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Article:
Gu, Y., Rasch, A. and Wenzel, T. (2022) Consumer salience and quality provision in (un)regulated public service markets. Regional Science and Urban Economics, 93. 103754. ISSN 0166-0462

https://doi.org/10.1016/j.regsciurbeco.2021.103754

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Consumer salience and quality provision in (un)regulated public service markets

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September 2021

Abstract

This paper examines the publication of quality indicators in service markets with public finance systems, such as education and healthcare markets. We provide a model in which the reporting of such indicators increases consumers' decision weight on quality relative to other attributes (such as prices and horizontal match) and study the effects in two market environments: markets with regulated prices and markets with unregulated prices. We find that the publication of quality indicators increases quality investments by service providers, but also leads to higher prices and less product variety. Consumer and total welfare can decrease with such policies, in particular when consumers are heavily subsidised.

JEL Classification: L15; L51; I10; I20.

Keywords: Service markets; Quality reporting; Variety; Entry; Regulation; Public finance.

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1 Introduction

There might be several reasons why consumers do not make individually optimal decisions in certain markets. For instance, in public service markets, such as education and health, quality is often a relatively opaque attribute and consumers may find it difficult to assess and compare quality levels across different alternatives. This might lead consumers to misperceive quality and compare different alternatives according to more salient attributes that are easier to compare, such as the price of a product or service.[1] On a more general note, it is also known that consumers have difficulties in correctly assessing the relative importance of different attributes of a product. As argued in Bachi and Spiegler (2018), in complex decision environments, decision makers might focus only on one or a limited number of attributes to simplify the decision process.

We take these observations as a starting point to study consumers' difficult task of comparing diverse attributes, such as the quality of a product, its price and its horizontal match. There are different ways to interpret and influence consumers' stronger focus on some attributes. From the viewpoint of the firms, they may use advertising messages to lead consumers to overestimate the importance of one product attribute relative to others (Zhou, 2008; Zhu and Dukes, 2017). Firms may also make use of certificates or labels to draw consumers' attention to certain aspects of a product or service. Whereas such considerations are part of firms' strategic behaviour, consumer choices can also be affected by policy interventions. In our analysis, we focus on such policy actions that aim at making quality levels provided by firms more salient. In the above-mentioned markets, authorities have been keen on making service providers' performance information more accessible to the public. For example, in the context of English hospitals, the Department of Health and NHS England publish information about A&E Attendances and Emergency Admissions performance, Mortality rate, "Recommended by staff", Infection control and cleanliness, Waiting time, and Inpatients'

[1] Healthcare and education services are prime examples of so-called experience (Nelson, 1970) or credence goods (Darby and Karni, 1973). Such services are characterised by asymmetric information between the service provider and the customer (see Dulleck and Kerschbamer, 2006, for an overview of the economics of credence goods). See, for example, Borghans et al. (2015) for evidence of how experts improve educational choices and Handel et al. (2020) for factors affecting choice qualities in health insurance markets.

friends and family satisfaction, etc. For English universities and other higher education institutions, the Research Excellence Framework (REF) evaluates their research impact, whereas the recently introduced Teaching Excellence and Student Outcomes Framework (TEF) assesses and publishes the quality of their undergraduate teaching.[2]

Our main assumption is that exposure to such performance information makes quality concerns more salient in consumers' decision process (Bordalo et al., 2013). Indeed, there is evidence that consumers indeed react to the publication of performance measures. For instance, Mukamel and Mushlin (1998) conclude that patients seem to respond to information about quality of surgeons and hospitals after publication of the New York State Cardiac Surgery Mortality Reports. Further evidence for such a reaction in the healthcare industry is provided by Pope (2009), Wang et al. (2011) and Yoon (2020). Furthermore, Hastings and Weinstein (2008) report evidence in the context of school choice.[3]

Based on this assumption, we study the effects of publishing provider quality information on market outcomes. In contrast to existing approaches (surveyed below), we do not focus on imperfect information. Instead, we follow Bordalo et al. (2013) and Allcott et al. (2014) and provide a model in which consumers might not correctly make comparisons across attributes via introducing decision weights.[4,5] Motivated by the above-mentioned empirical evidence, we let consumers' decision weight on service quality be influenced by the publication of quality data, such that more information provision leads to a higher decision weight.

[2]Similar quality scores have been published in many other markets. Examples include hospitals (e.g., US, UK, Germany, Italy), doctors (e.g., UK) and nursing homes (e.g., US, UK, Germany).

[3]See also the survey by Dranove and Jin (2010) and the references therein.

[4]Allcott et al. (2014) consider a framework in which consumers can choose between an energy efficient and inefficient durable product. Consumers might not correctly assess the effect of energy efficiency on their future utility from adopting a product, but may either over- or underestimate the effects. Similarly to our model, this is captured by a decision weight.

[5]Whereas in our paper, the decision weight only depends on the publication of quality indicators, there is a growing literature that determines the saliency of product attributes endogenously within the choice context. For instance, in Bordalo et al. (2013, 2016), the decision weights are endogenous and the saliency of an attribute depends on how much an attribute varies within the choice set. Kőszegi and Szeidl (2013) is a similar approach with a focus on intertemporal decisions. Closer to our paper, Zhou (2008) studies a model in which firms' advertising messages lead consumers to overestimate the importance of one product attribute relative to others.

