner 2012; Van Slyke 2003, 2007). Especially under these circumstances, we would expect government to behave in accordance with its imperative to be a "smart buyer" (Kettl 1993). Nonetheless, complex procurements regularly run over budget, fall behind schedule, and fail to deliver products with all the promised performance capabilities—so much so that observers have likened these outcomes to an "iron law" of procurement programs. (Flyvberg 2014).[43,44]

That issues with cost, schedule, and performance persist despite numerous efforts governments have undertaken to implement improved program management practices suggests procurement is highly change-resistant (Fernandez 2015; Fernandez and Rainey 2006; Fox 2011; Kelman 2005). With relatively few exceptions, procurement programs fail to follow management practices many observers deem key for successful execution (see, e.g., Garemo et al. 2015; GAO 2015).

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[43] Certainly, cost, schedule, and performance short-falls do not always indicate underlying management problems—projects can suffer from exogenous shocks that lead to changes in product requirements, raise costs, and extend schedules beyond original estimates—but these outcomes frequently reflect flaws in execution rather than shocks per se (see, e.g., GAO 2015).

[44] For purposes of theory and empirical analysis, this paper is focused principally on the procurement of goods such as satellites, weapon systems, information technology, and other large-scale, sophisticated products combining hardware, software, and other components.

Among these practices, observers stress in particular the use of a sound procurement strategy: a plan for how a product will be developed, produced, and fielded over time (Brown 1992; GAO 1992, 2015). In general, observers argue an evolutionary strategy focused on delivering product capabilities in increments, and within each increment, transitioning from development to production sequentially, presents less risk than a revolutionary strategy aiming to deliver full capabilities in a single step and involving overlap between development and production activities (see, e.g., GAO 2015). The claim is that by pursuing modest capability objectives and providing the time necessary for development, testing, and evaluation activities before transitioning to production in earnest, evolutionary, sequential strategies—also referred to as *knowledge-based* strategies—minimize the risk of production disruptions attributable to issues such as failure to discover design flaws (which reduce efficiency, waste resources, and lead to schedule delays). Revolutionary, concurrent strategies, by contrast, pursue ambitious capability objectives and provide less time for development activities, thereby increasing risk of disruption during the production stage. Given these risks, why do many procurements still follow a revolutionary approach? What differentiates procurements executed on a knowledge-basis?

Ex-post examinations of procurements following a knowledge-based strategy have shown that use of this approach consistently coincides with strong leader commitment—the presence of individuals who hold senior leadership positions and are purported to be pivotal in ensuring project execution based on knowledge-oriented principles (see, e.g., Gansler 2011; GAO 2010; Garemo et al. 2015). However, the mechanisms underpinning the association between leader commitment and knowledge-based procurement are not clear. Whether through engaging in sustained oversight, establishing accountability measures, or taking other steps, *how* leaders influence implementation of knowledge-based strategies remains unclear.

Drawing from organizational economics, this essay argues leaders influence adoption of knowledge-based procurement strategies by establishing *relational contracts*: systems of informal mutual understanding predicated on credible commitments to reward desirable behavior—here, employment of knowledge-based approaches by teams tasked with procurement execution (Kreps 1990; Baker et al. 2002; Gibbons and Henderson 2012). Specifically, the essay argues leaders serve an advocacy role for the procurements they oversee, ensuring their projects receive sufficient support and protecting them from policymakers wishing to commit resources to other procurements (including those for which failure to follow a knowledge-based approach could invite future delays, but, at least in the short-run, promise to deliver more capability in less time). As such, leaders provide their teams with incentives to "stay the course," maintaining adherence to a knowledge-based strategy, pursuing modest capability objectives, and taking the time necessary for sequential development and production.

To probe the plausibility of a credibility mechanism linking leader commitment and knowledge-based strategy implementation, this essay samples and briefly examines four cases from United States weapon systems procurement. Weapons systems are a quintessential example of a complex product for which observers argue procurement strategies contribute importantly to cost, schedule, and performance outcomes (see, e.g., Brown 1992; Fox 2011; GAO 1992, 2015; Lorell et al. 2015). Moreover, improving procurement strategies has been a centerpiece of numerous past efforts to implement change in the U.S. weapons buying enterprise—by far the world's largest and most complex—and each procurement the essay considers is one for which observers have argued sustained leadership was a key contributor to use of knowledge-based principles (Fox 2011; GAO 2010). Accordingly, the procurement programs sampled represent "most likely" cases—those for which leadership was purported to

play a pivotal role—and thus provide fertile ground on which to explore mechanisms underpinning the leadership-strategy association.

Examination of the cases provides evidence in support of a credible commitment mechanism as a channel through which leadership influences implementation of a knowledge-based procurement approach. Each of the cases includes instances where leaders signaled and followed through on commitments to ensure programs received sustained support for use of knowledge-based procurement despite the fact that, in the short-run, this strategy implied "starting slow to go fast"—pursing capabilities on an incremental basis and taking the time needed to complete development efforts before committing to production rather than rushing ahead. Collectively, these findings thus confirm the plausibility of the commitment mechanism as a link underpinning the leader-procurement strategy association, and motivate additional research on this relationship that draws from a larger number of cases and contexts.

The remainder of this essay is organized in five sections. Section one provides an overview of procurement strategies, their implications for procurement program outcomes, and the observed association between leadership commitment and strategy implementation. Section two introduces the concepts of relational contracts and commitment credibility, and presents the argument that leaders facilitate implementation of knowledge-based strategies through making credible commitments to support this practice. Section three provides an overview of the essay's data and methods, describing the case selection strategy and analytical approach. Section four presents the case analyses and reviews evidence for the presence of a credibility mechanism linking leader commitment and employment of knowledge-based procurement. Section five concludes by discussing the implications of the essay for future research and practice.

