Intermediary Commissions and Kickbacks*

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Abstract

The pervasive use of commissions to compensate information intermediaries has recently come under increased scrutiny in many industries—including health care, insurance brokerage, and financial advisory services for products such as pensions and mortgages. Through commissions to intermediaries who advise customers, selling firms can steer demand toward their products, counteract the commissions paid by competitors, and provide intermediaries with incentives to acquire information in the first place. This paper analyzes when caps on commissions, mandatory disclosure, and other policy interventions aimed at subduing the use of commissions have unintended consequences for the efficiency of advice.

JEL Classification: D18 (Consumer Protection), D83 (Search; Learning; Information and Knowledge), L15 (Information and Product Quality), L51 (Economics of Regulation), M52 (Compensation and Compensation Methods and Their Effects).

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1 Introduction

The high commissions earned by brokers of subprime mortgages have been identified as one of the main culprits in the aggressive sale of these products, allegedly resulting in excessive lending and leaving households ill advised in their choice among available mortgages.[1] These claims mirror those made only a few years ago by former New York State Attorney General Eliot Spitzer against U.S. insurance providers, most notably AIG, regarding the provision of hidden, high-powered sales incentives to supposedly independent agents.[2] Over the last two decades, U.K. courts and regulators also have expressed concerns about the commissions paid to intermediaries and advisers in a number of prominent prosecutions of widespread misselling of financial products, ranging from mortgages to pensions.[3]

Outside of the financial industry, payments and gifts made by pharmaceutical companies to physicians are also attracting closer scrutiny. The *Physician Payment Sunshine Act*, cur

This paper introduces a simple modeling framework to use in clarifying the main roles played by commissions and the likely implications of a number of commonly adopted policy interventions. Our model embeds the provision of product advice by an information intermediary into Hotelling's (1929) classic model of competition between two price-setting firms. The intermediary agent advises the customer about which product to purchase, on the basis of information about the match between the customer's needs and the characteristics of the products offered by the two firms. The agent is compensated through commissions paid by firms, but also cares about advising the customer to purchase the most suitable product. In the context of this model, we analyze the following three functions performed by commissions:

1. Steering an agent's advice toward selling a firm's own product;

2. Counteracting a rival firm's attempt to steer sales toward their product;

3. Affecting an agent's willingness to acquire information about the match between products and customers.

We apply this modeling framework to assess policies aimed at disciplining information intermediaries for unsuitable advice (or malpractice). As part of their occupational licensing procedures, various U.S. states require mortgage brokers to maintain a minimum net worth or to post a "surety bond".[6] The risk of losing this surety bond should have a direct disciplining role on the agent, in addition to reputational concerns and general liability. The agent could be disciplined further through the imposition of higher penalties or closer monitoring by supervisory authorities and professional associations.

In an attempt to protect consumers of retail financial and insurance products, regulators often mandate that brokers, financial advisers, and other intermediaries disclose to customers the commissions paid by product providers. For example, after several attempts over the last few years, in November 2008 the U.S. Department of Housing and Urban Development strengthened the requirement imposed on third-party brokers to disclose to homeowners the payments they receive for intermediated mortgage agreements.[7]

from the documents relating to the agreed settlement between four leading manufacturers of orthopedic devices and the Department of Justice in 2005 (cf. http://www.usdoj.gov/).

[6] Pahl (2007) documents the use of surety bonds and other licensing provisions across U.S. states. In practice, surety bonds are typically posted through third parties that initially check whether the broker has sufficient net wealth. While these third parties are the first to be liable, they are then compelled by regulation to seek redress from the broker.

[7] For details see www.hud.gov. In the European Union, the Markets in Financial Instruments Directive

Our model analyzes the effect of policies aimed at imposing transparency of commissions, as well as the impact of direct caps on admissible commissions. Furthermore, we study the effect of caps on products' prices, which are commonly imposed in the health care sector.[8]

Our analysis reveals that policy intervention that has (intended) chilling effects on commissions may have unintended consequences for the efficiency of advice as well as for the provision of other valuable services by intermediaries. One of our first results is that mandatory disclosure of commissions leads to a reduction in their level. However, this reduction is not necessarily beneficial from a social point of view because it may shift sales to products that cost more.

One key finding is that the equilibrium outcome typically is not efficient when commissions are disclosed, even when holding fixed the agent's effort to acquire customer-specific information. Disclosure ensures that, when choosing the level of commissions to be paid to intermediaries, a firm takes into account customers' perceived value of advice, because this is reflected in the maximum price the firm can charge for its product. Nevertheless, a firm may have inefficiently low incentives to steer the agent's advice through commissions, simply because it is costly: the firm has to pay any increase in commissions not only on the incrementally higher probability of a sale, but also "inframarginally" whenever its product is sold. Thus, cost differences between firms' products may not be adequately reflected in sales figures that result in equilibrium with disclosed commissions. In particular, a more cost-efficient firm finds it relatively more costly to steer demand toward its product because of its larger market share, and so ends up selling inefficiently too little. In addition, the more the agent is concerned about future liability or reputation with customers, the more costly it becomes for firms to steer sales through commissions.

As we show, lack of disclosure can tilt the balance towards the more cost-efficient product. When customers no longer observe commissions and thus base the perceived value of advice only on the level of commissions they (rationally) expect agents to receive, a firm is no longer disciplined through a lower product price when it further steers the agent's advice through higher commissions. Therefore, commissions are higher when they are not disclosed, resulting in an increase in sales for more cost-efficient firms. This enhances

(MiFID) requires since January 2008 the disclosure of commissions on retail financial products. In the U.K., similar provisions have been imposed earlier by the Financial Services Authority.

[8]Price caps are imposed also for certain financial products that receive tax subsidies. Sometimes, governments restrict tax advantages aimed at encouraging savings for retirement to low-fee products. More indirectly, price caps may reflect the activity of competition authorities. For instance, the U.K.'s consumer protection authority, the Office of Fair Trading, recently has undertaken steps to bring down prices for financial and insurance products, such as Payment Protection Insurance (cf. http://www.oft.gov.uk/advice_and_resources/publications/reports/financial/).

efficiency, provided that the liability for unsuitable advice is not too low. For sufficiently low levels of liability, however, the sales of the more cost-efficient firm "overshoot" and become inefficiently too high when commissions are not disclosed. Compared to mandatory disclosure, caps (or outright bans) on commissions—with their more immediate chilling effect—have similar implications for the role of commissions in steering the agent's advice as well as in counteracting commissions paid to the same agent by rival firms.

The intermediary agent's incentives to acquire customer-specific information depend on the difference between (rather than the overall level of) commissions paid by competing firms. While one firm may want to increase commissions in order to increase the agent's incentives to acquire information, another firm selling a competing product may want to raise commissions to obtain the *opposite* effect of making advice less informative. Disclosure of commissions thus can have, again, a disciplining effect, as a firm that tampers with the informativeness of advice is immediately punished through a reduction in customers' willingness to pay. This disciplining role of the pricing mechanism is absent not only without disclosure, but also if commissions are regulated more directly through caps.

Related Literature. Our analysis of how the information transmitted by an adviser impacts product demand is related to the recent literature on firms' incentives to provide customer-specific information. See, in particular, Lewis and Sappington (1994) and, more recently, Johnson and Myatt (2006), Ganuza and Penalva (2007), and Bar-Isaac et al. (2008). While these papers analyze a firm's incentives to directly improve the quality of customers' information, firms in our model use commissions to affect the incentives of an intermediary adviser to acquire and transmit information to customers.

We contribute a tractable model that embeds a streamlined game of strategic advice into a market environment in which different firms are allowed to bribe the advising agent as well as to set product prices.[9] The agent's incentives to provide biased advice are influenced by firms' commissions, rather than being specified exogenously as in most of the theoretical literature on strategic communication, following Crawford and Sobel (1982).[10]

The presence of an information intermediary provides a key departure from the extensive literature on credence goods. In a recent contribution to that literature, Bolton et al.

[9] Durbin and Iyer (2008) also allow a (single) biased principal to influence the preferences of an adviser who wants to be perceived as being incorruptible. See also Li's (2007) analysis of how a biased sender may affect an intermediary through information provision, rather than monetary transfers, as in our model.

[10] See Morgan and Stocken (2003) and Li and Madarász (2008) for an analysis of the effect of the disclosure of an exogenous bias on the resulting cheap talk equilibrium.

(2007) study the provision of financial products by firms that advise customers directly, rather than through an intermediary agent. In their model, firms compete directly for customers, while in our model commissions steer the advice of a "bottleneck" agent who controls the ability of firms to access customers. The independence of the agent is the key difference from Inderst and Ottaviani (2007), in which a single firm, directly liable for unsuitable advice, faces the task of optimally compensating an (exclusive) employee through fixed and contingent compensation.

The role of the agent as information intermediary also differentiates our paper from the industrial organization literature on vertical chains. In addition, the agent in our model does not take ownership of the product and hence does not determine a separate retail price. Firms play the role of principals, as in the menu auction model of Bernheim and Whinston (1986), but here the agent further communicates to the customer, who makes the final purchase decision. In our setting, principals compete for the agent's favorable advice in order to attract the customer to their own (and away from the competitor's) product, though we find that in some circumstances they jointly benefit when, through their adjusted commission levels, the agent acquires more customer-specific information.[11]

The paper proceeds as follows: Section 2 formulates the model. Focusing initially on the baseline case in which only one product is actively marketed by a monopolistic provider, Section 3 analyzes how commissions steer advice toward the firm's product and investigates the effect of public disclosure of commissions. Section 4 analyzes the role of commissions in incentivizing the agent to acquire information about the match between products and customers, and, thus, to provide more valuable advice. Section 5 turns to the more general common agency case in which the agent's advice is affected by commissions paid by different firms. Section 6 further discusses some of the key modeling assumptions. Section 7 concludes. Proofs that are not included in the main text are relegated to Appendix A. Appendix B contains details of an analytically tractable example.

[11] Whereas the literature on multi-task common agency models (Holmström and Milgrom 1988 and Dixit 1996) has focused on classic moral-hazard environments, in our model the agent also possesses private information about the match between customer's needs and products' characteristics. (In a common-agency model with moral hazard, Maier and Ottaviani 2009 analyze the incentives of two principals to share their individual performance measures about the agent's unobservable effort. Here, instead, principals have access to the same information about the agent's performance regardless of the disclosure regime—disclosure affects how customers interpret the agent's advice.)

2 Model

We consider a customer's choice of whether to purchase a single unit of one of two products, $n = A; B$. Products are sold by separate firms and are produced at respective costs c_n. The customer's valuation depends on a binary state variable denoted by $\ \ = A; B$. The customer derives utility v_h if the product matches the state and utility $v_l < v_h$ if not.

Information. The customer purchases the product based on the advice provided by an intermediary agent. The agent privately observes an informative signal about whether product A or product B is more suitable for the particular customer. The precision of the signal depends on the agent's non-contractible information-acquisition effort, a, in a way that will be specified below. This signal gives rise to the (posterior) belief that product A is more suitable, $q = \Pr(\ \ = A)$, which is distributed ex ante according to $G(q; a)$, assumed to be continuous with density $g(q; a) > 0$ over $q \in [0; 1]$.

The posterior belief captures the private information possessed by the agent. For example, the customer's choice could be between two different investment plans, one of which is more suitable than the other, based on the customer's financial condition, tax status, and remaining life expectancy. In an application to health care, the two products could represent different treatments. At the end of this section, we show how the information structure can be endogenized further by stipulating that the agent observes an informative signal about the quality of the match.