We analyse a two-stage market game in which in the second stage, providers compete to serve the demand, and in the first stage, entry is determined by a zero-profit condition. In this framework, we study how information provision affects service quality, prices, variety, consumer surplus and social welfare. Importantly, and in line with the public service markets we have in mind, we also consider potential subsidy payments to consumers as well as their interaction with quality information. In particular, our focus is on the long-run effects of information provision, where providers can enter the service market by incurring an entry cost to overcome entry barriers, or exit the market when suffering losses.

We consider two regimes depending on whether price is regulated or not. Both regimes are common in service markets. For example, hospitals normally face strict rules on how they can charge for their services. In many countries, hospitals are often compensated through a diagnosis-related group (DRG) payment system. In contrast, in markets such as senior care homes and nursing homes, providers normally have a larger degree of freedom in setting prices than hospitals do. Not to unnecessarily restrict our study to a particular type of market, we find it important to understand the effects of information provision under both regimes.

In the unregulated market, we find that releasing quality indicators has the intended effect of raising service quality. However, higher quality implies larger investment in quality and hence reduces provider profitability. Under endogenous entry, this means fewer providers entering the market which can have detrimental effects of higher prices and lower welfare. Indeed, we find increasing exposure to quality information improves consumer surplus when consumers' initial decision weight is relatively low. However, when consumers put a high weight on service quality, consumer surplus decreases with further exposure to quality information. In our setting the negative effects on consumers comes from reduced market entry leading to less product variety and higher prices for consumers. It is in this sense, we demonstrate that publishing quality indicators can bring about overexposure to quality information. A similar pattern applies to social welfare. Interestingly, the negative effects of quality information exposure are more likely to occur when consumers are more heavily subsidised, because in such cases, providers mainly compete on quality.

In this unregulated market, we also compare equilibrium entry and quality levels with their respective welfare-maximising benchmarks. We find that market entry and quality can be either insufficient or excessive depending on consumers' decision weight on quality. These findings differ from existing contributions that are based on standard spatial models. For example, Economides (1993) finds that entry is always excessive and quality insufficient. In contrast, this holds in the present model only when consumers' decision weight on quality is sufficiently small. Otherwise, entry can be insufficient and quality excessive. Relatedly, and perhaps more surprisingly, in the current setup, an increase in public subsidies does not necessarily improve consumer surplus, a result that is not likely to occur in a standard spatial model. Indeed, when the decision weight on quality is sufficiently large and the market sufficiently competitive, a more generous subsidy reduces consumer surplus.

In the regulated market, there is also an inverted u-shaped relation between the publication of quality indicators and welfare. However, the scope for detrimental effects is much smaller in the regulated market, because with exogenous prices, consumers do not pay more when the decision weight on quality increases. In addition, when the price is optimally regulated, the regulator can fine-tune the price to either boost the positive effects or mitigate the adverse effects of increasing quality information exposure. This is reflected in the observation that the optimally regulated price increases with consumers' decision weight on quality when it is initially low, whereas the price decreases when quality is already high. The reason is that when the quality decision weight becomes large in consumers' decision process, the regulator can revise the regulated price to counter its adverse effects. As a result, further exposure to quality information reduces the regulated price which in turn can reduce market quality and may increase entry. In this regard, regulatory agencies can coordinate their policies on price regulation and on the release of quality information.

Related literature

A number of recent papers have studied the effects of reporting quality scores focusing on healthcare markets. Gravelle and Sivey (2010) examine

the effects in a setting in which consumers are imperfectly informed about the quality of the healthcare product and prices are regulated. They find that better information only leads to higher quality provision if firms differ not too much in the costs of providing quality.

Ma and Mak (2014) consider a good with two quality attributes. While all consumers have the same valuation of the first quality attribute, their valuations of the second vary and are their private information. In this setting, the authors compare Full Quality Report and Average Quality Report, and find that the latter yields the first-best prices and qualities. Ma and Mak (2015) study an insurer's optimal reporting policy and payment method, simultaneously. The authors show that the first-best can be implemented by either prospective payment or cost reimbursement method. However, the associated reporting policies differ. Finally, Mak (2017) studies firms' service decisions, in particular decisions on the dumping of consumers with certain characteristics, under various reporting regimes.[6]

Our approach differs from the above papers in that we consider a setting in which the publication of quality indicators is guiding a consumer's decision focus towards quality attributes. This mechanism can be viewed as complimentary to the above papers. While the modelling of information has been kept intentionally simple (we do not consider imperfect information about quality), our framework with horizontal differentiation allows us to study how the publication of quality indicators affects a provider's choice of quality and price, *and* the level of variety provided in the market in equilibrium. Thus, our welfare results bear more relevance in the long run.

The aspect of quality and competition has been theoretically investigated by a number of studies, often employing a model of spatial product differentiation. An overview of the theoretical and empirical literature regarding the effects of competition is provided in the survey by Gaynor (2007). For example, Brekke et al. (2006) extend the Hotelling model such that, for regulated prices, firms choose their locations and the quality of their products. Bardey et al. (2012) analyse the regulation of payment schemes (a prospective payment per consumer and a cost reimbursement rate) for healthcare

[6]We note that earlier contributions studied quality provision and price competition in a consumer search model without horizontal differentiation (see, e.g., Chan and Leland, 1982 and Dranove and Satterthwaite, 1992).

firms competing in both quality and product differentiation in a Hotelling framework. Brekke et al. (2017) examine the effects of mergers on quality provision in healthcare markets (with and without regulated prices). Relatedly, Brekke et al. (2011) examine quality provision with semi-altruistic firms. Hehenkamp and Kaarbøe (2020) focus on mixed markets and show that the entry of a public firm may disincentivise quality investment by private firms. Particularly related to our approach are Gravelle (1999) and Nuscheler (2003). Gravelle (1999) provides a general framework for studying quality and entry decisions in a model with differentiated products. In contrast to our approach, the paper considers more general demand and cost functions, but does not consider changes in decision focus and the effects of public subsidies. Nuscheler (2003) is a similar framework and studies quality investments in a setting with differentiated products and endogenous entry. The paper focuses on markets with regulated prices. Within this setting, the paper explores the optimal policy (with regard to quality levels and entry).

