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Searching for Patterns of Competitive and Relational Contracting over Time: Do Prime and Subcontractor Networks Follow Similar Patterns?

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Abstract: This paper explores and compares two sets of contractual relationships over a twelve-year period: the patterns of contracting between a state transportation agency and its prime contractors providing engineering design services, and between the prime- and sub-contractors. We find evidence that patterns of relational and competitive contracting may co-exist in the same contracting context. While the patterns of agency-prime contracting are indicative or relational contracting, the patterns of prime-sub contracting imply relatively more competitive processes. Implications for policy and theory of outsourcing are discussed.

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Searching for Patterns of Competitive and Relational Contracting over Time: Do Prime and Subcontractor Networks Follow Similar Patterns?

One of the many concerns that arise when public agencies transition to doing significant amounts of professional work on an outsourced basis is establishing contracting processes that secure the best value from the marketplace. Researchers who find positive outcomes from privatization (of which outsourcing is one form) argue that competitive processes are the key to securing greater value from the marketplace (Savas, 1987). However, relational contracting, i.e. contracting that moderates competition to allow for building working relationships built upon trust, has also been found to be conducive to effective service delivery (Sclar, 2000).

From a management perspective each of these points of view makes an important and, arguably, heroic assumption that an agency might actually know when the overall pattern of contracting in which it is engaged is competitive or relational in nature. Over time agencies develop a portfolio of professional service contracts to deliver their program of public services. Federal and state acquisition regulations specify that contracting processes should encourage competition. However, when an agency transitions to high levels of outsourcing it may be some time before a trend is established indicative of a particular form of contracting (i.e. competitive or relational).

This issue is complicated by the fact that contracts are complex documents that pledge a number private sector firms to provide services in a coordinated and even cooperative ways. Acquisition regulations for professional services allow the agency to delegate considerable management oversight to prime contractors for pricing, organizing,

and monitoring the work of subcontractors. Thus, it is conceivable that contracting patterns at the agency-prime level may exhibit patterns of relational contracting while the prime-subcontractor level exhibits patterns of competitive contracting. However, prime contractors may also have an incentive to hold together winning teams of sub-contractors particularly under qualification-based contracting where awards are based first on quality of service.

In this study we examine whether patterns of contracting over time between an agency and prime contractors trend towards competitive or relational contracting. We also explore whether the pattern of contracting between the agency and the prime contractors influences the patterns of contracting between primes and subcontractors. To study this relationship we examine the development of a network of service providers for engineering design services from 1991-2003. Drawing upon the adaptations of transaction cost economics used in studies of the management capacity for contracting (Brown & Potoski, 2003; Choi & Heinrich, 2004) and Sclar's theory of relational contracting (2000) we test hypotheses concerning the nature of the structural links between an agency and prime contractors and between primes and subcontractors.

Competitive and Relational Contracts

Advocates for both the competitive contracting and relational contracting build arguments by noting the dangers of agencies engaging in processes that result in incomplete contracts. Fundamental information asymmetries associated with contracting processes that are incomplete can leave public agencies vulnerable to contractors making adverse selections on their behalf or are engaging in moral hazards and other forms of principal-agent problems. The result can be poor contract performance and poor public

service. Professional service contracts, such as the engineering design services that we study here, are particularly vulnerable to the dangers of incomplete contracts (as is discussed in greater detail below).

The long history of government contracting has provided agencies with a wealth of understanding of the many and varied ways in which the contracting process can be corrupted and abused (Cooper, 2003). This has led to the creation of acquisition regulations at the federal, state and local levels that are designed to assure that agencies engage in competitive bidding processes, but which also permit exceptions for when agency decisions must be driven by public values other than seeking market efficient prices, such as assuring the quality of a service or assuring for security.

Acquisition regulations offer guidance concerning conditions for competitive contracting. A process is considered competitive if multiple sealed bids are solicited from contractors through open and general announcements. As a practical matter this is designed to encourage low barriers to entry into the market. Exceptions are allowed when a criterion such as quality trumps price in the contracting process. However, even under these conditions acquisition regulations require that the agency articulate reasons why it is deviating from the competitive ideal.

In following these procedures agencies are also encouraged to distinguish between those services that are “inherently governmental functions” and other types of services. This can be a controversial exercise with regards professional services. Bureaucratic agencies are shaped by professions whose practices and standards frame perceptions regarding core competencies (Wright, 1987). For example, the dominant profession inside state transportation agencies has historically been civil engineering.

Outsourcing decisions trigger difficult discussions concerning which services will call upon the services of the private sector. In the ensuing bureaucratic political battles it is not uncommon for managers to confound the discussion of core competencies describing them as inherently governmental functions. However, under the Federal Acquisition Regulations core competencies are not shielded by this standard (Cooper, 2003). In fact, great latitude is extended to agencies to select the bundle of services that will be outsourced and in determining the method of outsourcing.

Competitive contracting is dependent upon a market in which there are sufficient numbers of suppliers with the requisite skill sets to serve the demand of the public agency and there are low barriers to entry and exit. Transaction cost economics identifies several factors that explain why governance systems might align with market forces or organize through hierarchies (Williamson, 1975). Public management scholars have embraced this perspective in identifying key elements of systems for managing contracts. Government agencies must have the capacity to monitor contractor performance either directly or through surrogates (Brown & Potoski, 2006) and align incentives to ensure contractor behavior (Tosi, Katz, & GomezMejia, 1997). It is also important that the risks associated with the service being outsourced are well understood by agency and contractors (Greene, 2002) and shared by both parties (McAfee & McMillan, 1988). It is also important that the agency and contractor are able to specify with some degree of precision the scope of the work being contracted (Sclar, 2000).

