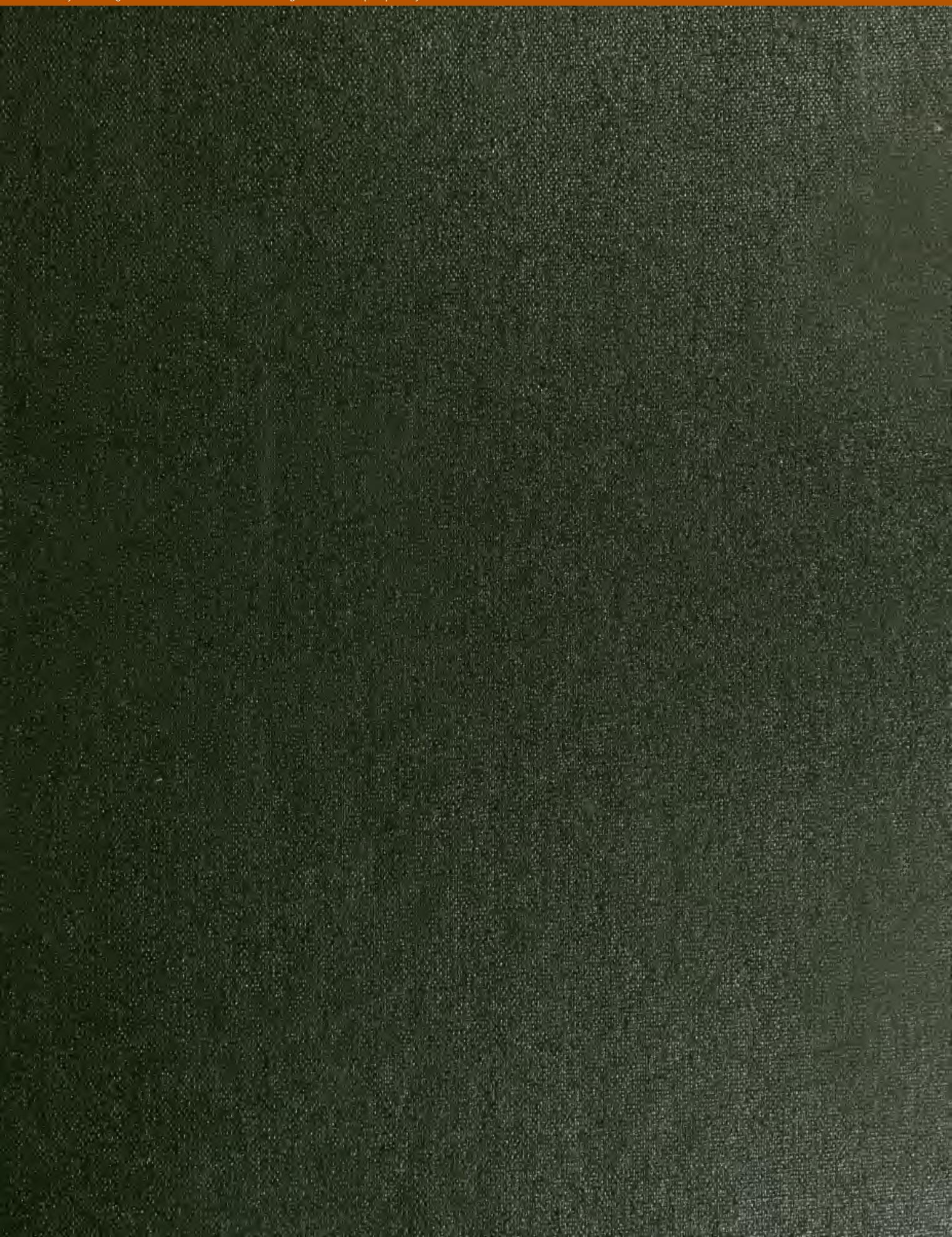

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Switching Costs and Bidding Parity in Government Procurement of Computer Systems

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*Faculdade de Economia, Universidade Nova de Lisboa, and University of Illinois, Champaign/Urbana, respectively. A substantial portion of this work was completed when both authors were associated with the Center for Economic Policy Research at Stanford University. We would like to thank Tim Bresnehan, Roger Noll, and Mike Riordon for many useful remarks. Only we are responsible for any remaining errors.