The customer's expected utilities (gross of prices) for the two products are denoted by $v_A(q) := qv_h + (1 - q)\, v_l$ and $v_B(q) := (1 - q)\, v_h + qv_l$, respectively. The agent's advice is directed towards the choice between the two products and not towards the decision of whether to purchase. We thus specify that it is always efficient for a customer to purchase either of the two products: $v_l - \max_{n=A,B} c_n > 0$.[12] To make the problem interesting, we assume that

$$|c_B - c_A| < v_h - v_l; \tag{1}$$

so that there is an interior cutoff $0 < q_{FB} < 1$ such that the surplus from product A, $v_A(q) - c_A$, is strictly larger than the surplus from product B, $v_B(q) - c_B$, for all $q \geq q_{FB}$, while the converse holds for all $q < q_{FB}$, with

$$q_{FB} = \frac{1}{2} - \frac{c_B - c_A}{2\,(v_h - v_l)}: \tag{2}$$

[12] For instance, it may be common knowledge that a customer has a particular illness, while the agent may be better informed about the advantages of various treatments. This is analogous to the specification in Bolton et al. (2007).

We simplify derivations by restricting attention to distributions of posterior beliefs that are symmetric around the (common) prior belief $q = 1/2$, with $G(q; a) = 1 - G(1 - q; a)$.[13] Higher values of a make q more informative in the following sense. A higher value of a rotates the distribution of the posterior belief q around $G(1/2; a) = 1/2$ through a mean-preserving spread (MPS) with

$$\frac{dG(q; a)}{da} \gtreqless 0 \text{ for } q \lesseqgtr \frac{1}{2}; \tag{3}$$

holding weakly at $q = 0$ and $q = 1$ and strictly over a positive measure.[14]

Suitability. We posit that the agent cares directly about whether the recommended product is suitable for the customer's needs. Independent advisers, for example, are legally subject to a fiduciary duty toward the customer. In regulated industries, supervisors impose stringent suitability standards, leading to penalties for alleged breach of fiduciary duty and unsuitable advice. In the U.S., mortgage brokers risk losing their license and the surety bond they are required by state regulators to post. To capture this penalty for unsuitable advice in a parsimonious way, we stipulate that the agent bears the expected liability cost w following a mismatch between the product's characteristics and the customer's needs.[15] In our main analysis, we further stipulate that the payment of w represents a pure transfer to the respective regulatory authority.[16]

Timing. To influence the agent's advice, at period $t = 1$ firms simultaneously set respective commissions (or fees) f_n to be paid to the agent conditional on a sale of their product. In our benchmark case, commissions are not observed by the customer.[17] Commissions are

[13] Thus, we are also imposing that the prior belief is symmetric, $\Pr(\theta = A) = \Pr(\theta = B) = 1/2$. The restriction to symmetric distributions is customary in the analysis of Hotelling models, to which we relate our setup and analysis throughout the paper.

[14] In this model with two states of the world, a signal structure that results in a rotation in the posterior distribution is more informative in the sense of Blackwell. For more on rotations see Johnson and Myatt (2006) and Szalay (2009), and for the relation between integral precision and Blackwell sufficiency for dichotomies see Ganuza and Penalva's (2009) Theorem 2.

[15] Alternatively, the agent's preference for suitable advice may be intrinsic or it may arise from reputational concerns. See Kartik et al. (2007) for a discussion of direct costs from "lying" and Bolton et al. (2007) on reputational concerns.

[16] While this specification helps to simplify the derivations, Section 6 extends the analysis to the case in which a fraction β_C of w is paid as compensation to the customer.

[17] In fact, policy intervention may be necessary to lend credibility to a firm's commitment to any given commission level. Section 3.3 and 6.1 consider the alternative policy scenario in which commissions are disclosed to customers.

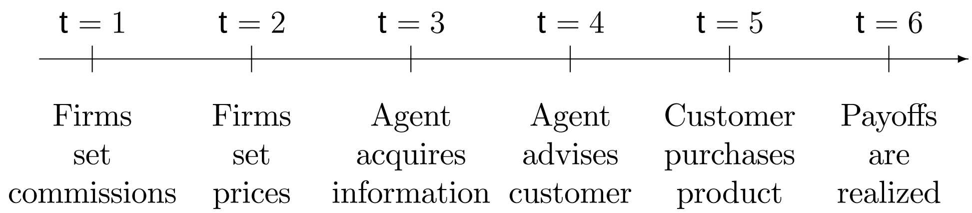

Figure 1: Timeline.

the only source of revenues for the agent.[18] Being an intermediary rather than a retailer, the agent does not take possession of the products. At period $t = 2$, each firm sets the respective price, p_n.[19]

At period $t = 3$, the agent exerts non-contractible effort $a \geq 0$ to acquire customer-specific information, as captured by the shift in the distribution $G(q; a)$ in (3). Effort to acquire information is unobservable and entails a private cost $k(a)$ for the agent, with $k'(0) = 0$, $k'(a) > 0$ for $a > 0$, and $k'' > 0$.

The provision of advice, which occurs at period $t = 4$, is a game of cheap talk, along the lines of Crawford and Sobel (1982). Our analysis abstracts from the uninformative (also known as "babbling") equilibrium and always focuses on the unique informative equilibrium, provided that it exists. Based on the agent's advice, which is represented by the messages $m = A; B$, the customer makes the final purchase decision at period $t = 5$.[20]

We abstract from discounting, so that we can stipulate conveniently that all payoffs are realized in the final period $t = 6$. We also assume that all parties are risk neutral. Figure 1 summarizes the timing of the full model.

[18] The assumption that the agent is remunerated solely by commissions, and thus does not receive payments from customers, reflects a common practice in many industries. For example, insurance and retail finance customers rarely pay brokers for services by the hour. In practice, there may be various reasons why direct fees by customers are uncommon. For instance, as explained by the Financial Services Authority (2008, paragraphs 2.4 and 2.5), direct compensation by customers would impose stricter fiduciary duties on the agent, in particular when the agent contemporaneously accepts commissions from firms.

[19] The assumption that f_n is set before p_n captures the notion that f_n is determined, possibly uniformly for a large number of agents, by some (long-term) negotiated contract. We also analyze below the case in which prices may be capped.

[20] Given that the customer has two actions (i.e., purchasing product A or product B), this restriction to binary messages is without loss of generality.

Hotelling Analogy. Equation (2) reveals a convenient mapping between our model of demand and Hotelling's (1929) classic setup with linear transportation cost.[21] Firm B is located at the origin, 0, while firm A is located at the other extreme, 1, of the unit interval of beliefs, $q \in [0;1]$. The belief q, corresponding to the probability that product A is a better match for the customer than product B, is distributed according to $G(q;a)$. This distribution captures the uncertainty about the customer's location.[22] If the customer knew the realization of q, as in the standard Hotelling model, the distribution G would induce the (probabilistic) demand functions for the two firms, with unit transportation cost equal to $v_h - v_l$.[23] In our setting, instead, only the agent privately observes q and then advises the customer. Nevertheless, we will show that competition among firms for the agent's advice in our model is isomorphic to Hotelling competition.[24]

Example. As noted above, the agent's information structure can be further endogenized by supposing that the agent's posterior belief is derived from the observation of a private signal $s \in [\underline{s};\overline{s}]$. For given state , the signal has conditional distributions $F_\theta(s;a)$, where $F_A(s;a)$ dominates $F_B(s;a)$ in the likelihood ratio order, so that the posterior belief $q(s;a)$ is strictly increasing in s.[25] For an illustration, we specify $F_A(s;a) = s^{a+1}$ and $F_B(s;a) = 1-(1-s)^{a+1}$ with support $s \in [0;1]$. This family of distributions is parametrized by the quality of information, $a > 0$. As we confirm in Appendix B, higher values of a rotate the conditional distribution $G(q;a)$ around the mean of 1=2, according to (3). The signal becomes uninformative when $a \to 0$ and perfectly informative when $a \to \infty$. Moreover, for $a = 1$ the posterior q is uniformly distributed: $G(q;1) = q$. In a standard Hotelling model, a uniform distribution of customers' locations generates linear demand functions. Likewise in our setting, when the agent's beliefs about match quality are uniformly distributed, firms have linear demand functions, albeit now with respect to the commissions paid to the agent rather than the prices charged to the customer, as we uncover below.

[21] Moscarini and Ottaviani (2001) further pursue this analogy for the case in which the customer has direct private information about the match between product characteristics and preferences. In the present paper, instead, the customer must obtain this information from the agent's advice.

[22] As a increases the distribution of the customer's location becomes more spread out. In the limit when the signal becomes perfectly informative, the customer is located at either at 0 or 1, depending on which of the two products represents the best match.

[23] By the indifference condition $v_A(\tilde{q}) - p_A = v_B(\tilde{q}) - p_B$, the marginal type would be $\tilde{q} = 1/2 - (p_B - p_A)/[2(v_h - v_l)]$, with transportation cost $v_h - v_l$ for each unit of belief travelled. The demand for products A and B would then be $1 - G(\tilde{q};a)$ and $G(\tilde{q};a)$, respectively.

[24] We will return to this reinterpretation of the model in terms of Hotelling competition throughout the paper.

[25] In this binary state model, this condition is satisfied without further loss of generality.

3 Steering

This section focuses on the agent's role as provider of product advice at period $t = 4$, taking as given the effort the agent undertakes to acquire information at period $t = 3$. To this end, we specify that the informativeness of the agent's signal is given exogenously and thus suppress the variable a in the distribution $G(q)$. This specification is relaxed in Section 4.

In addition, in this section we focus on how a single firm, namely $n = A$, uses commissions to steer the agent's advice. Thus we suppose that product B is provided non-strategically by a competitive sector, with a price equal to cost, $p_B = c_B$, and with zero commission for the agent, $f_B = 0$. This specification is relaxed in Section 5. To simplify expressions, for now we denote the single remaining commission by $f_A = f$.

This *baseline case* with single agency may be an apt description of situations in which the agent earns a fee when selling a novel product or treatment, but earns nothing (or a relatively small fee) from a standard product or treatment.[26] In fact, the case in which the novel product A is more cost-efficient, as $c_A < c_B$, will also prove the most interesting case in the analysis to follow.

When receiving commissions on only one product, the agent's preferences for providing advice at period $t = 4$ are as follows. Proceeding under the assumption that the customer follows the agent's advice, the agent recommends product A only if the respective commission f is not below $(1 - q)w - qw = (1 - 2q)w$, the difference in the agent's expected liability from the two possible recommendations.[27] If $f < w$, an interior cutoff

$$q^* = \frac{1}{2} - \frac{f}{2w} \tag{4}$$

results such that the agent recommends product A for $q \geq q^*$ and product B for $q < q^*$.[28] We capture the corner case with $f \geq w$ by setting $q^* = 0$. When no commission is paid, $f = 0$, then $q^* = 1/2$ obtains.

The term $1/(2w)$ in (4) corresponds the responsiveness of the agent's advice to changes in firm A's commission. The larger is the agent's liability, w, the less the agent is willing to steer customers to product A when the respective commission increases. Given that

[26] This initial asymmetry also provides the simplest case in which to isolate the steering role of commissions.

[27] In this paper, we are only interested in the agent's *relative* incentives whether to advise the purchase of product A or B. Hence, the model could be easily extended by introducing some other, fixed benefit $b \geq 0$ that the agent obtains when the customer purchases *any* product (such as profits from future cross-selling of other products).

[28] Note that the realization of q^* is a zero-probability event.

the customer follows the agent's advice, firm A's demand is represented by the probability that the customer's type is above the cutoff q^*, which in turn increases in the chosen commission level f. Similar to a price reduction in a standard model of demand, a higher commission increases the likelihood of a sale while lowering the firm's margin from all sales, $p_A - c_A - f$.