Relational contracting arises when an agency seeks to mitigate the transaction costs associated with competitive contracting by bundling many of the performance monitoring and management functions into the relationship with the prime contractor.

Agencies facing political pressures to outsource as well as significant constraints on personnel and programmatic budgets are likely to have incentives to seek managerial assistance from prime contractors. Relational contracting may stem from difficulties in specifying the scope of work associated for complex professional services as well as challenges in determining the level of risk that might be encountered (Sclar, 2000).

Ironically, as public law and public agencies work to develop processes that encourage competitive contracting, the private sector has gravitated towards developing relational contracts (e.g. Dyer & Singh, 1998). Designed to reduce transaction costs associated with outsourcing, relational contracts offer greater certainty to the supply chain relationship as principles and agents develop stronger bonds of trust. This type of contracting has also been found to reduce transaction costs as formal procedures become aligned with one another and, at times, is actually reduced. As firms develop greater trust and structural alignment decision-making can be decentralized. Relational contracts have also been found to hinder the development of negative forms of asset specificity in supply chain relationships. The evidence is mixed as to whether relational contracts extend the boundaries of the firm in a supply chain relationship (Lyons, 1996).

Engineering Design Contracts

There are good reasons to anticipate that relational contracting will emerge between an agency and prime contractors for professional services. Acquisition regulations at the federal and state level allow for agencies to contract for professional services based upon quality. In the typical qualification-based contract the agency will ask for each firm to submit an RFQ (request for qualification). From the pool of respondents a group potential prime contractors (usually three to four) are selected and

assessed based upon the firm that is capable of performing the level of quality that best meets the needs of the work. Only then will a negotiation ensue on the basis of price with the best qualified firm. If the negotiations fail, the agency moves on to the next best choice until they finally come to terms with a service provider.

This type of process is likely to favor the development of relational contracting as agencies may come to rely upon a set of firms that they have grown to trust for the quality of their work. The criteria for quality include assessments as to whether the firm has the capacity to deliver engineering designs that meet the standards used the agency engineers. Agencies can require that engineering design firms not only describe the type of work they propose to do, but also require that the firm submit the vitas of engineers that will be working on the design including key personnel from the team of subcontractors assembled for the proposal. Firms with engineers who are known for producing quality work and have a history of doing good work for the agency have an advantage over the competitors. Such firms are more likely to secure repeated business from the agency.

Several factors contribute to perceptions by public managers that a firm has sufficient capacity for assuring quality in an engineering design project (DeHart-Davis & Kingsley, 2005). One aspect is that a firm has the ability to monitor the performance of subcontractors and can deliver a design that meets the specifications of the agency. However, it is not uncommon for a complex engineering design project for the specifications to evolve over the life of the project. Firms that have the ability to work with the agency through the evolution of specifications and can translate these needs into work orders for subcontractors earn a measure of trust from the agency. It may be the

case that there are few firms that have the capacity to provide managerial oversight of quality assurance across a team of sub-contractors.

Such firms can develop a form of asset specificity in the agency-prime contractor relationship. Prime contractors learn to adapt the preferences of individual units and project managers within the sponsoring agency. For example, one of the firms studied in this research reported that they developed a very successful set of procedures for complying with the numerous audit regulations used by the sponsoring agency. They were so successful that the sponsoring agency began to refer other contractors to them to learn the way the agency preferred (Kingsley et al., 2004).

Engineering design contracts are very complex involving several distinctive professions in the execution of the work and take a long time to complete. A typical contract uses engineers to design the layout of the road system, geotechnical specialists to ascertain the nature and structure of the terrain upon which the project will be built, environmental specialists to ascertain the types of environmental impact, real estate specialists who secure the property rights for the project, and project managers who coordinate the work of the many parties working together on the project. Agencies will attempt to give contractors guidance regarding the scope of work by holding annual meetings to describe the types of projects that are going to be bid out during the upcoming year and at times issue templates for particular types of work. However, these efforts fall well short of providing a standardized template for scopes of work. As a consequence, firms that demonstrate an ability to navigate such a complex set of tasks are prized and this can be reflected in assessments of the quality of a proposal.

Another factor that can encourage relational contracting is the internal politics of the agency. The decision to increase the magnitude and scope of contracting can signal a period of intense bureaucratic politics amongst units inside an agency. The agency that serves as the foci for this study experienced significant politics around the question of whether the agency should engage in structural adaptations to outsourcing. Those who saw the need for outsourcing as a temporary phenomenon were more likely to resist structural adaptations. In contrast, managers who saw this as a trend were more likely to encourage change.

In the agency studied here there were three distinct engineering design offices dealing with state roads, urban roads, and the consultant design group (who managed external contracts). The managers in each of these offices have different perceptions of the importance of contractors in delivering the agency's program of service, preferences for design formats and expectations concerning the responsibilities of contractors. Those firms that can successfully navigate these differences and satisfy the expectations of all of the engineering design offices are likely to receive additional work and to engender a reputation as a reliable contractor that produces quality work.

