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Providers and Profiteers: Essays on Profit and Competition in the Provision of Public Services

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Introduction

How should we organize public services to make sure that patients will get the right treatment and students get a good education? This thesis uses a mix of theoretical and empirical techniques to study how various policy instruments such as allowing user choice, different price setting schemes, voucher levels, and taxes affect quality provision in public service sectors.

The first article studies the role of competition and tax incentives on voluntary profit restrictions in public service sectors with free price setting, and how this affects the quality of services. Private providers can voluntarily restrict profits as a commitment devise to produce higher quality. Providers are most likely to use this strategy when competition is "moderate", and when they place high intrinsic value on quality. It can be beneficial to introduce tax benefits as an incentive for providers to restrict profits. If the providers place high value on the quality of their services, tax benefits have the desired results of increasing the number of profit-restricting actors. However, if they place a low value on quality, tax benefits will instead decrease incentives to voluntarily restrict profits.

The second article models competition in two different quality dimensions, studying the role of private and public schools and whether competitive neutrality (i.e., the local government must set the same voucher-price to all actors) is a good principle by which to organize public service sectors. Under competitive neutrality, the best result will never be obtained by having both private and public actors present in the same district. However, if the local government is allowed to set a different voucher-price to private and public actors, this is no longer the case. By shifting resources away from the private schools to the public schools, better results can be achieved than with only private or inly public schools.

The third article uses an empirical approach to measure the role of competition on grade inflation in Swedish upper secondary educations. Using a spatial autoregressive model, I create a space-based measure of competition. The results do not show statistically significant evidence that competition drives grade inflation, but the size of the effect is large enough to be wary of. Also, there is no evidence that grade inflation is contagious, i.e., that grade inflation by a school would by itself increase grade inflation in its competitors.

Chapter 1

When would private providers of public services voluntarily restrict profits?

Sebastian Larsson

Abstract

This paper investigates incentives for private providers of public services to voluntarily restrict profits as a commitment to provide unobservable quality. My first finding suggests that making competition more intense (i.e., through subsidizing travel costs between providers) will not necessarily encourage all providers to restrict profits. Specifically, it is not good if competition is too intense. My second finding shows that setting lower taxes to providers who voluntarily restrict profits can make it more attractive to do so if the provider places a high enough intrinsic value on quality, but will make it less attractive if the providers have a lower value of quality. In fact, this lower tax rate may even lower investment in quality!

Keywords: Public Services, Competition, Nonprofits
JEL Classification: D43, H75, L32, L33

1 Introduction

Profits taken out by providers of public services are controversial for several reason, in particular when the providers are public actors. First, they are controversial since these sectors often are subsidized to some degree, meaning that state funding is taken out as profits. Second, they are controversial due to a fear that for-profit providers will under-provide quality, as quality is often difficult for users to observe (Molander, 2017). In comparison to private for-profit actors, the public has a more favorable opinion about private not-for-profit actors, both when it comes to their use of funding and in the quality of their services. Strategically manipulating the incentives for providers to adopt not-for-profit status can help deal with these two perceived problems. Additionally, if there is political opposition to government directly controlling public service providers, this would be a possible compromise.

This paper studies the incentives of private actors to voluntarily adopt not for profit status. The reason providers would be interested in adopting not-for-profit status is that doing so will send a credible signal to users that they provide higher quality services, and they should therefore be able to attract more consumers. I study two main questions. The first is how competition makes providers more or less interested in adopting not-for-profit status, and what we would then expect to see in different market environments. The second is how tax-benefits to not-for-profit providers affect incentives under different market environments. Due to the combination of free pricing and user choice, I will in this article use the term "market" to describe the districts where these providers are operating as I feel this most accurately reflects the operations, even though the term is somewhat contentious when applied to public services.

Here I assume that not-for-profit providers have made a voluntary choice to restrict profits. Compare this to public actors, where the policy maker has direct control over prices. By restricting the owners ability to take out dividends, it is more attractive for them to provide services of higher quality. This works if providers derive non-monetary value from offering services of high quality, by increasing the relative utility

of investing earnings rather than taking them out for a direct benefit. Also, the commitment provides not-for-profit providers with a competitive advantage.

I base my analysis on two stylized facts of public service sectors. The first characteristic is that public service sectors are often local markets with limited competition.[1] Because of this spatial aspect I use a Hotelling competition model, where the travel costs determines the strength of competition. The second characteristic is the special role that the quality of services plays in public service sectors. Quality is often ex-ante unobservable by users. For example it is difficult to judge how good a clinic is before actually visiting. However, public service providers often have social motives, and therefore care intrinsically about the quality of their services, which weakens the incentives for providers to shirk on quality. In my model, I capture this by having providers derive intrinsic non-monetary utility by providing high quality services, i.e., a "semi-altruistic" actors framework.

Policy-makers attempt to increase the quality of public services in many ways. It is therefore important to explore whether these policies have the desired effect. Tax subsidies can be costly, and intervening in a market can have unintended and negative consequences (Sivesind & Trætteberg, 2017). Consider for example policies to increase competition between providers, either by opening up for users to choose providers easier, subsidizing travel costs, or increasing information about providers to users. Consider the Swedish "Lagen om Valfrihet".[2] A motivation of this policy was that the competition would increase quality and/or decrease the costs of service provision. However, this type of policy may also increase the number of actors in the market who are primarily driven by profit motives (Svensson & Wingborg, 1991). Another policy example is tax incentives, which are used in many countries to make it more attractive to adopt not-for-profit status.

This article presents two main results. The first is that providers are more likely to become not-for-profit in markets with high to intermediate levels of competition,

[1] Consider that users will typically go to schools or primary care clinics in their area.

[2] The law regulates how authorities are to open up certain sectors to competition, by allowing people free choice of providers

while if the competition intensity is low, all providers tend to be for-profit. The likelihood that providers are not-for-profit is greater when they have sufficiently strong social motives. However, if the degree of competition in a market increases, social incentives can be crowded out even in markets where the producers have very strong social motives.

The second main result shows that tax subsidies may be counter-productive. For example, while tax subsidies make it less costly for providers to adopt not-for-profit status, it also makes it less attractive to invest earnings in improving quality. Moreover, if a provider delivers services of low quality, tax subsidies can have the unintended effect of making it less attractive to be not-for-profit. The reason for this is that, it the provider does not derive high utility from investing in quality, it will only adopt not-for-profit status if doing so will yield a large enough competitive advantage.