3.1 Advice Provision in Equilibrium

The customer calculates the expected utility derived from a given product, based on the advice received from the agent. In equilibrium, the customer rationally interprets the information content of the advice by using the advisor's expected cutoff which depends, in turn, on the commission the customer expects firm A to offer the agent. We denote the *expected* commission by $\widehat{f}$ and the corresponding *expected* cutoff by $\widehat{q}^*$, obtained by plugging $\widehat{f}$ into (4).[29]

When choosing the price p_A at period $t = 2$, firm A has to take into account the expectations held by the customer, because they determine the customer's willingness to pay for the product. The maximum feasible price that firm A can charge is determined by the value of the customer's next best option, which is to purchase product B instead.[30] Substituting $p_B = c_B$ into the customer's indifference condition we obtain the maximum feasible price

$$p_A = \int_{\widehat{q}^*}^{1} [v_A(q) - [v_B(q) - c_B]] \frac{g(q)}{1 - G(\widehat{q}^*)} dq; \tag{5}$$

as a function of the cutoff $\widehat{q}^*$ that the customer expects to prevail.[31] The firm's expected profits are given by

$$_A := (p_A - f - c_A) [1 - G(q^*)]: \tag{6}$$

Note that these profits depend directly on the *actual* cutoff q^*, which from (4) is a function of the actual commission f chosen by the firm. Note that in our model of sales with advice the marginal customer type, q^*, is determined by the *agent's* indifference condition, as

[29] Again, if substitution of $\widehat{f} \geq 0$ into (4) leads to a negative threshold, we set $\widehat{q}^* = 0$.

[30] Note that we need not specify whether the agent would incur also the penalty w in case the customer realized v_l after purchasing product B, even *against* the agent's advice. When the agent can document the advice (say through a "letter of suitability"), it is natural to expect no penalty.

[31] It should be noted that we abstract from the signaling problem that arises at this stage, given that firm A already has set its commission, which is not observed by customers. Hence, in the language of signaling games, the level of f would, at this stage, represent the firm's type. With only p_A as the remaining choice variable, however, the firm has no access to a sorting instrument. The characterized outcome in (5) would arise, for instance, under so-called "passive beliefs": customers do not update their beliefs about f when observing p_A.

captured by (4). In addition, profits depend on the cutoff $\widehat{q}^*$ that is anticipated by the customer through the maximum price, p_A, the customer is willing to pay, according to (5).

For an equilibrium to obtain, two conditions must be satisfied simultaneously. First, the firm's choice of f must maximize profits, $_A$. Second, expectations must be fulfilled, so that $\widehat{f} = f$ and thus also $\widehat{q}^* = q^*$.[32]

We now show that a unique equilibrium results. To see this, note first that once we substitute $\widehat{q}^* = q^*$ into (5), we obtain that the maximum feasible price p_A is an increasing function of q^*. Intuitively, the larger is the anticipated cutoff q^*, the higher is the customers' anticipated likelihood that product A provides indeed the better match. Consequently, customers are then willing to pay a higher price p_A.

Second, consider the firm's problem of choosing commission f so as to maximize, for given p_A, profits $_A$ in (6). As we show, a sufficient condition for f to be unique is that $G(q; a)$ satisfies the standard monotone hazard rate condition

$$\frac{d}{dq}\frac{g(q;a)}{1-G(q;a)} > 0; \tag{7}$$

which we assume to hold throughout the paper. The firm's maximization problem then gives rise to a decreasing mapping from p_A to q^*. Intuitively, the higher is the product's price p_A, the greater is the firm's incentive to raise its commission and thus to expand sales through a reduction in the resulting q^*.

An equilibrium is characterized by the intersection of these two mappings. By monotonicity of the two mappings, the equilibrium is indeed unique. To characterize it, we denote the *difference* in expected net surplus from the two products by

$$\Delta(q) := [v_A(q) - c_A] - [v_B(q) - c_B]:$$

Proposition 1 *There is an unique equilibrium. If product* A *is not more cost-efficient than product* B*, as* $c_A \geq c_B$*, then both products are always sold with positive probability,* $0 < q^* < 1$*; if the agent's liability* w *is not too high, the unique equilibrium commission level is strictly positive and is given by*

$$f = \int_{q^*}^{1} \Delta(q)\frac{g(q)}{1-G(q^*)}dq - 2w\frac{1-G(q^*)}{g(q^*)} > 0 \tag{8}$$

and results in a unique cutoff solving

$$q^* = \frac{1}{2} - \frac{1}{2w}\int_{q^*}^{1} \Delta(q)\frac{g(q)}{1-G(q^*)}dq + \frac{1-G(q^*)}{g(q^*)}: \tag{9}$$

[32] Note that in this model customers are perfectly informed about the firm's *incentives* to raise commissions. The case in which customers are imperfectly informed about firms' costs is discussed at the end of Section 3.3.

If instead $c_A < c_B$ *holds, then for sufficiently low* w *only product* A *is sold:* $q^* = 0$*.*

Condition (8) represents the first-order condition for an interior commission level, f. For an interpretation, it is convenient to rewrite it as

$$(p_A - c_A - f)\,\frac{g(q^*)}{2w} = 1 - G(q^*). \tag{10}$$

The left-hand side of (10) captures the marginal benefit from paying a higher commission so as to marginally shift q^* and, thereby, earn the margin $p_A - c_A - f$ on additional sales. A marginal increase in f expands sales by the density, $g(q^*)$, multiplied by the responsiveness of the agent's advice, $|dq^*/df| = 1/(2w)$. The right-hand side of (10) captures the marginal cost of raising f, which involves the payment of the necessary incremental commission for all "inframarginal" sales, $1 - G(q^*)$.[33] Observe that this trade-off in the determination of the equilibrium commission level is analogous to the classic trade-off between price and quantity in the theory of monopoly.[34]

The equilibrium cutoff is increasing in the agent's liability w. This reflects the agent's trade-off between commissions and liability for unsuitable advice—the agent's advice is less responsive to f when w is higher. Thus, the firm finds it less attractive to steer the agent when w increases. If w is sufficiently large, it becomes unprofitable for firm A to pay a positive commission. In contrast, when w is sufficiently small and product A is more cost efficient, only product A is sold in equilibrium.

As w and thus q^* decrease, also the customers' willingness-to-pay for product A decreases in equilibrium. Together with a higher equilibrium commission f, this leads to a strictly lower margin $p_A - c_A - f$. In fact, when product A is not more cost-efficient, as $c_A \geq c_B$, so that the equilibrium cutoff is always determined by (9), then the margin of firm A converges to zero as $w \to 0$. Firm A then ends up with (almost) zero profits. This case illustrates starkly the commitment problem the firm faces vis-à-vis its customers. The firm cannot help but bribing the agent to push its product—which in turn reduces the customers' willingness to pay, and eventually destroys the market when firm's A product is less cost efficient and the seller is not subject to any ex post liability. We return to this commitment problem in Section 3.3 when analyzing the impact of imposing public disclosure of commissions.

[33] Note that higher commissions translate into higher rents for the agent. This effect would be absent if the agent had deep pockets, in which case the incremental rent could be extracted upfront by requiring a higher ex ante payment from the agent.

[34] There, a lower price results in higher sales but reduces the margin on all sales, including the inframarginal sales that would have been made also without a price cut.

3.2 Efficiency

Consider initially the case in which product A is less cost efficient than product B, $c_A \geq c_B$. When the agent's liability is not too high, so that the firm pays a positive commission, the equilibrium outcome is always inefficient, given that the efficient cutoff then satisfies $q_{FB} \geq 1/2$ and thus lies strictly above the equilibrium cutoff $q^* < 1/2$. In this case, product A is sold too frequently from a social perspective. This inefficiency worsens as w decreases, because then firm A further steers sales towards product A by paying higher commissions.

Next, suppose product A is more cost efficient, $c_A < c_B$. When w is high and no commissions are paid, the outcome is also inefficient because product A is then sold too infrequently. However, in this case efficiency improves when w decreases and firm A starts to pay commissions. Comparing (2) and (4), a further increase in f in order to expand sales of product A improves efficiency as long as

$$\frac{f}{w} < \frac{c_B - c_A}{v_h - v_l}; \tag{11}$$

which does not hold for low w.

Proposition 2 *If product A is not more cost efficient than product B, as $c_A \geq c_B$, then efficiency is maximized when $f = 0$, which holds only when the agent's liability w is sufficiently large. If instead product A is more cost efficient, as $c_A < c_B$, then in equilibrium product A is sold too frequently when the agent's liability is low and too infrequently when it is high.*

An immediate implication of Proposition 2 is that a binding cap $\overline{f}$ on f is always welfare improving (at least weakly) when $c_A \geq c_B$, but may reduce efficiency for $c_A < c_B$. When the agent's liability w is not too low, then even firm A's choice of commissions will be too low from the perspective of maximizing efficiency, without such a binding cap. The intuition for this observation follows immediately from inspection of condition (10), which trades off the firm's benefits from paying higher commissions with the respective costs. When these costs are sufficiently high, given that it is relatively expensive for the firm to steer the agent, then $q^* > q_{FB}$ results in equilibrium, even when there is no cap on commissions.

Note finally that, as is straightforward to show, the expected utility of customers does not depend on q^* and thus on f. This follows intuitively because firm A, by adjusting its price p_A, is able to appropriate any incremental surplus that a more efficient advice would

create for customers.[35] A change in q^*, as could be induced by a change in w, has thus an impact on welfare, though not on consumer surplus. This property will prove robust also in the case of common agency analyzed in Section 5.

3.3 Disclosure of Commissions

With disclosed commissions, customers can directly infer the agent's optimal choice of the cutoff. Different from the derivation of p_A in (5) for the case without disclosure, the maximum price p_A that firm A can extract now depends on the actual cutoff, rather than on the rationally expected cutoff. For ease of exposition, we refer to the resulting equilibrium cutoff with disclosure by q^D, while f^D denotes the prevailing commission level.

Proposition 3 *With disclosed commissions, if the agent's liability is not too high, then the unique commission level is given by*

$$f^D = \Delta(q^D) - 2w\frac{1 - G(q^D)}{g(q^D)} > 0 \tag{12}$$

and results in a unique cutoff $0 < q^* < 1/2$ *solving*

$$q^D = \frac{1}{2} - \frac{1}{2w}\Delta(q^D) + \frac{1 - G(q^D)}{g(q^D)}. \tag{13}$$

The key difference between the disclosure and the non-disclosure regimes lies in theto

$q \geq q^*$, the commission with disclosure depends on the *marginal* net surplus at q^*. Because the net surplus from product A is strictly increasing in q, we have

$$\int_{\tilde{q}}^{1} \Delta(q) \frac{g(q)}{1 - G(\tilde{q})} dq > \Delta(\tilde{q}); \tag{14}$$

so that in equilibrium the commission is indeed higher without disclosure.

Proposition 4 *Firm* A *pays higher commissions in equilibrium when they are not disclosed compared to when they are disclosed to customers.*

Mandating disclosure of commissions has a chilling effect on their level, much like a direct cap. When product B is more cost efficient, this raises overall efficiency. Suppose instead that product A is more efficient ($c_A < c_B$), and observe from (13) that the resulting cutoff is now always inefficiently high: $q_{FB} < q^D$. While it would thus be efficient to lower the cutoff and expand the sales of product A until the relative net surplus of product A is exactly zero, $\Delta(q_{FB}) = 0$, this is not optimal for firm A. As can be seen from expression (10), this follows because the marginal cost of steering the agent towards lowering the cutoff q^D, which equals $1 - G(q^D)$, is strictly positive. Disclosure of commission can thus reduce efficiency by lowering the commission paid by firm A in equilibrium.

Defining the auxiliary function $(q) := w(1 - 2q) + 2w[1 - G(q)] = g(q)$, the equilibrium cutoff without disclosure is characterized by $(q^*) = \int_{q^*}^{1} \Delta(q) \frac{g(q)}{1-G(q^*)} dq$ and with disclosure by $(q^D) = \Delta(q^D)$, as illustrated in Figure 2. Once it is multiplied by the density $g(q)$, the function (q) corresponds to the firm's marginal cost of inducing the agent to lower the cutoff belief above which the agent recommends a purchase. This marginal cost comprises the commission $f = w(1 - 2q)$ paid at the margin on the incremental sales $g(q)$, according to the agent's indifference condition (4), and the increase in the commission by $2w$ for all inframarginal sales $1 - G(q)$.