4.1 Procurement Strategies and Their Features

A procurement strategy is a plan for a how a product government seeks will be developed, produced, and fielded over time. A strategy describes, in essence, how product capabilities will be delivered—either in increments (through an "evolutionary" approach), or on a single-step basis (through a "revolutionary" approach)—and whether, over the course of delivery, the product will proceed through development and production activities sequentially or concurrently. A given procurement strategy may mix and match these elements differently—e.g., by combining a revolutionary approach to capability delivery with a sequential development and production process, or an evolutionary approach with a concurrent process—and in practice, such tailoring may make sense. For example, adjoining incremental or evolutionary delivery with overlapping development and production could imply some risk of production disruptions (owing to not completing all development activities before beginning the production process), but compared with pursuit of capabilities via a revolutionary approach, such risks are relatively lower, and assuming them may permit faster fielding of a product for end users. Regardless of whether a program adopts an evolutionary or a revolutionary approach to delivering product capabilities, however, concurrency inevitably forces making choices without the level of information that would be available under a sequential process (Brown 1992). Insofar as concurrency means acquiring production inputs and tooling in the midst of development, for example, it requires configuring the production process before arriving at a fully stabilized product design (Brown 1992; GAO 2015). Thus, risk of discovering design flaws and inviting production disruptions is still higher than would be the case when proceeding through development and production sequentially. Over the course of time and experience, these risks and the problems stemming therefrom have (whether in the context of pursuing evolutionary or

revolutionary capability advances) generated significant skepticism as to the utility of procurement strategies predicated on concurrency (see, e.g., Brown 1992; Fox 2011; GAO 1992).

Given persistent problems with concurrency, observers have increasingly come to recommend sequential development and production as the most preferred strategy for executing large complex procurements (see, e.g., Fox 2011; GAO 1992, 2015; Lorell et al. 2015). Many have also become advocates of delivering capabilities in increments, arguing that in conjunction with sequential execution of development and production activities, this approach best positions procurements for success (see, e.g., GAO 2016a). Dubbed a *knowledge-based strategy*, observers argue this coupling of incremental capability delivery and sequential phasing of development and production promotes success through striking the best balance between speed and risk. Incremental delivery involves fulfilling capability requirements in a graduated fashion—first delivering a product with a baseline set of performance features and deferring procurement of additional capabilities to future development and production runs—thus compensating for the time commitment otherwise needed to proceed through development and production sequentially.[45] Meanwhile, adherence to a sequential process allows for retiring as much production risk as possible via efforts undertaken at the development stage, thereby minimizing the likelihood of problems experienced during production and promoting orderly, expeditious transition from one development-and-production increment to the next (which ensures end users continue receiving products that meet needs as they evolve over time, rather than waiting a prolonged period of time for receipt of a new product that may have experienced

[45] In other words, the argument here is that pursuing more modest capability development objectives reduces the likelihood of becoming bogged down in the development phase (on account of committing to production only after meeting all the pre-requisite development criteria—an outcome that would, all else equal, be more likely given more ambitious development objectives).

significant procurement challenges, and by extension, may not provide all its promised performance capabilities).

4.1.1 Fundamentals of Knowledge-based Procurement

A knowledge-based procurement strategy combines an incremental, evolutionary approach to delivering product capabilities with a sequential development and production process aimed at ensuring prudent, risk-cognizant progression of a procurement over time (Vane 2011). Its name stems from its objective of ensuring that development and production proceed based on the gathering of enough information—or "knowledge"—to support sound decisions at key points in the procurement process (GAO 2015; 2016b).

Building off an aim to deliver capabilities in increments, knowledge-based strategies stress the importance of fully developing the underlying technologies, or components, that enable a product to meet its required performance capabilities. Accordingly, upon determining the specific capabilities it will seek to procure in a given development-and-production increment, government initiates a knowledge-based strategy with a rigorous technology development phase. This phase may involve engaging one or more candidate producers of the product to develop new technologies, or scanning existing technology for purposes of incorporation into the product's overall design. To the extent the phase centers on development of new technology, it could also involve competitive prototyping—inviting candidate producers to compete with one another in creating a model version of the product to demonstrate the feasibility of its design, and then selecting the winner of the competition to proceed in developing and producing the product in earnest (thereby harnessing competitive forces to incentivize discovery and resolution of technology risk—see, e.g., Copeland et al. 2015). Whether through use of this process or other steps, knowledge-based procurement makes maturity of key technologies a prerequisite for

proceeding into full system development and production, and the presence of mature technologies provides an important indicator that a procurement program is situated to negotiate these phases successfully (GAO 2015, 2016b).

Following maturation of key technologies, the knowledge-based approach next entails a system development phase involving integrating the product's technological components— now mature—into a prototype article that can be tested and evaluated for purposes of demonstrating production readiness (rather than just design feasibility, as in the technology development phase). This outcome stems from a systems engineering process aimed at achieving a stable product design, which the knowledge-based approach makes a prerequisite for proceeding to assembly of a more advanced prototype, conduct of prototype testing, and preparation for launching production (GAO 2015; Vane 2011).

Upon achieving design stability, producing representative articles, and achieving satisfactory test results, the knowledge-based process then involves transition to preparation for production at a full-rate. Preparatory activities may include utilizing pilot production lines or other techniques for purposes of demonstrating the stability of production processes, which, collectively, inform the decision to begin full-rate production activities. Hereafter, full-rate production ensues.

Overall, the knowledge-based approach to procurement centers on identifying and taking steps to mitigate risk, and accordingly, on enabling an event-based process driven by informed decision making regarding whether and when progression from development to production occurs. Under this approach, in other words, "knowledge supplants risk over time" (GAO 2015: 3), thereby facilitating delivery of products with attention toward avoiding delays, breakdowns, and disruptions that raise costs and impede provision of needed capabilities.

