NBER WORKING PAPER SERIES

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Working Paper 20529
http://www.nber.org/papers/w20529

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2014

This work on pricing and authority is in memory of Dale Mortensen, much of whose life work was on search, pricing and wage setting. Dale was a great friend and scholar and his research and friendship will be missed. The literature that his ideas generated will continue to flourish. Comments from Steven Levitt, Paul Oyer, Glen Weyl, and Florian Zettelmeyer are gratefully acknowledged. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 20529
September 2014
JEL No. D4,M5

ABSTRACT

Sales agents are impatient relative to owners. If a good fails to sell, the owner still retains possession of that good and can enjoy its services, whereas the agent receives nothing. As a consequence, sales agents prefer a lower price than does an owner. Owners are therefore reluctant to delegate pricing authority to sales agents even when the agents have superior market information. Pricing authority is more likely to be delegated to agents when the owner lacks monopoly power and sells competitively and when the good is a non-durable. Agents who are given pricing authority are less likely to be paid commissions and more likely to be on a straight salary.

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When a seller offers a good like an antique, painting, or piece of used electronic equipment for sale on consignment or through an auction process, the seller is usually asked to set a reservation price below which no sale occurs. The seller could allow all the pricing decisions to be made by the agent who presumably has better information about the market than does the seller. In most cases, though, for example in online auctions like eBay, the seller is asked to set a reserve price.[1] Why doesn't the owner simply trust the agent to price the good in accordance with the owner's interests? Do agents have different pricing incentives than owners?

In particular, the existence of reserve prices that are set by owners suggests that a sales agent might choose too low a selling price.[2] Although it is true that a pure commission salesperson does not reap the full benefit of the sale, the price that maximizes profit also maximizes any fraction of profits as well. Specifically, if profit, π, is a function of price, R, given by $\pi(R)$, and if the salesperson receives λ of profit, then the R that maximizes the owners profit,

$$(1-\lambda)\,\pi(R)$$

also maximizes the salesperson's profit

$$\lambda\pi(R)$$

The scalars, $(1-\lambda)$ or λ, drop out of the first-order condition, which is simply $\pi'(R) = 0$ in both cases. Given this result, it is not obvious why a sales agent would choose a lower price than would an owner.

[1]The concept of setting reservation wages and prices was explored early by Burdett and Mortensen (1978,1989) and Burdett, Kiefer and Mortensen (1984), Mortensen (1986) and by Diamond (1981, 1982) in search frameworks.

[2]Bryan, Lucking-Reiley, Prasad and Reeves (2007) finds that setting reserve prices has positive effects on the auction price if the good sells. Analyses of reserve prices in auctions include papers on why reserve prices might be set for information reasons. See Brisset and Naegelen (2006), and Cai, Riley and Ye (2007).

In the case of eBay, on typical goods, the seller pays a fee of 10% of the sale price to eBay up to a maximum of $250 (see the appendix). The maximum creates a clear distortion because setting a price above $2500 results in no additional revenue to eBay, while decreasing the probability of a sale. The owner might be willing to trade off lower a lower selling probability against higher revenue received if a sale does occur. But even without a cap on commissions like that in the eBay contract, agents are too anxious to sell the good as compared to the owner.

There are two reasons why an agent will choose a lower price than the owner. The first relates to the standard principal-agent effort issue. A bird-in-the-hand is often more valuable than the two-in-the-bush when securing the second bird requires that additional effort be expended. Although valid in many circumstances, that explanation cannot be relevant in the case of online auctions because there is no additional effort involved in allowing the good to remain on the website at a high price for a longer period.

The more subtle, but conceivably more important reason is that the owner can continue to enjoy the services of the good if it does not sell, whereas the agent gets nothing out of a no-sale. The owner of a painting that fails to sell at auction still has the painting to enjoy, but the auction house gets no commission. As consequence, the owner has a higher reservation value than the agent, which causes the owner's desired price to exceed that of the agent. The owner can alter the compensation scheme to attempt to align incentives, but only by using a compensation scheme that is equivalent to selling the agent the good and thereby turning agent into principal can the owner induce the salesperson to price the good appropriately.

If salespersons' and principals' incentives differ, a principal will be reluctant to delegate pricing authority to an agent. Some agents, like sales managers at new car dealerships, are given price-setting authority (including choice of the reservation price) whereas others, like online auctioneers, are not. Realtors are almost always required to obtain authorization from the owner before a buyer's offer can be accepted.[3] What accounts for the difference?

The delegation of authority is a standard topic in personnel economics[4] but its interaction with price setting has not been explored in much detail. The goal here is to study pricing behavior and to use the implications of the theory to predict the amount of pricing discretion given to agents in different settings.

[3]Occasionally, realtors buy houses from the owners and resell them, which avoids any conflict.

[4]See Mayer (1960), Rosen (1982), Freeman and Lazear (1995), Lazear (1998, pp 452-60 and 474-76), Garicano (2000).

I. The main findings are: An agent prefers to set a lower price in order to obtain a higher probability of sale than that chosen by an owner.

2. Paying agents appropriately can remedy the incentive problem, but as is the case in the basic principal agent problem, this requires the equivalent of selling the asset to the agent and making him the principal.

3. Pricing authority is more likely to be delegated to the salesperson in firms that operate in highly competitive markets than those having significant monopoly power.

4. Pricing authority is more likely to be delegated for perishable goods than for durables.

5. Agents who are rewarded on a longer-term basis over multiple sales possibilities are more likely to be given pricing authority than those who receive the compensation based on single or a series of single sales opportunities. This explains why the managers at auto dealerships are given pricing authority, but the individual auto salespersons are not.

6. Those agents who are given the authority to set prices are less likely to be paid on a commission basis.

Basic Model

Consider first how an owner would behave if she were selling the good, e.g., an antique, by herself. There are two variables of interest: the price that is charged and the effort put into the activity.