Our innovation in relation to this strand of literature is two-fold. First, we allow consumers to misoptimise when comparing different alternatives. We have added a decision weight that measures the importance of quality in the decision process, which, however, can differ from the actual experienced utility derived from quality. Some existing papers also consider the implications when consumers attach more importance to quality, but in settings in which consumers do not misoptimise and can perfectly evaluate the quality levels offered by the firms. Thus, from a conceptual point of view, our approach differs in that consumers' perceived utility (but not the experienced utility) depends to a different extent on the quality attribute. Whereas some of the observational predictions coincide, the welfare implications are shown to be different. Second, we demonstrate that our analysis applies more broadly to service markets with public finance systems in general. We show that the interplay of price subsidies and decision focus plays a crucial role regarding the welfare implications, which is not considered by existing contributions. That is, in contrast to existing contributions, we study the effects of price subsidies in markets with horizontal product differentiation and quality provision.

On a more general note, the aspect of product quality in spatial models of competition has been analysed in a variety of papers. For instance, as

far as the relationship between entry and quality is concerned, Economides (1993) shows that adding competition in quality to the standard setup results in more entry and underprovision of quality compared with the socially optimal solution. In contrast, in our model with decision weights on quality and public subsidies, this may no longer hold, and entry can be insufficient and quality excessive. Brekke et al. (2010) stress the importance of income effects for the relationship between competition and quality. The presence of income effects may lead to a positive relationship between the (exogenous) number of firms and equilibrium quality. The current paper adapts their approach and studies the effects of publishing quality information in public service markets.

Finally, our paper contributes to the discussion of whether or not the free market provides optimal variety when products are differentiated. While it is often agreed that entry is excessive within the standard circular city framework (Vickrey, 1964; Matsumura and Okamura, 2006b), recent studies have demonstrated that entry can be insufficient, for example, when consumers are not necessarily uniformly distributed (Calvó-Armengol and Zenou, 2002), when entry cost is high (Matsumura and Okamura, 2006a) or when demand is price elastic (Gu and Wenzel, 2009; Gu et al., 2016). The current paper, however, presents a new mechanism for the possibility of insufficient entry to arise. We show that with firms competing on both prices and qualities, entry is insufficient when consumers' decision weight on quality is above a certain threshold. More interestingly, this threshold decreases when consumers are more heavily subsidised implying that entry is more likely to be insufficient when a more generous public finance system is introduced.

The remainder of the paper is organised as follows. Section 2 describes our model setup. Section 3 contains the analysis when providers are free to set prices, and Section 4 considers the case where prices are regulated. Section 5 concludes the paper.

2 The model

2.1 Consumer behaviour

Consider a market for a differentiated product. There is a measure one of consumers who are located uniformly along a circle of circumference one (Salop, 1979). A consumer who is located at x and who buys from firm i at location l_i derives the experienced utility (denoted by the subscript e)

$$u_e(p_i, q_i, x) = v + q_i - \gamma p_i - t|x - l_i|,$$

where v is the gross utility from consuming the product. We assume that v is sufficiently large such that the market is covered and every consumer purchases the product. The quality and the price of the good are denoted by q_i and p_i, respectively, and t is the transport cost per unit of distance travelled.

There is a public finance system in place so that a consumer only pays a share $\gamma \in [0, 1]$ of the total price. Borrowing from the healthcare literature, we call γ the coinsurance rate faced by a consumer. The remaining share, $1 - \gamma$, is covered by the public finance system. This could be, for example, a government-financed insurance system in the context of healthcare markets, subsidised student loans in higher education markets, or the "cash for care" scheme in senior care markets (see, for example, Ungerson, 2004). The case $\gamma = 1$ corresponds to a situation without government subsidies which means that a consumer pays the full price, whereas $\gamma = 0$ is a situation in which the product is provided to consumers free of charge.

In the model, we allow that consumers might not correctly make comparisons across attributes (as discussed in the Introduction). We capture misoptimising behaviour by introducing a decision weight $\lambda > 0$ on quality. This decision weight λ measures the extent to which consumers take quality into account when making their purchase decisions. We posit that, when deciding, a consumer acts as to maximise the following perceived utility u_p,

$$u_p(p_i, q_i, x) = v + \lambda q_i - \gamma p_i - t|x - l_i|.$$

Perceived and experienced utility differ when the decision weight $\lambda \neq 1$. We allow λ to be smaller or larger than one. In cases in which $\lambda < 1$, a consumer undervalues quality relative to price and fit, and in cases with $\lambda > 1$, a consumer attaches too much weight on quality. Only when $\lambda = 1$, a consumer evaluates quality correctly, and we have $u_p = u_e$.