While for this illustration it holds that $q_{FB} < q^* < q^D$, when the agent's liability w is sufficiently low, without disclosure the sales of product A are expanded too much—an instance of "overshooting".[36]

Proposition 5 *If product* A *is not more cost efficient, as $c_A \geq c_B$, then the equilibrium with disclosure is always (weakly) more efficient than that without disclosure. Suppose*

[36] In the signal example introduced in Section 2 with $a = 1$ (corresponding to uniformly distributed beliefs, $G(q) = q$), the equilibrium cutoff with disclosure is $q^D = \frac{3w-(c_B-c_A)+(v_h-v_l)}{4w+2(v_h-v_l)}$ and the cutoff with disclosure is $q^* = \frac{3w-(c_B-c_A)}{4w+(v_h-v_l)}$. The cutoff without disclosure overshoots the first-best level, $q^* < q_{FB}$, for $w < \frac{v_h-v_l}{2} \frac{(v_h-v_l)+(c_B-c_A)}{(v_h-v_l)+2(c_B-c_A)}$.

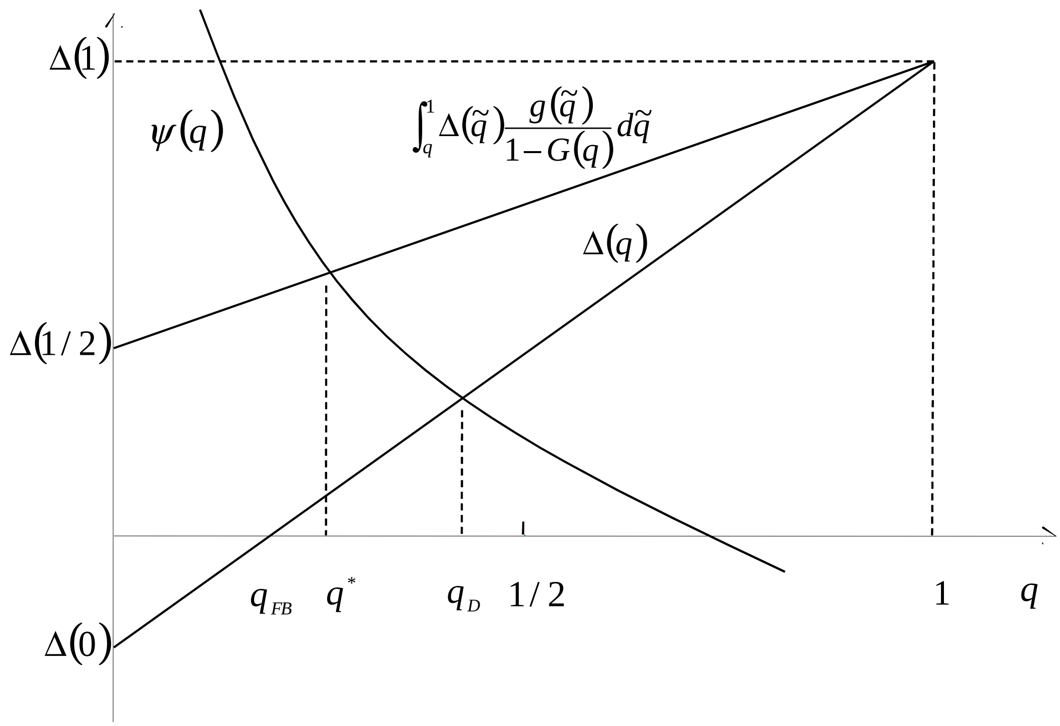

Figure 2: Effect of Disclosure on Equilibrium and Efficiency

instead that product A *is more cost efficient, as* $c_A < c_B$*. For intermediate levels of the agent's liability* w*, at which the firm chooses a positive commission level at least for the case without disclosure, disclosure leads to an efficient expansion of the sales of product* A*, given that* $q_{FB} \leq q^* < q^D$*. For low values of* w*, instead, disclosure leads to an inefficient expansion of the sales of product* A*, as* $q^* < q_{FB}$*.*

A key feature of our model is that customers are able to correctly anticipate the level of commissions that arise in equilibrium when commissions are not disclosed. This ability is based on our assumption that customers are perfectly informed about firm A's incentives to pay commissions. However, imperfect information about firm A's incentives to pay commissions does not necessarily bias the efficiency comparison obtained in Proposition 5 in favor of disclosure. To see this, note that when firm A privately observes its cost c_A, customers would "pool" firms with low and high cost realizations and thus higher and lower incentives to expand sales. Intuitively, compared to the case in which the cost is publicly known, equilibrium sales of a more cost-efficient firm would then be higher, while those of a less cost-efficient firm would then be lower.

4 Acquiring Information

This section focuses on the agent's task of acquiring customer-specific information at $t = 3$, which influences the quality of the observed signal q. The quality of advice that the agent provides at $t = 4$ then depends both on the amount of information gathered as well as on the agent's bias possibly induced by the commissions.

4.1 Agent's Incentives

The agent chooses a to maximize the expected revenue from commissions less the expected liability. The agent's payoff is a convex function of q (strictly for $0 < q^* < 1$), which takes its minimum at q^*, where the agent is just indifferent between advising customers to purchase product A or B. The agent thus benefits from an increase in a, given that this induces a MPS in the distribution of posterior beliefs, according to (3). This effect is more pronounced the closer q^* is to the mean $1/2$. In the extreme case, when q^* approaches zero, the agent's expected liability payment becomes, instead, invariant to a change in a, because it equals $w/2$, given that the expected probability that the advice is unsuitable $1 - q$ remains constant at the prior, $1/2$.[37] Because an increase in the commission by firm A leads to a higher $1/2 - q^* > 0$, we have:

Proposition 6 *The agent's incentives to acquire information are strictly decreasing in the commission paid by firm* A*.*

For the following analysis it is convenient to assume that the agent's optimal choice of effort is unique and denoted by a^*, for given f and resulting cutoff q^*.

4.2 Welfare Benchmark

The social welfare of information acquisition is, for any q^*, strictly larger than the private value for the agent when

$$v_h - v_l > w; \tag{15}$$

an assumption we maintain in the following analysis. When the agent's information is exogenous, if product A is not less cost-efficient than product B, as $c_A \leq c_B$, the agent chooses the first-best threshold of advice, $q^* = q_{FB}$, if

$$f = f_{FB} := w \left(\frac{c_B - c_A}{v_h - v_l} \right);$$

[37] The same holds when $q^* \to 1$, albeit this case is not applicable in the presently analyzed benchmark case, where only firm A may pay commissions.

as we obtained from (11) in Section 3.2. When information acquisition becomes endogenous, Proposition 6 implies that a higher commission on product A leads to a deterioration in the quality of the agent's information. From the perspective of maximizing welfare, the now *second-best* efficient cutoff $q^{**} = q^*$ maximizes

$$\Omega := \int_0^{q^*} [v_B(q) - c_B]\, g(q; a^*) dq + \int_{q^*}^1 [v_A(q) - c_A]\, g(q; a^*) dq - k(q^*). \qquad (16)$$

Assuming for simplicity that the program to maximize Ω with respect to $q^* \leq 1/2$ is strictly quasiconcave, we have the following result:

Proposition 7 *When the quality of the agent's information is endogenous, if* $c_A < c_B$ *social welfare is highest when the agent receives a strictly positive commission* $0 < f^{**} < f_{FB}$ *from firm* A*, which at the advice stage induces a cutoff* q^{**} *with* $q_{FB} < q^{**} < 1/2$*. If instead* $c_A \geq c_B$*, social welfare is highest when the agent does not receive any commission from firm* A*.*

4.3 Incentives to Pay Commissions

Customers cannot directly observe the effort chosen by the agent. When customers cannot observe commissions, they are also unable to infer a change in a^* from a change in commissions. Hence, it still holds that without disclosure the change in commissions does not affect directly the prevailing price p_A. However, commissions now affect the probability of a sale not only through the change in the cutoff q^*, but also through the induced impact on the agent's incentives to acquire information.

Given that in this baseline model only sales of product A may be "pushed" by commissions, when $f > 0$ and consequently $q^* < 1/2$ holds, then the MPS induced by an increase in a^* reduces the likelihood with which product A is sold, $1 - G(q^*; a^*)$.[38] Given that a higher commission further reduces q^* by (4) and that the agent's incentives to acquire information are lower when q^* decreases by Proposition 6, for firm A there are thus *two* channels through which a higher commission results in higher sales: a reduction in q^* *and* a reduction in a^*.

Proposition 8 *When the quality of the agent's information is endogenous and commissions are not disclosed, then firm* A *benefits when the agent acquires less information, which is the case when the firm's commission is higher.*

[38] In the language of Johnson and Myatt (2006), in this case product A is sold to a "mass market".

Impact of Disclosure. When keeping the quality of information fixed, we found that disclosure of commissions had a chilling effect on commission f, because from $dq^*{=}df < 0$ and $dp_A{=}dq^* > 0$ the induced shift in the agent's cutoff reduces the customer's willingness-to-pay thus the price p_A. When the quality of information is endogenous, customers also infer from f the endogenous quality of the agent's information. After rewriting p_A and integrating by parts, Proposition 9 shows that

$$\frac{dp_A}{da^D} > 0 \iff \frac{d}{da^D}\left[\frac{\int_{q^D}^{1}\left[G(q;a^D) - G(q^D;a^D)\right]dq}{1 - G(q^D;a^D)}\right] < 0, \tag{17}$$

for given q^*, which holds generally when q^D is close to 0 or 1=2. Appendix B also shows that this condition holds for all $0 < q^D < 1$ for the information example introduced in Section 2. When (17) holds, there are two conflicting effects on the incentives of firm A to pay commissions with disclosure when the quality of the agent's information is endogenous. On the one hand, as in the absence of disclosure, firm A benefits from the expansion in sales generated by a reduction in the quality of information, a^D. On the other hand, when (17) holds, a lower quality of information decreases customers' willingness-to-pay and thus p_A. While it is generally ambiguous how these two forces play out, when q^D is close to 0 or 1=2, we obtain unambiguous results.[39]

Proposition 9 *When commissions are disclosed, firm* A *still benefits when the agent acquires less information in case firm serves almost the entire market (*q^D *is close to* 0*). Instead, when the equilibrium market shares of products* A *and* B *are almost equal (*q^D *is close to* 1=2*), with disclosure firm* A *prefers more information acquisition. Firm* A *always pays higher commissions without than with disclosure.*

Efficiency. With disclosure, holding the quality of information fixed, we previously observed that through the adjustment of p_A the firm fully incorporates the effect that a shift of f and thus of q^D has on consumer surplus. Still, for the case with $c_A < c_B$ the equilibrium level of commissions was too low ($q^D > q_{FB}$) because raising commissions shifts profits to the agent and is therefore costly for the firm. Interestingly, when the quality of information is now endogenous, the firm still captures the full change in consumer surplus, again through an adjustment of p_A. This follows immediately from the

[39] Because in these cases (17) holds generally, in Proposition 9 we need not invoke additional assumptions for $G(q;a)$. Note also that whether q^D is close to zero or 1/2 in equilibrium is clearly endogenously determined. In particular, $q^D \to 0$ for $w \to 0$ applies only when condition (1) holds with equality.

observation that the customer's expected surplus (after substituting for p_A) is constant at $(v_h + v_l)/2 - c_B$. With disclosure, the only difference to the previous welfare comparison is thus that the benchmark q_{FB} must now be replaced by $\widehat{q}$, according to Proposition 7. Still, for $c_A > c_B$ the commission level remains always inefficiently low with disclosure so that $q^D > \widehat{q}$. Similar to the case with exogenous information quality, we thus have the following result:

Proposition 10 *When product* A *is more cost efficient, as $c_A < c_B$, with disclosure the equilibrium commission is below the socially efficient level, resulting in an inefficiently high cutoff $q^* > \widehat{q}$ and in an inefficiently high information quality. The strictly higher commission that results without disclosure can improve efficiency.*

5 Counteracting

We now turn to the model with common agency, in which also product B is sold by a firm setting a price and a commission. Given that in this case the agent earns a commission on both products, A and B, the agent recommends product A when $f_A - (1-q)w \geq f_B - qw$. An interior cutoff is

$$q^* = \frac{1}{2} + \frac{f_B - f_A}{2w}; \tag{18}$$

whereas the agent always recommends product A if $f_A \geq f_B + w$ and always recommends product B if $f_B \geq f_A + w$.