Initially, assume one period and let there be at most one customer who comes to examine the good. Most of the intuition can be gleaned from this simple structure. Let the cost of effort, e, be given by C (e). The probably of that a customer examines the good depends on effort by the seller. Let P (e) denote that probability with P'>0, P"<0 so that the probability of a sale is increasing and concave in effort. In this case, effort consists of marketing the good and displaying it to potential buyers.

Customers who view the good may attach different valuations to it. The valuation is given by V~g(V) with distribution function G(V). The price is R so that the probability of a sale, given a customer, is the probability that V>R or 1-G(R). Since the probability that a customer arrives is P(e), the probability of a sale is

(1) Probability of a sale = $P(e)\,[1 - G(R)]$.

Consider an owner who sells the antique without an agent. If the antique does not sell, the owner can continue to enjoy the antique and obtain value A. Then the problem for the owner is to choose price, R, and effort, e, so as to maximize

(2) $R\,P(e)\,[1 - G(R)] + A\,\{1- P(e)[1 - G(R)]\} - C(e)$

which has first order conditions

(3) $\partial / \partial e = (R - A)\,P'(e)\,[1 - G(R)] - C'(e) = 0$

and

(4) $\partial / \partial R = [1 - G(R)] / g(R) - (R - A) = 0$

or $R = A + [1 - G(R)] / g(R)$

The owner may choose instead to employ a salesperson as agent. In this case, a general linear compensation structure allows for a lump sum payment S if the antique sells plus λ times the sale price (commission) coupled with a lump sum payment W if the antique does not sell. This structure is sufficient to achieve first best if the parameters are set correctly.

Given this payment structure, the agent's problem is then to choose e* and R* to maximize

(5) $(\lambda R^* + S) P(e^*) [1 - G(R^*)] + W \{1 - P(e^*) [1 - G(R^*)] \} - C(e^*)$

This has first-order conditions

(6) $(\lambda R^* + S - W) P'(e^*) [1 - G(R^*)] - C'(e^*) = 0$

and

(7) $\lambda [1 - G(R^*)] / g(R^*) - (\lambda R^* + S - W) g(R^*) = 0$

or

$$R^* = [1 - G(R^*)]/g(R^*) + (W - S)/\lambda$$

In order to induce the salesperson to do the right thing, it is necessary to choose S, W and λ so that R* = R and e* = e where R and e are the solutions to (3) and (4). Additionally, it is necessary to compensate the salesperson enough to induce him to accept the job. The latter condition means that the expected payment must just cover the cost of effort, or from (5),

(8) $(\lambda R^* + S) P(e^*) [1 - G(R^*)] + W \{1 - P(e^*) [1 - G(R^*)] \} - C(e^*) = 0$.

The solution is straightforward. Set e*=e and R*=R. Then there are three equations, (6), (7), and (8), in three unknowns, S, W and λ. By setting λ = 1, W - S = A, and by choosing the level of S and W to satisfy (8), (6) reduces to (3) and (7) reduces (4). These are the same two equations in two unknowns that yielded R and e in the principal's problem so the solution to the

salesperson's problem is the same. The price at which the good is "sold" to the agent is, in expectation, C(e) because S and W are chosen so as to make the expected revenue from showing the antique equal to C(e) to satisfy (8). The salesperson never actually owns the good in a formal sense, but the contract mimics ownership by making him pay for it through S and W. The expected revenue from the combination of selling price, R, offset by W and S (which can be negative) is the price paid for the good.

Contracts of this form are rarely, if ever, observed. The typical contract in real estate generally sets S and W equal to zero and chooses a λ that is less than 10%. The agent's problem when S and W are zero is a special case of the above.

A salesperson who is paid a straight salary is another special case, where $\lambda=0$, S=W, and S,W > 0. With S=W, salesperson compensation is independent of the sale. In this formulation, motivating effort is problematic. Equation (6) implies that $C'(e^*)=0$ when $\lambda=0$ and S=W. Unless there is some intrinsic value to providing effort or some other mechanism (un-modeled in the current formulation) that induces salespersons to put forth effort, effort is minimized. This does not necessarily imply that no sale occurs because $P(e^*)$ may be greater than zero even for $e^*=0$. Customers may come to view the good even absent salesperson effort.

To understand why salesperson's pricing incentives deviate from those of owners, the analysis proceeds in two steps. For the next few sections, it is simply assumed that $\lambda>0$ and that S=W=0. The implications of what occurs when that contract is chosen are derived. Then, after discussing delegation of pricing authority, the compensation contract is revisited to consider when an owner might choose to move toward salary compensation and how that meshes with the delegation of pricing authority.

Agent Behavior with Pure Commission Sales Contracts

Businesses sometimes advertise that their salespersons are paid salaries rather than commissions. One example involves financial advisers and brokers who feature that their agents are paid salaries and do not receive commissions on trading. The goal is to convey to customers that the salesperson's goals will be aligned with those of the customer. The implication is that salespersons on commission care about profit and not customers. Whether this is true or not depends on many conditions. A competitive product market may provide discipline and incentives to handle customer needs, but let us leave that aside. At issue here is not whether salespersons' goals deviate from those of the customer, but rather how commission distorts salespersons' preference relative to the owner for a quick sale.

The main result derived below is that the salesperson is impatient and prefers to set too low a price because he does not take into account the owner's value of retaining the good.

A straight commission contract implies that $\lambda>0$ and $W=S=0$, which means that (8) becomes

(8') $\lambda R^* P(e^*) [1 - G(R^*)] - C(e^*) = 0$

and (6) and (7) become

(9) $\lambda R^* P'(e^*) [1 - G(R^*)] - C'(e^*) = 0$

and

$$\lambda [1 - G(R^*)] - \lambda R^* g(R^*) = 0$$

or

(10) $$R^* = [1 - G(R^*)]/g(R^*)$$

for $\lambda>0$.[5]

[5]If $\lambda=0$, the agent does not care about the price since compensation is independent of the sale and its revenue.