4.1.2 Leader Commitment and Knowledge-based Strategy Implementation

Given the benefits of knowledge-based procurement vis-à-vis other strategies that aim, for example, to deliver significant advances in capabilities via a single-step approach, and may forgo risk mitigation efforts the knowledge-based approach stresses during technology and system development (thereby raising the likelihood of challenges to efficient, timely production), we would expect government to employ knowledge-based approaches in its procurements of most complex products. However, from satellites and weapon systems to large-scale information technology products, numerous procurements of complex systems depart from knowledge-based principles (see, e.g., Brown 1992; Fox 2011; GAO 2005, GAO 2015, 2016a, 2016b, 2016c). These patterns have led observers to suggest complex procurement enterprises are highly "change-resistant," or prone to follow unproductive practices despite repeated efforts to implement improvements in management and execution (Fox 2011; see also Donahue and O'Leary 2011; Fernandez and Rainey 2006; Kelman 1990, 2005; Kotter 1996; NDIA 2014). Such conclusions beg the question: what differentiates those exemplar procurements employing knowledge-based strategies from the majority of cases taking a non-knowledge-based approach?

Among other factors, ex-post examination of procurements adopting strategies anchored in knowledge consistently emphasize the presence of committed leadership—of individuals purported to be pivotal in ensuring adherence to knowledge-based processes (GAO 2010; Garemo et al. 2015; Fox 2011). However, whether through engaging in sustained oversight, establishing accountability measures, or taking other steps, examinations of past cases do not systematically explore the mechanisms underpinning association between leader commitment and employment of knowledge-based procurement? In short, *how* might leadership influence implementation of this approach?

4.2 Relational Contracts and the Leader-Strategy Relationship

Understanding whether and how leadership influences employment of alternative procurement strategies requires an appreciation of the environment in which—and the conditions under which—governments execute complex procurements.

To start, governments commit significant resources to procuring complex assets and infrastructure. Precise figures vary by program, policy context, and the specific countries and government entities in question, but costs from some of the most high profile procurements governments have pursued illustrate the point. At $400 billion, the Joint Strike Fighter (JSF), a procurement program aimed at delivering a class of fixed-wing combat aircraft to the United States military and select U.S. allies, represents the most expensive project ever undertaken by the U.S. Department of Defense (DOD) (GAO 2016c). The UK's efforts to modernize information technology (IT) supporting operation of its national health service have consumed (in dollar terms) at least $11 billion. Other large-scale IT and software-type procurements have also come with significant price tags. The DOD's Electronic Health Records (EHR) system, intended to provide an interoperable, enterprise-level records management system in support of DOD and VA healthcare provision, will cost $11 billion based on current estimates (GAO 2016b). The Expeditionary Combat Support System (ECSS), a procurement to provide the U.S. Air Force with an integrated, global logistics management solution (and replace numerous legacy systems), consumed approximately $1 billion of taxpayer money before its cancellation in 2012 (GAO 2016b).

High resource commitments imply that complex procurements consume significant shares of government budgets, and through receiving shares of scarce budget funding, individual procurements effectively signify priorities about policy, strategy, and the relative importance of

different organizations in performing governmental missions. That is, funding issued for one type of procurement vis-à-vis others may indicate that a given mission will be performed in a particular way, and by a particular entity, rather than others. In the context of national defense, for example, electing to fund procurement of certain weapon systems could convey primary responsibility for performing a mission to one military service branch, unit, or functional area in lieu of its counterparts. Procurement funding can therefore become particularly important for purposes of negotiating the pull-and-haul of bureaucratic politics—the jockeying among different elements of government for control over how policies are formulated and put in place (Allison 1971; Halperin 1974). Moreover, receipt of funding opens up opportunities to use a procurement program as a vehicle for serving a variety of different interests. Of course, funding support benefits end users who can make use of a product acquired via a particular procurement program, and support for the program elevates the importance of this group of end users—as well as the organizations to which they belong—in performing a given mission. But receipt of funding and the scope it creates for pushing procurement programs forward may also, for example, benefit program managers who can demonstrate results through successfully transitioning a program from one step to the next during their tenure, and thus enhance their prospects for recognition, promotion, and other types of career advancement (Fox 2011; GAO 1992). In summary, the planning and execution of large-scale public procurement programs occurs in an environment characterized by significant pressure—to secure and maintain support for a program, and as such, to create a level of momentum behind it that keeps it moving forward (despite, for instance, potential desire among policy makers to curtail or cancel it and divert resources to other projects).

Such strong pressure may create incentives to overpromise. When competing for resources, managers of procurement programs focused on delivering products such as weapons, information technology (IT), and other complex hardware and software systems could feel compelled to "project unprecedented levels of performance (often by counting on unproven technologies) while promising low cost and short schedules" (GAO 2015: 5). Indeed, to the extent policymakers deciding how to allocate scarce resources otherwise prefer procurements that promise less time and cost for more capability, optimism may be the best strategy for securing policymaker support. The upshot is frequent "deviation from sound practices" (GAO 2015: 4). Subject to strong cost and schedule constraints, efforts to deliver revolutionary advances in capability inevitably force compromises—often in the form procurement strategies predicated on rushing through technology and system development, and initiating production before completing all the necessary development activities. In other words, strategies that make development and production concurrent, which may eventually result in procurements taking longer, costing more, and delivering less capability than would have been the case under an evolutionary, sequential approach. Were policymakers aware from the outset that a procurement would produce these outcomes, they may not have elected to support it. Insofar as problems stemming from a poor strategy do not materialize immediately, however, the time and resources already invested in the program could create a "compelling argument for continuing [it]" (GAO 1992: 46).