Expression (18) mirrors the derivation of the critical costumer type in a standard Hotelling model of price competition. While there the critical customer type, who is indifferent between the two offerings, reacts to the difference in products' prices, in our model the agent steers customers to the respective products and reacts to the difference in firms' commissions. In a standard Hotelling model the responsiveness of the critical customer type depends on the extent of product differentiation, as measured by transportation costs (equal to $v_h - v_l$ per unit of belief, as explained in footnote 23). In the present model, the role of these transportation costs is played by the agent's liability w, as seen in (18).

Without loss of generality, given that now sales of both products can be steered by positive commissions, in what follows we restrict consideration to the case with $c_A \leq c_B$.[40] Furthermore, for brevity's sake we stipulate that

$$c_B - c_A < \frac{1}{2}(v_h - v_l); \tag{19}$$

[40] The case with $c_A \geq c_B$ is perfectly symmetric.

in order to rule out the case in which only product A is sold in equilibrium.[41]

5.1 Advice

By optimality, each firm sets the price p_n so as to extract as much of customers' surplus as possible. Without disclosure, when a customer expects a cutoff $\widehat{\mathsf{q}}^*$ to prevail, the unique equilibrium prices are thus $\mathsf{p}_A = \mathsf{E}[\mathsf{v}_A(\mathsf{q}) \mid \mathsf{q} \geq \widehat{\mathsf{q}}^*]$ and $\mathsf{p}_B = \mathsf{E}[\mathsf{v}_B(\mathsf{q}) \mid \mathsf{q} < \widehat{\mathsf{q}}^*]$. Given that now also the price of product B is set strategically, while in the baseline model it was equal to marginal cost c_B customers are now always left with zero surplus when their expectations are satisfied, regardless of whether they followed the advice to purchase product A or the advice to purchase product B. This property holds equally with disclosure—the key difference to non-disclosure is again that customers' willingness-to-pay depends on observed commission levels and thus on the actual cutoff q^D, rather than on the expected levels.

As in the baseline model, each firm has higher incentives to raise commissions when this is not observed by customers, as then there is no negative impact on customers' willingness-to-pay. As is shown formally in the proof of Proposition 11, firms' commissions are *strategic complements* under the standard monotone hazard rate condition (7). This means that firm n finds it more profitable to raise its own commission f_n when it expects the rival firm n' to choose a higher commission $\mathsf{f}_{n'}$. This result is again analogous to the finding in Hotelling's model of price competition, in which final prices are strategic complements. This strategic complementarity reinforces the chilling effect that disclosure has on the prevailing level of commissions.

Proposition 11 *With common agency there is a unique equilibrium under either information regime. Without disclosure, equilibrium commissions (when both are positive as* w *is not too large) are*

$$\begin{aligned} \mathsf{f}_A &= \int_{q^*}^{1} \mathsf{v}_A(\mathsf{q}) \frac{\mathsf{g}(\mathsf{q})}{1-\mathsf{G}(\mathsf{q}^*)} d\mathsf{q} - \mathsf{c}_A - 2\mathsf{w}\frac{1-\mathsf{G}(\mathsf{q}^*)}{\mathsf{g}(\mathsf{q}^*)}; \\ \mathsf{f}_B &= \int_{0}^{q^*} \mathsf{v}_B(\mathsf{q}) \frac{\mathsf{g}(\mathsf{q})}{\mathsf{G}(\mathsf{q}^*)} d\mathsf{q} - \mathsf{c}_B - 2\mathsf{w}\frac{\mathsf{G}(\mathsf{q}^*)}{\mathsf{g}(\mathsf{q}^*)}: \end{aligned} \tag{20}$$

[41] Condition (19) thus replaces the weaker condition (1).

With disclosure, equilibrium commissions (when both positive) are

$$\begin{aligned} f_A^D &= v_A(q^D) - c_A - 2w\frac{1 - G(q^D)}{g(q^D)}; \\ f_B^D &= v_B(q^*) - c_B - 2w\frac{G(q^D)}{g(q^D)}: \end{aligned} \tag{21}$$

Commissions are higher when they are not disclosed. Furthermore, when products are equally cost-efficient, $c_A = c_B$*, then the efficient outcome prevails in both information regimes.*

Proposition 11 brings out a key difference to the baseline case of single agency. Under common agency and full symmetry ($c_A = c_B$), customers who do not observe commissions can still rely on competition between firms who want to steer the agent's advice, because this will ultimately create balanced incentives for the agent. In this case, nondisclosure of commissions does not affect the quality of advice, while raising the overall level of commissions. Likewise, in this case the imposition of a symmetric cap on commissions by regulators, requiring that $f_n \leq \overline{f}$, would have no impact on efficiency either.

This finding complements a key observation in Bolton et al. (2007), who noted that a multi-product firm has no incentive to give the wrong advice if it earns equal margins on both products. Instead, a single-product firm may want to advise a customer to purchase its product even though a rival product may provide a better fit. In our model, symmetric common agency provides equally balanced incentives for advice.

Asymmetries. We conclude this section by considering the asymmetric case in which product A is strictly more cost efficient, as $c_A < c_B$. To obtain an explicit characterization of the equilibrium outcome in the various scenarios, we now stipulate that q is uniformly distributed, $G(q) = q$.[42] Substituting (21) into (18), we obtain the equilibrium cutoff with disclosure

$$q^D = \frac{1}{2} - \frac{c_B - c_A}{2(v_h - v_l) + 6w}: \tag{22}$$

Thus, $q_{FB} < q^D < 1=2$. While firm A has more incentive to steer sales to its own product, given that it has lower cost, and while this indeed results in a strictly higher commission for firm A, the equilibrium difference $f_A^D - f_B^D$ remains too small. The intuition is the same as in the baseline model, although we now also have to incorporate the counteracting effect

[42] Recall that this distribution arises endogenously from the example introduced in Section 2 and analyzed in Appendix B for $a = 1$.

of the rival's commission. At any cutoff below 1=2, a marginal increase in the commission of firm A comes at a strictly higher incremental cost than the same increase does for firm B, given that the incremental commission must be paid more frequently by firm A.

Interestingly, this finding again mirrors results familiar from Hotelling's model of oligopolistic competition with horizontal differentiation. In a market with symmetric demand, the standard finding is that the more cost efficient product has an inefficiently low market share. Given that the more efficient firm ends up having higher sales, any price cut designed to expand sales is more costly for this firm than for its rival. Consequently, the more efficient firm ends up with a larger margin and, thus, a less than efficient share of the market. Likewise in our model, in order to expand sales the firm has to further steer the agent through a higher commission, which is more expensive if its product is already sold with higher probability.

Without disclosure, substituting (20) into (18), we obtain

$$q^* = \frac{1}{2} - \frac{c_B - c_A}{(v_h - v_l) + 6w}: \tag{23}$$

Comparison with the case of disclosure leads to the following result.

Proposition 12 *Consider the common agency case with* $c_A < c_B$ *and uniformly distributed* q*. When* w *is not too large, so that both commissions are positive, the equilibrium cutoff levels* q^D *and* q^* *that prevail with and without disclosure are explicitly characterized in (22) and (23), respectively. When the agent's liability satisfies* $w \geq (v_h - v_l)=6$*, then non-disclosure efficiently expands the sales of product* A*, given that then* $q_{FB} \leq q^* < q^D$ *holds. For lower values of* w*, product* A *is sold inefficiently too often without disclosure, as* $q^* < q_{FB}$*.*

Finally, it is worth noting that the implications of a cap on commissions are slightly more complex with common agency than in the baseline model. In contrast to the baseline model, the effect of a cap is no longer perfectly analogous to that of disclosure. This follows because when the cap affects both firms, then their commissions are necessarily equal, resulting in the cutoff 1=2. If the products are not equally cost efficient (as $c_A < c_B$), this immediately implies that the cap is necessarily too low from an efficiency perspective when it binds for both firms.

5.2 Information Acquisition

As in the baseline case of single agency, the agent's incentives to acquire information depend only indirectly on commissions, namely through the equilibrium cutoff. When

both firms can pay positive commissions, the cutoff and the agent's effort to acquire information depend only on the difference in commissions, $f_A - f_B$, rather than on the absolute level of commissions. Furthermore, recall that when the cutoff is equal to $1/2$, then the agent's effort is not affected by a marginal change in commissions, which induce a marginal change in the cutoff. As an immediate consequence, when $c_A = c_B$ the equilibrium is thus symmetric with and without disclosure, $q^D = q^* = 1/2$. In this case, even though commissions are higher without disclosure by Proposition 11, the agent's incentives to acquire information are unchanged; and firms' incentives to marginally raise commissions do not depend on their incentives to tamper with the agent's information acquisition incentives.

When $c_A < c_B$ holds strictly, in equilibrium firm A has a larger market share than firm B, both with and without disclosure, $q^D < 1/2$ and $q^* < 1/2$, and sets strictly higher commissions, $f_A^D > f_B^D$ and $f_A > f_B$. Recall that as long as $q^D < 1/2$, a further increase in the commission of firm A dampens the agent's incentives to acquire information, while the opposite effect obtains when the commission of firm B is increased.[43]

Without disclosure, for $c_A < c_B$ and thus $q^* < 1/2$ we know from the baseline analysis that firm A benefits from less information acquisition and that this induces it to raise f_A. Instead, for $q^* < 1/2$ the smaller firm B gains in market share when information acquisition a^* is higher, because this increases the likelihood of a sale, $G(q^*; a^*)$. As the agent's incentives to acquire information increase when q^* shifts closer to $1/2$, also firm B thus wants to raise f_B so as to thereby affect, in addition, the agent's incentives to acquire information.

However, with disclosure we observed that there is a countervailing effect for firm A under condition (17), thereby the reduction in the agent's information quality forces the firm to lower the price. For firm B, customers' willingness-to-pay and thus $p_B = E[v_B(q) \mid q \leq q^D]$ equally increase in information quality a^D whenever

$$\frac{d}{da^D}\left[\frac{\int_0^{q^D}\left[G(q^D; a^D) - G(q; a^D)\right] dq}{G(q^D; a^D)}\right] < 0; \tag{24}$$

as can be shown again after integration by parts. This condition always holds for q^D close to $1/2$, and it holds for all $0 < q^D < 1$ for the example analyzed in Appendix B. With disclosure and endogenous information acquisition, firm B, which is smaller from

[43] An immediate implication of this is that when firms' costs are different, the imposition of a symmetric cap, $f_n \leq \overline{f}$, would lead to more information acquisition, by bringing the resulting cutoff closer to 1/2, where information acquisition incentives for the agent are highest.

$q^D < 1/2$, thus gains from a higher a^D *both* through an expansion of sales *and* through a higher price.

Proposition 13 *In the case of common agency, the fact that the quality of the agent's information is now endogenous has only an impact on firms' incentives to pay commissions when firms have different cost efficiencies, $c_A \neq c_B$. When (17) and (24) hold, then under disclosure both firms benefit through higher prices when the agent has higher incentives to acquire information. For $c_A < c_B$, where firm A has the larger market share, this implies that disclosure dampens firm A's incentives to pay commissions, while it increases firm B's incentives.*

6 Discussion

6.1 Disclosure Incentives

Mandatory disclosure and monitoring by a third party may be necessary to make disclosure credible. In the absence of adequate supervision by an independent authority, firms may find ways to steer the agent through hidden kickbacks or "soft commissions". However, the following discussion considers the most optimistic scenario in which firms are able to credibly commit to make commissions perfectly transparent to customers.