Using (9), $\partial e/\partial\lambda|_{\lambda R^* P'(e^*)[1 - G(R^*)] - C'(e^*) = 0}$ is given by[6]

$$-\frac{R^* P'(e^*)[1-G(R^*)]}{\lambda R^* P''(e^*) - C''(e^*)}$$

which is positive.[7] Effort increases in λ and, not surprisingly, since $\lambda<1$, the agent puts forth less than the optimal amount of effort, which is the standard principal-agent result.

More interesting and central to the analysis here is the salesperson's choice of R as compared with that of the principal. First note from (10) that R* is independent of λ for any $\lambda>0$. For a given amount of effort, which affects only the probability that a customer shows up, the salesperson wants to choose a price that maximizes his share of the rents and that price is not dependent on the share, λ. The price that maximizes expected revenue also maximizes (λ)(expected revenue). The issue is determining whether R*<R. This comes directly from comparing (10) with (4) . The only difference between the two is A, so using (4), one only needs to calculate $\partial R/\partial A$ using the implicit function theorem. This is

$$\frac{\partial R}{\partial A}|_{(4)} = -\frac{\partial / \partial A}{\partial / \partial R}$$

which is positive because $\partial/\partial R$ must be negative for an interior maximum to exist.[8] Thus, $\partial R/\partial A > 0$ for all R that maximize the value of (2).

It is also clear from (6) and (7) that $\partial R^*/\partial A = 0$ because A enters neither condition. The salesperson is oblivious to changes in the reservation value of the good.

This is the central result. Because the salesperson ignores A, he is too impatient and prefers to set a lower price than the owner would choose. As a result, delegating pricing

[6]Note that R* depends on neither e* nor λ.

[7]R* is independent of λ from (10).

[8]The Hessian matrix must be negative definite for this to be a maximum.

authority to the salesperson results in too low a price. It also implies, of course, that absent perfect discipline of the market through reputation, the salesperson might advise a different price to the owner than would be optimal.[9]

Summarizing, the salesperson who has the authority to set price, but who does not have a compensation scheme that turns him into the implicit owner of the item for sale, is too impatient. This shows up in two ways. First, as is well-known, the salesperson puts forth too little effort because he does not capture the full returns to his effort. Second, the salesperson chooses too low a price because he does not get to enjoy the services from the good that is for sale if the good does not sell. This point has nothing to do with effort aversion. Even if effort could be set at the efficient level (by observing and requiring it), it would still be true that the salesperson would choose too low a price because, unlike the owner, he does not benefit from the services of a good that goes unsold. This is clear from (10). The choice of R* does not depend on effort. R* differs from R only because the A term, present in (4), is absent from (10). The owner is less anxious to sell an antique, painting or other good than is the salesperson because the owner has the option to continue to enjoy the services from that good if a sufficiently high price cannot be obtained. This is true even when effort is not a consideration, as would be the case in an online auction, where keeping the good on the site imposes no additional effort cost on the agent.

Agents with Longer Horizons

[9]In the case of houses, Bernheim and Meer (2012) report that the use of a broker lowers the selling price of the typical home by 5.9% to 7%, suggesting the brokers may talk owners into accepting a lower price. Rutherford, Springer, and Yavas (2005) find that when agents are selling their own houses, they sell them for 4.5% higher than the price on houses that they sell for others. Levitt and Syversson (2008) find that agents selling their own houses leave them on the market for about 10% longer than when they are selling another's house, suggesting that as owners, they choose a higher price than that which they recommend to others.

Some agents, like those who work alone in a retail shop, may have a longer time horizon and may behave differently from those who have only one shot at a customer. Consider, for example, an agent who manages and is the sole salesperson in a small jewelry store, which he does not personally own. If a customer fails to buy a piece of jewelry today, the agent knows that he will have the opportunity to attempt to sell that piece to another customer in the future. How do his incentives differ from those of a salesperson who gets one and only one shot to sell the item?

To analyze this it is necessary to model (at least) the two period problem to determine the waiting rule. It will be shown that the addition of a period induces the agent to raise the price that he would set as the initial price for the good relative to the one period problem. It remains true, however, that the agent's chosen price is still below the principal's price. This comes about for two reasons.

First, the agent's chosen price is below that of the owner because the agent's personal effort considerations lower the surplus associated with waiting for a higher value buyer to come along. A bird-in-the-hand has value because obtaining the two birds-in-the-bush requires additional effort by the agent. Second, the option value of retaining the good into subsequent periods remains lower for the agent than it is for the owner. The same consideration that causes the salesperson to price too low in the one-period context is at work here as well, just to a lesser degree.

That said, the existence of a second period does induce the agent to behave more like the owner than does an agent who is employed for one period. This provides implications for why, say, sales managers at auto dealerships may be given price-setting authority while salespersons are not. The sales manager can be compensated on total sales by all of his sales agents, rather

than the sale by one agent, which changes the option value of retaining the car for attempted sale at a higher price to the next customer. The individual salesperson that loses the sale will not likely have the opportunity to sell to the next customer who comes in.

The two period problem can be broken up into two parts. The second period has already been analyzed because the second period problem is a one-period problem, which is what was solved above. In the second period, the principal merely solves (3) and (4) to obtain e, whereas the agent solves (9) and (10) to get e*. Additionally, the agent chooses R* in the second period and the owner chooses R.[10]

The two period problem is distinguished from the single period one in that in the first period, there is option value of holding the good to the second period and attempting to sell it then. The option value is the expected rent from selling in the second period, which is obtained from solving the one period problem. Denote the expected rent to the agent in the second period as Q*. Denote R_t* and e_t* as the price that the agent chooses in period t.

The agent who is compensated for the sum of output over two periods (like a sales manager) maximizes

(11) $\lambda R_1^* P(e_1^*) [1 - G(R_1^*)] + Q^*\{1 - P(e_1^*) [1 - G(R_1^*)] \} - C(e_1^*)$

by choosing e_1* and R_1*, taking into account that Q is determined according to the one-period optimization described above. The optimization in (11) suppresses the choice of e_2* and of R_2*, which comes from the one period problem above. Instead, Q* which is the result of the optimization, reflects the value of having a second period that is handled optimally from the agent's viewpoint. Of course, the solutions for e_2* and R_2* are merely e* and R*, which solve

[10]Learning of the type modeled in Lazear (1986a) is ignored here.