My analysis shows that, when social planners formulate policy, it is very important to take into account how providers value quality. Sectors where the providers tend to value quality higher tend to more easily adopt not-for-profit status. This is consistent with not-for-profit actors being more common in certain sectors (e.g., charities) and less in others (e.g., heavy industry).

2 Background and research motivation

Not-for-profit organizations are a common feature in many countries and often coexist with private for-profit and public-sector providers. They are most common among charity organizations and research groups, as well as in the health-care and education sectors (Mckeever, 2015). Table 1 shows the proportions of public, private for-profit, and private not-for-profit actors in the US hospital and university sectors. The data shows that not-for-profit providers are not just an incidental phenomenon in public services. They are also not just small niche players but include many prestigious actors, including all the Ivy League universities. However, it is not clear to what

Table 1: Hospital and University status actors in the United States

	Hospitals	**Universities**
Private not-for-profit	59%	36 %
Private for-profit	21%	27%
Public	20%	37%*
Source	AHA	NAICU

* Both public and community colleges

degree social planners policies (for example preferential tax treatment) have affected the number of not-for-profit actors. Also, while not-for-profit companies are very common in certain sectors, they are almost non-existent in others, which implies that the status is tied to characteristics of certain markets. This is supported by research arguing that when users are well informed and goods are private, for-profit providers tend to produce higher welfare. In cases where there is information asymmetry and/or goods are public, not-for-profit or public providers tend to produce higher welfare (Powell & Steinberg, 2006). My results show that low intrinsic valuation of quality may be a reason for the lack of not-for-profit actors in certain industries.

There is also interesting empirical research on not-for-profit companies. Quality was indeed found to be higher in not-for-profit nursing homes compared to for-profit ones, potentially driven by asymmetric information about quality (Chou, 2002). In other sectors, the results are more ambiguous. For example, not-for-profit clinics tend to be perceived to have higher quality, but they also to have a greater tendency to use antibiotics more liberally (Maun, Wessman, Sundvall, Thorn, & Björkelund, 2015). Also, not-for-profit providers have become more sensitive to price competition over time, and prices have risen in concentrated districts both among for-profit and not-for-profit actors (Keeler, Melnick, & Zwanziger, 1999).

Previous research on why public service providers choose to restrict profits falls into three groups (Malani, Philipson, & David, 2003). First, the "altruism model" states that providers use not-for-profit status to signal that they care about users' welfare, either directly via deriving value from consumer utility, or indirectly by deriving intrinsic value from providing high quality services. This can be in addition to valuing

profits(Lakdawalla & Philipson, 1998) or instead of valuing profits (Newhouse, 1970). Second, the "physician cooperative model" states that highly qualified employees, e.g., physicians or professors, can push the manager to adopt not-for-profit status. The motivation is that not-for-profit status allows these employees to retain control over assets, by removing profit incentives from an outside investor. These models do not necessarily assume that the agents are more socially motivated than the manager, but that they can leverage their expertise to achieve their own goals(Pauly & Redisch, 1973). Third, the "non-contractible quality" model states that not-for-profit status exists in markets where users cannot observe quality, and where they cannot contract for the quality level. A for-profit provider then has incentives to shirk on quality to generate higher profits. Not-for-profit providers are not affected by this problem to the same degree, since there are restrictions in place preventing them from taking out profits as dividends (e.g., according to the US Internal Revenue code 501(c)(3)). A common factor in these three groups of models is the tension between taking out profits as dividends and investing in quality. However, adopting not-for-profit status might also make it easier to raise funds through donations (Malani and David, Ghatak and Mueller).

The discussion above focuses on not-for-profit status as a means to inform users, or to control assets, which is also the framework I will use here. But there are other potential models, for example using labor-market dynamics. The idea is that Competition for motivated workers can drive providers to become not-for-profit. In case the financial incentives are strong, or the motivation levels are very low, providers prefer for-profit status. If workers are very motivated, they tend to prefer not-for-profit status (Ghatak & Mueller, 2011). Not-for-profit providers also tend to invest more in training their employees, and attract more socially motivated employees. However, the wage level in these organizations has also been found to be lower (DeVaro, Maxwell, & Morita, 2017).

There is some previous research that has looked at voluntary choice of status where, if the users value quality high enough, companies will convert to not-for-profit status. However, unless providers have different intrinsic values of providing quality, for-

profit and not-for-profit providers typically cannot exist in the same market. The authors also don't take into account how preferential tax treatment may affect the incentives of providers. Perhaps regulating competition could be one way to make it more attractive for providers to choose not-for-profit. Sectors with low profits and where switching costs are high for users should typically have a higher proportion of not-for-profit actors (Glaeser & Shleifer, 2001). Research on how not-for-profit providers react to competition do not focus on choice to the same degree. Examples of interesting findings include that profit restriction often reduces cost-containment efforts, but can increase investment quality. This is particularly true with regulated prices (Brekke, Siciliani, & Straume, 2012). However, the relationship between competition and quality is ambiguous (Brekke, Siciliani, & Straume, 2011). The aforementioned models typically use a semi-altruistic actors framework with observable quality. When quality is difficult to observe users must form expectations on observable characteristics, for example prices. Motivated providers can increase returns to quality of competition, but only when prices are sufficiently high (Siciliani, Straume, & Cellini, 2013).

This paper fills a few interesting gaps in the literature. First, I explore how competition affects the choice of voluntarily adopting not-for-profit status. I also explore the interaction of incentives to providers (e.g., more favorable tax rates) and the degree of competition in the market, as well as how this interaction will depend on how altruistic the providers are and how important quality is to the consumers.

3 Theoretical Model

I use a Hotelling competition model where actors provide services of unobservable quality. The providers are "semi-altruistic", meaning that they are "selfish" in the sense they only maximize their own value function, but also value quality intrinsically. Similar models have previously been used in the literature to describe competition in public services, e.g.,Brekke et al. (2012).

There are two providers, which can have either for-profit (FP) or not-for-profit (NP) status, with the distance between the two providers normalized to 1. FP providers can take out their profits as dividends (Π_i). The value they derive from dividends is equal to the monetary value. NP providers are instead required to spend all excess earnings on "perquisites" (Φ_i), which they value less than dividends. Here, \$1 buys $\$\tilde{d} < 1$ worth of perquisites[3]. In other words, adopting NP status induces a cost to the provider in the value they give up by taking out earnings as perquisites instead of profits. The status of the provider will also send a signal about the ex-ante unobservable quality that the provider produces: $\hat{q}_i$.