Switching Costs and Bidding Parity in Government Procurement of Computer Systems

By Luis Cabral and Shane Greenstein *

June 1989,

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ABSTRACT: In the late 1970s Federal agency computer users complained that the General Services Administration was not accounting for "conversion costs" when choosing among alternative suppliers of computer systems. This motivates our analysis of a general tradeoff in procurement between the costs of switching suppliers and the degree of "competitive behavior" elicited by the absence of incumbent advantages in a bidding game. Our analysis shows that arguments in favor of accounting for conversion costs were not sufficient to justify the change in the policies which took place. There are plausible circumstances in which switching costs should be estimated as best they can and be used, and circumstances where they are best ignored.

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"The issue in dispute,... began with HGOC's (House Government Operations Committee) resistance to allowing consideration of full costs for converting computer programs from the form used by incumbent computers to the form needed for equipment of prospective new vendors. HGOC correctly believes that considering full conversion costs tends to restrict competition to vendors of equipment compatible with incumbent machines."

-- P. R. Werling (1983), pg. 138.

1. Introduction

The General Services Administration (GSA) has supervised all large federal agency computer acquisitions since the late 1960s[1]. For most large-valued procurement, GSA solicits bids for needs specified by a Federal agency and selects the winning bid. The policies governing GSA's bidding procedures have frequently been a focal point of debate.

One issue for debate, the topic of this paper, concerned GSA's procedures for determining the winning bidder to supply a computer system when the new acquisition is subject to "conversion costs" -- costs incurred as consequence of switching suppliers of a mainframe computer system[2]. In the late 1970s many computer users complained that the GSA was not using systematic procedures to account for "conversion costs" when choosing among alternative suppliers' bids. A government accounting office (GAO) report phrased the issue in the following manner:

"Would including conversion costs in computer procurement result in selecting the (computer mainframe) system that would cost the government the least over the lifetime of the system?" (GAO, 1980, p. ii).

Though the GAO phrased the question clearly, most government analyses, including the report just cited, have focused on subsets of the economic issues[3]. The GAO established through careful work that switching costs could be large and could influence procurement outcomes. However, the GAO reports implicitly assume that bids should fully account for switching costs under all circumstances. Hence, the reports assume that establishing the existence of switching costs justifies accounting for them[4].

In contrast to the GAO report, we show in this paper why this assumption is not appropriate. There may be plausible circumstances in which it is optimal not to account for switching costs -- even when those costs are large and can influence procurement outcomes.

We compare two stylized procurement systems in which the winner is chosen either by a third party, GSA, who does not account for switching costs, or by the eventual user, who does (correctly) account for switching costs. We call the first "centralized" procurement and the latter "decentralized" procurement[5]. We focus on whether it is plausible for the extra competitive bidding in a procurement which ignores switching costs to outweigh the losses from occasionally "unnecessarily" switching computer suppliers.

Centralized procurement can be optimal for the federal government as a budgetary unit (e.g. from OMB's perspective) when most agencies are "locked-in" to the low cost bidder. Centralized procurement will elicit more competitive behavior from the bidder who already has a competitive advantage without incurring much expense from switching suppliers. On the other hand, when most agencies are "locked-in" to the high cost bidder, decentralized procurement will be favored over centralized procurement because

lower costs from switching more than make up for the higher prices paid.

We also show that bidding using an under-estimate of switching costs -- or partly accounting for them -- will trade off the same factors. In some circumstances, under-estimates will even be preferable to the extreme cases of "centralized" and "decentralized" procurement. We conclude from this analysis that the policy of ignoring switching costs, which appeared misguided to many contemporary observers at the time, had some economic merit.

This paper can be viewed in the context of recent attempts by economists to understand the influence of switching costs on competitive behavior and "lock-in", where the focus has been on understanding pricing and entry when incumbent firms are at a competitive advantage relative to non-incumbents[6]. The issues in this paper are also related to the literature on second sourcing in government procurement, which discusses the trade-offs facing policy makers when there is a choice among two alternative vendors, one of whom has a previous history with the buyer, or has progressed down a learning curve[7]. While these previous theoretical investigations are useful descriptions of the possible behavioral dynamics, we think that the concrete policy problem we describe here helps make an important economic tradeoff more accessible and its implications more concrete.