Take first the baseline case with single agency. When commissions are not disclosed, firm A faces a commitment problem, while with disclosure the firm internalizes through an adjustment of the price the effect of commissions on the quality of advice. Firm A's profits are thus higher with disclosure. Next, recall that commissions are strategic complements with common agency. By reducing each firm's incentives to steer the agent, disclosure thus further benefits firms when they compete.[44]

However, the agent's profits are higher when commissions are not transparent. Given the agent's position as gatekeeper to buyers, the agent might be able to succeed in undermining firms' attempts to commit to full transparency.[45]

[44] This becomes particularly clear for very low values of w and symmetry with $c_A = c_B$. Inspection of Proposition 11 reveals that for $w \to 0$, commissions converge to the respective margins, $p_n - c_n$. Hence, firms' profits converge to zero as $w \to 0$, provided that commissions are not disclosed. When commissions are disclosed, it holds that $f_n^D \to v_n(q^D) - c_n$ as $w \to 0$, which instead implies strictly positive profits for both firms.

[45] It could be argued that a firm has more authority to force the agent to disclose the level of commissions by hiring the agent as an employee rather than using him as an independent intermediary. However, employees often are compensated in less transparent ways through non-contractual bonus payments, internal promotions, and other implicit career rewards.

Proposition 14 *Firms prefer to commit to disclosing commissions, whereas the agent prefers that commissions not be disclosed.*

6.2 Price Caps

We now turn to a discussion of the price caps that are imposed in some regulated markets, such as health care (see also footnote 8). Clearly, price caps have no impact on the efficiency of advice under symmetric common agency. Restricting attention to the asymmetric case, we return for brevity to the baseline model of Section 3, where only one price, p_A, is strategically set above cost, c_A, although now a binding price cap may apply, $\mathsf{p}_A \leq \bar{\mathsf{p}}$.

It might be conjectured that reducing the margin that firm A can earn would reduce the firm's incentives to expand sales, so that a binding price cap would lead invariably to lower commissions. Hence, at least for the purpose of suppressing commissions, price caps thus would seem like a substitute for outright caps on commissions. This is indeed the case when commissions are not disclosed. Focusing instead on the more interesting case with disclosed commissions, we show that this intuition is incomplete.

Proposition 15 *In the baseline single-agency model with disclosed commissions, a price cap $\mathsf{p}_A \leq \bar{\mathsf{p}}$ has an ambiguous impact on the prevailing commission level. If the cap is binding but not too low, then a further reduction leads to higher commissions, while if the cap is already sufficiently low, then a further reduction decreases commissions.*

The intuition for the reversal of the sign of the comparative statics when the cap $\bar{\mathsf{p}}$ is not too low is as follows. Recall that with disclosure the firm's incentives to expand sales by paying higher commissions are dampened because, absent a price cap, customers' lower willingness to pay forces the firm to lower its price. This disciplining channel is muted when the price cap is binding.[46]

6.3 Customer Compensation

We stipulated for simplicity that the agent's expected penalty from a mismatch, w, represents a transfer to the regulator, rather than to customers. Suppose instead that the fraction $_C$ of w is paid to the respective customer. This affects customers' expected gross

[46] As the proof of Proposition 15 makes clear, a lower price cap leads to higher commissions and thus a lower cutoff q^D until the cutoff with disclosure—but also with a price cap—exactly equals the cutoff that would prevail without disclosure. Thereafter, the dominating effect of a further reduction in the cap comes from the ensuing reduction in the firm's margin, implying that commissions are lower and the cutoff is now higher.

utility from either product. Denoting $\widehat{v}_l := v_l + \ {}_C w$, we now have $v_A(q) = qv_h + (1-q)\widehat{v}_l$ and $v_B(q) := (1-q)\, v_h + q\widehat{v}_l$, respectively. Holding the cutoff q^* fixed, this implies a higher willingness to pay, $E[v_A(q) \mid q \geq q^*]$ and $E[v_B(q) \mid q < q^*]$, and thus higher prices, p_A and p_B. This in turn provides firms with higher incentives to pay commissions so as to steer the agent's advice and, thereby, realize higher sales.

We can show that our key qualitative insights are robust to the introduction of a positive value $\ {}_C > 0$. A change in $\ {}_C$, however, also affects the efficiency of advice. With disclosure the outcome becomes more efficient the higher is $\ {}_C$. To see this, recall that when product A is more cost-efficient ($c_A < c_B$), then it is sold too infrequently, $q_{FB} < q^D$, both in the baseline model and with common agency. When a larger fraction of w is used to compensate the customer in case of a mismatch, then for all $q < 1{=}2$ this increases $v_A(q)$ by more than it increases $v_B(q)$. This follows immediately from the fact that, for all $q < 1{=}2$, product A is more likely to be unsuitable than product B. Hence, when $q^D < 1{=}2$ holds, an increase in $\ {}_C$ raises customers' willingness to pay for product A by more than for product B. This provides firm A with (relatively) larger incentives to increase its commission, which pushes q^D closer to the first-best level. From our previous results it then also follows that when commissions are not disclosed, a marginal increase in $\ {}_C$ has an ambiguous effect on efficiency, depending on whether we have that $q_{FB} < q^*$ (for intermediate values of w) or $q < q_{FB}$ (for low values of w).

Proposition 16 *When a fraction $\ {}_C$ of w is paid to the customer in case the product turns out to be unsuitable ($v = v_l$), commissions increase in equilibrium. If commissions are disclosed, this leads to a more efficient outcome (lower $\left|q^D - q_{FB}\right|$). If instead commissions are not disclosed, the impact on efficiency is ambiguous.*

7 Conclusion

This paper proposes a modeling framework for studying the different functions performed by commissions and the effects of policy interventions in that regard. We have shown that policies (such as caps on commissions and mandatory disclosure) intended at reducing commission levels may have unintended consequences leading to a reduction in welfare. Some recent experimental studies suggest that imposing mandatory disclosure of commissions may have additional drawbacks. Lacko and Pappalardo (2004) conjecture that disclosed commissions may prevent overloaded customers from adequately digesting other payoff-relevant information. In another experimental study, Cain et al. (2005) argue that

disclosure of bias may lead advisers to feel morally justified when deviating from professional standards, resulting in a reduction in the quality of advice.[47] While such effects may be only transitory in nature, our analysis suggests that mandatory disclosure or other interventions to reduce commission levels may have ambiguous welfare implications even in the long term, when customers and advisors adjust their expectations through repeated experience.

An interesting extension of our framework would be to allow customers to have heterogeneous private characteristics, thereby creating a (continuously) downward sloping demand curve. Sales then would depend, in a non-trivial way, both on the levels of commissions, which steer advice, and on prices, which determine the probability that any given customer will follow the agent's advice, rather than abstaining from purchase. Products' characteristics also could be endogenized. Firms' investments in cost reduction or quality improvement only pay when they have access to a sufficiently large fraction of the market. If policy measures make it more costly for firms to adequately incentivize agents, product innovation may be inefficiently hampered.

Finally, commissions may also affect the incentives of agents to provide other services. Most notably this could relate to the acquisition of customers in the first place. Particularly in the case of common agency, where either firm can free-ride on the incentives that the other firm provides to the agent to locate customers, the agent's effort to locate customers should be inefficiently low. Moreover, this inefficiency would be worsened by the reduction in commissions with disclosure.

8 References

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[47] In our model, w could capture also an ethical cost of lying for the agent. Note, however, that even when commissions are not disclosed, in equilibrium customers have rational expectations about the agent's potential bias.

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Appendix A: Proofs

Proof of Proposition 1. As a first step, we have for interior $0 < q^* < 1$ that

$$\frac{d\ _A}{df} = g(q^*)\frac{1}{2w}\left(p_A - c_A - f\right) - [1 - G(q^*)]\,; \tag{25}$$

which gives rise to (8) and (9). Note next that from (25) and the hazard rate condition (7) it holds that $\ _A$ is strictly quasiconcave. As an immediate consequence of this, we have that $f = 0$ holds in equilibrium if and only if $d\ _A{=}df \leq 0$ is satisfied at $f = 0$ and $q^* = \widehat{q}^* = 1{=}2$, which using $G(1{=}2) = 1{=}2$ transforms to

$$w \geq \widetilde{w} := 2g(1{=}2)\int_{1/2}^{1} \Delta(q)g(q)dq: \tag{26}$$

Next, an interior equilibrium with $f > 0$ and $q^* > 0$ is uniquely determined from the intersection of two continuous and strictly monotonic mappings between q^* and p_A: (i) the first-order condition (25), by which q^* is a strictly decreasing function of p_A; and (ii) the customer's willingness-to-pay (5), which, after replacing $\widehat{q}^* = q^*$, defines p_A as a strictly increasing function of q^*.

When $c_A \geq c_B$, we have from $w > 0$ that $d\ _A{=}df < 0$ holds at $\widehat{q}^* = q^* = 0$, so that indeed $q^* > 0$. Instead, when $c_A < c_B$, we have from this condition that $q^* > 0$ holds only as long as

$$w \geq \widehat{w} := \frac{c_B - c_A}{1 + 2{=}g(0)}:$$

Proof of Proposition 2. We first make formal the claim that $dq^*{=}dw > 0$, as long as $f > 0$. This follows immediately from implicit differentiation of (9), using that $\frac{d}{dq^*}\left[\int_{q^*}^{1} \Delta(q)\frac{g(q)}{1-G(q^*)}dq\right] > 0$, that $\int_{q^*}^{1} \Delta(q)\frac{g(q)}{1-G(q^*)}dq > 0$ holds in equilibrium, and that $\frac{d}{dq^*}\frac{1-G(q^*)}{g(q^*)} < 0$ holds from (7). For $c_A \geq c_B$, efficiency is highest when $w \geq \widetilde{w}$, as characterized in (26), so that $f = 0$. For $c_A < c_B$, condition (11) and $dq^*{=}dw > 0$ give rise to a strictly positive threshold $w_{FB} < \widetilde{w}$ and a corresponding strictly positive threshold f_{FB} such that efficiency is highest when $w = w_{FB}$ and $f = f_{FB}$.

Proof of Proposition 3. With disclosure, after substituting for p_A from (5), firm A's profits are $_A = \int_{q^D}^1 \left[\Delta(q) - f^D\right] g(q)dq$. When $0 < q^D < 1$, the derivative of profits with respect to f^D is

$$\frac{d \quad _A}{df^D} = g(q^D)\left[\Delta(q^D) - f^D\right]\frac{1}{2w} - \left[1 - G(q^D)\right]: \tag{27}$$

With assumption (7), the firm's problem is strictly quasiconcave. For an interior solution $f \ > 0$ and $q^D > 0$, the characterization in (12) and (13) is then pinned down uniquely from the first-order condition. Next, evaluating $d \quad _A{=}df^D$ at $f^D = 0$, we have that $f^D > 0$ is optimal if and only if

$$w \geq \widetilde{w}^D := g(1{=}2)\Delta(1{=}2); \tag{28}$$

Note finally that from the first-order condition, $d \quad _A{=}df^D = 0$; together with condition (1) it is immediate that $q^D > 0$ must hold in equilibrium.

Proof of Proposition 4. From the proofs of Propositions 1 and 3 we have that $\widetilde{w}^D < \widetilde{w}$, so that we have $f \ > f^D = 0$ for all $w \in [\widetilde{w}^D; \widetilde{w})$. When $w \geq \widetilde{w}$, we have $f \ = f^D = 0$. Finally, when $w < \widetilde{w}^D$ we have $f \ > 0$ and $f^D > 0$. That $f \ > f^D$ holds in this case follows then from $q^D > q^*$, which in turn holds from the characterization in (9) and (13), in combination with (14).