To the extent this pattern holds in practice, it suggests implementing knowledge-based procurement strategies requires overcoming incentives that otherwise motivate bad practice—and that leaders may influence use of the knowledge-based approach through establishing an understanding that employment of this strategy will be rewarded rather than punished. Drawing

from organizational economics, this essay characterizes such systems of mutual understanding as *relational contracts*.

4.2.1 Relational Contracts and Use of Knowledge-Based Procurement Strategies

At its core, a relational contract represents an informal link between two or more actors that relies on assurances of reciprocity to sustain cooperative outcomes (Kreps 1990). The idea is that one actor behaves in a manner deemed desirable by the other, the other responds in kind, and the value stemming therefrom effectively sustains cooperation on an ongoing basis.

As this characterization suggests, establishing and maintaining relational contracting arrangements requires clear, credible commitments to follow-through on promises. Actors must say what they mean, and mean what they say (Baker et al. 2002; Gibbons and Henderson 2012; Kreps 1990). Communicating what one means—establishing clarity—can be challenging in and of itself, but in many instances, credibility is the issue (Gibbons and Henderson 2012). Provided an actor can clearly communicate how it wishes its partner to behave, its overriding objective is to convince the partner it will reciprocate (Axelrod 1984; Baker et al. 2002; Gibbons and Henderson 2012; Kreps 1990).

Such is arguably the case regarding procurement strategies. The principles and overarching process comprising a knowledge-based approach to procurement are well established; incentivizing *use* of this approach represents the primary challenge (Fox 2011; GAO 2015). Knowledge-based strategies may be a best practice, but insofar as funding preferences extend to procurements that depart from this approach, they discourage implementing it. Accordingly, instances of procurements planned and executed following a knowledge-based process suggest the presence of an understanding that support for this process will be forthcoming. That is, these cases suggest the presence of a relational contract.

Insofar as they serve as an interface between stakeholders concerned with a procurement program's means and ends—the resources it receives, and the level of capabilities it aims to deliver—senior leaders overseeing programs arguably play a key role in establishing relational contracts that buttress employment of knowledge-based strategies. Leaders can provide the programs in their purview with assurances that they will advocate for them in funding processes, as well as represent their interests in forums established for purposes of considering programmatic objectives—what capabilities procurements will ultimately aim to deliver. These assurances, in turn, can alleviate pressure programs feel to make overly optimistic projections regarding the level of capability they can deliver in a single development and production cycle, as well as the time and resources required to do so. Thus, they can encourage the adoption of procurement strategies underpinned by knowledge-based principles, including delivery of capabilities on an incremental, evolutionary basis, and a sequential rather than a concurrent approach to development and production activities. Accordingly, regarding the association between leadership and employment of knowledge-based procurement strategies, this essay posits the following:

> H_1: *Leader commitment influences adoption of knowledge-based procurement strategies through the formulation by leaders of credible commitments to ensure procurements receive support in exchange for adopting an evolutionary, sequential approach to developing, producing, and delivering products.*

Of course, other mechanisms may also underpin the leader-strategy association. For example, in addition to signaling and following through on credible commitments to reward desirable behavior, might leaders also facilitate adoption of knowledge-based procurement strategies through simply providing ongoing counsel as to the implementation of strategy? That is, in addition to incentivizing adoption of a knowledge-based strategy per se, might leaders also

aid program teams in making decisions about tactics underpinning use of this strategy type? For example, in contemplating how to mature key technologies before transitioning to the full system development stage, could leaders help their teams weigh the strengths and drawbacks of alternative actions—such as maturing completely new technologies versus scanning and making use of technology already in existence—in order to make decisions most commensurate with achieving a procurement program's overall goals? As alluded to in the conclusion of the essay, exploration and process tracing of additional mechanisms such as this one constitutes one avenue for future research. For purposes of laying a foundation for future work, however, this essay focuses on the presence and operation of the credible commitment mechanism.

4.3 Case Selection and Methodological Approach

For hypothesis testing purposes, this essay samples and investigates a set of four procurement programs where observers have argued leadership played a key role in the adoption and implementation of a knowledge-based approach to capability delivery, product development, and production. As such, the case selection strategy involves examining a set of "most likely" cases for which there is scope to investigate mechanisms that underpin the association of interest (George and Bennet 2005; see also Eckstein 1975).

Case analysis and investigation proceeds through use of "process tracing," an approach that aims to "identify the [mechanism] between an [explanatory] variable and the outcome of the dependent variable" (George and Bennet 2005: 206). As its name suggests, process-tracing centers on charting—or "tracing"—the path that leads from the explanatory variable to the outcome, gathering observations that suggest the presence of alternative mechanisms (Collier 2011). To the extent observations accumulated over the course of examining a case point to a

particular mechanism, they provide a basis for inferring that that mechanism constitutes a channel transmitting the influence of an explanatory variable on an outcome (Collier 2011; Fairfield and Charman 2015; George and Bennet 2005). Combined, the process tracing analysis of the cases in this essay constitutes a "plausibility probe" of the credible commitment mechanism, or an effort to determine the "relevance of a theoretical proposition" (Levy 2008: 6) as a precursor for a larger scale research effort involving, for example, "a large survey, [interviews], [or] [highly] detailed archival work" (Levy 2008: 6; also see Eckstein 2005; Bennet and George 2005).

