

Managing Dynamic Procurements

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Abstract

This chapter examines the optimal strategies in repeated procurement settings by large power buyers when there are costs to switching suppliers. It is found that buyers can use switching costs to their advantage. When switching costs are high, a buyer may credibly threaten to replace the incumbent supplier with the rivals. The policy implications of this finding for adoption of technology and firm organization are explored.

1 Introduction

Recently we considered which laptop computer to purchase for the new and returning faculty at our business school. The choice was between an old proven brand that we had been using and a new brand that was attractively priced but unfamiliar to our people. The old brand was reliable but it had not been updated much recently, whereas the new brand incorporated some advanced technology and attractive design features. Overall the new brand seemed like a better buy than the old one. But, there was a cost to switching from the old to the new brand. We would have to learn new skills to operate the new brand and our technicians would need additional training to repair and service the new machines.

We decided after much deliberation to remain with the old brand. The cost of switching computers was too high. We realized the school had become so dependent on the old technology that we were locked in. Switching to a new one was not feasible, at least

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not in short run. But, this was just the tip of the iceberg. We discovered there were many more products and services that we were locked into buying, including computer software, reproduction equipment, communication services and information technology. In each case, we would need to retrain our employees and adjust our operating procedures to switch products. We were unwilling to bear these costs and so we continued to use the old products.

From this experience we learned the importance of formulating a dynamic procurement strategy for buying products that entail switching costs. Switching costs occur with many of the high technology products including computer software and hardware, communications services, and information technology we have come to rely on. One can reduce the life cycle costs of procurement by understanding how suppliers of high technology goods compete to attract and maintain their customer base and how the switching costs that result can be minimized.

We lay out some best practice rules of procurement for switching cost goods in this chapter. These recommendations are based on research on managing dynamic competition we have conducted for the last five years that is summarized in Lewis and Yildirim (2002, 2005). In the analysis to follow we first describe the factors to consider when purchasing services with switching costs. We indicate how optimal procurement auctions are designed to manage dynamic competition in section 2. In section 3 we identify the essential trade-offs between *conservation* of switching costs and *diversification* of supply. Conservation leads one to renew service from an incumbent supplier to avoid switching costs. Purchasing from a new supplier maintains future options for diversification of services from independent providers. In section 4 we discuss long term strategies for training employees and organizing production to manage long term procurements of switching cost goods. We identify instances when the creation of switching costs within an organization may actually reduce the life cycle costs of procurement by forcing suppliers to price more competitively to maintain their incumbency advantage. Section 5 concludes with some summary observations.

2 The Procurement Setting

To fix ideas, suppose a government or private procurement agency needs to purchase computer equipment or software on a regular basis. There are several qualified suppliers for the

agency to select among but their products aren't necessarily compatible with each other. To effectively employ a product may require employees to develop a new set of skills, to reconfigure hardware and software to be compatible, and to acquire other complementary services. All of these are time consuming and costly activities. These skills employees acquire to operate new equipment are likely to be retained if the organization continues with the same product. However, these skills may deteriorate if the product is not used for some time or it is replaced with an alternative.¹ As a result, when an incumbent supplier is replaced, employees may incur short term and long run switching cost. In the short term employees need to invest in learning new skills to operate the new equipment. In the long run the employees' skill at operating the old equipment must be reacquired as operating skill deteriorates with non use. The task for the procurer then is to optimally manage these short and long term switching cost while minimizing the price of acquisition over time.

The procurer may acquire equipment like computer hardware or software by various means. One way, perhaps the ideal one, is to integrate with the suppliers and make the products in house. Here the "integrated buyer" would minimize the switching cost and choose the efficient product in each period since the purchase price wouldn't be marked up above production cost. The only reason the procurer would switch products is if it were warranted by changing production costs or because of varying effectiveness of different products. Despite its apparent efficiency, supplying itself with goods and services is typically not feasible for a government agency due to the costs of establishing supply sources.² Nonetheless, we will retain the integrated buyer case as a benchmark for comparison with other procurement strategies.