Proof of Proposition 5. When $c_A \geq c_B$, we have from Proposition 4 that $q^* < q^D \leq q_{FB}$ for $w < \widetilde{w}$, where $\widetilde{w} > 0$, and that $q^* = q^D \leq q_{FB}$ for $w \geq \widetilde{w}$. When $c_A > c_B$, we have from Proposition 4 together with Proposition 2 that $q_{FB} < q^D = q^* = 0$ for $w \geq \widetilde{w}$, that $q_{FB} \leq q^* < q^D$ for $0 < \widehat{w} \leq w < \widetilde{w}$, and that $q^* < q_{FB} < q^D$ for $w < \widehat{w}$.

Proof of Proposition 6. The agent chooses a to maximize $u - k(a)$, where

$$u := f \ [1 - G(q^*; a)] - w\left[\int_0^{q^*} qg(q; a)dq + \int_{q^*}^1 (1-q)g(q; a)dq\right]: \tag{29}$$

After integration by parts and using (4), this can be written as

$$u = f \ + w\left[\int_0^{q^*} G(q; a)dq - \int_{q^*}^1 G(q; a)dq\right];$$

so that

$$\frac{du}{da} = w\left[\int_0^{q^*} \frac{dG(q; a)}{da}dq - \int_{q^*}^1 \frac{dG(q; a)}{da}dq\right]: \tag{30}$$

The agent's incentives to acquire information thus depend only indirectly on commissions, namely through the obtained cutoff q^*. Then, because information acquisition induces a

MPS in the distribution of posterior beliefs, according to (3), by (30) the agent's incentives to acquire information decrease as $|q^* - 1=2|$ increases.

Proof of Proposition 7. After integration by parts of (16) and substitution of the agent's first-order condition $du=da^* - k'(a^*) = 0$, where $a^* > 0$ holds from $k'(0) = 0$ as long as $0 < q^* < 1$, we have

$$\frac{d\Omega}{dq^*} = -g(q^*; a^*)\Delta(q^*) + \frac{da^*}{dq^*}\left[(v_h - v_l) - w\right]\left[\int_0^{q^*} \frac{dG(q; a^*)}{da^*}dq - \int_{q^*}^{1} \frac{dG(q; a^*)}{da^*}dq\right]; \quad (31)$$

with

$$\frac{da^*}{dq^*} = -\frac{2w\frac{dG(q^*;a^*)}{da^*}}{\frac{d^2u}{da^{*2}} - k''(a^*)}: \quad (32)$$

The denominator is negative by the second-order condition for the agent's optimal choice of a^*. Note that from (3) we have that $da^*=dq^* = 0$ when $q^* = 1=2$, while $dG(q^*; a^*)=da^* > 0$ holds for $q^* < 1=2$. (The case with $q^* > 1=2$ does not apply, because in the baseline model the commission can only be positive for product A.)

With $c_A < c_B$ and thus $q_{FB} < 1=2$ as well as $\Delta(1=2) > 0$, we thus have from (31) that, given assumed strict concavity of the program, the cutoff that maximizes welfare, q^{**}, must indeed satisfy $q_{FB} < q^{**} < 1=2$. The respective commission level f^{**} is obtained from (4). Finally, the case with

Take next the case with disclosure. We first prove the assertion on p_A in the main text. Writing out $v_A(q)$ and $v_B(q)$ explicitly, we obtain after substitution into $p_A = E[v_A(q) - v_B(q) + c_B \mid q \geq q^*]$ and integration by parts

$$\frac{dp_A}{da^D} = -2\left(v_h - v_l\right)\frac{d}{da^D}\left[\frac{\int_{q^D}^1 \left[G(q;a^D) - G(q^D;a^D)\right]dq}{1 - G(q^D;a^D)} - 1\right], \tag{34}$$

from which we obtain condition (17). More explicitly, $dp_A/da^D > 0$ thus holds if

$$\frac{\frac{dG(q^D;a^D)}{da^D}\int_{q^D}^1 \left[G(q;a^D) - G(q^D;a^D)\right]dq + \left[1 - G(q^D;a^D)\right]\int_{q^D}^1 \left[\frac{dG(q;a^D)}{da^D} - \frac{dG(q^D;a^D)}{da^D}\right]dq}{\left[1 - G(q^D;a^D)\right]^2} < 0. \tag{35}$$

At $q^D = 1/2$ this holds as $dG(q^D;a^D)/da^D = 0$, which by continuity extends to all q^D close to $1/2$. At $q^D = 0$, expression (35) does not hold strictly, as the left-hand side of the inequality is zero. Differentiating with respect to q^D and evaluating at $q^D = 0$, where we can use that $\int_0^1 \left[dG(q;a^D)/da^D\right]dq = 0$ for all a^D, we thus obtain that $d^2p_A/da^D dq^D > 0$ holds at $q^D = 0$ whenever

$$\left.\frac{d^2G(q^D;a^D)}{dq^D da^D}\right|_{q^D=0}\left[\int_0^1 G(q;a^D)dq - 1\right] < 0,$$

which must hold from (3).

Note next that after substitution for p_A and integration by parts we have that, holding still q^D fixed,

$$\frac{d\pi_A}{da^D} = -\left[\Delta(q^D) - f\right]\frac{dG(q^D;a^D)}{da^D} - 2(v_h - v_l)\int_{q^D}^1 \frac{dG(q;a^D)}{da^D}dq. \tag{36}$$

At $q^D = 1/2$ this is from (3) strictly positive. Generally, from symmetry of the mean-preserving spread, the second term in (36) is strictly positive as long as $q^D > 0$, while from the first-order condition it holds that $\Delta(q^D) - f > 0$, implying that the first term is strictly negative for $0 < q^D < 1/2$. While (36) is thus zero at $q^D = 0$, it is strictly negative when q^D is close to zero in equilibrium, given that by (3) the second derivative satisfies

$$\left.\frac{d^2\pi_A}{da^D dq^D}\right|_{q^D=0} = -\left[\Delta(0) - f\right]\left.\frac{d^2G(q^D;a^D)}{dq^D da^D}\right|_{q^D=0} < 0.$$

For now and the following proofs, it is useful to express the incentives of firm A to pay commissions with disclosure as

$$\frac{d\pi_A}{df^D} = \frac{1}{2w}\left[\left(p_A - f^D - c_A\right)g(q^D;a^D) - \frac{\partial p_A}{\partial q^D}\left[1 - G(q^D;a^D)\right] - \frac{da^D}{dq^D}\frac{d\pi_A}{da^D}\right] - \left[1 - G(q^D;a^D)\right], \tag{37}$$

where we still take the program to be strictly quasiconcave, once we substitute for p_A. From $da^D/dq^D = 0$ for $q^D = 1/2$ the condition for when $f^D > 0$ holds in equilibrium is still given by $w > \widetilde{w}^D$, as in (28). The assertions on firm A's incentives with disclosure follow from $da^D/dq^D > 0$ for $q^D < 1/2$ together with the preceding observation on $d\pi_A/da^D$.

Finally, that $f > f^D$ follows for all $w < \widetilde{w}$, where $f > 0$ and $f^D > 0$, immediately from the observation that, for given cutoff and thus given p_A, we have that $d\pi_A/df < d\pi_A/df^*$, when comparing (33) with (37), where we can use that $\partial p_A/\partial q^D > 0$ and that, again for given cutoff smaller than $1/2$, $d\pi_A/da^D > d\pi_A/da^*$.

Proof of Proposition 11. Take first the case with disclosure. With common agency firms' profits equal $\pi_A = (p_A - f_A - c_A)\left[1 - G(q^D)\right]$ and $\pi_B = (p_B - f_B - c_B)\,G(q^D)$. When q^D is interior, $d\pi_A/df_A$ is given by (27), while, again after substitution of p_B,

$$\frac{d\pi_B}{df_B} = g(q^D)\frac{1}{2w}\left[v_B(q^D) - f_B - c_B\right] - G(q^D). \tag{38}$$

From (7) and symmetry of $G(q)$, both profit functions π_n are strictly quasiconcave in the respective strategy variable f_n, while strategic complementarity follows as $dq^D/df_A^D < 0$ and $dq^D/df_B^D > 0$. At an interior solution, the first-order conditions yield

$$q^D = \frac{1}{2} - \frac{\Delta(q^D)}{2w} + \frac{1 - 2G(q^D)}{g(q^D)}, \tag{39}$$

which from (7) and symmetry of $G(q)$, together with (1), has a unique solution $0 < q^D < 1$. A sufficient condition for this to be also the unique equilibrium outcome is that[49]

$$w > \widetilde{w}^D := g(1/2)\left[\frac{v_h - v_l}{2} - c_B\right]. \tag{40}$$

Without disclosure, in equilibrium customers must hold consistent expectations, $\widehat{f}_n = f_n$ for $n = A, B$, implying also that $\widehat{q}^* = q^*$, while both f_n are optimally chosen. With given p_n, $d\pi_A/df_A$ is given by (25), while

$$\frac{d\pi_B}{df_B} = g(q^*)\frac{1}{2w}\left[p_B - f_B - c_B\right] - G(q^*).$$

Writing out p_n explicitly, we have from the first-order conditions that at an interior equilibrium it holds that

$$q^* = \frac{1}{2} - \frac{\left[E\left[v_A(q) \mid q \geq q^*\right] - c_A\right] - \left[E\left[v_B(q) \mid q < q^*\right] - c_B\right]}{2w} + \frac{1 - 2G(q^*)}{g(q^*)}. \tag{41}$$

[49] Condition (40) is only sufficient but not necessary for $f_n > 0$ to hold in case $c_A < c_B$ holds strictly. Then, $w > g(1/2)\left[(v_h - v_l)/2 - c_A\right]$ ensures that $f_A > 0$, while as commissions are strategic complements the condition for $f_B > 0$ is weaker than (40). As this is rather immediate, for brevity's sake we omit a full derivation of the respective case distinction.

Given (7) and symmetry of $G(q)$, together with (19), this pins down a unique solution $0 < q^* < 1$. A sufficient condition for this to be also the unique equilibrium outcome is that[50]

$$w > \widetilde{w} := g(1{=}2)\left[v_l + 2(v_h - v_l)\int_{1/2}^{1} qg(q)dq - c_B\right]: \qquad (42)$$

For what follows, it is helpful to observe that both commissions are strictly decreasing in w: For given cutoff, the derivatives $d\ {}_n{=}df_n$ and $d\ {}_n{=}df_n^D$ are strictly decreasing in w, while for given w the derivatives $d\ {}_n{=}df_n$ and $d\ {}_n{=}df_n^D$ are strictly increasing in $f_{n'}$ and $f_{n'}^D$, respectively. Also, for given cutoff and respective willingness-to-pay, as represented by p_n, we have $d\ {}_n{=}df_n > d\ {}_n{=}df_n^D$. This together with strategic complementarity implies that both commissions are strictly higher without disclosure. Finally, $q^* = q^D = 1{=}2$ in case $c_A = c_B$ follows immediately from (39) and (41).

Proof of Proposition 14. From the arguments in the main text, it remains to show that in the common agency case both firms prefer the regime with disclosure. Take without loss of generality firm A. Starting from the case without disclosure, suppose that the firm could choose for any rationally expected level $\widehat{f}_B = f_B$ an *observed* commission f_A. Profits would then, as there is no longer a commitment problem vis-à-vis customers, be strictly higher. Note next that in this auxiliary case ${}_A$ is clearly strictly higher when the rival's (rationally expected or observed) commission is lower. As we know that indeed $f_B^D < f_B$, by this two-stage argument the profits of firm A are thus indeed higher with disclosure than without disclosure.