The sampled cases are weapon system procurements executed by the United States Department of Defense (DOD). Weapon systems are quintessential examples of "complex products," and the U.S. weapon system procurement enterprise is among the single largest in the world in terms of resources committed to individual projects.[46] Moreover, for analysis purposes, U.S. weapon procurements proceed through a well-specified technology development, system development, and production process onto which the knowledge-based approach readily maps and has been repeatedly cited as an example of a best practice in enabling cost, schedule, and performance success (see, e.g., GAO 2015; Lorell et al. 2015; Wyman 2010). The case analyses draw from a large stock of reports, periodicals, and other document and archival evidence illuminating the nature of each case's procurement process and strategy, as well as the role of senior leaders and other stakeholders in the formulation and implementation of alternative procurement approaches.

[46] As of 2017 (latest available data), the United States Department of Defense (DOD) is currently procuring 78 major weapon systems with a combined development and production cost of $1.4 trillion (GAO 2016).

4.4 Case Analysis

For analysis purposes, the sampled cases represent a diverse range of weapons procurement programs spanning each of the U.S. military service branches, as well as weapon systems employed across the land, air, and sea-based operational domains. Use of this approach, as opposed to one centered on analysis of a more homogenous set of cases, guards against generating findings particular (in the context of this essay) to a single service branch, weapon type, or operational context. In other words, the case selection approach creates scope for uncovering more generalizable findings robust to varying contexts, conditions, and alternative sets of circumstances.

The specific cases considered are: the Small Diameter Bomb (SDB), a fixed wing aircraft munition used by the U.S. Air Force and the U.S. Navy (with the U.S. Air Force as the primary procurement agent); the Joint Direct Attack Munition (JDAM), a tail-kit used by the U.S. Air Force and the U.S. Navy for purposes of providing fixed wing aircraft munitions with enhanced targeting capabilities (with the U.S. Air Force as the primary procurement agent); the P-8A Maritime Patrol Aircraft (P-8A), a large aircraft procured and used by the U.S. Navy for reconnaissance and combat against enemy surface ships and submarines; and the High Mobility Artillery Rocket System (HIMARS), a truck-mounted artillery weapon procured and used by the U.S. Army to launch rockets from long distances at enemy ground targets.

4.4.1 Small Diameter Bomb

The Small Diameter Bomb ("SDB") is a fixed wing aircraft munition that can autonomously acquire and strike both fixed and mobile ground targets across a range of weather conditions (GAO 2016b, GAO 2017; Osborne 2016). Initiated in August, 2001, and involving (among others) defense contractors Raytheon and Boeing, the U.S. Air Force has structured the

SDB program around a knowledge-based procurement strategy by procuring the munition in two increments—SDB I and SDB II—and adhering largely to a sequential development and production process, with particular emphasis on use of mature technology (GAO 2004, 2010, 2017; Osborne 2016).[47]

In determining the capabilities ultimately desired of the SDB, Air Force leaders played an essential advocacy role for an evolutionary approach to capability development and delivery. To start, the Air Force Chief of Staff, the service's highest ranking military officer, pre-empted what could have been a long and burdensome process to determine the bomb's desired capabilities by issuing a "Commander's Intent" to have increment one of the bomb ready at the end of calendar year 2006 (GAO 2010; Justice 2006). Such a move provided the SDB program team with a considerable degree of "top cover" in its interactions with other stakeholders as to the type of product that ought to be delivered, and when (GAO 2010). For example, while some stakeholders expressed a desire that the SDB be "nuclear hardened"—made to withstand the potentially damaging effects of ionizing radiation to which munitions may be exposed at high altitudes—senior leaders invested in the quick fielding of the SDB argued vigorously against the necessity of this capability, ultimately succeeding in removing it from the table (GAO 2010). Absent such support, the program could very well have acquiesced to including nuclear hardening in the set of capabilities the SDB would be required to fulfill, in part to appease stakeholders who may otherwise have been essential for purposes of ensuring the program's ongoing support.

Beyond establishing a baseline set of capabilities exclusive of non-essential requirements, the support of Air Force leaders further promoted use of knowledge-based procurement by

[47] The program entered production with some design stability issues, although, as of 2017, its production processes are under control. See GAO (2017).

facilitating an evolutionary approach to capability delivery. As noted above, the SDB program proceeded in two increments, and while its second increment—currently in the production phase—is delivering bombs capable of striking both fixed and mobile targets, the program initially focused on acquisition and destruction of only fixed targets. Such incremental delivery contrasts with the frequent pressure toward a revolutionary approach meant to field the full suite capabilities in the context of a single design, development, and production run (which may otherwise make programs more attractive from a funding perspective—GAO 2015). Here, however, with the support and commitment of senior leaders, the team executing the SDB program was empowered to break capability delivery into two parts, deferring fielding of a bomb capable of hitting mobile as well as fixed targets to a future time-period without concern that this decision could threaten the program's funding support—and thereby facilitating the bomb's quicker delivery to end users (GAO 2010; Justice 2006).

With respect to process, both increments of the SDB program have pursued design, development, and production on a largely sequential basis. Indeed, through conduct of a vigorous technology maturation phase—including use of competitive prototyping—the first increment of the program entered full system development "with an unprecedented level of design maturity and production readiness" (GAO 2010: 20). Accordingly, the full system development phase of increment one proceeded from a starting point of fully mature technology, which could be readily integrated to create a production representative version of the bomb. Creation of such a representative article ensured readiness for production on a larger scale without significant risk of production disruptions attributable to underlying, otherwise undiscovered designed flaws (GAO 2010). Such outcomes may have been more likely had the SDB program succumbed to incentives to pursue a concurrent approach, "rushing ahead" by

devoting less time to technology maturation and system development. However, with committed leadership, the SDB proceeded on the basis of sequentiality, a fundamental tenant of knowledge-based procurement and, in this case, a key factor in setting up the second increment of the program for success.