When self supply is not feasible, the procurer must outsource the product. An outsourcer is unlikely to know the exact cost of production for outside suppliers because monitoring costs is difficult. This gives outside suppliers an incentive to exaggerate their costs of production to increase profits. To reduce acquisition costs, the outsourcer needs to carefully negotiate the terms of purchase prices that also reflects the costs of switching suppliers.

¹There is a vast empirical literature that document the presence of learning-by-doing in various industries. See, for instance, Alchian (1963) and Asher (1956) on aircraft production; Hirsch (1952) in machine tools; Gruber (1998) and Nye (1996) in semi conductors; Thompson (2001) on shipbuilding. There is also an emerging literature that report the importance of forgetting or depreciation of knowledge in manufacturing, industrial and service sectors. See, for instance, Argote et al. (1990), Benkard (2000), and Darr et al. (1995).

²Imagine the setup cost of making laptop computers in house.

One plausible strategy is to negotiate a long term sole source contract with one supplier to govern the terms of exchange for an extended period of time. Sole sourcing minimizes switching cost, but restricts the procurer's flexibility to adopt new products when appropriate. Besides this, it is notoriously difficult for a government agency to write long-term procurement contracts. Administrative and legal rules typically constrain public officials from making commitments for purchase of goods and services beyond their term in office. Similar concerns are also present for private procurements. Incompleteness of contracts and enforcement problems render long-term contracts difficult to write for a buyer and seller. When long-term agreements are not available sole-sourcing works less well because the supplier is unwilling to discount price without the guarantee of future purchases.

Absent the ability to make long term commitments, the procurer must resort to short term competitive bidding mechanisms to manage his supply. This is the topic we now turn to.

2.1 Procurement Auctions

Imagine a setting where the procurer designs a sequence of auctions to purchase goods and services. Here our goal is to describe the optimal feasible auction format, so we will not restrict attention to a particular auction form such as an oral ascending auction. At the beginning of each auction suppliers are privately informed of their cost of production. The procurer wishes to purchase the product at lowest cost, but he must also account for the costs of switching he will incur if he adopts a new supplier. The procurer requests the competing producers to simultaneously submit a supply price. The sellers independently and without consultation select a supply price based on their knowledge of the buyer's skill in employing their product and any switching costs that might occur.³ The buyer selects one supplier to produce the desired good based on the submitted prices and the subsequent switching costs there are involved. After the winning supplier is determined the product is provided at the price bid and whereupon the process moves on to the next auction which is held during the next procurement cycle.

³In many settings, suppliers will be able to observe directly or to infer the buyer's current skill with their product. The buyer will often reveal his skill state and knowledge in operating products during material specifications for procurement. Moreover, Appleyard (2002) indicates that suppliers often work with buyers to help them use their product. Given that we have in mind large power buyers, such a close relationship seems reasonable.

3 Factors in Choosing Suppliers

The procurer's objective is to minimize the discounted sum of switching costs and purchase prices. There are two conflicting factors that govern the procurer's optimal choice of supplier in each auction that we refer to as *conservation* and *diversification*. The conservation factor argues for the procurer to continue purchasing from the incumbent supplier to conserve employees' skill in using this product. This is important when expertise in operating sophisticated equipment is easy to lose during periods of non use. The diversification factor argues for procuring from alternative suppliers to enable employees to acquire skill with other products. Diversifying enables employees to switch more readily between suppliers to take advantage of lower cost products in future periods. The procurer also increases future competition among suppliers when he diversifies his purchases.

The procurer's optimal purchasing policy is shaped by these two factors: conservation and diversification. The procurer's concern for diversification is generally outweighed by his concern for conservation.⁴ This implies the procurer must contend with positive switching costs in each auction that he conducts. This brings us to our first Rule of Thumb.