(9) and (10) in the one period problem since the second period of a two-period problem is the agent's single-period problem.

The first-order conditions are

(12) $(\lambda R_1^* - Q^*)^* P'(e_1^*) [1 - G(R_1^*)] - C'(e_1^*) = 0$

and

$$\lambda [1 - G(R_1^*)] - \lambda R_1^* g(R_1^*) + Q^* g(R_1^*) = 0$$

which can be rewritten as

(13) $$R_1^* = [1 - G(R_1^*)]/g(R_1^*) + Q^*/\lambda$$

First note that from (13), $R_1^* > R^*$ because one can simply think of Q^*/λ as A and it has already been shown that R is increasing in A. The agent chooses a higher price in the first period than he would absent a period 2 because the existence of the second period allows the option of waiting to sell in 2 if a sale does not occur in 1. Also, the agent's price in period 1 is higher than his price in period 2 because in period 2, there is no option value, which is equivalent to setting $Q^*=0$, and as noted, R^* increases in A.

Although the agent sets the price higher in period one of a two-period problem than he would in a single period situation, it remains true that he sets the price lower than the principal would like both because he wants to avoid effort in period two and because Q^* is less than the value of the good to the owner. Consider each in turn.

First, the owner prefers a higher price in the first period than does the agent because the agent wants to avoid having to put forth effort in period 2, a consideration that is ignored by the owner. This is the bird-in-the-hand effect. The salesperson is willing to accept a lower price so that he need not take the chance of having to put forth sales effort again in period 2.

To understand the bird-in-the-hand effect on first period price, let us determine the price that the agent would choose if the cost of effort were not a consideration and then compare that to the one that the salesperson would actually choose, given costly effort. Therefore, assume that $C(e_2)=0$ for all e_2 in period 2. If this were the case, then the agent would not worry about the period 2 effort cost. Given $C(e_2^*)=0$, the agent would choose e_2^* such that $P(e_2^*)=1$. The period 2 expected rent, Q^*, would necessarily be higher with $C(e_2^*)=0$ than it would be were $C(e_2^*)>0$ because $C(e_2^*)$ enters negatively in (8'), which is the expected value of rent in period 2. Setting $C(e_2^*) = 0 \; \forall \; e_2^*$ must be rent increasing because at worst, the agent could keep effort at e^* (the effort level of the single period problem with costly effort) and rent would increase. Allowing e_2^* to differ from e^*cannot lower rent. This means that Q^* increases when $C(e_2^*)=0$. However, already shown is that from that R_1^* increases in A^*. Simply defining $A=Q^*/\lambda$ in (13) means that A increases in Q^*, which in turn implies that R_1^* increases in Q^*. Because Q^* is higher when then cost of effort is zero than when it is positive, R_1^* is higher when the cost of effort is zero than when it is positive. Thus, the agent sets a lower price when effort is a consideration because effort cost lowers the second-period expected rent. The fact that selling in period 2 requires effort means that the salesperson sets the price too low in period one to avoid the effort cost of period 2. The agent prefers a bird-in-the-hand because obtaining the one in the bush requires that he put work harder.

Effort considerations cannot be a factor, however, in cases like online auctions, where there is no effort cost to allowing the good to remain on the website for longer periods of time. There is another reason why the multi-period agent chooses a price that differs from that chosen by the owner. Even absent effort considerations, the option value Q^* to the agent is not the same as the reservation value to the owner. Although the owner also sees option value in retaining the

good from period 1 to period 2, the owner differs from the agent in that if the good does not sell in period 2, the owner gets to consume the good, whereas the agent does not. As a consequence, the value of retaining the good into the second period is higher for the owner than for the agent. If the option value to the agent of retaining the good is Q*, then the option value to the owner of retaining the good must exceed Q* because A>0. As a consequence, even ignoring effort considerations, the multi-period agent sets too low a price relative to the owner. As above, the choice of first period price rises in Q* so the higher value to the owner of retaining a good into period 2 than to the agent means that the owner would choose a higher price in the first period than the agent even if effort were not a factor.

Despite the fact that the agent does not perfectly internalize the owner's preferences, as the prior derivation shows, the multi-period agent chooses a higher price in period 1 than does an agent who does not have the option of selling the good again in period 2 (specifically, $R_1^*>R^*$). Therefore, long-term agents choose prices that are more in line with those that the owner would choose than do agents who have only one shot to sell a good. The distinction between the behaviors of one- and two-period agents explains why auto-dealership sales managers and salespersons have different goals and are therefore given different price setting authority. Typically, customers are allocated to salespersons on some rotational basis. As a consequence, a salesperson who fails to sell to a particular customer is not given the opportunity to sell to the next customer who comes in to buy the car in question. But the sales manager who supervises all the salespersons is credited with subsequent sale of the vehicle even if it is sold by another salesperson. In the context of the structure above, Q* for the sales manager exceeds Q* for the salesperson who is unlikely to have the opportunity to sell the same car again.[11]

[11]Miceli (1989) discusses the incentive effects of placing limitations on the length of the listing contract for realtors, pointing out the problem associated with the behavior of agents whose contracts are about to expire. Clauretie and

The Choice of λ

How does the principal set λ? Let us return to the one period framework, which is sufficient to make the remaining points.

The standard principal-agent problem is relevant here, where the instrument that the owner uses to affect the salesperson's behavior is λ. Consequently, the owner wants to maximize her expected rents by choosing λ, assuming that the agent determines both his own effort and the price. Then the problem is to maximize

(14) Expected Owner Rent = $(1-\lambda)\, R^*\, P(e^*)\, [1 - G(R^*)] + A\, \{1- P(e^*)[1 - G(R^*)]\}$

s.t.