Proof of Proposition 15. When the price cap binds, the firm's first-order condition obtains, as without disclosure in (25),

$$f^{CAP} = \overline{p} - c_A - 2w\frac{1 - G(q^{CAP})}{g(q^{CAP})}; \qquad (43)$$

implying for the resulting cutoff

$$q^{CAP} = \frac{1}{2} - \frac{\overline{p} - c_A}{2w} + \frac{1 - G(q^{CAP})}{g(q^{CAP})}: \qquad (44)$$

Define next $\widehat{q}^{CAP}$ such that, when $q \geq \widehat{q}^{CAP}$, the customers' willingness-to-pay is equal to $p_A = \overline{p}$. Note that $d\widehat{q}^{CAP}{=}d\overline{p} > 0$. When the price cap binds, then from strict quasiconcavity of the firm's program we have that, as long as $\widehat{q}^{CAP} \geq q^{CAP}$; firm A sets $p_A = \overline{p}$ together

[50] In analogy to the discussion in footnote 49, for $c_A < c_B$ this is not a necessary condition. Again, we omit the full characterization of the unique equilibrium outcome for all other cases.

with $\mathsf{f} = \widehat{\mathsf{f}}^{CAP} := \mathsf{w}(1 - 2\widehat{\mathsf{q}}^{CAP})$. Then, for the prevailing cutoff we have $\mathsf{d}\widehat{\mathsf{q}}^{CAP}\mathsf{=d}\overline{\mathsf{p}} > 0$ and for the prevailing commission $\mathsf{d}\widehat{\mathsf{f}}^{CAP}\mathsf{=d}\overline{\mathsf{p}} < 0$. Instead, when $\widehat{\mathsf{q}}^{CAP} < \mathsf{q}^{CAP}$ holds, given that $\overline{\mathsf{p}}$ is sufficiently low, we have $\mathsf{dq}^{CAP}\mathsf{=d}\overline{\mathsf{p}} < 0$ and $\mathsf{df}^{CAP}\mathsf{=d}\overline{\mathsf{p}} > 0$. Finally, observe that the price cap binds whenever

$$\overline{\mathsf{p}} - \mathsf{c}_A \leq \int_{q^D}^{1} \Delta(\mathsf{q}) \frac{\mathsf{g}(\mathsf{q})}{1 - \mathsf{G}(\mathsf{q}^D)} \mathsf{dq}:$$

Proof of Proposition 16. In analogy to Proposition 3, at an interior equilibrium we now have

$$\mathsf{f}^D = \Delta(\mathsf{q}^D) + (1 - 2\mathsf{q}^D) \quad {}_C\mathsf{w} - 2\mathsf{w}\frac{1 - \mathsf{G}(\mathsf{q}^D)}{\mathsf{g}(\mathsf{q}^D)}$$

and, after rearranging terms,

$$\Delta(\mathsf{q}^D) = 2\mathsf{w}\left[\frac{(1 - 2\mathsf{q}^D)(1 - \quad {}_C)}{2} + \frac{1 - \mathsf{G}(\mathsf{q}^D)}{\mathsf{g}(\mathsf{q}^D)}\right]: \tag{45}$$

When $\mathsf{c}_A < \mathsf{c}_B$ and thus $\mathsf{q}_{FB} < 1\mathsf{=}2$, it follows from implicit differentiation of (45) that with disclosure, where $\mathsf{q}^D > \mathsf{q}_{FB}$, we have that $\mathsf{dq}^D\mathsf{=d} \quad {}_C < 0$. Without disclosure, as in Proposition 1, we have that

$$\mathsf{f} = \int_{q^*}^{1} [\Delta(\mathsf{q}) + (1 - 2\mathsf{q}) \quad {}_C\mathsf{w}] \frac{\mathsf{g}(\mathsf{q})}{1 - \mathsf{G}(\mathsf{q}^*)} \mathsf{dq} - 2\mathsf{w}\frac{1 - \mathsf{G}(\mathsf{q}^*)}{\mathsf{g}(\mathsf{q}^*)}$$

and

$$\mathsf{q}^* = \frac{1}{2} - \frac{1}{2\mathsf{w}} \int_{q^*}^{1} [\Delta(\mathsf{q}) + (1 - 2\mathsf{q}) \quad {}_C\mathsf{w}] \frac{\mathsf{g}(\mathsf{q})}{1 - \mathsf{G}(\mathsf{q}^*)} \mathsf{dq} + \frac{1 - \mathsf{G}(\mathsf{q}^*)}{\mathsf{g}(\mathsf{q}^*)}: \tag{46}$$

From implicit differentiation of (46) we have that $\mathsf{dq}^*\mathsf{=d} \quad {}_C < 0$. Together with the results from Proposition 2, this implies that the impact on efficiency is ambiguous.

Appendix B: Information Example

This appendix analyzes the signal example introduced in Section 2 with conditional distributions $\mathsf{F}_A(\mathsf{s}; \mathsf{a}) = \mathsf{s}^{a+1}$ and $\mathsf{F}_B(\mathsf{s}) = 1 - (1 - \mathsf{s})^{a+1}$. By Bayes' rule the posterior belief is $\mathsf{q}(\mathsf{s}) = \mathsf{s}^a\mathsf{=}[\mathsf{s}^a + (1 - \mathsf{s})^a]$, with $\mathsf{q}(0) = 0$ and $\mathsf{q}(1) = 1$. Given that the unconditional distribution of the signal is $\mathsf{F}(\mathsf{s}) = 1\mathsf{=}2 + [\mathsf{s}^{a+1} - (1 - \mathsf{s})^{a+1}]\mathsf{=}2$, the distribution of the posterior is

$$\mathsf{G}(\widetilde{\mathsf{q}}; \mathsf{a}) = \frac{1}{2} + \frac{[\mathsf{q}^{-1}(\widetilde{\mathsf{q}})]^{a+1} - [1 - \mathsf{q}^{-1}(\widetilde{\mathsf{q}})]^{a+1}}{2}:$$

We show that this family of distributions satisfies all the assertions made in the main text.

$\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a})$ **satisfies (3).** To see that this is the case, note first that for $\tilde{\mathsf{s}} := \mathsf{q}^{-1}(\tilde{\mathsf{q}})$ we obtain, after some transformations,

$$\frac{d\tilde{\mathsf{s}}}{d\mathsf{a}} = -\frac{\tilde{\mathsf{s}}(1-\tilde{\mathsf{s}})}{\mathsf{a}}\left[\ln(\tilde{\mathsf{s}}) - \ln(1-\tilde{\mathsf{s}})\right];$$

so that

$$\begin{aligned} \frac{d\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a})}{d\mathsf{a}} &= \frac{1}{2}\{[\tilde{\mathsf{s}}^{a+1}\ln(\tilde{\mathsf{s}}) - (1-\tilde{\mathsf{s}})^{a+1}\ln(1-\tilde{\mathsf{s}})] \\ &\quad -\frac{\mathsf{a}+1}{\mathsf{a}}(\ln(\tilde{\mathsf{s}}) - \ln(1-\tilde{\mathsf{s}}))[\tilde{\mathsf{s}}^{a+1}(1-\tilde{\mathsf{s}}) + \tilde{\mathsf{s}}(1-\tilde{\mathsf{s}})^{a+1}]\}: \end{aligned}$$

For $\tilde{\mathsf{s}} = 1{=}2$, it is straightforward to show that $d\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a}){=}d\mathsf{a} = 0$. For $\tilde{\mathsf{s}} < 1{=}2$, from

$$\begin{aligned} \frac{d\mathsf{G}(\mathsf{q};\mathsf{a})}{d\mathsf{a}} &> \frac{1}{2}\{[\tilde{\mathsf{s}}^{a+1}\ln(\tilde{\mathsf{s}}) - (1-\tilde{\mathsf{s}})^{a+1}\ln(1-\tilde{\mathsf{s}})] \\ &\quad -(\ln(\tilde{\mathsf{s}}) - \ln(1-\tilde{\mathsf{s}}))[\tilde{\mathsf{s}}^{a+1}(1-\tilde{\mathsf{s}}) + \tilde{\mathsf{s}}(1-\tilde{\mathsf{s}})^{a+1}]\} \end{aligned}$$

we have

$$\frac{d\mathsf{G}(\mathsf{q};\mathsf{a})}{d\mathsf{a}} > \frac{1}{2}\{\underbrace{[\tilde{\mathsf{s}}\ln(\tilde{\mathsf{s}}) + (1-\tilde{\mathsf{s}})\ln(1-\tilde{\mathsf{s}})]}_{<0}\underbrace{[\tilde{\mathsf{s}}^{a+1} - (1-\tilde{\mathsf{s}})^{a+1}]}_{<0} > 0:$$

Similarly, for $\tilde{\mathsf{s}} > 1{=}2$ we have

$$\frac{d\mathsf{G}(\mathsf{q};\mathsf{a})}{d\mathsf{a}} < \frac{1}{2}\{\underbrace{[\tilde{\mathsf{s}}\ln(\tilde{\mathsf{s}}) + (1-\tilde{\mathsf{s}})\ln(1-\tilde{\mathsf{s}})]}_{<0}\underbrace{[\tilde{\mathsf{s}}^{a+1} - (1-\tilde{\mathsf{s}})^{a+1}]}_{>0} < 0:$$

Claim: $\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a})$ **satisfies (17) and (24).** Condition (17) is equivalent to

$$\frac{d}{d\mathsf{a}}\left[\frac{\int_{q^*}^{1}\mathsf{q}\mathsf{g}(\mathsf{q};\mathsf{a})d\mathsf{q}}{1-\mathsf{G}(\mathsf{q}^*;\mathsf{a})}\right] > 0;$$

which transforms to

$$-\frac{\overbrace{(\mathsf{s}^*)^{a+1}(1-\mathsf{s}^*)^{a+1}}^{>0}\overbrace{\ln(\mathsf{s}^*)}^{<0} + \overbrace{(1-\mathsf{s}^*)^{a+1}(1-(\mathsf{s}^*)^{a+1})}^{>0}\overbrace{\ln(1-\mathsf{s}^*)}^{<0}}{[1-(\mathsf{s}^*)^{a+1} + (1-\mathsf{s}^*)^{a+1}]^2} > 0:$$

Condition (24) is verified by a similar argument.

$\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a})$ **satisfies (7) for all** $\tilde{\mathsf{q}}$ **when** $\mathsf{a} \le 1$. We obtain

$$\begin{aligned} &\frac{d}{d\tilde{\mathsf{q}}}\frac{\mathsf{g}(\tilde{\mathsf{q}};\mathsf{a})}{1-\mathsf{G}(\tilde{\mathsf{q}};\mathsf{a})} \\ &= \frac{1+\mathsf{a}}{2\mathsf{a}}\frac{[\tilde{\mathsf{s}}^{a} + (1-\tilde{\mathsf{s}})^{a}]^2}{(1-\tilde{\mathsf{s}})^{a-1}\tilde{\mathsf{s}}^{a-1}}\left(\frac{\mathsf{a}[1-(1-\tilde{\mathsf{s}}^{a-1})(1+(1-\tilde{\mathsf{s}})^{a-1})] + [\tilde{\mathsf{s}}^{a} + (1-\tilde{\mathsf{s}})^{a}]^2}{[1-\tilde{\mathsf{s}}^{a+1} + (1-\tilde{\mathsf{s}})^{a+1}]^2}\right): \end{aligned}$$

which is positive if $\mathsf{a}[\tilde{\mathsf{s}}^{a-1} - (1-\tilde{\mathsf{s}}^{a-1})(1-\tilde{\mathsf{s}})^{a-1}] + [\tilde{\mathsf{s}}^{a} + (1-\tilde{\mathsf{s}})^{a}]^2 > 0$. Note first that for all $\mathsf{a} < 1$ also the first term on the left-hand side is positive for all $\tilde{\mathsf{s}}$. When $\mathsf{a} = 1$; the inequality holds strictly for all $\tilde{\mathsf{s}} > 0$ and weakly at $\tilde{\mathsf{s}} = 0$.