Over time all of these factors can lead to a small set of firms offering engineering design services to become preferred vendors from a quality perspective. This, in turn, leads to a deepening of the relationship between agency and the prime contractor. This leads us to the first hypothesis tested here:

H1: Over time, the number of contractual links between the agency and a select set of prime contractors will increase in frequency as the agency awards more contracts to this subset.

Does this pattern of relational contracting also extend to the prime contractor-subcontractor relationships? Prime contractors are free to negotiate first on the basis of price rather than quality. It is not uncommon for there to be a greater number of firms that have the capacity to provide a portion of the technical and engineering services required by the project. Thus, there may be fewer incentives at work for relational contracting to develop.

When an agency enters into a contractual relationship with a prime it is essentially outsourcing the management responsibility for assembling the sub-contractors needed to deliver an output of sufficient quality. In most cases there is no legal mandate that the agency exercise oversight of the relationship between the prime contractor and the subcontractor on price or the quality of the work to be performed. As far as the agency is concerned the prime is responsible for assuring the final work of all sub-contractors. In interviews with agency managers many expressed the view that they did not want to become involved in prime-sub relationships.

Engineering design firms may not have the interest or the capacity to develop the organizational resources needed for managing the relationship with the sponsoring agency. There is a particular skill associated with translating the many interests of the agency into a set of specifications for an engineering project. In a typical market there is a greater number of firms who can provide the engineering design services but not the relational aspects of project management. Subcontracting may have fewer barriers to entry and exit and firms as the prime parcels the work into smaller units that are manageable by small and medium sized firms.

Subcontracting will also experience competitive pressures as firms who may be the prime on one project, compete to be a subcontractor on another project. It is not uncommon for agencies to monitor the work loads of prime contractors and attempt to spread the work around to other prime contractors. This may be done in an effort to foster competitive markets. It may also be done to avoid congestion of work flowing through the prime contractor. However, firms that are serving as a prime contractor may also have sufficient slack remaining to successfully compete for a subcontract job on a different project. The likelihood of competitive pressures in the subcontracting market leads to the second hypothesis:

H2: Over time, the number of contractual links between primes and subs will increase and the network will grow as new entrants come into the network of primes and subs in response to market growth and competitive pressures.

While these hypotheses do not conclusively demonstrate that contracting is following relational patterns at the prime contract level and competitive processes at the subcontract level, they do serve to demonstrate patterns of contracting that are indicative of each contracting type over time. In combination these hypotheses are useful for ascertaining whether contracting patterns are distinctive the level of primes and subcontractors or whether patterns indicative of relational contracting cascades through to the subcontractor level.

State Transportation Agencies, a Backdrop

State transportation agencies historically have outsourced the construction of transportation systems (such as roads, bridges, air and water ports, and metropolitan subway and light-rail systems). Over the last 10 years state transportation agencies have

come under increasing pressure to outsource other activities such as maintenance, information systems, entire road and port systems, and other administrative activities (Witheford, 1997). However, many state agencies have been reluctant to outsource engineering design work because it is a key point of quality control in the development of the public infrastructure. Both the number of agencies who outsource and the number of units in agencies that utilize outsourcing has been increasing over the last decade.

This paper emerges from an ongoing, long-term study of outsourcing at the Georgia Department of Transportation (GDOT). The overall project aims to understand and improve contracting practices within the organization and includes document analysis, surveys, and in-depth interviews with both GDOT employees and private contractors and consistent feedback with the organization.

In a typical state transportation project roughly 90 percent of the budget is dedicated to construction, leaving the remaining eight to 10 percent for engineering design (also called the preconstruction). Over the last 10 years state transportation agencies have come under increased pressure to outsource activities such as maintenance, information systems, entire road and port systems, and other administrative activities (Witheford 1997). Despite this pressure, many state agencies have been reluctant to outsource engineering design work because it is a key point of quality control in the development of the public infrastructure (Cochran et al. 2004).

The GDOT Case: Setting the Stage

The Georgia DOT, like many state departments of transportation, has a history of conducting all engineering design work within the agency. The internal engineering

design team constitutes the “cultural heart of state DOTs” (Kingsley & Lee, 2005) because these civil engineers typically receive all of their training and spend their entire careers in the public sector. In the past, departments of transportation have provided the core of civil engineering professional training by grooming entry-level engineers through various engineering design departments to the top of the agency. Though the number of individuals involved in engineering design is relatively small (roughly ten percent or less of most state DOTs), over time they provide an essential pool of talent for agency management and add a thread of consistency throughout the agency.

Recently the Georgia DOT has begun contracting out traditional in-house services such as engineering design and inspection services. According to DeHart Davis and Kingsley (2005) the increase in design and inspection outsourcing at GDOT was not primarily driven by external leadership or top-down political mandates from the governor or the legislature. Instead, GDOTs outsourcing was driven by a combination of internal constraints and external conditions which simultaneously made it more difficult to conduct engineering design in-house and increasingly advantageous to contract out these services.