To increase the quality of their services, providers invest part of their earnings into improving their business. This investment is a fixed cost, which does not affect the marginal costs of service provision.[4] An intuitive example of this is investments in improving the quality of the providers' service time. If a clinic invests in their doctors, making sure they are up-to-date with the latest medical research, it will increase the quality of time they spend with the patients. However, it will not directly affect the cost of doctors providing that time to their patients. The cost of investing in quality is $F(q_i) = \frac{1}{2}q_i^2$. Users use the status of the provider to form rational expectations about quality. They then choose providers based on the price the provider sets and whether it has adopted FP or NP status.

Using these assumptions, I will now characterize the providers earnings function. The providers set their own price P_i, decide on FP or NP status, and invest in quality ($\frac{1}{2}q^2$). These decisions also inform user choice and determine demand $D_i(P, \hat{q})$. The providers' investment costs and marginal costs of production are exogenous and identical. Both types of providers pay taxes, although the tax-rates, denoted t_i, differ. FP providers take out all excess earnings as profits Π_i. NP providers take

[3]Perquisites are non monetary benefits that the provider still values, for example better offices, longer vacations, etc

[4] This avoids price being a signal of quality, an interesting aspect that would create problems with tractability in the model. With a prior assumption on beliefs, it would be possible to model this (Overgaard, 1993). Another option is to study voucher markets, where the prices are not set by provider at all.

out all excess earnings as perquisites Φ_i. The earnings functions of the FP provider (equation 1) and the NP provider (2) are characterized below.

$$E_{FP} = (1 - t_{FP})[(P_{FP} - c) * D_{FP}(P, \hat{q}) - \frac{1}{2}q_{FP}^2] - \Pi_{FP} = 0 \quad (1)$$

$$E_{NP} = (1 - t_{NP})[(P_{NP} - c) * D_{NP}(P, \hat{q}) - \frac{1}{2}q_{NP}^2] - \Phi = 0 \quad (2)$$

Providers derive utility from profits and perquisites. Profits yield the full monetary amount in utility, but perquisites yield less, valued at $\tilde{d} < 1$. Regardless of status providers derive non-monetary benefit from producing higher quality services, valued at $\tilde{b}$. Since I am interested in comparing the effects of competition and tax incentives, I will assume that $\tilde{b}$ is the same for all providers. The utility functions of a FP (W_{FP}) and NP provider(W_{NP}) are given by

$$\begin{aligned}\tilde{W}_{FP} &= \Pi_{FP} + \tilde{b}q_{FP} \\ &= (1 - t_{FP})[(P_{FP} - c) * D_{FP}(P, \hat{q}) - \frac{1}{2}q_{FP}^2] + \tilde{b}q_{FP}, \\ &\text{and} \\ \tilde{W}_{NP} &= \tilde{d} * \Phi + \tilde{b}q_{NP} \\ &= \tilde{d}(1 - t_{NP}) * [(P_{NP} - c) * D_{NP}(P, \hat{q}) - \frac{1}{2}q_{NP}^2] + \tilde{b}q_{NP}.\end{aligned}$$

By dividing both providers utility function by $1 - t_{FP}$ (which is a linear transformation), and defining $b = \frac{\tilde{b}}{1-t_{FP}}$ and $d = \tilde{d}\frac{1-t_{NP}}{1-t_{FP}}$, we get the optimization function of the provider, in equations 3 and 4.

$$W_{FP} = (P_{FP} - c)D_{FP}(P, \hat{q}) - \frac{1}{2}q_{FP}^2 + bq_{FP} \quad (3)$$

$$W_{NP} = d[(P_{NP} - c)D_{NP}(P, \hat{q}) - \frac{1}{2}q_{NP}^2] + bq_{NP} \quad (4)$$

A unit mass of users are located between the two providers on a Hotelling line, i.e., a

continuum of users normalized to unit mass. Individuals at $x \in (0,1)$ receive utility: $U = z + mq_i - P_i - T(x)$ from the first unit they consume, and zero from subsequent units. The parameter z is the user valuation of a service where the provider has made no investment in quality. The user derive additional utility from unobservable quality $m * q$, where m captures the users' valuation of this quality. The factors P_i and $T(x)$ capture the dis-utility of price and transport costs, respectively.

Period 3: Solving for demand

Demand is derived by finding the marginal user, i.e., the user who is indifferent between provider 1 and provider 2. Note that since quality is not observable, the users select provider based on *expected quality*, which is a function of the status of the provider. So all else equal, users will be more drawn to a provider with higher expected quality. The marginal user $(barx)$is found by setting the utility of going to provider *1* equal to going to provider *2*.

$$z + m\hat{q}_1 - P_1 - T\bar{x} = z + m\hat{q}_2 - P_2 - T(1 - \bar{x})$$
$$\bar{x} = \frac{1}{2} + \frac{P_2 - P_1 - m(\hat{q}_2 - \hat{q}_1)}{2T}$$

All users to the "left" go to provider 1, which allows us to define the demand function of provider 1, and similarly all users to the "right" are used to define the demand function for provider 2. The demand function can thus be characterized as:

$$D_i(\mathbf{P}, \hat{\boldsymbol{q}}) = \frac{1}{2} + \frac{P_j - P_i - m(\hat{q}_j - \hat{q}_i)}{2t}.$$

Users select providers based on the observed price and status, with everyone having formed rational expectations about quality. These expectations are formed based on the signal sent by the choice of status, and are denoted $\hat{q}_i$ and $\hat{q}_j$. Since status is a binary choice (FP vs NP), the providers can only send one of two signals. A good way to think of this is that the providers are sending a signal of high" or "low" quality, even if actual quality is a continuous variable. A consequence is that providers only

attract more users if they have a different status than their competitor.

Period 2: Price competition and choice of quality

Providers observe the status of their competitors, and make rational conjectures about what users will do in period 3. They then simultaneously choose prices and quality to maximize utility given by

$$W_i = \alpha_i[(P_i - c) * D_i(\boldsymbol{P}, \hat{\boldsymbol{q}}) - \frac{1}{2}q_i^2] + bq_i,$$
$$\text{where } \alpha_i = \begin{cases} 1 & \text{If for-profit} \\ d & \text{If not-for-profit.} \end{cases}$$

First, consider the choice of prices. By taking the first-order derivative of the utility function and re-organizing it we can derive the best-reply function of the provider with respect to prices:

$$P_i = \frac{T + P_j + m(\hat{q}_i - \hat{q}_j) + c}{2}.$$

A provider will set a higher price if its competitor has a high price (i.e. their strategies are strategic complements), if competition is low, and if its expected quality is higher than that of its competitor. The equilibrium prices are given by:

$$P_i = T + c + \frac{m(\hat{q}_i - \hat{q}_j)}{3}.$$

This equilibrium price is similar to the traditional Hotelling framework, with the addition that prices also reflect the difference in expected quality.