2. The debate surrounding computer procurement procedures

Changes in computer procurement policy in the 1970s affected many users. Virtually every civilian agency and military fort possesses one, if not many, general purpose mainframes to keep records, process checks, and perform calculations.

By the late 1970s agencies had reasons to worry about conversion costs and their impact of procurement decisions. Many federal agencies feared that moving to alternative suppliers would result in a large loss in the value of their previous investments, especially if users had to convert idiosyncratic complementary assets, such as large programming packages, to work on the new system from an incompatible supplier[8]. Moreover, switching costs could potentially be large enough to affect the outcomes of bids. The 1980 GAO report mentioned in the introduction was one among several to show this[9].

Computer procurement by federal agencies was also shaped by the nature of supervision. The acquisition and use of computers in the federal government had been guided by the public law 89-306 ("The Brooks Act", named for Congressman Jack Brooks (D, Texas) of the House Government Operations Committee), who had long ago become interested in the procurement and use of federal information technologies. The Brook's Act delegated to GSA the authority to decide the winner of computer competitive bids[10]. GSA could also delegate to agencies the authority to decide the winner if GSA personnel so desired, and usually did so when the procurement was small in value[11]. As a consequence, procurement decisions could be made by someone other than the eventual user of the system, and if not, then reviewed for approval.

The de-emphasis on switching costs in GSA-supervised procurement was not a written policy, but one that was believed by many participants to be de facto in place[12]. It was believed that Brooks pursued policies to make procurement procedures more "competitive", directing attention at eliminating "sole source" procurement of systems, primarily from incumbent suppliers[13]. GSA was not initially sympathetic to arguments that the costs of switching to incompatible computer suppliers justified limiting the number of competitors. GSA could not easily learn whether an

agency was exaggerating the costs to avoid supervision or gain a larger budget. There was little reason to design an explicit policy for switching costs without concrete proof that they were unavoidably large.[14]

The GAO (1980) report was a catalyst for change[15]. After considerable debate at the end of the 1970s the GSA settled on a policy for systematically estimating switching costs prior to any procurement. These estimates were typically added to each incompatible vendor's bid and agencies used the extra funds to do the conversions themselves.[16] Comparisons between the pre-1979 bidding procedures and the system that "fully" account for switching costs motivated our analysis below.

3. Economic Trade-offs in Computer Procurement Policy

To illustrate the economic tradeoffs between the alternative regimes, we focus on a replacement purchase, a case where switching costs are likely to be greatest. We assume there are only two potential suppliers, firms h and l, with constant marginal cost c^h and c^l, respectively. Without loss of generality, we assume $c^h > c^l$. For simplicity, mainframe computers are assumed to be a homogeneous product, i.e., apart from the costs of switching suppliers, users are indifferent between firm h's and firm l's mainframes and agencies and oversight committees identically evaluate competing products[17].

Demand consists of "offices", each office demanding one unit of the good with a reservation price of u[18]. We assume that m offices are locked-in to firm h before any procurement takes place, and that these offices must incur a cost s in order to switch to firm l, where s is assumed to be independent of the firm to which an office is locked-in, and is distributed with c.d.f. F(s). A similar description applies to the remaining 1-m

offices, who are locked into firm l and can switch to firm h at a cost of s.

Throughout the paper, we will assume that the relevant costs, c^h, c^l, and s, are common knowledge to buyers and sellers. This turns out not to be an essential assumption for the points we want to make, although, as we will see in the end of the section, it abstracts from some other aspects of potential interest.

The central result of this section concerns the choice of the optimal procurement mechanism. While we recognize that computer procurement subject to oversight is a complex process, for heuristic purposes, we first consider two possible mechanisms that are stylized models of the procurement policies followed before and after 1979:

(i) **Centralized procurement:** The government commits to provide bidding parity in the procurement process. The lowest price bid is selected in each case independently of the firm to which the office is locked-in.

(ii) **Decentralized procurement:** Each office is allowed to take into account the costs of switching when choosing the supplier. Therefore, only if the difference in prices is greater than the switching costs will an office decide to switch suppliers.