In the analysis below, the decision weight λ will be one of our key parameters and we compare market outcomes with different levels of λ. We also use this framework to analyse the effects of quality disclosure policies. We think of policy interventions, such as publishing quality indicators (on care homes, hospitals, universities, etc.), as increasing the saliency of quality in the decision process.[7] For a consumer who receives information on such quality indicators, the quality dimension may become more salient relative to the other characteristics, and as a result, she puts more weight on this dimension during the decision process. Hence, we view policies that increase the visibility of quality indicators as increasing the value of λ by making quality more salient. For example, as Mukamel et al. (2007) point out, the underlying rationale for so-called quality report cards is "to address an inherent limitation of health care markets, namely the imbalance information between price and quality" (p. 1228). As a consequence, choosing a medical provider is "likely to be influenced mostly by the more easily observable attributes, such as price, distance to the provider, and the nonclinical aspects of quality" (p. 1228).[8]

Note that our starting point is a scenario without any policy intervention in which consumers put only little weight on quality (or have little knowledge about quality), that is, $\lambda < 1$. Then, as the result of a policy intervention, consumers put more weight on quality, such that quality also gains in importance relative to price and preference. We allow for cases in which a policy intervention results in a situation in which quality becomes the most important aspect in the decision-making process, that is, $\lambda > 1$. As such, the

[7] This is similar to a firm advertising a specific product attribute as studied in Zhu and Dukes (2017).

[8] As another example, Choi et al. (2010) provide evidence that presenting information indeed shifts consumers' focus. In their experimental study, consumers have to choose between four index funds. Consumers are more likely to choose a fund according to past performance when this information is highlighted. Similarly, consumers care more about prices when there is more price information. See also the evidence discussed in the Introduction of this paper.

increase in the quality weight may capture additional implications of policy interventions (in a rather stylized manner). Putting a lot more weight on quality in the wake of information dissemination appears to be a realistic outcome: As Haisken-DeNew et al. (2018) find in their empirical study on the effects of a government-run website for quality in Australian schools, there is a causal effect of the release of information about high-quality schools and the increase of property prices in the neighborhood in the state of Victoria.

2.2 Firm behaviour

Let there be $n \geq 2$ firms with equidistant locations along the circle. Firms compete to supply the differentiated product to consumers. For each firm, the (fixed) cost of producing the good at quality q is $K(q) = kq^2/2$. We assume a constant marginal cost of production which is normalised to zero.[9] A firm must also incur a fixed cost $f > 0$ to enter the market.

We consider two regimes: with and without regulated prices. In both cases, firms decide about market entry in the first period. In the second period, if the price is not regulated, firms set their prices and qualities simultaneously. On the other hand, if the price is regulated, firms only compete in qualities. We consider free entry in each regime, that is, the equilibrium profit after entry is equal to the entry cost.

3 The unregulated market

Consider first the case in which firms can freely set prices, that is, firms compete both in prices and qualities.

We assume that horizontal differentiation among firms is sufficiently large:

Assumption 1. $t > \frac{\lambda^2}{2k\gamma} = \underline{t}$.

This assumption ensures that there is a positive level of entry and that firms offer a positive level of quality.

[9] In Section 3.3 we explore the implications of an alternative cost structure, where a higher quality level does not lead to higher fixed costs, but rather increases the per-unit costs.

3.1 Equilibrium outcomes with free market entry

Assume $n \geq 2$ firms have entered the market. We seek for a symmetric equilibrium. Suppose all firms except firm i that is located at 0 choose quality q_o and price p_o. The indifferent consumer located at d between firm i and its immediate neighbour at $1/n$ is given by

$$v + \lambda q_i - \gamma p_i - td = v + \lambda q_o - \gamma p_o - t\left(\frac{1}{n} - d\right).$$

That is,

$$d = \frac{1}{2n} + \frac{\lambda(q_i - q_o)}{2t} - \frac{\gamma(p_i - p_o)}{2t}.$$

Firm i's profits are

$$\pi_i = 2d \cdot p_i - \frac{k}{2}q_i^2 = \left[\frac{1}{n} + \frac{\lambda(q_i - q_o)}{t} - \frac{\gamma(p_i - p_o)}{t}\right]p_i - \frac{k}{2}{q_i}^2. \qquad (1)$$

Maximising expression (1) with respect to q_i and p_i and using symmetry gives the following equilibrium price and quality:

$$\hat{q} = \frac{\lambda}{\gamma k n}$$

and

$$\hat{p} = \frac{t}{\gamma n}. \qquad (2)$$

Regarding the price, we see expected comparative statics. The price is increasing with the transport-cost parameter but drops with a larger number of competitors. Quality provision is also decreasing with the number of firms. However, quality provision is higher if consumers have a larger decision weight on quality, as measured by λ. Of course, higher costs k lead to less quality. Interestingly, both price and quality are decreasing with the coinsurance rate γ. A higher γ makes demand more sensitive to price increases, and hence reduces the incentives to provide high quality.

Equilibrium profits are thus

$$\hat{\pi} = \frac{\hat{p}}{n} - \frac{k}{2}\hat{q}^2 = \frac{t}{\gamma n^2} - \frac{\lambda^2}{2\gamma^2 k n^2} = \frac{2\gamma t k - \lambda^2}{2k\gamma^2 n^2}.$$

Assumption 1 implies that firms earn positive profits. This also implies that profit $\hat{\pi}$ decreases in n. Under free entry, the number of firms n^* is determined by the zero-profit condition:

$$\frac{2\gamma tk - \lambda^2}{2k\gamma^2 n^2} = f.$$

Hence,

$$n^* = \sqrt{\frac{2\gamma tk - \lambda^2}{2fk\gamma^2}}.$$

This implies the following quality and price level in the free-entry equilibrium:

$$q^* = \lambda\sqrt{\frac{2f}{k(2tk\gamma - \lambda^2)}}$$

and

$$p^* = t\sqrt{\frac{2fk}{2tk\gamma - \lambda^2}}.$$

The following proposition describes the effects of increasing the visibility of quality (as measured by λ):

Proposition 1. i) An increase in λ leads to higher quality, lower entry and higher prices.

ii) The effect of an increase in λ on quality provision and on prices is stronger for a lower coinsurance rate, that is, $\partial^2 q^*/\partial\lambda\partial\gamma < 0$ and $\partial^2 p^*/\partial\lambda\partial\gamma < 0$.