(15) $\lambda\, R^*\, P(e^*)\, [1 - G(R^*)] - C(e^*) \geq 0$.

and where R*, e* come from the agent's first-order conditions, (9) and (10). Both R* and e* depend on λ through (9) and (10) and that relationship is simply denoted as $\partial R^*/\partial\lambda$ and $\partial e^*/\partial\lambda$. The first-order conditions then for the owner's problem from maximizing (15) are

(16) $\{(1-\lambda)\, P(e^*)\, [1 - G(R^*)] - P(e^*)\, g(R^*)[(1-\lambda)R^* - A]\}\, \partial R^*/\partial\lambda$

$$+ P'(e^*)\, [1 - G(R^*)]\, [(1-\lambda)R^* - A]\, \partial e^*/\partial\lambda - R^*P(e^*)[1 - G(R^*)] = 0$$

After solving for λ, it is necessary to check that the constraining weak inequality in (15) holds to ensure that the salesperson is willing to work at the optimal λ. If not, there is a corner solution where λ is set sufficiently high to induce participation by the salesperson.

The first-order condition in (16) is not particularly informative, but a numerical example illustrates the logic of this section. Let $C(e)=e^2/10$, $P(e)=1-1/e$ ($e\geq 1$), $V\sim U[0,100]$ and $A=10$, then the value of λ that maximizes (14) is .14. Given this, the agent chooses effort level of 2.6

Daneshvary (2008) find a negative price effect on the sale of a house that is approaching the expiration date of a sales contract.

and a price of 50, which results in surplus to the principal of 20.145 and expected rent to the agent of 1.48 so the IR constraint is satisfied. Consider the extremes of λ to get a sense of the issues. If λ were 1, all the rent is given to the agent. In that case, the owner hopes that the good does not sell because she receives none of the revenue and prefers to get A. In fact, at λ=1, with the agent optimizing, the good sells .4 of the time so the owner's expected surplus is 6, which is A times the probability of no sale. At the other extreme, with λ=0, the agent does nothing and the good fails to sell with certainty, in which case, the owner receives A = 10. The optimal λ=.14 yields owner's surplus of 20.145. This is the best the owner can do when working through an agent who has the authority to choose effort and price.

Delegation of Authority

There are some situations in which pricing authority is delegated to the salesperson and some in which it is not. For example, homeowners rarely, if ever, delegate pricing decisions to the salesperson. Although the salesperson may suggest an initial list price, owners, not real estate agents, determine whether an offer is accepted or refused. Retail clerks in grocery stores do not determine prices, but in large stores, neither does the owner. In auto dealerships, the owner is rarely involved in determining acceptance price on individual sales. Owners may provide guidelines on appropriate pricing behavior, but the sales manager has the authority to make decisions on specific transactions.

Why is there a difference across markets?

There are three factors that affect the decision to delegate pricing authority. First is the informational advantage that one party, presumably the salesperson, has over the other party.

Second is the higher cost of time that one, presumably the owner, has over the other party. Third is the difference between the salesperson's and owner's incentives with respect to price.[12]

Most of the issues can be analyzed formally using the one period model. The problem here is not to decide whether to use an agent or not. Instead, assume that the owner has already decided in favor of hiring a salesperson. The question here is only whether the salesperson should be given pricing authority.

To get at this, assume that the market may be either a "buyers' market" or a "sellers' market." The sellers' market has a distribution of buyer valuations that first-order stochastically dominates the buyers' market so

$$G_s(V) < G_b(V) \; \forall \; V$$

where G_s is the distribution in the sellers' market and G_b is the distribution in the buyers' market. Let the probability of the seller's market occurring be q and that for the buyers' market be 1-q.

The salesperson has the information advantage of knowing the true state of the market, whereas the owner only knows the ex-ante probability, q.

The difference between the owner's and salesperson's cost of time used in pricing is given by h.[13] Normalize the cost to the salesperson to be zero so that the cost to the owner of spending time pricing is h, which is borne only when a customer actually shows up, which

[12]Prendergast (2002) argues that informational considerations imply, contrary to standard risk arguments, that agents receive more contingent compensation in riskier environments. A paper that has a closely related title to this one and similar apparent focus, but non-formal approach is Frenzen, Hansen, Krafft, Mantrala, and Schmidt (2010). The find, consistent with the superior-information-of-agents argument, that delegating pricing authority results in better performance of the business unit. Hahn, Homburg, and Jensen (2012), find that both low and high amounts of pricing delegation lead to lower profits.

[13]The cost, h, is just the cost of the actual pricing. It is conceivable that the owner could make an investment in learning more about that distribution of values in the market. That informational investment decision is ignored here. Note also that the cost of pricing is distinct from the cost of selling, C(e), which is borne only by the salesperson.

happens P(e*) of the time. (Note that because effort is determined by the salesperson, effort equals e* rather than e.)

Finally, as already shown, pricing incentives differ between owner and salesperson because the owner has an alternative use of the good, namely A, which the salesperson does not have.

If the owner does the pricing herself then for a given λ, she chooses R_O to maximize

(17) Expected Rent to owner without delegation = $q \{(1-\lambda) R_O P(e^{**}) [1 - G_s(R_O)] + A (1- P(e^{**})[1 - G_s(R_O)])\} + (1-q)\{(1-\lambda) R_O P(e^{**}) [1 - G_b(R_O)] + A (1- P(e^{**})[1 - G_b(R_O)])\} - h P(e^{**})$

where e** is the effort chosen by the salesperson when he can choose effort but not price. The salesperson selects effort level e**, which is chosen in accordance with eq. (9) and assumes that the price will be owner-selected price R_O as determined by the first-order condition to (17). The first-order condition is

$$R_O = \frac{q\, g_s(R_O)}{q\, g_s(R_O) + (1-q) g_b(R_O)} \left[\frac{1-G_s(R_O)}{g_s(R_O)} + \frac{A}{1-\lambda}\right] + \frac{(1-q)\, g_b(R_O)}{q\, g_s(R_O) + (1-q) g_b(R_O)} \left[\frac{1-G_b(R_O)}{g_b(R_O)} + \frac{A}{1-\lambda}\right]$$

or

(18) $$R_O = \gamma R_s + (1-\gamma) R_b$$

where $\gamma = \dfrac{q\, g_s(R_O)}{q\, g_s(R_O) + (1-q) g_b(R_O)}$,

$$R_s = \frac{1 - G_s(R_s)}{g(R_s)} + \frac{A}{1-\lambda}$$

and

$$R_b = \frac{1 - G_b(R_b)}{g(R_b)} + \frac{A}{1-\lambda}$$

The owner chooses a price that is a convex combination of the price she would choose in a seller's or buyer's market, respectively.