The increased demand for roads and highways coupled with personnel shortages and decreased budgets made it increasingly difficult for GDOT to ignore the possibility of contracting out engineering design services. More specifically, Georgia saw an increase in the expansion of public transportation programs and highway building under the Governor's Road Improvement Program (1989), the Statewide Transportation Plan (2001)[1] and the State Transportation Improvement Program (STIP). Second, the public finance rules governing state issued public bonds limit the ability of GDOT to hire or pay

[1] The State Transportation Board adopted the SPTP for 2000 to 2025, in December 2001.

state personnel working on transportation projects. Third, the completion of the federal interstate highway system led to a decline in the federal funds for road building. Fourth, GDOT faced a wave of retirements among senior personnel along with reductions in force and the elimination of vacant positions. For example GDOT lost nearly 60% of its employees between the mid 1960s and 2005 (DeHart Davis and Kingsley, 2005).

Finally, in the mid-1990s Georgia approved *GeorgiaGain* and *Act 816* which altered its civil service rules, eliminating the merit system for all employees hired after July 1, 1996 (Kellough & Nigro, 2002) and eliminating revolving door restrictions which previously prevented public employees from accepting positions in consulting firms[2] with whom they contracted with for two years after leaving the public sector. With the elimination of the revolving door restrictions, GDOT employees were able to retire or quit their jobs and immediately transfer to higher paying positions in consulting firms. The transfer of GDOT employees to consulting firms raised concerns about conflicts of interest as GDOT managers began to see their contractors as potential employers and consulting firms sought to recruit GDOT managers. In summary, the personnel and budget conditions of the state made it impossible for GDOT to maintain a large in-house engineering staff, and instead hastened the rush to contract preconstruction and construction services with private firms.

The consultant community is critical to the success of GDOT projects. Since the 1990s, the percentage of consulting contracts at GDOT has been steadily increasing. Senior GDOT managers estimate that contractors perform approximately 60% of GDOT professional services work annually (July 2003 report). Among the firms conducting

[2] Throughout this paper we use the term "contractor" to refer specifically to consulting firms who provide engineering and design services to the agency

GDOT work, over 500 firms have passed through the pre-award audit and approximately 50 firms have served as prime contractors for the majority of GDOT work. Between December 1994 and the fall of 2002, GDOT had paid out approximately $502 million to 276 consulting firms. Beginning in 1998 GDOT began offering contracts and task orders to contractors. Over the eight year period from 1994 to 2002, 75% of consultant projects were contracts with the remaining 25% dedicated to task orders. Approximately 46% of all GDOT contracting funds during that time period went to 10 firms with the top firm earning 8% of those funds.[3]

Due to increased workloads and reduced staff sizes, most state departments of transportation contract out services. Though GDOT continues to expand its contracting activities, it is not a national leader by percentage of contracts or effective use of contracting, compared to other departments of transportation. By 1999, approximately half of state DOTs contracted out 50% or more of their preconstruction engineering, while GDOT reported contracting out 25-30% of their preconstruction engineering work (Hancher & Werkmeister, 2001). In comparison, the neighboring state of Florida contracted out 80% of its preconstruction work (Witheford 1999). In a recent study of state DOT outsourcing, Georgia was not listed among the top ten state DOTs that effectively use contractors in project work (Hancher & Werkmeister, 2001).[4]

In response to the growing reliance on contractors and contracts with private firms and the challenge of managing these relationships, in 1999 GDOT created the Office of Consultant Design (OCD) to assist GDOT divisions and units with securing services and

[3] GDOT records list prime and sub-contractors on contracts over $1 million but list only the prime contractor in contracts under $1 million.

[4] Hancher (2001) ranked the following state DOT as the most effective: Colorado, Florida, Kentucky, Missouri, Kansas, North Carolina, South Carolina, Texas, and Utah.

managing contractors. Initially, OCD was intended to manage all projects working with contractors and act as a buffer and boundary-spanning unit shielding state design engineers from the distraction of contract management (and possibly to protect the agency from losing these employees to contracting firms). However, as transportation programs in Georgia continued to grow, OCD during this time period shared contract management responsibilities with other GDOT design offices.

Data and Methods

We use contract records maintained by the agency, covering contracts initiated between 1992 and 2003. The database contains information about 395 individual projects. Of them, 352 have been awarded (initiated) at the time the research team received the database in 2003. For the purposes of our analysis we utilize the following variables: year contract is initiated, prime and sub-contractor status of the companies participating in a contract, and amount of contract award. Every project is represented by the connections between the agency, prime and subcontractors.

Throughout the period under study 68 companies have served as primes, and 129 companies have served as subs. Since 38 companies among the 68 primes have also served as subs, the total number of companies that appear in the database for this period is 159.

We test our hypotheses by examining the development of the social network of contracts over time. Our fist test is to examine the number of new entrants as prime contractors and subcontractors into the network over time in light of the number of new contracts offered by GDOT. The second test examines the role change in the relationship in which over time firms who enter the network as prime contractors also enter as

subcontractors at a later date. We also explore the mobility of subcontractors who later become prime contractors. The third test examines the number "exits", i.e. the number of contractors that do not get new contracts over time. The final test is to examine the trends for network centrality and density over time.

In the analysis we treat the network as cumulative: that is, once a tie occurs between actors in the network in a certain time period, it remains there even if it is not repeated. Engineering design contracts can remain open and active for several years as the design process unfolds through several phases of work and stages of review. In doing so, we assume that the network structure emerges from the aggregation of past events (Moody, McFarland, & Bender-deMoll, 2005).