It is instructive to compare how the equilibrium changes with consumers' decision weight on quality in the unregulated market. The first finding is that quality provision and prices increase, whereas entry levels go down.[10] Because a higher λ means that firms have higher incentives to invest in quality for a given number of firms (see equation (3.1)), entry levels go down as the additional quality investments make it less profitable to enter

[10]There is indeed some evidence that quality disclosure leads to quality improvements. See, for instance, Chou et al. (2014) and Filistrucchi and Ozbugday (2012) for hospitals and Herr et al. (2016) for nursing homes.

the market in the first place. With a smaller number of firms, prices increase and quality increases even further.

The second finding is that the effects of additional quality provision and prices are larger in markets with more generous public finance systems (that is, a low coinsurance rate). With a more generous public finance system, firms mainly compete on quality, thus increasing the focus on quality, leading to even higher investment levels.

Given that the release of quality indicators, which makes quality more visible in consumers' eyes, has positive effects (higher quality) as well as negative effects (higher prices, less variety) on consumers, it is a priori unclear whether consumers benefit from such interventions or not. It is also unclear whether social welfare increases. Given equilibrium behaviour, the surplus of consumers and total welfare can be expressed as:

$$CS^* = v - \frac{t}{4n^*} + q^* - \gamma p^* = v - \frac{\sqrt{2f}(5kt\gamma - 4\lambda)}{4\sqrt{k(2kt\gamma - \lambda^2)}}$$

and

$$W^* = v - \frac{t}{4n^*} + q^* - n^* \left(f + \frac{k}{2} q^{*2} \right) = v - \frac{\sqrt{2f}(4kt + kt\gamma - 4\lambda)}{4\sqrt{k(2kt\gamma - \lambda^2)}}.$$

Note that here the actual effect of quality on consumer surplus matters, not the perceived surplus.

Differentiation with respect to λ gives the following findings:

Proposition 2. i) In the unregulated market, the surplus of consumers increases (decreases) with decision weight λ if $\lambda < (>) 8/5$.

ii) Define $\tilde{\lambda} := 8\gamma/(4 + \gamma)$. In the unregulated market, total welfare increases (decreases) with decision weight λ if $\lambda < (>) \tilde{\lambda}$.

iii) As $\partial\tilde{\lambda}/\partial\gamma > 0$, an increase of the decision weight λ is more likely to be welfare-reducing for a lower coinsurance rate.

Proposition 2 has two messages. First, if quality information in the market is poor, improving this information generates better outcomes in terms of con-

sumer surplus and welfare. However, if this additional information induces consumers to put an excessively large weight on quality, market outcomes can worsen. Parts i) and ii) demonstrate this effect for the surplus of consumers and total welfare. We note that the negative effects on welfare come from long-run effects via entry decisions. As mentioned above an increases in λ reduces entry levels and therefore leads to reduced product variety and higher prices. Second, part iii) relates to the interaction of the public finance system and decision focus. It shows that additional quality information is more likely to be welfare-reducing if consumers receive heavy subsidies, that is, if coinsurance rates are low. This follows because with heavier subsidies, prices receive a relatively low decision weight compared to quality provision. As in many such markets in which consumers receive generous subsidies, it might indeed be the case that releasing quality information shifts consumer focus too much on quality such that quality is overprovided relative to the optimum, at the expense of higher prices and less variety.

It should be pointed out that the critical level of λ for the negative welfare effects to materialise is not particularly large. The critical level in part i) of Proposition 2 is slightly larger than the rational benchmark of $\lambda = 1$. In part ii), the critical level of λ can even be smaller than the rational benchmark of 1 if the level of public subsidy is sufficiently large.

We note that in our setting with varying decision weights on quality, the effects of subsidies on consumer surplus can be unexpected:

Corollary 1. Let $\bar{t} := \lambda(5\lambda - 4)/5k\gamma$. (i) In the unregulated market, consumer surplus decreases with the coinsurance rate γ if $\lambda < 8/5$ *or* $\lambda > 8/5$ and $t > \bar{t}$. (ii) Consumer surplus increases with the coinsurance rate γ if $\lambda > 8/5$ and $\underline{t} < t < \bar{t}$.

The corollary shows that, contrary to conventional wisdom, consumers may be hurt by higher levels of public subsidies. When the decision weight on quality is sufficiently large and the market sufficiently competitive, smaller values of γ can indeed lead to lower levels of consumer surplus. This cannot happen in a standard framework where $\lambda = 1$.

3.2 Optimal market entry and quality

It is often debated whether or not the free market provides optimal variety and quality levels. While in a standard spatial setup, free entry seems to offer too much variety and too little quality (Economides, 1993), this question is yet to be investigated in the current framework of varying decision weights and in the presence of public subsidies. We note that social welfare for a fixed number of firms but allowing for free competition in price (2) is

$$W = V - \frac{t}{4n} + q - n\left(f + \frac{k}{2}q^2\right). \tag{3}$$

Let t be sufficiently large, that is, $t > 2/k$. Under this assumption, social welfare is maximised with respect to the number of firms and the quality levels at

$$n^s = \sqrt{\frac{tk-2}{4fk}} \tag{4}$$

and

$$q^s = \sqrt{\frac{4f}{k(tk-2)}}. \tag{5}$$

Proposition 3. Define $\hat{\lambda}_1 := \sqrt{tk\gamma(4-\gamma)/2+\gamma^2}$ and $\hat{\lambda}_2 := \sqrt{4\gamma}$, where $\hat{\lambda}_1 > \hat{\lambda}_2$. In the unregulated market, there is (i) excessive (insufficient) entry when $\lambda < (>)\hat{\lambda}_1$, and (ii) an insufficient (excessive) quality level when $\lambda < (>)\hat{\lambda}_2$.