Alternatively, the owner can delegate pricing to the salesperson. Then the expected rent to the owner is given by

(19) Expected Rent to owner with delegation = $q\ \{(1-\lambda)\ R_s^*\ P(e^*)\ [1 - G_s(R_s^*)] +$

$A\ (1 - P(e^*)[1 - G_s(R_s^*)]\ )\}$

$+(1-q)\{(1-\lambda)\ R_b^*\ P(e^*)\ [1 - G_b(R_b^*)] +$

$A\ (1 - P(e^*)[1 - G_b(R_b^*)]\ )\}$

There is nothing for the owner to maximize here (assuming that λ is given as above). Because the owner has delegated pricing authority, the salesperson chooses not only e*, but also R_s^* or R_b^*. The price chosen by the salesperson is done according to (9) and (10), but now (9) and (10) use the appropriate value distribution, G_s or G_b., depending on the actual state of the market, which is known to the salesperson. Equation (19) characterizes the owner's expected rent calculation, given that she knows that the salesperson will choose the price depending on the actual state of the market.

The owner delegates pricing authority to the agent if the rents in (19) exceed the rents in (17), given the choices of price and effort as stated above. The primary differences between (17) and (19) is that the salesperson knows the correct distribution and so could do a better job at maximization than the owner if he had the same incentives as she. But because the salesperson ignores the reservation value, A, the choice of price is not the one that the owner would choose were she to know the realized state of the market. Additionally, the hP(e*) term is absent from (19) because when pricing authority is delegated, the owner does not bear the higher time cost of pricing the good herself.

The Value of Time

A few implications are provided, some of which are unsurprising. First, the likelihood of delegation is increasing in h. As the owner's time becomes more expensive relative to the salesperson's time, the owner is more likely to delegate pricing authority. That is one reason why owners of dealerships do not monitor and price every deal. Even if the owner started her career as a salesperson and knew the market well, as her time value rises, she delegates pricing to the sales staff to avoid costly use of her time.

Information Differences

Now assume that h=0. Then the choice to delegate pricing authority depends only on the tradeoff between better information possessed by the salesperson and the fact that the salesperson has distorted incentives.

Using (17) and (18), it is clear that the owner, absent knowledge of the state of the market, sets a price, R_O, that is a convex combination of R_s and R_b. There are two parameters of information deficiency. The first is the difference between the optimal price in a sellers' market

and the optimal price in a buyers' market, i.e., $R_s - R_b$. . The second is q, the probability that the market favors sellers. Let us consider each in turn.

First, suppose the truth is that the market is a sellers' market good so that $G(V) = G_s(V)$. Then the optimal price is R_s. The actual price that the owner would choose is R_O given by (18). The difference between the optimal price and actual price is $R_s - R_O$ After substitution,

$$R_s - R_O = R_s - \gamma R_s - (1-\gamma) R_b$$

or

$$R_s - R_O = (1-\gamma)(R_s - R_b)$$

which increases as the difference between R_s and R_b increases.

In the case where the market is a buyers market, the correct price is R_b. The difference between the owner-chosen price and R_b is

$$R_O - R_b = \gamma R_s + (1-\gamma) R_b - R_b$$

or

$$R_O - R_b = \gamma(R_s - R_b)$$

which increases as the difference between R_s and R_b increases.

The owner's surplus decreases monotonically as the price charged moves further away from the optimal price. Consequently, the owner becomes more willing to delegate pricing authority to the salesperson as the difference between the optimal prices in the two types of markets increase.

It is also true that as q moves away from 0 or 1, the owner becomes more willing to delegate pricing authority. When q=0, from (17) and (18), $R_O = R_b$, which is the correct price because the market is a buyers' market with certainty. When q=1, $R_O = R_s$, which is also the correct price because the market is a sellers' market with certainty. For $0<q<1$, R_O differs from

the optimal price. The distance between the owner-chosen price and the ideal price moves non-monotonically because the difference reaches zero at the limiting values of q=0 and q=1.

The two measures relate to two different concepts. The q parameter captures the amount of uncertainty that the owner has about the state of the market (buyer or seller). As q moves away from 0 or 1, the owner becomes less sure of the nature of the market and is more likely to delegate pricing to a salesperson. The difference between R_s and R_b relates to how different the markets are. Even if the seller were very uncertain about the state of the market, say, with q=.5, she would be unlikely to delegate pricing authority were R_s very close to R_b. When the two optimal prices are close, it does not matter much whether it is a buyer's or seller's market so not know which prevails causes little damage in pricing. At the other end, were R_s and R_b very different, then even were the seller reasonably sure about which market prevailed, she might still delegate pricing to the agent because the markets are so different and choosing the wrong price could cause lots of economic loss.

Alternative Value, Durables and Perishables

One of the first results was that the salesperson's pricing incentives deviate fromrhw owner's because the salesperson does not take into account appropriate the reservation value, A, of the good being sold. It is natural to expect, therefore, that as A diminishes, the owner would be more likely to delegate pricing authority. This follows directly from (4) and (9), which imply, as already shown above, that $\partial R/\partial A > 0$ and that $\partial R^*/\partial A = 0$. Since for any state of the world i, the deviation between maximum profit and actual profits increase as $R_i - R_i^*$ increases and since R_i^* is independent of A, but R_i is increasing in A, it follows that $R_i - R_i^*$ increases in A. That also means that profits decrease in A when the salesperson is allowed to choose price. Since this

is true for every state of the world i, it is true in general. As a result, the difference between maximum profit and attained profit under delegation moves with A. As A decreases, salespersons incentives become more aligned with those of the owner and the likelihood that authority is delegated should increase.