Findings

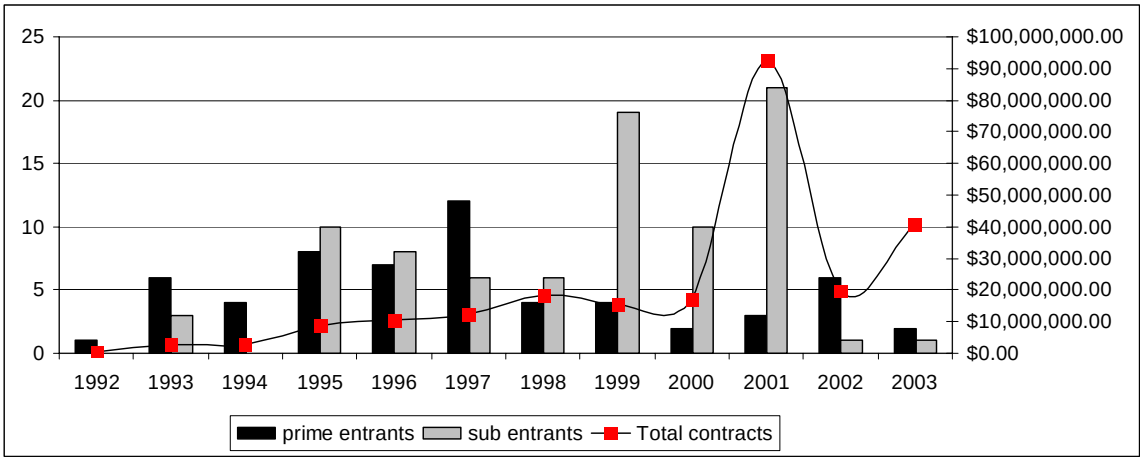
Test 1: The number of new entrants as prime and subcontractors over time.

A necessary condition for the relational hypothesis to be true over time is an increase in the frequency of contracting between the agency and a select set of prime contractors. The figure below presents the number of prime contractor and subcontractor entrants in the contracting network of the agency over the 12-year period while controlling for the level of new contract opportunities offered by the agency. Hereafter, "new entrants" are defined as companies that appear in the database for the first time (in a certain year). Figure 1 below compares three trends: it combines the distribution of primes and sub entry presented separately above with the total contract amounts dispensed by the agency in a given year.

The distribution of new prime contractor entrants depicted in Figure 1 reveals a gradual increase of new firms that join the network up until 1997 that is proportional to

the amount of new work offered by the agency. After this time the number of new prime contractors becomes that enter the network smaller in spite of new business being offered indicating that primes are getting repeat business. This is particularly pronounced in 2001 when there is a four-fold increase in the number of contract opportunities offered by the agency but relatively few new prime contractors. The entry of sub-contractor firms follows a different pattern in which the growth of entry of sub-contractors is relatively modest until 1999, when it sharply increases throughout 2001.

Figure 1. Counts of new prime and sub entrants in the contracting network compared with total dollar amounts awarded by GDOT.



Comparing the changes in contract awards against the patterns of entry for primes and sub-contractors reinforces the possibility of relational contracting among the agency and the prime contractors, but not necessarily between primes and subs. The biggest increase in new sub-contractor entrants coincided with the biggest increase in the contract amounts awarded. However, at the same time, the period of the highest increase in contracting dollars awarded, the entry of new prime contractors is at its lowest. This pattern is accompanied by the agency using contract vehicles, such as task order and turnkey contracts which can organize larger amounts of engineering design work and

larger numbers of subcontractors into a single contract vehicle. This move was made in an effort to reduce the administrative burden of contracting so many projects under the more traditional cost plus contract.

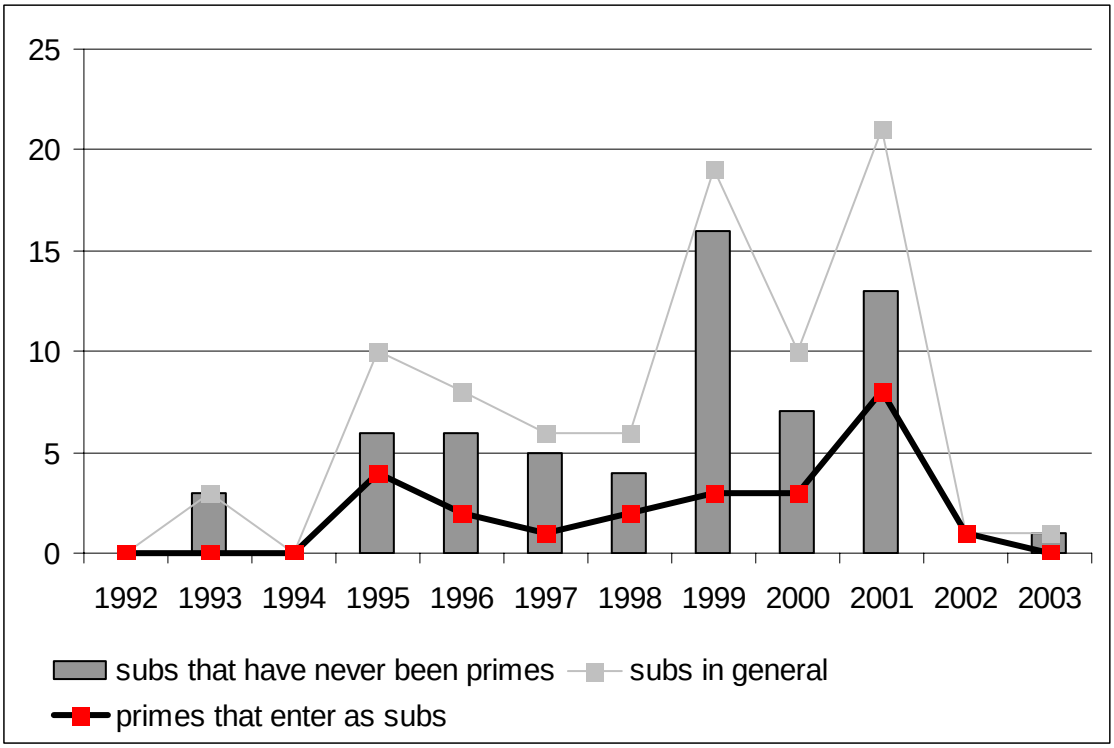
The most plausible interpretation of the combination of these three trends is that the large increase in contracting work is absorbed predominantly by prime firms that already are in the contracting network, but not by new entrants. At the same time, since the workload to be handled will also inevitably increase, these prime firms have utilized relatively larger number of sub-contractors – including many new entrants – to accomplish the additional work on these contracts.