The intuition follows from Proposition 1. As the decision weight on quality λ increases, the number of entrants decreases in equilibrium, but quality investments increase. On the one hand, when $\lambda > \hat{\lambda}_1$, the equilibrium number of entrants falls below the socially optimal level and, hence, entry becomes insufficient. On the other hand, when $\lambda > \hat{\lambda}_2$, the equilibrium quality level rises beyond the socially optimal level and, hence, quality becomes excessive.

As $\hat{\lambda}_1 > \hat{\lambda}_2$, we also point out that cases might arise where both quality and entry is excessive. These findings differ from existing contributions. Economides (1993) finds that entry is always excessive and quality insufficient. In contrast, in our setup with a varying decision weight on quality

and consumer subsidies, the exact opposite outcome can indeed emerge. Regarding entry levels, the underlying mechanism for insufficient entry in the current paper, however, is different from that in, for example, Gu and Wenzel (2009) where the driving force is price-sensitive demand.

Corollary 2. The critical values $\hat{\lambda}_1$ and $\hat{\lambda}_2$ are increasing in γ.

It is also worth noting that the quality decision weight thresholds $\hat{\lambda}_1$ and $\hat{\lambda}_2$ increase in the coinsurance rate γ. That is, for a given decision weight on quality λ, entry is more likely to be insufficient and quality more likely to be excessive when consumers are more heavily subsidised.

3.3 Output-dependent costs

In the base model, we consider output-independent costs when firms offer a higher quality. In this subsection, we briefly discuss the results when firms have to incur output-dependent costs associated with quality provision. This might be relevant for markets in which quality is associated with an improvement of the service quality leading to higher costs for each consumer served.

Suppose that firms face per-unit costs of $\kappa q_i^2/2$ that are strictly increasing with the level of quality provided. The main difference to the base model is now that with higher quality levels, firms face higher marginal costs and, hence, there is stronger upward pressure on prices when a firm increases its quality level.[11] Regarding the welfare effects on consumers, as in the base model (see Proposition 2), we find that consumer surplus increases in λ only for smaller levels of λ. We note, however, that the scope for surplus improvement is smaller, because higher quality levels (induced by the increase in λ) have a stronger effect on the prices consumers have to pay. Relatedly, we find that the scope for an increase in total welfare is also somewhat smaller than in the base model.

[11] Note that in the base model, equilibrium prices are increasing in λ due to reduced entry, whereas in the case of output-dependent costs, prices also increase for a given number of firms. One implication of this finding is that in this version of the model an increase in λ can lead to lower consumer surplus for a given number of firms.

An interesting difference emerges with regard to entry incentives. We find that the entry level is independent of λ. That is, in contrast to the base model, higher quality levels (induced by larger λ) do not diminish the incentives to enter the market, because higher costs are now passed on to consumers. An immediate implication of this finding is that market entry is always excessive (as in the standard circular market model), but quality provision can be excessive or insufficient.

4 The regulated market

In this section, we consider the situation in which prices are regulated. This is, for instance, relevant in hospital markets in which treatment charges are typically fixed, and hospitals are not free to compete on prices (in contrast to, for example, care homes that are typically free to decide on their prices). Similarly, universities in the UK face regulated tuition fees, but are free to invest in quality by providing better learning facilities, attracting more prominent academics, etc. In addition, we consider a setting with complete commitment power, so that the regulator is able to set the price before entry takes place.[12]

4.1 Competition in the regulated market

We will start our analysis by looking at the case in which the price is exogenously given by p_r. We impose the following assumption on parameter values to ensure that in equilibrium there is a positive level of entry and firms offer a positive quality level:

Assumption 2. $t > \frac{\lambda(8-\lambda)}{8k}$.

Given that the price is regulated at the level p_r, the indifferent consumer is

[12] In Section 4.3, we also consider a case of partial commitment, where the regulator chooses the price after observing market entry.

given by

$$v + \lambda q_i - \gamma p_r - td = v + \lambda q_o - \gamma p_r - t\left(\frac{1}{n} - d\right)$$
$$\Leftrightarrow d = \frac{1}{2n} + \frac{\lambda(q_i - q_o)}{2t}.$$

Note that because prices are regulated at the same level, the coinsurance rate has no influence on consumers' decision making and, as a result, has also no effect on firms' incentives to invest in quality.

Firm i's profit becomes

$$\pi_i = p_r \left[\frac{1}{n} + \frac{\lambda(q_i - q_o)}{t}\right] - \frac{k}{2} q_i^2.$$

Equilibrium quality is thus given by

$$\bar{q} = \frac{\lambda p_r}{tk}. \tag{6}$$

Equilibrium profits are

$$\bar{\pi} = \frac{p_r}{n} - \frac{k}{2}\bar{q}^2, \tag{7}$$

and, hence, the number of firms under free entry is

$$\bar{n} = \frac{p_r}{f + \frac{k}{2}\bar{q}^2} = \frac{2kt^2 p_r}{2t^2 kf + \lambda^2 p_r^2}. \tag{8}$$

From profits (7) and entry (8) one can see that a higher price p_r has two effects on the firms' entry decisions. On the one hand, a higher price induces more entry by increasing the profit margin of each firm. On the other hand, a higher price also leads to increased quality investments (see equation (6)), leading to higher investment cost and less entry. The following lemma shows that either effect can dominate:

Lemma 1. i) Define $\hat{p}_r := t\sqrt{2fk}/\lambda$. Then, a higher regulated price p_r increases (decreases) entry if $p_r < (>)\hat{p}_r$. $\hat{p}_r$ negatively depends on λ.

ii) An increase in λ leads to higher quality and lower entry.