What are the outcomes under these two alternative arrangements? Consider first the case of centralized procurement. Given the fact that there is bidding parity, we have a simple Bertrand game with different constant marginal costs. The low cost firm (firm l) prices just below the level of firm h and takes all the market demand. The cost incurred by each office is

the price ($P = c^h$) plus the switching costs, if the incumbent supplier is firm h. Therefore, total benefit to the government from this type of procurement procedure is given by

(1) $B^c = u - c^h - m\ E(s)$.

where E(s) is the average value of s.

Note that the net benefits under this regime are decreasing in m. The greater the number of offices locked-in to the high cost supplier, the greater the expenses for switching suppliers after the low cost supplier wins a bid.

In contrast, switching costs are taken into account in each purchase in a decentralized procurement. We consider two possible cases, depending on whether s is greater or smaller than the difference $s^* = c^h - c^l$. If $s > s^*$, then the incumbent firm, i.e., the firm to which the buyer is locked-in has a sufficiently large strategic advantage that it sells even if it has a higher cost. The price charged by the incumbent is given by the cost of the other firm plus the value of s. Average benefit conditional on s being greater that s^* is then given by

(2) $B^{dh} = u - m\cdot(c^l + s^h) - (1-m)\cdot(c^h + s^h)$,

where $s^h \equiv E(s|\ s>s^*)$.

If, on the other hand, $s < s^*$, then the low-cost firm has a sufficiently large cost advantage that it sells even if it is not incumbent. The price charged by the low cost firm is $c^h + s$ if it is incumbent and $c^h - s$ if it is not. Average benefit conditional on s being lower than s^* is then given by

(3) $B^{dl} = u - m\cdot(c^h - s^l + s^l) - (1-m)\cdot(c^h + s^l)$,

where $s^l \equiv E(s|s < s^*)$.

Total benefit under the decentralized procurement regime is given by

(4) $B^d = (1-F^*)\ B^{dh} + F^*\ B^{dl}$,

where $F^* = F(s^*)$. Substituting (2) and (3) into (4) and doing some algebraic manipulation, we get

(5) $B^d = u - c^h - E(s) + m\ K$,

where $K = (1 - F^*)\ (c^h - c^l) + F^*\ s^l > 0$.

The benefit function under decentralized procurement is increasing in m. The greater the number of offices locked-in to the high cost firm, the fewer the firms that switch, and the lower the total expenditure the entire government spends on switching costs.

We are now ready to state the main result of this section.

Proposition 1: If m is sufficiently small (resp. large) then the regime of centralized procurement (resp. decentralized procurement) yields higher net benefit.

The result follows straightforwardly by comparing (1) and (5). The intuition behind the proposition is quite simple, and best explained for the extreme cases. When m is small, the low cost firm has the advantage in a bidding game, whether or not procurement is centralized. When switching costs are taken into account (i.e., under the decentralized regime), the low cost firm, if incumbent, has one less cost associated with its systems

than its competitor. This manifests itself in a higher price and thus a lower benefit to the buyer. When m is large, on the other hand, switching costs will be incurred in a centralized regime quite often. The total switching costs will more than make up for the lower prices induced by bidding parity. In other words, the two regimes trade off the gains from a more competitive behavior with the costs of switching suppliers as a consequence.

One of the peculiarities of a centralized regime is that behavior which appears to be sub-optimal on a local level can be optimal when viewed globally. In this case, even though an agency might be better off not switching in a particular procurement, the buyer is not responding to this knowledge, because more competitive bidding makes the government better off over a wide number of cases.

This feature of the model relates to similar themes found in the theoretical economic literature on auctions -- namely, if a bidder can commit to a course of action, irrespective of the information he receives later which may reveal that his strategy is sub-optimal, then he may be better off. Commitment to one type of action leads other players to change their behavior in a favorable manner. Usually this observation is problematic, because there is no practical method for ensuring the commitment of the first decision maker. We have no such troubles here, since the situation motivating our investigation provides ample evidence that an institutional mechanism enforces the commitment -- namely, GSA decides the winner of the bid and administrative law regulates procedures[19].

In closing this section, we should mention that there are various ways one can depart from the simple common-knowledge model present here. For example, one can assume that production costs are each firm's private information. The model would then

be isomorphic to an auction with a discriminating factor z (McAfee and McMillan, 1985), z being zero when switching costs are ignored. This and other possible departures from the common knowledge assumption make the model more difficult to solve (sometimes impossible to solve analytically), but do not change the basic points brought out by the analysis of the simple case.