4.4.2 Joint Direct Attack Munition

The Joint Direct Attack Munition ("JDAM") is a tail kit that enhances fixed-wing aircraft munitions' targeting capabilities—in effect, a system that turns "dumb" bombs into "smart" bombs with autonomous target acquisition and strike capabilities operable across a range of weather conditions. Initiated via research and development efforts in the early 1990s, and involving (among others) defense contractor Boeing, the U.S. Air Force and the U.S. Navy (with the Air Force acting as the lead procurement agent) adopted a knowledge-based approach to procuring JDAM predicated on delivery of capabilities in multiple increments and a largely sequential design, development, and production process.

Much like the SDB, the JDAM benefitted from strong U.S. Air Force leadership participation early in the capability determination process, which motivated an evolutionary approach to product delivery and laid the foundation for sequentiality in design, development, and production activities. During capabilities determination, Air Force leaders insisted on simplicity, demanding a strict focus on precision, reliability, and cost—that the tail kit enable munitions to hit their targets, that they worked every time activated, and that, specifically, they come in at or below a $40,000 unit cost figure (such that they could be bought in sufficient volume—see Gansler 2011; GAO 2010). This last requirement made cost a "key performance parameter" and, as such, effectively incentivized trade-offs among cost and capability as the

program initiated its work to determine what, exactly, it could deliver through its early efforts (GAO 2010).

Ultimately, such clear specification of an end state and support over the course of realizing it motivated the JDAM team to focus, at first, on only delivering a basic guidance capability arrived at through extensive engagement and analysis of cost-capability trade-offs with the product's end users (GAO 2010; Gansler 2011). As such, the program deferred delivery of enhanced capabilities to the future (in lieu of striving for a "great leap forward" through employment of a revolutionary approach).

Over the course of capability delivery, the JDAM program adhered closely to knowledge-based principles for phasing its design, development, and production activities. The JDAM benefitted from an extensive effort to mature key technologies in advance of full system development, including through the use of competitive prototyping (GAO 2010). Like the SDB, it was therefore positioned to enter full system development and production with a stable design and minimal risk of production problems—it did not succumb to pressure to "rush ahead" with immature technology, a cursory system development effort, and a decision to enter production before completing prerequisite development activities.

Senior Air Force leaders played a particularly important role in incentivizing this discipline, making good on commitments to "back up" the program team in implementing a knowledge-based strategy through a combination of evolutionary delivery and sequentiality in technology maturation, system development, and progression toward the production stage. For example, at one point program officials reported receiving pressure from a member of the Air Force's general officer corps to accelerate the JDAM's planned schedule of technology and system development prior to production activities. However, after individuals leading the

program inquired as to whether the Air Force Chief of Staff had endorsed such an acceleration, "the subject was dropped" (GAO 2010: 13). Such action suggests a clear presence of mutual understanding between the program and the leaders overseeing it. That is, it suggests an arrangement wherein the Air Force's most senior leaders committed to supporting use of knowledge-based principles and, critically, followed through in a manner that made their commitment credible. The up-shot was consistent adherence to a procurement strategy predicated on knowledge and mitigation of production risk. Ultimately, the initial phase of the JDAM program delivered tail kits at twenty-five percent below estimated unit costs, allowing for procurement of nearly twice as many units as originally planned (Gansler 2011; GAO 2010). The system has since become a key enabler of U.S. air power, and has been used extensively in U.S. military operations in the Middle East (including ongoing operations against ISIS).

4.4.3 P-8A Multi-Mission Maritime Aircraft

The P-8A Multi-Mission Maritime Aircraft ("P-8A") is a maritime patrol aircraft dedicated to anti-surface ship and anti-submarine warfare, as well as intelligence, surveillance, and reconnaissance (ISR) missions. Initiated in March, 2000, with Boeing as the primary contractor, the U.S. Navy formulated a knowledge-based strategy for procuring the P-8A that centered on incremental capability delivery and initiation of production with mature technologies and a stable design (GAO 2013).

From its outset, senior Navy leaders stressed that the P-8A be delivered quickly to replace its aging precursor, the P-3C Orion (GAO 2010). Accordingly, leaders provided support for the program to break capability delivery into increments in lieu of allowing others to pressure it into a single-step approach. Specifically, leaders stressed that under the initial increment the aircraft's capabilities "only be as good as those of the P-3C" (GAO 2010: 17)—thus facilitating

deferment of additional capabilities to future increments without concern for loss of policymaker support.

As leaders put this commitment in place, the program took several steps to leverage mature technologies, including through using an airframe derived from the existing commercial version of the Boeing 737 rather than an entirely new airframe (GAO 2010, 2016). As part of its design and development process, the program also made use of open systems architecture (OSA), an approach that allows for greater modularity and flexibility (and thus, participation by more producers) in product upgrades (GAO 2010; also Brown et al. 2010; GAO 2013, 2014; Welby 2014). To combat problems with less maturity in technologies other than the airframe, the program also developed "back-ups" that could be substituted in the event of problems integrating the technologies of first choice (including the less mature ones) during full system development (GAO 2010, 2016).

Collectively, these steps required that the program take a relatively longer period of time in the technology development phase than may have otherwise been the case absent a sustained leader commitment. However, with this commitment in place, the leadership "permitted the program to conduct detailed planning" (GAO 2010: 13) and take appropriate technology development measures before beginning system-level development per se—in effect, permitting the program to "start slow" for the purposes of going fast rather than succumbing to pressure to "rush [toward] failure" (GAO 2010: 13). Early signaling and follow-through on this commitment paid off as the program unfolded, with the program team indicating that they felt empowered to engage in "candid communication" (GAO 2010: 13) regarding problems and the need to resolve issues that could otherwise generate risk that would be carried into the production phase. Accordingly, while the program subsequently experienced some problems in

system development (including unanticipated requirements for design changes), it received "top cover" (GAO 2010: 13) from senior leadership and thus took additional steps to ensure production readiness rather than carry these risks into production. The program has experienced some cost growth and schedule delays subsequently, but is currently progressing with upgrades in accordance with its incremental approach to capability delivery (GAO 2017).