In Lemma 1 we also note that, as in the unregulated market, a higher decision weight on quality λ reduces the incentives to enter the market. A higher λ is associated with higher quality investment costs that act as an additional entry cost. This mechanism is qualitatively similar to the effect in the unregulated market in which firms also compete in prices.

For given prices, consumer surplus and total welfare are given by

$$CS = V + q - \frac{t}{4n} - \gamma p_r$$

and

$$W = V + q - \frac{t}{4n} - n\left(\frac{k}{2}q^2\right) - nf.$$

Using the competitive level of quality (6) and entry (8) induced by a regulated price of p_r, we have

$$CS = V + \frac{8\lambda p_r^2 - \lambda^2 p_r^2 - 2fkt^2}{8tp_r k} - \gamma p_r$$

and

$$W = V + \frac{8\lambda p_r^2 - \lambda^2 p_r^2 - 2fkt^2 - 8kp_r^2 t}{8tp_r k}. \tag{9}$$

The following proposition evaluates the impact of λ on welfare measures.

Proposition 4. In the regulated market with an exogenous price, consumer surplus and total welfare increase (decrease) with a higher decision weight λ if $\lambda < 4$ ($\lambda > 4$).

The proposition reveals that also in a regulated market, the surplus of consumers and total welfare may decrease with higher values of λ. In both cases, the welfare effects are negative if the decision weight is excessively large. The trade-offs for consumers concern a positive effect of higher quality but less variety. Regarding total welfare, there is an additional negative effect via the costs of providing quality.[13]

[13] In the existing literature, a similar finding emerges. Competition (that can be viewed as having similar effects as an increase of λ) among firms can lead to excessive quality and can, therefore, be detrimental to overall welfare. See, for instance, the survey by Gaynor (2007). We note that in our setting, there can also adverse effects for consumer surplus.

4.2 Optimal price regulation

So far in our analysis, we considered the price in a regulated market as fixed exogenously. Here we consider the implications if a regulator can set the price as to maximise total welfare in the market. In this section, we focus on full commitment power. With full commitment power, the regulator commits to a fixed price p_r before firms enter and choose their quality levels. We are interested in understanding how a regulator should regulate this price and the resulting welfare consequences of increasing quality visibility with an endogenously regulated price.

By maximising expression (9), we can determine the optimal regulated price as

$$p_r^* = t\sqrt{\frac{2fk}{8kt + \lambda^2 - 8\lambda}}.$$

Lemma 2. The optimal price is increasing in λ for $\lambda < 4$, and decreasing for $\lambda > 4$.

Lemma 2 shows there is an inverted u-shaped relation between the regulated price and λ. For low values, the optimal price is increasing, whereas it is decreasing for higher levels. The intuition is as follows. Because with a higher λ, firms invest more in quality, investment costs rise and entry goes down. By increasing the price the regulator can dampen such effects. This is the dominating effect when $\lambda < 4$ and the regulated price increases in λ over this range. On the other hand, the regulator can also dampen potentially excessive incentives to invest into quality by reducing the price p_r. Becaue with high values of λ, firms have strong incentives to increase quality, the regulator reacts by reducing p_r^* for sufficiently high levels of λ.

The optimally regulated price induces the following levels of quality and entry:

$$q^* = \lambda\sqrt{\frac{2f}{k(8kt + \lambda^2 - 8\lambda)}} \tag{10}$$

and

$$n^* = t\frac{\sqrt{k(8kt + \lambda^2 - 8\lambda)}}{(4kt + \lambda^2 - 4\lambda)\sqrt{2f}}. \tag{11}$$

Note that by Assumption 2 equilibrium entry and quality are positive.

It is instructive to compare the induced quality (10) and entry (11) with corresponding first-best quality (5) and entry (4), respectively. A simple comparison indicates that $q^* > q^s$ and $n^* < n^s$ if and only if $\lambda > 4$. That is, the quality and entry induced by the optimally regulated price coincides with the first-best quality and entry levels when $\lambda = 4$. If $\lambda > (<)4$, the regulator settles at a higher (lower) level of quality provision and a lower (higher) level of entry.

We can now examine the effects of the publication of quality indicators as measured by an increase in λ on the key outcomes, quality and entry:

Lemma 3. i) Let $\tilde{\lambda}_1 := 2kt$. Then, quality provision is increasing (decreasing) in λ for $\lambda < (>)\tilde{\lambda}_1$.

ii) Let $\tilde{\lambda}_2$ be implicitly defined by $12kt\tilde{\lambda}_2 + \tilde{\lambda}_2^3 - 16kt - 12\tilde{\lambda}_2^2 + 16\tilde{\lambda}_2 = 0$. Then, entry is increasing (decreasing) in λ for $\lambda < (>)\tilde{\lambda}_2$.