This result provides the intuition behind the result that pricing authority is not delegated in the case of a house, a durable, but is delegated in the case of a perishable. In the latter case, the owner is as anxious to get rid of the good as the salesperson so there is no difference in incentives.

The logic is also consistent with delegation of pricing authority to sales managers at auto dealerships, but not to salespersons. It is unlikely that the sales manager has better information about how to price a car for a particular consumer than the salesperson who negotiated with that consumer. The difference, as discussed earlier, is that the sales manager is more likely to internalize the option value that the owner sees in retaining the car for the next potential customer because he will be the manager even if the car is unsold, but later sold by another salesperson. Losing the opportunity to sell to the current customer the point makes the salesperson impatient, which is why pricing authority is not given to him.

Market Structure

The market structure affects the delegation of authority. Owners are more likely to delegate pricing authority in competitive markets than they are in markets where there is some monopoly power.

Perfect competition is characterized by one price being viable in the market. It is a special case of the structure considered above where, defining R_i^c as the competitive price in

state i, $G(V) = 0$ for $V<R_i^c$ and $G(V) = 1$ for $V \geq R_i^c$. As a result, the probability of sale at any price above R that exceeds R_i^c is 1 - G(R) which equals zero. Conversely, the probability of sale at $R = R_i^c$ is one and as a result, there is no reason to set R less than this. That point holds for the salesperson as well as for the owner. The salesperson's incentives are the same as those of the owner as long as $R_i^c \geq A$. Discretion over price is meaningless because the market disciplines the salesperson to charge exactly R_i^c . If $R_i^c < A$, then the owner prefers not to sell at all.

The more general model used throughout this paper is one where the seller has some monopoly power, at least in a stochastic sense. There is a "downward-sloping demand curve" created by the distribution of values across potential buyers so that the probability of sale increases in a continuous fashion as the price is lowered. It is the monopoly pricing power that gives the salesperson the ability to act differently from what the owner would like him to do. Thus, it is only in imperfectly competitive environments that there should be any reluctance to delegate pricing authority to agents. A farmer should not worry about the price that her sales agent will charge for her crops. The price is determined by the market, the agent and farmer can sell as much as desired at that price, and there is no incentive for the agent to reduce the price below it. The same is not true of a homeowner when selling her house. Because of the idiosyncratic nature of the good, heterogeneous valuations exist that result in deviations between the owner-chosen price and the agent-chosen price.

Appraisals

Appraisals are a form of price setting by an agent because using an appraiser generally obliges a principal to accept the price determined by an agent, whose incentives may or may not be aligned with the principal. There are a number of examples that come to mind. Insurance

companies generally require third-party appraisals of jewelry to determine the amount that the owner of the jewelry will be paid in case of loss. Houses are appraised for the purpose of mortgages and when there is shared ownership that requires transfers from one party to another. In divorces, appraisals are used to determine the amount that one spouse pays to acquire a piece of joint property.

Unlike sales agents, the appraisers tend to be paid a fixed fee. The fixed fee contract avoids apparent conflict of interest, but it requires the market to work to ensure that incentives are appropriate. There are two issues: bias and precision. It would be possible to pay the appraiser a function of the deviation of sale price from assessed value, but this requires that a verifiable transaction occurs. In many cases, such as valuing jewelry for loss, the verification process never occurs because the jewelry is either kept or stolen. A market for appraisers based on reputation could provide the appropriate incentives, but it is necessary to understand how the reputation develops in cases where the transaction is absent. Similarly, reputation could prevent bias. An appraiser who chooses values that are too high would be rejected by the buyer, insurer, or lender, and an appraiser who chooses values that are too low would be rejected by the seller, insured, or borrower. Appraisers may acquire their reputations by being involved in some verifiable transactions of similar items and the skills may carry over to unobserved items. As discussed in the next section, the fixed fee contract implies no bias, but it does imply too little effort and therefore inefficient amounts of precision on those items that are never expected to be sold.

Delegation of Authority and the Choice of Compensation Scheme

Recall that the general compensation scheme allowed for commission coupled with a fixed payment when the good sells as well as a potentially different fixed payment when the good does not sell. Then the maximization objective was given by (5), repeated here:

(5) $(\lambda R^* + S)\, P(e^*)\, [1 - G(R^*)] + W\, \{1 - P(e^*)\, [1 - G(R^*)]\} - C(e^*)$

The problem, discussed earlier, is that unless the salesperson is essentially made the owner, he will not take into account owners' preferences properly. Yet there may be situations where the salesperson has better information about the market and where the owner would like to delegate pricing authority to the salesperson, despite the distorted incentives. What can be done?

Under these circumstances, it may pay for the owner to delegate pricing authority, but to pay the salesperson a salary rather than a commission. Paying straight salary aligns pricing incentives. The disadvantage is the fact that salesperson effort is too low, absent some other monitoring mechanism.

Recall that a straight salary is a special case of the general compensation scheme, where $\lambda=0$ and $W=S$. The salary is simply W in this case. Then (5) becomes

(20) $W - C(e^*)$

Price does not appear in (20) and effort is chosen so as to set $C'(e^*) = 0$. The agent does not care about price because compensation is not contingent on the sale so the agent has no reason to deviate from the price that the owner would choose. Because there is no conflict between owner and salesperson's incentive with respect to price, a simple instruction from the owner to price in accordance with the owner's preferences should suffice.

The standard difficulties associate with using a salary over a piece rate apply.[14] Most important is that, as is clear from (20), too little effort is exerted because pay is not contingent on

[14]See Lazear (1986b) and Lazear (2000). Also, Baik and Lee (2013) who consider the amount of contingent compensation offered in a game of delegation by players with different valuations.

it. The advantage of the salary structure is that although effort is diminished, the pricing distortion is eliminated.

An implication is that when delegation of pricing authority is preferred, either because salespersons have informational advantages or because the owner's time is too valuable, there will be a tendency to move in the direction of using salary over commission as a compensation method. This certainly fits standard retailing, where most are paid hourly wages that are unrelated to sales and most owners delegate pricing to their agents.