4.4.4 High Mobility Artillery Rocket System

The High Mobility Artillery Rocket System ("HIMARS") is a truck-mounted artillery weapon used by the U.S. Army to target enemy artillery, light armor, and other ground assets, infrastructure, and personnel from a long distance. Initiated via an advanced concept technology demonstration (ACTD) effort in 1996 (a type of research and development effort meant to establish proof of concept via creation of a prototype article in a science and technology environment rather than in the context of a formal program), the program entered full system development in January 2000. Working with Lockheed Martin as a lead contractor, the Army adopted a knowledge-based approach to procuring HIMARS by emphasizing constrained capability development and delivery objectives, and use of mature technology to the greatest extent possible.

From the outset, senior Army and DOD leaders strove to ensure that, rather than being encumbered with a long and complex set of capability requirements, HIMARS entered procurement with a simple, straightforward objective—to provide an accurate, rapidly transportable artillery asset for use in ground combat (GAO 2010). Accordingly, the HIMARS program began its efforts with a constrained set of capability goals in lieu of more ambitious ones, and an understanding that (much like the other case study programs and their peers) its team should focus on the "art of the possible" (GAO 2010: 16).

With strong leadership backing and emphasis on speed and transportability, program personnel focused on executing HIMARS using an evolutionary, sequential strategy rather than a revolutionary one. Insofar as it aimed to deliver a wheeled version of an existing, tracked artillery piece, the program team strove to insert as much technology as possible from the existing tracked version, called the M-270 (GAO 2010). The team also drew upon technological components created and integrated into other ground vehicles, including a chassis and rocket pod (GAO 2010). Combined with the demonstration effort conducted prior to program initiation, these steps dramatically reduced the level of effort required for technology development. However, the program still did additional prototyping before progressing to system development, and in conjunction with use of mature technological components, the prototyping exercise generated significant information as to the feasibility and stability of the system's design. This advanced planning an effort—another example of leader-incentivized efforts to "start slow" before rushing ahead—aided in full system development and reduced production risk. Such a strategy paid off, with the Army delivering HIMARS in accordance with its original schedule (2005), with only slight cost increases to accommodate unforeseen needs brought about by emerging threats in the Iraq and Afghanistan conflicts (GAO 2010).

4.4.5 Case Analysis Summary

In totality, evidence accumulated from analysis of each of the sampled cases provides firm ground for asserting the plausibility of a commitment mechanism as a link between leadership and implementation of the knowledge-based approach to procurement strategy. Among other observations, the cases point, in particular, toward the importance of leaders signaling and following through on commitments at their programs' earliest stages. Across the cases, leaders expressed their desire for and took action early on to motivate pursuit of

constrained capability objectives, as well as adoption of incremental approaches to capability delivery. The Small Diameter Bomb provides a particularly evocative illustration of these dynamics at work, with the Air Force's most senior leadership conveying in no uncertain terms their desire for quick delivery, and then weighing in to help stave off pursuit of unnecessary capability requirements—specifically, nuclear hardening—that would have burdened the program with more difficult performance objectives. Following this action, the SDB program broke delivery of the more simplified capabilities into two parts—focusing first on fixed targets, then on mobile ones—rather than delivering these capabilities using a single-step method.

In addition to early facilitation of constrained capability objectives and incremental delivery approaches, the cases also point toward the importance of leaders in incentivizing sequentiality in development and production from the earliest stages. For example, the cases suggest leaders played a particularly important role in incentivizing thorough technology development, ensuring programs took time to mature technologies in lieu of carrying immature technology risk into later development and production phases. In the case of the P-8A, for example, leaders expressed a desire for speed, but also took steps to alleviate "rush ahead" pressure by encouraging adequate time for program planning and technology maturation, which the program took efforts to accomplish.

In combination, these dynamics suggest that the commitment mechanism operates with especially potent force to the extent leaders establish and follow through on commitments as soon as possible. In doing so, they incentivize early steps aligning with a knowledge-based strategy (such as an incremental approach to capability delivery and vigorous technology development), which the cases suggest pay dividends down the road (such as through carrying of less risk into system development and production).

4.5 Conclusion

Given the level of resources governments commit to large-scale, complex procurements, we would expect that they would be especially diligent in adhering to their imperative to be a "smart buyer" in this procurement context. Nonetheless, across countries, jurisdictions, and policy contexts, governments regularly depart from practices observers argue are important for enabling success. In particular, observers argue a knowledge-based procurement strategy predicated on incremental, evolutionary delivery of capabilities, as well as a sequential approach to developing products' underlying technology, integrating the technology into a full system, and avoiding premature commitment to production, is fundamental for providing products in a manner that meets cost, schedule, and performance objectives. Despite a broad consensus as to the utility of this strategy, however, procurements tend toward an approach predicated on revolutionary capability delivery and overlapping development and production processes, which often coincide with cost and schedule overruns, as well as deficiencies in product performance. The relatively less common occurrence of cases featuring close adherence to the knowledge-based approach, and execution in accordance with cost, schedule, and performance goals, have naturally motivated investigation of what makes these cases different.

Taking as a point of departure the observed association between leader commitment and use of knowledge-based procurement approaches, this essay posited and tested for the presence of a "credible commitment" mechanism wherein leaders motivate use of knowledge-based strategies through acting as advocates for the programs they oversee. Examination of a set of "most likely cases" drawn from United States weapon systems procurement—cases for which leader commitment is purported to have played a key role in the employment of knowledge-based principles—provides some evidence in support of the credible commitment mechanism as

a link between leadership and procurement strategy. Across each case, senior leaders signaled and followed through on commitments to reward employment of evolutionary, sequential plans for product development, production, and delivery, and facilitated use of these techniques in lieu of succumbing to pressure to avoid their use.