Test 2: Role change between prime and subcontractors over time.

Approximately half of the prime contractor firms have also served as sub-contractors. We investigate the patterns of entry of companies that first appear in the network as prime contractors and later as subcontractors in Figure 2. The trends are interesting and are suggestive of a trend toward relational contracting. In all years some prime contractors enter the market as sub contractors. Their number grows steadily, with two notable exceptions. First, in 1995 for the first time several primes enter as subs. This initial entry is non-coincidental as in the years before 1996 the Department of Transportation has authorized relatively greater number of projects as a part of the infrastructure improvements undertaken in the Atlanta area in preparation for the Olympic games of 1996. After 1996, with some minor fluctuations the number of prime contractors who enter as subs remains roughly stable up until 2001, when there is a two-fold increase in the number of such firms.

Recall that 2001 is the year of a sharp increase in the contract amounts awarded by the transportation agency. Also recall that this sharp increase in available contract funds did not result in corresponding increase of new entrants, but was rather absorbed by primes who have already done business with the agency. Instead we observed relatively high influx of new subcontractors.

Figure 2. New entrants by years: subs total, subs that have never been primes, and primes who also enter as subs.



What the graph above shows is that this major influx of subcontractors considered at the aggregate may hide the fact that primes absorb an even larger proportion of the agency work, by undertaking disproportionately more subcontractor projects that previously and working with other primes in the network. This reinforces the initial conclusion suggested here that relatively stable relationships form between the agency and the prime contractors. Even in periods of rapid increase in outsourcing, this work is

more likely to be absorbed by the firms that have already established relationships with the agency rather than by a proportionate increase in the new entrants who could accommodate this work.

Test 3: The number of exits by prime contractors and subcontractors over time.

In this context we interpret an "exit" to mean that a firm has entered the network at some point, but did not receive repeat business. The exit rates for subcontractors are much higher than the ones for primes. Specifically, while 36% of sub-contractors receive only one contract, this proportion among primes is 50% lower: only 23% of the prime contractors have only one contract. Comparing the trends for prime and sub firms that receive repeat business, the trends are reversed. For example, the proportion of subcontractors with 3 and 4 contracts are 9% and 5% respectively, while for primes these proportions are twice as big – 19% and 9%.

Table 3. Share of primes and subs getting repeat contracts by range

Number of contracts	Number of sub-contractors with this number of contracts	Percentage of sub-contractors who have this number of contracts	Number of primes who have this number of contracts	Percentage of primes who have this number of contracts
1	47	36.43%	16	23.53%
2-5	35	27.13%	29	42.64%
6-10	18	13.95%	10	14.70%
10-20	12	9.30%	12	17.64%
>20	7	5.46%	1	1.47%

Prime contractors seem to receive repeat business to a greater extent than subcontractors. In terms of the hypotheses investigated here this implies that the relationships between the agency and the prime contractors exhibit properties of relational contracting to a greater extent than the relationships between sub- and prime-contractors. These preliminary findings indicate that even though relational linkages may

exist between prime contractors and an agency, primes, instead of forming similar relational contracts with subs, might be utilizing competitive processes to a greater extent.

Test 4: Network density and centrality over time.

To further provide evidence supporting the second hypothesis, we examine the prime-subcontractor network over time. We compare the trend across several network measures that summarize structure of the overall network, but do not have any a priori normative value. Network *density* measures the percentage of ties that exist in relation to the number of potential ties. This measure provides a description of the extent to which potential ties have been unexploited. *Average degree centrality* is a measure of the average number of other participants in the network to which nodes have immediate connections. This measure allows for some consideration of the level of participation in network activity by the 'average' participant in the network. For example, if Firm A has contracts with two other firms, (i.e. degree of 2) and these two firms contract among themselves, (i.e. degree of 1 each) then the average degree for this network of three firms is 1.33. Network *centralization* measures the extent to which the network is centralized around one or more key actors. For example, a network of 5 firms, 4 of which are sub-contractors to only one firm would reflect a network centralization of 100%. On the contrary, if the firms connect among themselves, but not exclusively to one firm, the centralization of the network will be lower.