Conclusion

Commission-paid salespersons, if allowed to set price, will generally choose a lower price for a good than would the owner of the good. The reason is that an owner can enjoy the services from an unsold good, but a salesperson receives nothing in the absence of a sale. As a consequence, salespersons are impatient and set too low a price. To counteract this tendency, owners may refuse to delegate pricing authority to agents.

The problem is most pronounced for durable goods and in situations where there is some monopoly power in the market for that good. The problem is less pronounced when the agent has a long-term relationship with the owner and where compensation can be based on multiple transaction opportunities. It is for this reason that sales managers may be given the authority to set price even when the individual salespersons are not.

In situations where agents have superior information or cheaper time than owners, it may make sense to allocate pricing authority to agents. When pricing authority is given to agents, pricing incentives can be aligned by paying agents a straight salary that is independent of sales.

Although this sacrifices other motivating aspects of performance pay, it has the virtue that it eliminates the incentive to distort the pricing decision.

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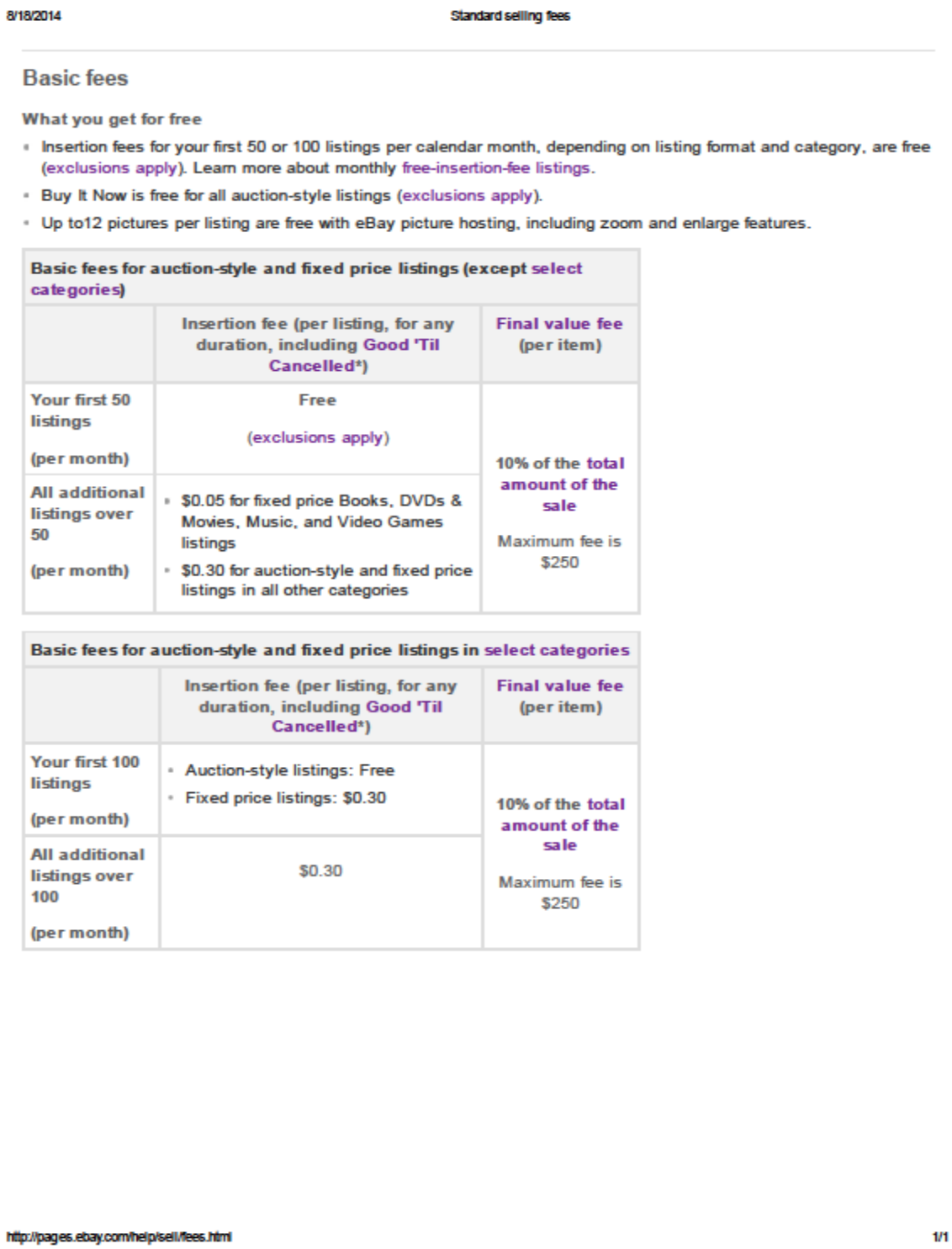
Appendix



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What you get for free

- Insertion fees for your first 50 or 100 listings per calendar month, depending on listing format and category, are free (exclusions apply). Learn more about monthly free-insertion-fee listings.
- Buy It Now is free for all auction-style listings (exclusions apply).
- Up to12 pictures per listing are free with eBay picture hosting, including zoom and enlarge features.

Basic fees for auction-style and fixed price listings (except select categories)

	Insertion fee (per listing, for any duration, including Good 'Til Cancelled*)	Final value fee (per item)
Your first 50 listings (per month)	Free (exclusions apply)	10% of the total amount of the sale. Maximum fee is $250
All additional listings over 50 (per month)	• $0.05 for fixed price Books, DVDs & Movies, Music, and Video Games listings • $0.30 for auction-style and fixed price listings in all other categories	

Basic fees for auction-style and fixed price listings in select categories

	Insertion fee (per listing, for any duration, including Good 'Til Cancelled*)	Final value fee (per item)
Your first 100 listings (per month)	• Auction-style listings: Free • Fixed price listings: $0.30	10% of the total amount of the sale. Maximum fee is $250
All additional listings over 100 (per month)	$0.30	

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