Through probing and confirming the plausibility of the commitment mechanism as underpinning the leader-strategy relationship, the essay lays the foundation for larger-scale investigation of additional cases. This research could center on additional testing of the credible commitment mechanism as a channel transmitting the influence of leadership on procurement strategy, as well as the uncovering of other mechanisms that may link these variables. Building off the findings presented in this essay, such a research program could inform practice through suggesting how governments should arrange management and leadership oversight of complex procurement programs, including through establishment of policies that encourage leadership commitment and tenure, as well as the institutionalization of behavioral patterns otherwise facilitated by individual leaders on a case-by-case basis (such that, in practice, procurement programs regularly employ, and receive support for employing, knowledge-based strategies rather than being discouraged from doing so).

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Chapter 5: Conclusion

5.0 Conclusion

With procurement among the most important functions enabling government to achieve its missions, the need for rigorous, high-quality theoretical and empirical scholarship informing the practice of the procurement function remains paramount. Building on this imperative, this dissertation presented three essays aiming to advance scholarly and professional understanding of three heretofore-unresolved questions about government and non-governmental actors' decision making at different points in the procurement process. Unified in their concern with strategic behavior, the essays examined how the nature of products governments procure and the contexts of their procurement activities—economic, political, and organizational—structure actor incentives, create scope for behaving in more or less desirable ways, and prompt taking different courses of action as a consequence. Across the essays, three overarching themes emerge, with implications for both scholarship and practice.

First, context matters. For example, in emphasizing the challenges complex services imply for contract specification and the attendant creation of contractual ambiguities through which sellers may aim to exploit government buyers, the transaction cost approach provides a powerful argument as to why a government may internally produce ("make") rather than contract out (or "buy") production of more complex public services. However, through arguing that make-or-buy decisions are not made in a vacuum—but rather in a larger environmental context—essay one demonstrates that we can gain insight into how contextual conditions may otherwise mitigate (or exacerbate) seller incentives to behave opportunistically. Accordingly, the essay offers a more refined theoretical argument regarding the make-or-buy decision and establishes scope for future empirical testing—an endeavor profitable in that it will both motivate additional theoretical work and, through the cumulative process of theory building and

testing, provide practitioners with a more and more precise picture of (i) what their peers consider in selecting among service delivery modes, as and (ii) what issues they may wish to take into account when making these decisions themselves.

Second, incentives matter. For example, in casting a "win probability" effect as an alternative explanation of the role product complexity plays in influencing competition for government procurement business, essay two demonstrates that, context notwithstanding, incentives still operate and deeper consideration of them may lead to counterintuitive insights. Indeed, through creating a potential collective action dilemma—where actors behave in a manner that produces the classic "tragedy of the commons" phenomenon—we can see how government may believe buying simpler products will engender competition, but may in fact incentivize sellers to stay on the sidelines, creating an entirely different result from the one intended. To the extent the empirical test in this essay demonstrates that the win probability effect plays at least some role in seller decision making, it suggests researchers would profit from additional theoretical and empirical work—on both bidding decisions and the broader suite of choices government and non-governmental actors make in the procurement enterprise—that more carefully considers how incentives could produce unintended consequences. Insofar as this work generates additional, novel insights, it may provide new and useful guidance to practitioners otherwise unaware of some of the consequences their decisions may yield.

Third, management matters. For example, in emphasizing the role committed leaders play in motivating the use of knowledge-based procurement strategies, essay three shows that, despite a context and attendant set of incentives that otherwise strongly inhibit the application of best procurement practices, sound management and leadership matter. Through exercising committed oversight, control, and attention toward programs and personnel within their

purviews, leaders can incentivize adoption and implementation of practices conducive to better program and organizational performance. Building off essay three, further exploration of the mechanisms linking leader commitment and adoption of performance-enhancing procurement practices could provide numerous insights as to how leaders can best exercise oversight, make decisions, and provide strategic direction in their positions—thus enhancing their ability to make positive, impactful, lasting change in their organizations.

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PUBLICATIONS AND REPORTS

Armstrong, Nicholas J., Zachary S. Huitink, Matthew A. Hidek, Rosalinda Maury, and Nathaniel Birnbaum. *Implementation Review of Presidential Executive Order 13518—The Veterans Employment Initiative*. Syracuse, NY: Institute for Veterans and Military Families. January 2017.

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Huitink, Zachary S., and David M. Van Slyke. *Beyond Business as Usual: Improving Defense Acquisition through Better Buying Power*. Washington, DC: IBM Center for the Business of Government. November 2015. **Lead Author.*

Huitink, Zachary S., David M. Van Slyke, and Trevor L. Brown. "Contracting in Pursuit of Public Purposes," in James Perry and Robert Christensen (eds.). *The Handbook of Public Administration, 3E*. San Francisco, CA: Jossey-Bass, February 2015. **Lead Author*.

GRANTS

Investigator, "A Formal Review of USO Program Evaluation Efforts." The United Service Organizations. November 2015 – March 2016. $26,045. Co-Investigators: Nicholas J. Armstrong, Rosalinda Maury, Bonnie Chapman-Beers—Institute for Veterans and Military Families.

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CONFERENCE PRESENTATIONS

O'Keefe, Sean C., David M. Van Slyke, Trevor L. Brown, and Zachary S. Huitink. "Partnerships for Fulfilling Arctic Responsibilities." Presented at the August, 2015 Summit on the Alaskan Arctic, Anchorage, AK.

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OTHER EMPLOYMENT

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