Rule of Thumb 1. *Favor the incumbent supplier in any given auction. That is, the procurer should generally purchase from the incumbent unless one of the other suppliers offers a significantly lower price than the incumbent's price to compensate for the costs of switching suppliers.*

Rule 1 indicates that all else equal, the procurer is more likely to purchase from the incumbent.⁵To appreciate the extent of the incumbency advantage, next we compare this with integrated buyer's procurement strategy. Recall the integrated buyer who self supplies is not concerned about the purchase price since he knows the cost of production. Like the procurer the integrated buyer is also concerned with conservation and diversification. Unlike the integrated buyer though, the procurer wishes to promote price competition. This means the procurer has a stronger diversification motive than the integrated buyer and will therefore discount some of her switching cost to foster greater price competition among rival suppliers. This leads to our second Rule of Thumb:

⁴Lewis and Yildirim (2002, 2005) show this point in a formal model.

⁵In his study of U.S. Government procurement of mainframe computers, Greenstein (1993) finds that 73% of procurements were awarded to incumbent suppliers.

Rule of Thumb 2. *When outsourcing, ignore part of the switching cost to increase price competition.*

To rationalize Rule 2, recall the outsourcer is concerned with limiting price markups of suppliers. These markups are especially high for the incumbent, who knows the buyer is partially locked into his product [Rule of Thumb 1]. The buyer is willing to ignore part of his switching cost to signal that the incumbent's lead is not insurmountable. This allows the outsourcer to counter the incumbent's (partial) monopoly power. Rule 2 implies the outsourcer switches suppliers too frequently compared to the integrated buyer who takes full account of switching cost.⁶

4 Organizing Production to Reduce Switching Costs

The procurer can adopt various ex ante measures to reduce switching costs. First, he can adopt a flexible production technology to adapt to different inputs at a small cost, or require suppliers provide compatible products. Second, he can train his employees to learn new technologies and to invest in organizational memory by documenting best practice procedures to reduce the loss of skill during periods of non use.

Before we discuss the procurer's incentives to invest in these measures, let us clarify how switching costs affect multiperiod procurements. The procurer becomes biased toward the incumbent's products when there are costs to switching. [Rule of Thumb 1]. This creates an asymmetry between the incumbent and other suppliers which benefits the procurer in two ways. On the one hand, nonincumbent suppliers discount their price to take over production, while the incumbent supplier reduces price to maintain its place as the primary supplier. Both incentives for discounting price increase with switching cost and the incumbency bias which results. Thus while an increase in switching cost has an adverse direct effect on the overall cost of procurement, this is offset to a degree by its beneficial strategic impact on competition that arises. To determine how these countervailing effects of switching costs impact on procurement costs, note that the strategic effect is absent for an integrated buyer and a sole-sourcing procurer and likely to be small for an outsourcing procurer with many

⁶This excessive switching contrasts with other motives for switching. For instance, Taylor (2002) indicates that consumers with private costs of switching may engage in excessive switching to signal they have low switching costs. This enables them to gain a favorable bargaining position in future exchanges. Cabral and Greenstein (1990) find a buyer may commit to switching often by ignoring switching costs altogether.

suppliers.⁷ This leads us to:

Rule of Thumb 3. *Try to avoid switching costs whenever (1) products are made in-house, (2) sole-sourcing is feasible, or (3) there is strong competition among numerous suppliers.*

According to Rule 3 the procurer will want to reduce switching costs whenever there is effective competition among suppliers. For instance, the procurer may install a flexible production technology that adapts readily to the inputs from different suppliers. He may procure from suppliers with substitute products or require suppliers to produce compatible products.

When the buyer is unable to procure from a competitive group of suppliers the strategic benefits from switching cost may outweigh their direct costs. The procurer will want to facilitate the creation of the switching cost in such cases. For instance, the procurer may use a dedicated production technology that is costly to adapt to different inputs. He may purchase from suppliers whose products are not compatible with each other. With regards to organizing production, the procurer may not document best operation practices for different types of equipment or retain skilled employees able to switch between different production processes. We summarize this observation in

Rule of Thumb 4. *If an outsourcing procurer faces a small number of non competitive suppliers, investing to reduce switching cost may not be profitable.*

Rule 4 may appear counterintuitive. After all, the extant literature on switching cost economics⁸ concludes that switching costs are generally harmful to consumers, who should avoid them if possible. An important assumption driving this conclusion is that consumers are small and passive price-takers. Our analysis reveals that this prescription may be reversed when buyers are large and powerful with the ability to affect prices as in the case of a government procurement agency, the department of defense, a university or a large corporation. Indeed, switching cost can be a useful strategic tool for a power buyer in negotiating price when there are few suppliers who don't compete directly with each other. A buyer who can, for instance, regulate the degree of compatibility between competing

⁷Recall that the integrated and sole-sourcing buyers are not concerned with competition. In addition, the outsourcer with many alternative suppliers should already be able to obtain a reasonably low price due to competition.