We also compute two other measures that apply equally to primes and subs: the first is *average number of contracts* for the firms active during specific year, and the

second is a *cumulative average number of contracts* relative to the entire network (i.e. including all cumulative participants in 2003).

The first of these measures gives an idea about how much contracts on average firms (either primes or subs) win within a certain year. The second measure gives a good idea to what extent the work is "spread around" in the two networks or concentrated; it indicates to what extent the networks of primes and subs are "saturated" with contracts. The two measures are complementary: for example, if subs active during certain year get numerous contracts, but we see not much increase in the cumulative average number of contracts, this is an indication that the new contracts are won by new players rather than saturating the existing network.

Table 4: Trends in average degree centrality, network density and network centralization over time

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Network density	0.3	0.1	NA	0.045	0.033	0.025	0.025	0.022	0.021	0.019	0.019	0.019
Average degree centrality in the prime-sub network	2.4	1.8	NA	2.8	2.33	2.58	3.05	3.48	3.69	4.68	4.78	4.8
Network centralization of the prime-sub network	25%	16%	NA	14%	26%	33%	28%	25%	22%	18%	19%	19%
Average number of contracts per firm (primes active during the particular year)	1	1	1.2	1.54	1.14	1.26	1.6	1.69	1.25	2.34	2	1.93
Average number of contracts per firm (subs active during the particular year)	1	1	NA	2	1.85	2.54	1.81	2.13	1.48	3.3	1.2	1
Average cumulative number of contracts per firm – relative to the full set of primes	0.015	0.103	0.19	0.49	0.72	1.07	1.43	1.82	2.12	3.22	3.57	3.97
Average cumulative number of contracts per firm – relative to the full set of subs		0.008	NA	0.194	0.038	0.636	0.86	1.43	1.74	2.77	2.81	2.86

Table 4 reveals several trends that lend support for the hypotheses advanced here. First, looking at the average degree centrality for subcontractors, we can see a clear trend towards an increase in the average number of other companies with which the companies in the prime-sub network do business over time. Indeed, this trend is a support for the second hypothesis, which stated that over time the number of contractual links between primes and subs will increase and that the network will grow as new entrants come into the network of primes and subs in response to market growth and competitive pressures. The increases in average degree centrality are especially notable after 1998, corresponding to the largest increases in business awarded by GDOT.

The increase in the average number of nodes to which companies connect in the case of prime-sub network implies that the network grows over time but does not become consolidated over pre-existing relationships (in which case the average degree centrality would remain roughly constant as companies would tend to form repeat linkages with the same set of firms rather than form new linkages). What these numbers show is that subs tend to form increasing number of linkages with many different companies, as opposed to forming stable alliances with one or two firms.

This conclusion is further supported by the trends in the network centralization over time. It is most centralized in 1997, and after that point the centralization gradually decreases. The implication of this trend is that the prime-sub network is not necessarily characterized by a set of core prime contractors which attach to stable sets of sub contractors, in which case the linkages in the network would be focused, and this would be reflected in higher network centralization. Instead, decreases in the network

centralization index imply that the new entrants connect to a variety of existing companies thus creating more distributed, decentralized network.

The trends in network density also support this conclusion. The network density raw measure decreases from 1995 to 2000, after which it remains constant. However, in this context the conclusion should be the opposite, due to a peculiarity of the network density measure. Raw measures of network density are directly comparable only in networks of identical size, because network density is inversely related to network size as the number of theoretically possible connections increases much faster than the capacity of actors in the network to form such new connections. For example, in a network of 4 nodes, the maximum number of connections is 16. Adding just 1 more node increases the number of possible connections to 25, 2 more increase the possible connections to 36 and so on in geometric progression. Thus, considering the massive influx of new sub-contractors in 1999 and 2001, even the fact that the density remains constant, but does not decrease is remarkable and indicates that the old and new entrants intensively forge new connections (but are not necessarily confined to preexisting ones), thus de-facto increasing the network density given the increase in the overall size of the network.

Lastly, in the second half of the table we compare the trends in average number of contracts for primes and subs: both for the companies active during certain year and for the network overall. Overall, the number of subcontractors (active during a given year) receive slightly more contracts on average than primes. This implies that every year in the period under study, the subcontractors that work with primes during this year are likely to get more contracts on average than the prime contractors working with the agency. Since not all firms in the network are active in all years, this implies a lively

market where whichever subcontractor companies actually pursue business during given year are likely to get relatively higher number of contracts on average.

We interpret he lower average number of contracts for subs during given year as a result of 1) the tendency of primes to receive repeat business over time, not necessarily in the short term 2) the number of agency offices with which a prime can do business is limited, while there is not a practical limitation on the number of primes with which a contractor may work; and 3) while one agency project involves only one prime contractor, it may involve multiple subcontractors, thus again increasing the pool of possible contracts for subs relative to primes.

To put these trends in perspective, we must compare the average cumulative number of contracts for the entire networks of primes and subs. This measure is simply the cumulative number of contracts awarded up to certain year, divided on the size of the network in 2003. This number can only grow over time and (unlike the average number of contracts per company during given year) allows to make direct comparisons in the distribution of contracts across the subsets of prime and subcontractor firms. This measure is best interpreted as an indication of the level of "saturation" of the prime and subcontractor communities with contracts.