Providers choose how much to invest in quality at the same time as they set prices. Because quality is a fixed investment, it will not be more expensive on the margin to provide higher quality services to users compared with lower quality services. Also, investing more in quality does not affect the strength of the signal, which is

based on the status of the provider chosen in period 1. This is the case because promising higher quality here is not enforceable, and the users cannot distinguish between a provider truthfully promising higher quality and a provider lying to try to attract more users. For these reasons, we can solve for the equilibrium quality level separately from the equilibrium price level. Providers choose quality with respect to both monetary and non-monetary incentives. The first order condition can be used to derive the equilibrium quality level:

$$\frac{\partial \Pi}{\partial q_i} = b - \alpha_i q_i = 0 \implies q_i = \frac{b}{\alpha_i}.$$

The quality produced by the provider is increasing in its valuation of quality (b). Note that unless providers assign some level of intrinsic value to quality, they will not invest anything (i.e., if $b = 0$ providers always set $q_i = 0$). If that is the case quality is meaningless to producers, which may be a reason that NP companies do not exist in many markets, even assuming it could fill a signaling function. Since $d < 1$, the NP providers will always invest more than the FP provider. The difference in produced quality between NP and FP providers is given by:

$$\Delta q = \frac{b}{d} - b = b(\frac{1-d}{d}) > 0.$$

Thus, quality is always higher for NP providers than for FP providers. Consequently, the average quality in the market is measured in the number of not-for-profit providers. This corresponds to proposition 1 obtained by Glaeser and Shleifer in their model.

In equilibrium, the users' quality expectations must be equal to the actual quality choice of the providers.[5], which is in line with the rational expectations hypothesis. This hypothesis has been criticized, as many empirical studies have failed to find acceptable support for it. Some markets work in line with it, while others seem

[5]It is important to note that this is not the same as quality choice affecting the perceived quality directly

to work more in line with expectations updating theory (Svendsen, 1993). There are a few possible ways to justify using the rational expectations hypothesis in this case. One is to assume that users are very sophisticated, and will always correctly infer quality.[6] The second is that these expectations are formed after having made similar choices in the past, and living in a fairly static world. Users can then draw on this previous experience when choosing providers, and be fairly certain that the expectations will be correct. A third is that the model actual captures the average market results, while allowing some variation in quality investments by the individual providers

After deriving the equilibrium price and quantity levels, the equilibrium demand can be written:

$$D_i = \begin{cases} \frac{1}{2} + \frac{mb}{6T}\frac{1-d}{d} & \text{if } \hat{q}_i > \hat{q}_j \\ \frac{1}{2} & \text{if } \hat{q}_i = \hat{q}_j \\ \frac{1}{2} - \frac{mb}{6T}\frac{1-d}{d} & \text{if } \hat{q}_i < \hat{q}_j \end{cases}$$

The quality, price, and quantity choices in all three ownership configurations are presented in Table 2. In column 1, both providers are for-profit. Quality, prices,

Table 2: Quality, price, and quantity choice in all possible market equilibria

	Both are FP	**Both are NFP**	**Mixed Market**
Quality	$q_1 = q_2 = b$	$q_1 = q_2 = \frac{b}{d}$	$q_1 = b$ $q_2 = \frac{b}{d}$
Price	$P_1 = P_2 = T + c$	$P_1 = P_2 = T + c$	$P_1 = T + c - \frac{mb}{3}\frac{1-d}{d}$ $P_2 = T + c + \frac{mb}{3}\frac{1-d}{d}$
Quantity	$Q_1 = Q_2 = \frac{1}{2}$	$Q_1 = Q_2 = \frac{1}{2}$	$Q_1 = \frac{1}{2} - \frac{mb}{6T}\frac{1-d}{d}$ $Q_2 = \frac{1}{2} + \frac{mb}{6T}\frac{1-d}{d}$

[6]This is the most classical interpretation, where users are rational enough to correctly infer providers action, working with the same information.

and demands are symmetric, and the two split the market in half. The only other condition for the market to be viable is that the providers' earnings are large enough to cover the costs of production and quality investment, a condition which becomes $T > b^2$. In column 2, both providers are NP. Quality, prices, and demands are symmetric here as well, but the quality level produced by each provider is higher than when both providers are FP. In this case, the earnings must be larger to make the market be viable, such that $T > \frac{b^2}{d^2} > b^2$. In both of these cases, the providers split the market in half, and these viability conditions must hold for each of the providers.

In column 3, the market is not symmetric and there is one FP and one NP provider. The NP provider receives a price premium and a larger market share compared to the FP provider in these markets, but will also need to recoup their higher cost of investing in quality. The provider with the lower net earnings margin will have a harder time being economically viable, and whether this is the FP or NP provider depends on how the value of perquisites (reflecting the costs of adopting NP status) relate to the premium that the NP actor receives. The greater is the price premium, the more likely it will be that the FP provider has the harder viability condition. A good way to think about this is that if the premium for NP providers is small, the fixed costs of investing in quality are comparatively large, and NP providers have a harder time recouping the cost of investment. However, as the price premium grows, the cost of investing in quality becomes comparatively small. If $d > \frac{T-\frac{mb}{3}\frac{1-d}{d}}{T+\frac{mb}{3}\frac{1-d}{d}}$, the FP provider has the hardest time recouping investments. For the market to work, it must be the case that $b < \frac{T}{\sqrt{T}+\frac{mb}{3}\frac{1-d}{d}}$. If $d < \frac{T-\frac{mb}{3}\frac{1-d}{d}}{T+\frac{mb}{3}\frac{1-d}{d}}$, the NP provider has the hardest time recouping investments. For the market to hold, it must be the case that $b < d\frac{T}{\sqrt{T}-\frac{mb}{3}(1-d)}$.