⁸See, e.g., Klemperer (1995), and Farrell and Klemperer (2004) for excellent surveys.

products will wish to retain some incompatibility to insure there are costs to switching from the incumbent supplier. This establishes an advantage for the incumbent that other suppliers will compete to attain and the incumbent will attempt to defend by reducing price.⁹

Another implication of Rule 4 is that the outsourcer will be less concerned about turnover in skilled labor as compared to an integrated buyer. Letting go of skilled employees signals to the incumbent supplier that he will lose his stature as the favored producer unless he discounts his price to maintain the buyer's interest. Although there is a direct cost to losing skilled workers, the signal value of this strategy is very valuable to the outsourcer. We further illustrate this point with a numerical example.

An Example¹⁰: Consider the procurement decision our business school faces as to which brand laptop computers to buy for the new and returning faculty. This is a decision the business school (buyer) needs to make almost annually. Suppose there are two suppliers. Although each supplier produces a different brand, both serve the buyer's purpose. We assume the unit production cost for each supplier changes from year to year and it is an independent draw from two values, \$800 and \$1200, with equal probability. Each supplier privately knows its current cost draw but it is uninformed of the rival's or its own future costs. Finally, all parties discount future costs and profits with a common discount factor $\delta \in [0, 1]$. To highlight the strategic role of switching costs, we start with a benchmark case where there are no switching costs from changing suppliers. In this case, without the benefit of long term contracts, the best the buyer can do is to hold an auction each year, and a simple second price auction will achieve this objective. The buyer's expected cost will be $\frac{800+3(1200)}{4} = 1100$. This means the buyer's expected discounted cost for the lifetime product purchases is $\frac{1100}{1-\delta}$.

Now, consider the case with switching costs. In particular, suppose the buyer incurs a one period switching cost of \$200 every time he switches products. At any point in time, the buyer is skilled at using the incumbent supplier's product, while he is unskilled at using the product of the other supplier, who we will call the potential entrant. Note that it is optimal

⁹Standard theory of oligopoly with passive price-taking consumers suggest that consumers might benefit from compatibility and standardization of products to avoid switching costs. However, the theory also suggest that suppliers are better off differentiating their products to prevent head-to-head competition, unless standardization and compatibility improve market demand.

¹⁰A more general version of this example can be found in Lewis and Yildirim (2005).

for the buyer to switch brands only when the entrant actually has a lower supply cost than the incumbent, which occurs with probability $1/4$. This is the only case where the switching cost is justified. In the remaining three cases of cost draws, the buyer purchases from the incumbent. From here it is immediate that the buyer will pay an expected discounted switching cost of $\frac{1}{4}(\frac{200}{1-\delta}) = \frac{50}{1-\delta}$ and production cost of $\frac{3}{4}(\frac{800}{1-\delta}) + \frac{1}{4}(\frac{1200}{1-\delta}) = \frac{900}{1-\delta}$ for the lifetime of purchases. These are however not the only payments the buyer has to make. Since suppliers' actual costs are unobservable, these costs can be exaggerated. This is however possible only for the incumbent with an actual cost \$800. Such an incumbent will be tempted to ask for a price \$1200 and win the auction with probability $1/2$.¹¹ Hence, the incumbent earns an expected profit of $\frac{1}{2}(1200 - 800) = 200$, whereas the entrant earns 0. As a result, the buyer pays a total discounted cost of $\frac{50}{1-\delta} + \frac{900}{1-\delta} + 200 = \frac{950}{1-\delta} + 200$. Comparing total procurement costs in the two cases, we see that the buyer is better off in the presence of switching costs as long as $\delta \geq 0.25$, i.e., as long as the buyer as well as suppliers sufficiently care about future costs and returns. By breaking the symmetry between suppliers, switching costs create rents to the incumbent, which induces a fierce competition early on.