On the other hand, one must recognize that, in its simplicity, our model leaves out some aspects of potential interest. For example, we could discuss the case when s is the buyer's private information and see what his or her incentives are to reveal that information[20]. We could also discuss the case when s is known to the buyer and the incumbent firm, and see how this affects the tradeoff between the two regimes[21].

4. Choices among procurement regimes

The analysis implies that the existence of switching costs associated with a purchase does not, per se, provide a compelling reason for adopting a system that fully accounts for them. Centralized procurement is optimal for the federal government as a budgetary unit (e.g., from OMB's perspective) when most agencies are "locked-in" to the low cost bidder; decentralized procurement will be favored when most agencies are "locked-in" to the high cost bidder. The analysis also implies that a system which did not fully account for switching costs in the 1970s was optimal if the dominant incumbent suppliers, such as IBM and Univac, had lower costs than the new entrants. We note that this condition was never discussed in the records of the debate.

Evidence that switching costs can alter outcomes or complaints about "unnecessary switching" also does not provide a sufficient reason to alter the procurement system (Yet, this was the major substantive evidence in GAO 1980). In our model, an

"unnecessary switch" in a centralized regime is a bid awarded to the low cost supplier when the incumbent would have been awarded the contract under a decentralized regime. Clearly, an optimal centralized system will produce switches between manufacturers that would not occur in a decentralized system, even when these costs are correctly estimated.

The above argument does not entirely vitiate the force of complaints in a centralized regime. "Unnecessary switching" could result in complaints if it reflected more profound equity problems in the centralized regime than are modelled here. The costs and benefits of a centralized system may not be equally borne by all offices, since any particular office may benefit from more competitive pricing under the centralized regime, but some offices "locked-in" to the high cost supplier will "unnecessarily switch". If each office is constrained by a budget that includes its own switching costs, then one can expect complaints from the offices whose switching costs were ignored. Thus, complaints will arise even if whether partly accounting for switching costs is optimal or not for the entire government as a budgetary unit.

We now consider a more general procurement regime in which a fraction of switching costs is taken into account. This is equivalent to a situation in which switching costs are systematically underestimated.[22] Let the procurement authorities commit to taking into account a fraction, p, of the switching costs.[23] Will the optimal p always be zero or one? In Appendix 1 we show that the total benefit for the government under this "flexible regime" policy is given by

(6) $B^f = u - c^h + (1-F^*)\cdot m\cdot\delta - p\cdot E(s) - (1 - 2p)\cdot F^*\cdot m\cdot s^l$, where

$\delta \equiv c^h - c^l$, $s^* \equiv (c^h - c^l)/p$, $s^l \equiv E(s|s < s^*)$, and $F^* \equiv F(s^*)$.[24]

Although a systematic characterization of the optimal solution is not possible, we can state the following general results:

Proposition 2: There exist parameter values such that $p^* = 0$ is optimal, $p^* = 1$ is optimal, and $p^* \in (0, 1)$ is optimal. For example:

(i) If m is very small, then the optimal solution corresponds to $p = 0$.

(ii) If m is very large, then $p = 1$ yields a higher benefit than $p = 0$, but it may be the case that the optimal solution lies strictly between zero and one.

(iii) If there is an interior solution and $p^* < 1/2$, then an increase in m implies an increase in the optimal p.

(iv) If there is an interior solution and both $p^* < 1/2$ and $m < 1/2$, then an increase in δ implies an increase in the optimal p.

The proof may be found in Appendix 2. The proposition provides some insight into the comparative statics of the optimal choice. However, even with the simple structure of our model the derivation of the optimal p turns out to be fairly complex.

Through numerical simulations we have found that p^* is strictly between zero and one generally for cases where m is neither very large nor very small. As an illustration, Figure 1 plots B^p as a function of p, assuming that $c^h = 1.1$, $c^l = 1$, $m = .5$, $u = 2$, and s is uniformly distributed between zero and one. As can be seen, $p = .215$ maximizes the government's total benefit.

This analysis makes clear that under-estimating switching costs also trades off the costs of additional "unnecessary" switching costs with the more competitive behavior induced from

incumbents. In some circumstances, the intermediate solution may be better that the extreme solutions of not accounting or fully accounting for switching costs.