If either of these conditions fail, the model collapses into a global monopoly, where one provider prices the other out of the market. This places an upper limit on how competitive the market can be before one provider disappears completely. Also, if competition becomes too lax, the market degenerates into two local monopolies, placing a lower limit on how competitive the market needs to be. This condition is

discussed further in Appendix C.

Period 1: Choice of for-profit or not-for-profit status

In period 1 providers must make the choice of being for- or not-for profit, after forming rational expectations of what will happen in periods 2 and 3. Their choice then signals the level of quality they provide. This can be illustrated by a normal-form game as seen in Figure 1. Both providers make the choice of status simultaneously,

Figure 1: Choice of NFP vs FP status

	FP	**NFP**
FP	$\frac{1}{2}T + \frac{1}{2}b^2$ $\frac{1}{2}T + \frac{1}{2}b^2$	$(T - \frac{mb}{3}\frac{1-d}{d})(\frac{1}{2} - \frac{mb}{6T}\frac{1-d}{d}) + \frac{1}{2}b^2$ $d * (T + \frac{mb}{3}\frac{1-d}{d})(\frac{1}{2} + \frac{mb}{6T}\frac{1-d}{d}) + \frac{1}{2}\frac{b^2}{d}$
NFP	$d * (T + \frac{mb}{3}\frac{1-d}{d})(\frac{1}{2} + \frac{mb}{6T}\frac{1-d}{d}) + \frac{1}{2}\frac{b^2}{d}$ $(T - \frac{mb}{3}\frac{1-d}{d})(\frac{1}{2} - \frac{mb}{6T}\frac{1-d}{d}) + \frac{1}{2}b^2$	$d * \frac{1}{2}T + \frac{1}{2}\frac{b^2}{d}$ $d * \frac{1}{2}T + \frac{1}{2}\frac{b^2}{d}$

knowing how all actors value quality, the value providers assign to perquisites, and the best-response functions of all providers. Three distinct types of market structures can arise, depending on what the period 1 equilibrium becomes. The equilibrium can result in a market where all providers are for-profit ({FP, FP}), where all providers are not-for-profit ({NP, NP}), or where there is a mix of FP and NP providers, ({FP, NP}) and ({NP, FP}).

4 Equilibrium and policy effects

My main aim in this paper is to study how policy makers can incentivize providers to choose NP status, and what the welfare effects might be. Providers choose to adopt NP status if doing so results in greater utility for them than adopting FP status does. To facilitate my analysis I will study incentives using two value functions, which describe the value added of being NP over FP, given the status of the other

player. If the value is positive, providers will choose to be NP as it gives higher utility. If the value is negative providers will choose to be FP. Let $V_1(T,d)$ be the value for a first provider to switch from FP to NP status (that is, the value of switching given that the competitor is FP). Likewise, let $V_2(T,d)$ be the value for a second provider to switch (i.e. given that the other provider is NP). These values are functions of T and d, and are given by

$$V_1(T,d) = W^i_{NP,FP} - W^i_{FP,FP} = \frac{(1-d)}{2}[\frac{2}{3}mb(1+\frac{mb}{6T}\frac{1-d}{d}) - T + \frac{b^2}{d}], \quad (5)$$

and

$$V_2(T,d) = W^i_{NP,NP} - W^i_{FP,NP} = \frac{(1-d)}{2}[\frac{2}{3}mb(1-\frac{mb}{6T}\frac{1-d}{d}) - T + \frac{b^2}{d}]. \quad (6)$$

Note that the incentives will always be greater to become NP given that the competitor is FP than if they are NP ($V_1(T,d) > V_2(T,d)$). See Appendix B for a proof of this. When $V_1(T,d) > 0 > V_2(T,d)$, the equilibrium will be in mixed markets, i.e., either {NP, FP} or {FP, NP}. If $0 > V_1(T,d) > V_2(T,d)$, the equilibrium is {FP, FP}. In the same way if $V_1(T,d) > V_2(T,d) > 0$, the game settles in the {NP, NP} equilibrium.

Since $V_1(T,d)$ and $V_2(T,d)$ are non-crossing and continuous, they can also be used to show uniqueness of equilibrium. If the equilibrium results in a market where all providers are for-profit, {FP, FP}, it is a unique equilibrium. If the equilibrium results in a market where all providers are not-for-profit, {NFP, NFP}, it is also a unique equilibrium. Otherwise, there are two equilibria, {NFP, FP} and {FP, NFP}, both of which result in the same mixed market. In this case, there is also a mixed-strategy equilibrium, but I will not address this in the present paper.

The above analysis results in proposition 1.

Proposition 1. *In the generic case there will be a market equilibrium in pure strategies for each value of the parameter space. Each of the three possible equilibrium outcomes {FP,FP}, {NP,FP}, and {NP,NP} is achievable for certain values of the*

parameter space.

This result runs contrary to that obtained by Glaeser and Shleifer. In their study, it is not possible to have an equilibrium in mixed markets unless companies and/or users have different quality valuations. Here, there can be a mixed market equilibrium when all companies/users have the same valuation.

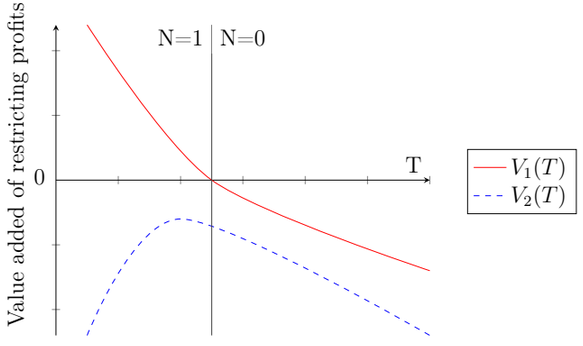
4.1 Competition and quality

The first potential policy variable I will discuss is the degree of competition (as measured by T). The social planner could affect this by for example subsidizing transport or making sure users are well informed. By studying the value functions, I will show how the incentives for providers to switch to NP status depends on competition. The exact characterization of $V_i(T,d)$ depends on the providers' and users' valuations of quality, and on the value providers assign to perquisites. There are two distinct cases, which I will call the *base case* and the *alternative case*. These cases are similar in some ways, but have some important differences, the largest being how many providers will choose to be NP in equilibrium.