4.1 Frequency of Procurement and Make-or-Buy Decision

The make or buy decision is an important one for all organizations. Self provision requires costly investment in production capacity but it allows the firm to control the acquisition price of the good. Outsourcing of products is typically preferred when the procurer can effectively control the purchase price through careful design of the acquisition process. Incumbent suppliers will price more competitively when they fear being replaced by a rival producer. The likelihood of being replaced is greater the shorter the procurement cycle. If supply contracts are rebid more frequently, say annually rather than every five years, there is greater pressure on the incumbent to discount price to retain his business. This leads us to:

Rule of Thumb 5. *The more frequently the product is procured, the more preferable it is to outsource it.*

Rule 5 highlights the importance of switching costs in determining the boundaries of the

¹¹The incumbent who asks for \$1200 will win the auction if the entrant draws a high cost. Otherwise, the buyer will find it optimal to switch.

organization. The organization literature¹² argues how buyers may integrate with suppliers to overcome production inefficiencies. Our analysis suggests in contrast that switching costs lead to less integration when procurements are frequently repeated. The incentives to self supply are smaller and the benefits to outsourcing are greater, when goods are often replaced.

5 Conclusion

This chapter provides some guidelines for designing on-going procurement auctions to acquire products with switching costs. Although both the outsourcer and integrated buyer occasionally will choose to switch products the outsourcer will change suppliers less frequently [Rule of Thumb 1] The outsourcer buyer deliberately ignores part of the switching cost to foster greater price competition between the incumbent and rival suppliers [Rule of Thumb 2]. Whereas the integrated buyer tries to avoid switching costs, the outsourcer buyer may employ switching cost to facilitate greater competition with repeated acquisitions [Rules of Thumb 3 and 4]. The incumbency advantage is fragile in this setting, requiring constant price discounts from the current producer to avoid being displaced by rivals. Unlike the integrated buyer, the outsourcer has little incentive to lower switching cost by standardized his sources of supply, employing a flexible technology or investing institutional memory to document best practices. Finally, we find that switching costs are easier to manage, the greater is the frequency of procurement.[Rule of Thumb 5]. The incumbent must discount price with each acquisition cycle to main his prominent supply position. Frequent replacement of products tilts the choice make or buy decision towards outsourcing as switching costs are less problematic in this setting.

We can extend this analysis to address other important conceptual and policy issues. The current analysis does not address the possibility that rival suppliers may collude –a major concern in repeated procurements as discussed in Chapter ?. A topic for future research is how the outsourcer optimally designs procurements when suppliers may collude in setting price. The current analysis also presumes production is awarded to a single supplier. A further extension would be to incorporate split award auctions into our analysis. Dual sourcing becomes an attractive option for supply when there are small fixed costs to

¹²See, for instance, the seminal studies by Williamson (1975) and Klein et al. (1978).

production with different goods and operating skill deteriorate rapidly through non use. A third extension of our work would be to identify standard auctions formats including English and Dutch auctions that one could implement to manage multiperiod acquisitions of goods with switching costs.

6 Bibliographical Notes

The recommendations for optimal procurement auctions we discuss in this chapter are based on our two papers Lewis and Yildirim (2002, 2005). These papers contain a formal model and rigorous derivation of the five rules of Thumbs presented here. A related analysis in which procurers are assumed to be small passive price takers is Cabral and Riordan (1994)

Our analysis is at intersection of the two literatures on repeated procurement with a large buyer and switching cost economics with small passive buyers. A classic reference on procurement theory is the book by Laffont and Tirole (1993). Klemperer (1995), and Farrell and Klemperer (2004) provide excellent surveys of switching cost literature. Also the economics of lock-in and learning by doing and the policy questions associated with these processes are reviewed in Benkard (2000), Darr et al (1995), Dudley (1972) and Greenstein (1995,1997)

An analysis of split award auctions and dual sourcing is in Anton and Yao (1987).

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