5. Final Remarks

The main message of our paper is that complaints about GSA's procedures for accounting for switching costs too superficially scratched the surface of the relevant economic issues. We have shown that there may be merit in ignoring those costs, because the increased competitiveness in response to bidding parity can outweigh the costs of "unnecessarily" switching between suppliers.

We have also shown that the 1980 GAO report should not have presumed that proof of the existence of switching costs was sufficient to motivate systematically fully accounting for them in all computer procurement. In our view, to make that claim the report should have also investigated the degree to which the earlier procedures were eliciting more competitive bidding behavior from incumbent vendors, as well as the degree to which federal offices were "unnecessarily" switching vendors[25]. Such an investigation would have to fully account for the extent of the federal installed base with different vendors and try to estimate the competitive positions of these vendors[26]. We are not arguing that the policies of the 1970s and 1980s were correct or incorrect, only that changing them required fully considering several fundamental economics issues underlying the policy[27] .

The next step of this research should investigate whether imperfect estimation of the costs of switching alters the relevant trade-offs. Further work could also explicitly model the conflicts between the supervising and supervised agencies in order to understand the relevance of this conflict for the choice

among alternative policy rules[28]. This research could emphasize, among other things, that oversight agencies establish routine procedures as a means to monitor and elicit control over sub-agencies (See McCubbins, Noll and Weingast (1988)). If GSA auditors found it costly to collect that information, how did they prevent offices from "loading up" on switching costs if it wanted to favor an incumbent supplier? If switching costs were paid for by the supplier at the time of a new acquisition, how did the GSA prevent offices from not avoiding costs today that increase switching costs later on? Understanding the efficacy of these administrative solutions allows us to understand more fully the relative merits of alternative procurement policies when products are subject to switching costs.

Appendix 1: The expected benefits under the flexible regime

We suppose that a fraction p of the switching costs is taken into account. the crucial value of s is now $s^* \equiv (c^h - c^l)/p$.

If $s > s^*$, then the incumbent always sells at price

$c^l + p \cdot s$ with probability m
$c^h + p \cdot s$ with probability 1 - m.

If $s < s^*$, then the low cost firm always sells at price

$c^h + p \cdot s$ with probability m
$c^l + p \cdot s$ with probability 1 - m

and a switching cost s is paid with probability m.

Total benefits is therefore

(A1) $$B^f = u - (1 - F^*) \cdot [\, m \cdot (c^l + p \cdot s^h) + (1 - m) \cdot (c^h + p \cdot s^h) \,]$$
$$- F^* \cdot [\, m \cdot (c^h - p \cdot s^l + p \cdot s^l) + (1 - m) \cdot (c^h + p \cdot s^l) \,]$$

which can be simplified into the expression in the text.

Appendix 2: Proof of Proposition 2.

(i) Substituting m = 0 in (3), we get

(A2) $$B^f = u - c^h - p \cdot E(s)$$

and the result follows straightforwardly.

(ii) The first part of the result corresponds to Proposition 1. The ambiguity of the optimal solution is evident by computing the derivative $\delta B^f/\delta p$ (done below) for m = p = 1. One can find functions F() for which this is negative, which implies an interior optimal solution.

(iii) and (iv) We make use of the following useful Lemma (See, for example, Varian (1984)):

Suppose $z(y) = \text{argmax } f(x,y)$, then

(A3) $$\text{sign } (\delta z/\delta y) = \text{sign } (\delta^2 f/\delta x \delta y).$$

Differentiating (3) with respect to p, we get

$$(A4) \qquad \delta B^f/\delta p = f(\mu/p)\cdot(\mu/p^2)\cdot m\cdot\mu - E(s) + 2\cdot F(\mu/p)\cdot m\cdot s^l$$

$$+ (1 - 2p)\cdot f(\mu/p)\cdot(\mu/p^2)\cdot m\cdot s^l + (1 - 2p)\cdot F(\mu/p)\cdot m\cdot(\mu^2/p^3)\cdot f(\mu/p)$$

where we use the fact that $s^d = \int_0^{s^*} s\cdot dF(s)$

and therefore $\delta s^l/\delta p = \delta s^*/\delta p\cdot s^*\cdot f(s^*) = -(\mu/p^2)\cdot(\mu/p)\cdot f(\mu/p)$. Taking the derivative of (A4) with respect to m and μ, and applying the above lemma the results follow.