First I will define the *base case*, where two conditions must hold. First, the providers' valuation of perquisites must be low relative to their valuation of profits: ($d \in (0, \frac{1}{2})$). Second, the providers' valuation of quality must be low relative to that the users ($\frac{b}{m} < \frac{2}{3}(\sqrt{\frac{1-d}{d}} - 1)$). This means that the providers value money a lot more than they value both perquisites and quality. In the base case, there is no level of competition that will result in all providers in the market choosing NP status. If competition is lax, all providers are FP, otherwise one provider is NP. See Figure 2 for an illustration of this.

If the market is in the *alternative case* (i.e. either $d > \frac{1}{2}$, $\frac{b}{m} < \frac{2}{3}(\sqrt{\frac{1-d}{d}} - 1)$, or both), then it is possible to have a market where both providers choose NP status. This is illustrated in Figure 3. If competition is lax enough, both providers choose FP status. Then, as competition increases, first one provider (at $\tilde{T}_1$) and then the

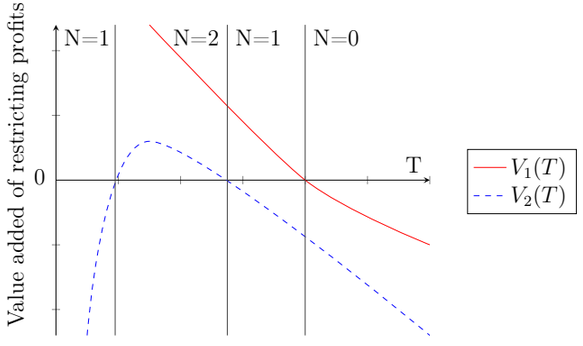
Figure 2: Competition and incentives, base case, with number of NP providers N



second (at $\tilde{T}_2$) become NP. Sometimes, if competition becomes very intense (at $\tilde{T}_3$), one provider will revert back to FP status (assuming the market is still viable in this case, as discussed above). This is potentially because if competition is intense and the margins are very small, it will be better to get the full amount as profits rather than a lower amount as perquisites. This would be more likely if users assign a low value to quality ($m \approx 0$), providers assign a low value to quality ($b \approx 0$), and/or the value of perquisites is close to the value of profits $d \approx 1$. Then, the price difference between NP and FP providers tends to be low. Note that this is somewhat of a special case.

In summary, the figures reveal that the value of switching to NP status is lower if the competitor is NP (since $V_1(T, d) > V_2(T, d)$). The figures also reveal that both providers will be FP in equilibrium if competition is lax enough (since $V_2(T, d) < V_1(T, d) < 0$ at high enough values of T, i.e., at low levels of competition). At least one provider will choose to be NP if competition is intense enough (since $V_1(T, d) > 0$ at low enough values of T). Moreover, in the base case, at most one provider selects NP status (since $V_2(T, d) < 0$ for all T). In the alternative case, both providers choose NP status for intermediate values of T (since $V_2(T, d) > 0$ for some values of T). These

Figure 3: Competition and incentives, alternative case, with number of NP providers N



results lead to Proposition 2. Let N be the number of NP providers in equilibrium, and let $N(T)$ be the equilibrium relation between the degree of competition and N.

Proposition 2. *In the base case, there is a mixed-market equilibrium if competition is sufficiently intense ($N(T) = 1$ for $T < \tilde{T}_1$) and only FP providers if competition is sufficiently lax ($N(T) = 0$ for $T > \tilde{T}_1$). In the alternative case, as the degree of competition increases,the equilibrium market structure goes from only FP providers via a mixed market to only NP providers. However, for very intense competition, the equilibrium market structure may be mixed.*

The formal proof is relegated to Appendix A, while the values of the cut-off points is found in Appendix B.

4.2 Preferential tax treatment and quality

Governments and social planners often use preferential tax-rates to favor NP providers. For example, according to Section 501 of the IRS tax code NP providers are exempt from federal income taxes, and also some state taxes. However, there are restrictions

as to what spending is allowed under the tax-exemption status, with spending that is deemed "excessive" often being taxed. This fits with the model I use as perquisites being used as an alternative to profits. It shows that NP providers do earn money, otherwise there would be no reason for the tax exemption. The restriction is on how the providers are allowed to *use* the money, with NP providers (hopefully) reinvesting the money in their business (improving quality), or spending it on perquisites.

I assume that perquisites are taxed along the same principles as dividends, but that the social planner can change the tax-rate for the NP provider. In comparison the tax-rate set for FP providers remains constant. By giving NP providers a lower tax rate, it can become more appealing to choose this status. For example, if providers pay less taxes, they have more excess earnings to spend on perquisites or to reinvest into the provider. Recall that we have defined $d = \tilde{d}\frac{1-t_{NP}}{1-t_{FP}}$. The parameter d becomes lower when the providers intrinsic value of perquisites $\tilde{d}$ goes down, or when the tax-rate for NP providers goes down. Setting a lower tax-rate for NP providers is then equivalent to lowering d in the model.[7]

As I will show, a lower tax rate can make it either more or less attractive adopt NP status! This is because changing the tax-rate also changes the trade-off that NP providers make, with the consequence that providers invest less in quality, and more in perquisites. This makes sense, since it is now less costly than before to take out earnings as perquisites, but the non-monetary value of investing in quality is unchanged. Recall that this higher cost of taking out earnings was the reason NP providers invested more from the beginning. This is summarized in Proposition 3:

Proposition 3. *Giving NP providers a lower tax rate will result in them producing lower quality services*

[7]Note that in theory, the social planner could lower taxes enough that $d > 1$. However, in this case the not-for-profit actors produce less quality than the for-profit actors, and will for this reason fall outside the scope of this paper.

Proof. Recall that:

$$W_{FP} = (P_{FP} - c)D_{FP} - \frac{1}{2}q_{FP}^2 + bq_{FP},$$
$$W_{NP} = d[(P_{NP} - c)D_{NP} - \frac{1}{2}q_{NP}^2] + bq_{NP}.$$

First, note that since $d = \tilde{d}\frac{1-t_{NP}}{1-t_{FP}}$, d increases when the tax rate t_{NP} decreases. Next, note that the equilibrium quality produced by not-for-profit providers is given by $q_{NP} = \frac{b}{d(1-t_{NP})}$. Thus, a reduction in t_{NP} lowers q_{NP}, proving proposition 3. □

So how should the social planner set taxes in order to make NP status more attractive? Again, the answer will depend on how the providers' valuation of quality relates to that of the users. Recall that the value functions are:

$$V1 = \frac{(1-d)}{2}[\frac{2}{3}mb(1 + \frac{mb}{6T}\frac{1-d}{d}) - T + \frac{b^2}{d}]$$
$$V2 = \frac{(1-d)}{2}[\frac{2}{3}mb(1 - \frac{mb}{6T}\frac{1-d}{d}) - T + \frac{b^2}{d}]$$

Knowing that lowering taxes for NP providers lowers the value of d in the functions, it is possible to state proposition 4.