Comparing the trends for the two communities reveals that 1) the cumulative average number of contracts is higher for primes than for subs in all years and 2) that the cumulative average number of contracts grows faster for the set of prime contractors. At the end of the period, prime contractors, on average, have one more contract than the subs (and this number hides that many of the subs have been primes too). This we interpret as further evidence that the community of primes, to a larger extent than the community of

subcontractors, engages in patterns of contracting that are more likely to exhibit patterns of relational versus purely competitive contracting.

Conclusions

In this paper we assessed two hypotheses regarding changes in the composition of qualification-based contractual relationships between a transportation agency and the network of service providers at the prime and subcontractor levels. We identified diverging trends in these two sets of relationships. At the agency-prime level, after an initial build-up of the contractor network, the rate of new entries of firms in the contractor network noticeably diminishes. The expanding workload contracted out is increasingly awarded to pre-existing relationships rather than put into new ones. The relationships at the subcontractor level exhibited relatively greater volatility, and are characterized with more pronounced entries and exits roughly proportionate to the amount of work awarded by the agency.

These distinct trends emerged over time while the agency was contracting out increasing amounts of engineering design services and was attempting to adjust to a way of working featuring increased number of external suppliers. We suggest, albeit with this data cannot prove, that the relationship between the agency and prime contractors shows signs of shifting towards relational contracting. The evidence for this is that the size of the contracts have grown larger, through the use of task orders and turnkey projects, and the frequency of contracting with a set of prime contractors has increased. However, this pattern does not cascade to the prime-subcontractor relationship. Stable teams of

contractors tend not to emerge over the time period examined here as there are considerable changes in the composition of teams from one contract to the next.

Our findings raise doubts about the ability of agencies to be aware of whether they are trending towards competitive or relational contracting. The ongoing discussion in the privatization literature regarding the relative merits of relational versus competitive contracting is informed in large part by transaction cost economics and assumes that public organizations do (or should) stop, think, compare and weigh, the pros and cons associated with each type of contracting and proceed accordingly. The assumption is that organizations indeed make conscious strategic choices regarding what system of contractual arrangements to enter. Even if there has been no such strategic process, at the very least, organizations are assumed to "know" what type of contracting they actually engage in.

This paper undermines these connected assumptions. Specifically, we test a scenario in which an agency could slide into a certain pattern of contracting without any prior decisions and choices regarding what type of contracting to pursue. Moreover, such a trend could emerge even in the case of an agency that follows a competitive contracting process, such as the ones considered in this paper. Federal and state contracting laws are explicit in requiring that contracts are awarded on a competitive basis. Over time, however, it may be possible that relational linkages develop between agency and its prime contractors. The incentive structures of a contracting situation may lead managers in directions that are more relational. Since relational contracting is sufficiently competitive to pass the requirements for competition under the law it is unlikely that

there will be a natural checkpoint for considerations of the type of patterns of contracting that agencies might prefer to engage.

We do not argue that relational contracting is a bad outcome for agencies. However, it does require a different set of structural adaptations to the agency's organizations. Transaction cost economics predicts that as more cooperative governance strategies are required then the vulnerability of agencies to maladaptive hazards from contracting will increase (Sclar, 2000; Williamson, 1999). The ambiguities associated with adapting to a rapid increase in the amount of contracting as well as the more commonplace challenges associated with the specification and adaptation of the scope of work of qualification-based contracts over the life of the project have tended in the GDOT case to lead to more cooperative strategies. The increasing frequency of work going to a set of contractors gives some evidence of relational contracting. If this pattern holds transaction cost economics would predict that the agency will pursue a range of strategies to improve the relationship through training, stakeholder committees to facilitate communication and efforts to increase contract oversight. In doing so a set of contractors will gain asset specificity by being better at managing this oversight, and if they are also able to manage subcontractors well and deliver projects in a timely fashion, then the level of trust by the agency will grow. We do argue that this organizational form should develop from strategic choices.

Our findings also suggest that agencies are likely to develop and maintain a more complex portfolio of projects over time than simple models of competitive vs. relational contracting might suggest. For example, over time our network of contracts demonstrates both efforts to recruit new contractors and patterns indicative of relational contracting.

At the level of subcontractors we found evidence of a substantially more competitive market. Thus, the patterns of contracting that dominate the relationship between prime contractors and agencies do not seem to extend, at least in the network that we have examined, to the prime and subcontractor relationship. At this point, our data regarding the relatively more competitive sub-contractor market suggests that the outcomes of the overall trends may be positive for the agency. Specifically, while more stable relationships with prime contractors promote trust and inter-organizational learning, more competitive linkages between prime and sub-contractors both take advantage of market competition (presumably accompanied by lower prices and higher quality), as well as "spread around" the business of the agency without excessively concentrating into a select group of elite companies that have de facto monopolized the business with the agency and trade prime and sub-contractor roles.

Even if we do not register it here, the latter scenario is not unlikely. Federal and state contracting regulations are currently silent on this matter and are predicated on the relationship of the agency with the prime contractors. We suggest that future legal and scholarly contributions to the problem of outsourcing in the public sector pays specific attention to the implications of the sub-contractor networks and for their implications for the success of outsourcing at the agency.

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