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Endnotes

1. See GAO (1977a) for a summary of the structure of computer procurement.

2. "Switching costs" refer to the costs associated with moving to a new supplier. These are not to be confused with conversion expenses which would be incurred irrespective of the identity of the new supplier, i.e. expenses associated with technically "orphaned systems" -- systems with no available upward compatible upgrade.

3. Two issues which received much attention included: (1) What principles should guide the implementation of policies for incorporating switching costs into procurement?; and (2) What can be done to aid agency managers in reducing the costs of conversion? See GAO (1977b, 1980).

4. GAO (1977b, 1980) both assume that the procurement system ought to account for switching costs. In addition, they also assume that switching costs could be accurately estimated. For many technical reasons, this is difficult to accomplish (Greenstein 1989, chapter 2). P. R. Werling's (1983) doctoral thesis provides detailed accounts of the political dynamics and administrative shortcomings of federal computer procurement policy, but his discussion also presumes that the procurement system ought to fully account for switching costs.

5. While we could imagine a centralized procurement system that accounts for switching costs, we maintain this terminology for simplicity.

6.See Farrell (1986), Farrell and Shapiro (1986a), and (1986b), and Klemperer (1986).

7. See Anton and Yao (1987), Demski, Sappington and Spiller (1987), Farrell and Gallini (1987), Laffont and Tirole (1987), and Riordan and Sappington (1988).

8. Several mainframe system manufacturers had developed compatible families of systems and offered upgrades -- the IBM 360 and 370 families being the most popular -- which were compatible with each other but not with systems made by other firms. By the 1970s many agency offices had built a substantial library of software investment that was compatible with only one firm's systems and potentially very costly to replace. See Greenstein (1989), chapter 2, for more technical detail.

9. The GAO report brought to light examples where the procurement procedures did not reflect the full costs of switching between alternative suppliers. The GAO auditors observed that if the GSA

did not fully account for these "conversion expenses", then the bid would not fully reflect the costs the user would eventually incur, the supplier with the lowest "lifetime costs" would not always be chosen, and users would unnecessarily incur switching expenses "too frequently". GAO (1977, 1980) are the best sources. For other useful retrospective studies see GSA (1983, 1986), and NBS (1980a, 1980b). Also see Werling (1983).

10. Among its directives, the Brooks Act also delegated authority for computer procurement policy and decision making to several federal agencies, the GSA, the National Bureau of Standard (NBS), and the Bureau of the Budget (later to become the Office of Management and budget (OMB)).

11. Guidelines today are set at $50,000 for sole-source procurement and $300,000 for competitive procurement. See NBS (1983).

12. It was widely believed that Congressman Brooks held ultimate authority over the purchase of any large computer system to which he turned his attention, though he never retained any formal authority to veto a computer procurement (Petrillo, 1982). Paul Werling, who wrote a thesis on the Brooks Act, alleges that Brooks especially targeted the dominant system supplier in the early 1970s, IBM (Werling, 1983).

13. A sole source contract is one where an agency contracts with a single contractor. If the supplier possessed a "unique capability and experience", agencies could justify bypassing competitive procedures.

14. Indeed, this proof was not forthcoming until the GAO did its reports in the late 1970s. These demonstrated that switching costs existed for technical reasons which are unaffected by an agency's behavior, that switching costs could be large, and, moreover, could be large enough to alter the outcomes of bids if correctly estimated. See GAO (1980), which focused on six case studies. On the presumption that bidding does not change, GAO concluded that accounting for switching costs would have altered outcomes in two cases.

15. It was not the sole publication on the issue. GAO (1977a, 1977b) contained research that foreshadowed the results in the 1980 GAO report. These were quickly followed by NBS reports on related topics. See NBS (1980a, 1980b).

16. Agencies prefer to do this because of difficulties associated with contracting out for software conversion. Contracts cannot account for all contingencies, nor guarantee precisely the desired performance -- agencies found they had to substantially revise conversions done out of house.

17. We ignore the possibility that agencies and oversight committees might differently evaluate the same vendor traits, due to different marginal valuations of the next dollar spend from capital and operating budgets. See Greenstein (1989, Chapter 2) for greater detail.