Proposition 4. *If the producers' valuation of quality (b) is sufficiently high, lowering taxes for NP providers either increases the equilibrium number of NP providers, or it remains unchanged. Otherwise, lowering taxes for NP providers either decreases the equilibrium number of NP providers, or leaves it unchanged.*

Proof. I will start by characterizing the function V_1. First, note that as d goes to zero $V_1(d)$ becomes large, i.e. $\lim_{d\to 0} V_1(d) = \infty$. Also, note that when $d = 1$, $V_1(1) = 0$. Second, since $V''(d) = \frac{b^2(m^2+9t)}{9d^3t} > 0$, $V_1(d)$ is strictly convex. Third, note that $V_1'(1) = \frac{1}{2}[T - b(\frac{2}{3}m + b)] > 0$ if $T > b(\frac{2}{3}m + b)$, implying that $V_1(d)$ slopes upwards at $d = 1$, and $V_1(d)$ thus crosses the d-axis, and has a local, negative minimum on the interval $d \in (0, 1)$. Otherwise, $V_1(d)$ is continuously downwards sloping on the interval. Rewrite this condition as $b \gtrless \sqrt{(\frac{m}{3})^2 + T} - \frac{m}{3}$.

I will continue by characterizing the function $V_2(d)$. First, note that as d goes to 1, $V_2(d)$ goes to zero, $\lim_{d\to 1} V_2(d) = 0$. Expand$V_2(d)$ such that $V_2(d) = \frac{1-d}{2}[\frac{2}{3}mb + (\frac{mb}{3})^2 - T - (\frac{mb}{3})^2\frac{1}{dT} + \frac{b^2}{d}]$. Now, if $(\frac{mb}{3})^2\frac{1}{T} > b^2 \Leftrightarrow m > 3\sqrt{T}$, then $V_2(d)$ becomes negative as d goes to 0, $\lim_{d\to 0} V_2(d) = -\infty$. Similarly, if $m < 3\sqrt{T}$, then $V_2(d)$ becomes large as d goes to zero, $\lim_{d\to 0} V_2(d) = \infty$. Second, note that the second derivative is $V_2''(d) = -\frac{b^2(m^2-9T)}{9d^3T}$. If $m < 3\sqrt{T}$, the second derivative is strictly positive, and the function is thus strictly convex. If $m > 3\sqrt{T}$, the second derivative is strictly negative, and the function is thus strictly concave. Third, note that the first derivative at the upper limit is $V_2'(1) = \frac{1}{2}(T - b(\frac{2}{3}m + b))$, and behaves the same as $V_1(d)$.

□

Both $V_1(d)$ and $V_2(d)$ are continuous on the interval. The characterization above shows four distinct cases, denoted cases A through D. For case A, assume $m > 3\sqrt{T}$ and $b > \sqrt{(\frac{m}{3})^2 + T} - \frac{m}{3}$. Then, there exists a $d_1 \in (0,1)$ such that

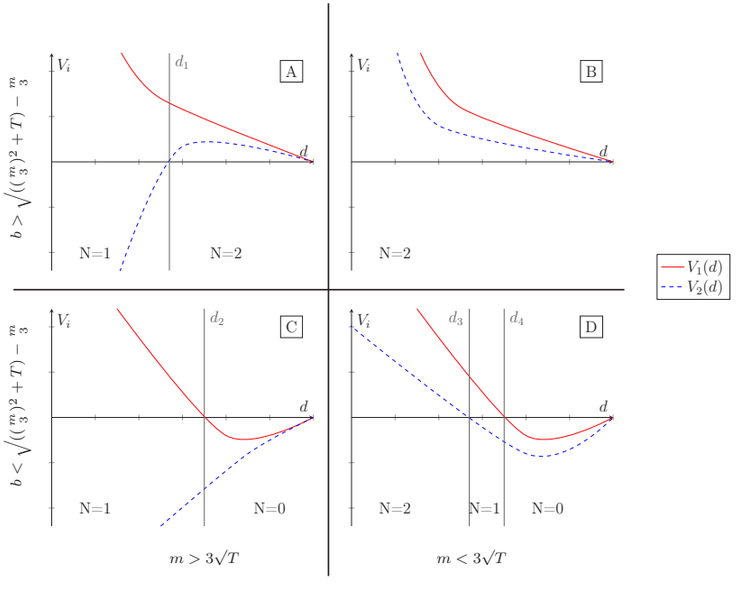
$$N(d) = \begin{cases} 1 & \text{if } d < d_1 \\ 2 & \text{if } d \geq d_1. \end{cases}$$

This is illustrated in figure 4 A. For case B, assume $m < 3\sqrt{T}$ and $b > \sqrt{(\frac{m}{3})^2 + T} - \frac{m}{3}$. Then, for all $d \in (0,1)$, $N(d) = 2$. This is illustrated in figure 4 B. For case C, assume $m > 3\sqrt{T}$ and $b < \sqrt{(\frac{m}{3})^2 + T} - \frac{m}{3}$. Then, there exists a $d_2 \in (0,1)$ such that

$$N(d) = \begin{cases} 1 & \text{if } d < d_2 \\ 0 & \text{if } d \geq d_2. \end{cases}$$

This is illustrated in Figure 4 C.

Figure 4: Incentives and value of perquisites at four levels of T, with number of NP providers N



For case D, assume $m < 3\sqrt{T}$ and $b < \sqrt{(\frac{m}{3})^2 + T} - \frac{m}{3}$. Then, there exists $\{d_4 > d_3\} \in (0,1)$ such that

$$N(d) = \begin{cases} 2 & \text{if } d \leq d_3 \\ 1 & \text{if } d \in (d_3, d_4) \\ 0 & \text{if } d > d_4. \end{cases}$$

This is illustrated in Figure 4 D.