It is interesting to note that increasing λ has a non-monotonic effect on quality levels. For low levels of λ, quality provision is increasing, whereas it is decreasing for higher levels. This is different to the case of the unregulated market (studied in Section 3) in which equilibrium quality provision is strictly increasing with the visibility of quality to consumers. In the regulated market, as λ increases, the regulator finds it worthwhile to reduce the price as to curb (excessive) investment in quality by reducing payments to the firms (see Lemma 2). Moreover, over some region, the number of firms in the market is increasing, dampening the incentives to invest in quality.

Given optimally regulated prices, a higher level of λ does not necessarily lead to lower entry levels (compared to the unregulated case). This is because, at least for low levels of λ, the optimal price is also increasing in λ, because the regulator wants to prevent lower entry levels.

We are now in a position to evaluate the welfare effects of publishing quality indicators:

Proposition 5. In the regulated market with optimal prices, consumer surplus and total welfare are increasing (decreasing) in λ for $\lambda < (>)4$.

The proposition highlights that consumer surplus and total welfare can even decrease when the price is optimally regulated. In particular, this negative welfare effect arises when λ is sufficiently large. It is interesting to note that the critical level of $\lambda = 4$ is the same for an arbitrary price and the optimally regulated price (see Proposition 4). The intuition comes from the finding that quality is insufficient for $\lambda < 4$, but excessive when $\lambda > 4$, combined with the optimal response of the regulator, as described in Lemma 2. When $\lambda < 4$, quality is insufficient and the regulator responds to an increase of λ by increasing the price so that both quality and entry levels get closer to the first-best levels, which increases welfare. In contrast, when $\lambda > 4$, quality is excessive so that the regulator responds by decreasing the price to curb further excessive investment. However, both quality levels and entry levels move away from the first-best outcome leading to a decrease in welfare.

As in the unregulated market, publishing quality indicators can reduce consumer surplus and total welfare if consumers place an excessive weight on quality when making decisions. However, the scope for this surplus-reducing effect is much smaller in the regulated market. This finding arises, because the critical parameter levels of λ for the welfare-decreasing effect to arise is strictly smaller in the unregulated market. In the regulated market, via reducing prices, the regulators can limit these negative effects. Moreover, it can also affect the entry level by adjusting regulated prices. This intuition follows from Lemmas 2 and 3.

4.3 Partial commitment power

In this section, we investigate the situation in which the regulator sets the regulated price after entry has taken place but before the firms compete in qualities. This is a relevant scenario when the regulator does not have full commitment power and has to respond to market entry.

For a given combination of regulated price p_r and entry n, in the last stage of quality competition, social welfare is given by (3) with corresponding endogenous equilibrium quality (6). Taking n as given, the regulator's maximization of social welfare with respect to p_r leads to $p_r^* = t/\lambda n$. In contrast to the case with full commitment power, price regulation here affects welfare through quality provision only, and intuitively, the regulated price

increases as market competition decreases to restore quality provision.

Entry is determined in the first stage as usual by the free-entry condition with firms anticipating the regulated price being $p_r^* = t/\lambda n$. Simple algebra leads to equilibrium entry of $n^* = \sqrt{2fk\lambda(2tk-\lambda)}/2fk\lambda$, which in turn implies that the regulated price will be $p_r^* = tfk\sqrt{2}/\sqrt{fk\lambda(2tk-\lambda)}$ and equilibrium quality $q^* = \lambda f\sqrt{2}/\sqrt{fk\lambda(2tk-\lambda)}$.

In this case of partial commitment power, quality decision weight λ unequivocally increases equilibrium quality and decreases entry. Whereas the regulator can respond to changes in λ by adjusting the regulated price and influencing quality provision, the first order effects of λ dominate and, hence, these observations are more in line with Lemma 1 than with Lemma 3.

In contrast, the effects on social welfare and consumer surplus are comparable to those in Proposition 5. Under partial commitment power with optimally regulated prices, total welfare is increasing (decreasing) in λ for $\lambda < (>)4$. A similar result holds for consumer surplus but with a different critical value for λ.

In summary, our analysis has shown that, with some exceptions in details, the main results from the case with full commitment power are mostly valid when the regulator only has partial commitment power and optimally adjusts the regulated price according to entry.

5 Conclusion

This paper offers a model of how the publication of quality indicators affects competition between service providers (firms). In our setting, we model the release of quality scores as an increase of the decision weight on the quality variable, relative to other attributes (such as prices). We argue that reporting quality scores increases the visibility of quality, and therefore consumers are likely to attach a larger weight to this attribute during their decision process. In our model, the number of firms is endogenous and depends on the competitiveness of the market. We contrast the effects in markets in which prices are regulated (such as hospitals or universities) and those in which prices can be set by firms (such as care homes).

The results of our analysis have implications for policy design. Our main message is that an increased visibility of quality information can have ambiguous effects on market performance. In the unregulated market, we find that better access to quality rankings leads to higher quality investments, which is the intended effect of such policy interventions. However, we also identify unintended effects of such interventions: The positive effect of higher quality is countered by higher prices and lower product variety. As a result, consumer surplus and total welfare increase with increased quality visibility only if the initial weight of the quality attribute is low, but decrease if consumers put a large weight on the quality dimension. Importantly, there is also an interaction with the degree of the public finance system. Making quality information more transparent is more likely to have adverse effects if consumers are heavily subsidised.

We find qualitatively similar effects for the case of regulated prices. Also, in the case of regulated markets, releasing quality scores can have detrimental welfare effects, but compared to an unregulated market the scope for this to happen is much smaller. However, we also note that quality disclosure can be complementary to price regulation. The optimal price is non-monotonic in the degree of information. Because consumers attach excessive weight to quality, optimal regulation reacts by reducing the regulated prices.

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