18. Throughout the analysis, we assume that u is sufficiently large, so that it is not a binding constraint.

19. This ignores the incentives for a foresighted agency to report technical specifications that "unnecessarily" favor one supplier. It presumes that the central authority can elicit truthful information about the agency's needs. See Greenstein (1989, chapter 2).

20. Basically, if sellers have approximately the same cost and s is low, then it is in the buyer's interest to reveal that information, assuming that switching costs are to be taken into account in the bidding process. However, it is unclear whether there could ever be any credible information disclosure, for a high-s buyer would also benefit by convincing sellers that his or her s is low.

21. Our first guess is that the centralized mechanism would be relatively more favored in this case, because, in addition to the switching costs, the incumbent firm would have an information advantage relative to its rival.

22. We believe that this is a relevant issue because any definition of a switching cost is in practice somewhat arbitrary, and thus, can systematically under-estimate the true switching cost the agency incurs.

23. In practice, this could be done through rules which limit what features an office may require in its technical specifications, and thus, what expenses a seller must cover in each procurement. This ignores the incentives of a foresighted agency to misrepresent the level of "allowable" switching costs, as a means to favor an incumbent supplier. We presume that the central authority can elicit truthful information about the level of switching costs. For related discussion, see Greenstein (1989, chapter 2).

24. Note that s^*, s^l, and F^* are a function of p.

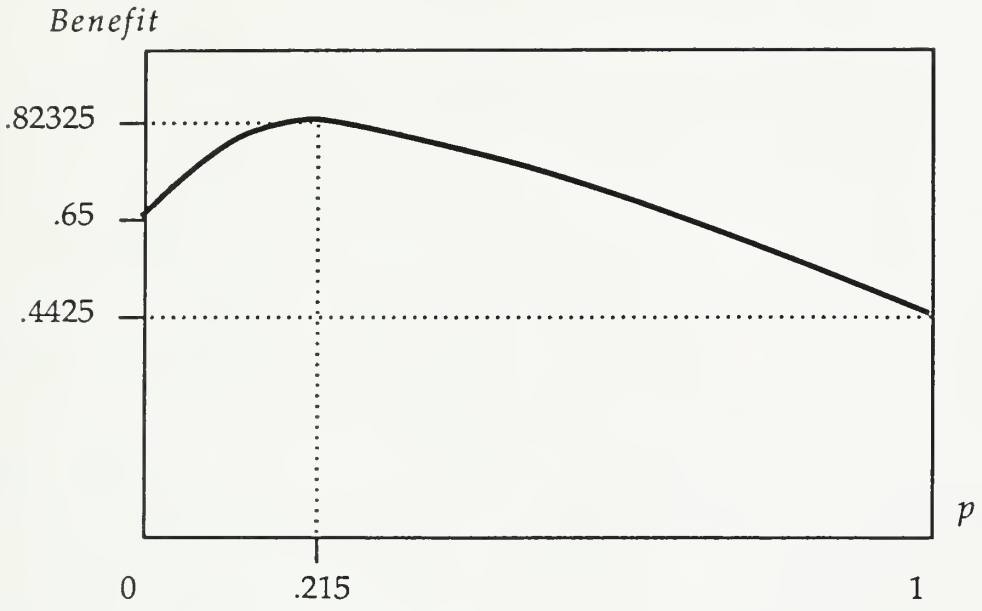
25. Indeed, these issues were investigated in the six cases examined in GAO (1980), though no estimate was given of the extent to which these were representative. In addition, the conclusions about "unnecessary switching" in those reports presumed that the prices in bids would not change under different procurement rules, and that using the actual costs incurred in switching between vendors could serve as a reasonable proxy for

what would have been estimated prior to switching. While these may not have been harmful assumptions for the particular cases investigated there, it is an important qualification for a wider investigation. See the appendix to GAO (1980) for detail.

26. For example, suppose the largest incumbent mainframe vendor during the 1970s, IBM, was at a cost disadvantage relative to competitors, then there would be economic justification for accounting for switching costs.

27. We also note that the relative benefit to the two regimes would differ if central authorities wanted to develop a more "competitive" industry by using government procurement to "subsidize" several non-dominant (and non-incumbent) industry suppliers -- which was commonly alleged when federal agencies purchased non-IBM equipment.

28. See Greenstein (1989, chapter 2) for steps in this direction.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