5 Public policy analysis

A social planner, e.g., a municipality or other local government, wants to increase welfare as measured by user utility. This will in practice mean that they will try to increase the quality in the market, and/or to decrease the price level, since these two factors increase user utility. They have two main policy instruments to influence incentives. The first is providing tax benefits to the NP providers. The intuition is that the planner can lower the tax rate that an NP provider faces to lower the costs of restricting profits. From proposition 4 we saw that giving tax incentives can increase the number of NP providers in equilibrium if the providers value quality sufficiently. Otherwise, it will not work. The second instrument consists of influencing the degree of competition in the market, for example by decreasing the cost of switching providers. They could do this by providing users with more information, by subsidizing transport or by adopting strategic zoning plans. From Proposition 2 we know that the number of NP providers in equilibrium is greatest if competition is intense, but not excessively so. Note that since users pay out of pocket, the social planner does not have a clear cost of using these instruments. I will for this reason conduct the welfare analysis as an overview, rather than give a concrete policy recommendation. The analysis will start from a pure FP market, then move on to a mixed-market, and finally to a pure NP market.

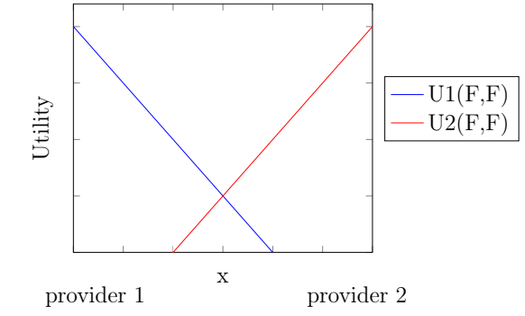
Figure 5 illustrates how the utility of the users change when the market goes from a pure FP market, to a mixed market, and finally a pure NP market. In the welfare

analysis I will primarily study what happens when the providers "jump" from one status to the other. Then the only shift in utility will be due to the change of market type, and we can disregard the effects of changes in price and quality on the margin. Figure 5a illustrates the utility levels of users in a pure FP market. In this market, the providers split the market in half and set the same price and quality.

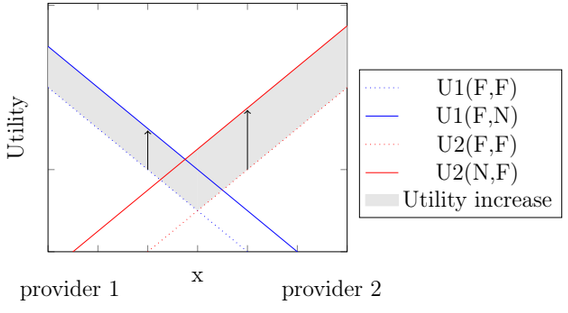
Now, assume that the social planner imposes policy that causes one provider to switch to NP status. Figure 5b illustrates this. How does this shift affect the utility of users in the market? For users who choose provider 1 both before and after the jump the utility increases. The quality of the services they are provided does not change due to the shift, but they receive the services at a lower price. As utility is affected positively by lower prices, this implies that the utility will go up. For users choosing provider 2 both before and after the jump, there are both positive utility effects (they get higher quality goods/services) and negative utility effects (they are also charged more). However, if we compare the change in utility for each user, we find: $\Delta U = m\Delta q - \Delta P = mb\frac{2}{3}\frac{1-d}{d} > 0$. This shows that the net change in utility for these users is also positive, and they all have a net gain from the shift. We can combine these arguments to show that it must be the case that users who switch also get obtain utility. If they were to stay, they would obtain higher utility than in the pure FP market. Since they decide to switch, the utility of going to the NP provider must be even higher than the utility of staying. Now I have covered all three cases, which combines to show that the utility in the mixed market is always higher than the utility in the pure FP market.

Now assume that the social planner imposes policy that causes the other provider to switch to NP status as well. Figure 5c illustrates this pure NP market. The same argument can be made for why the pure NP market is better than the mixed market. Users choosing provider 2 both before and after the switch still obtain the same level of quality as in the mixed-market case, but now they are paying a lower price for these services. These users then get a strict increase in utility. For the users who use provider 1 both before and after the switch, there are both positive utility effects (they obtain higher quality) and negative utility effects (they

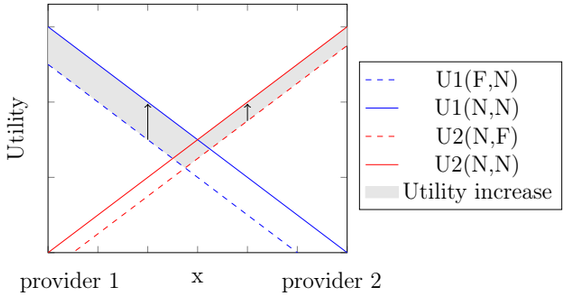
Figure 5: User utility in all market structures



(a) Pure for-profit market



(b) Mixed market



(c) Pure Non-profit market

get a lower price). However, this net shift in utility is the same as the shift above: $\Delta U = m\Delta q - \Delta P = mb\frac{2}{3}\frac{1-d}{d} > 0$, i.e. a net increase. Finally, the people who switch would have obtained a utility increase by staying with provider 2, but switch to an even higher utility level.

The above analysis shows that the total welfare level in the sector is directly related to the number of NP providers in the market, or that $U_{FF}^{TOT} < U_{NF}^{TOT} < U_{NN}^{TOT}$. A social planner who wants to maximize user welfare should then use the two policy instruments at their disposal to achieve this (assuming they are not costly). In some cases this is believable, for example by increasing competition by providing users with more information. However, in the case of tax incentives there is a direct income loss to the planner due to the loss of tax revenue, but I will disregard this in the welfare analysis. This could be because the tax-loss is insignificant, or that they have the opportunity to adjust taxes in other areas to compensate for the tax loss.

6 Conclusion

This paper discusses how ex-post competition influences the choice of quality provision and choice of for-profit versus not-for-profit status. The results derived so far are based a specific type of quality investment. I derive conditions defining which combination of statuses the companies will choose, and how these relate to the users' and providers' valuations of quality. I also sketch how a social planners ability to set tax incentives and influence the degree of competition in the market influences this choice.

While general recommendations are difficult to present, it is possible to state that while very low competition does not create strong incentives for providers to be not-for-profit, very intense competition is not necessarily optimal either. Also, policy-makers must be mindful of how companies invest in quality when creating incentives for providers to be not-for-profit, since it might not have any effect on providers incentives to adopt NP status, or even make adopting NP status less attractive.

Appendix A Equilibrium market structure

This section shows the formal proof of the number of NP organizations in the base and alternate case. Recall that our base case is defined

$$d \in (0, \frac{1}{2}) \text{ and } \frac{b}{m} < \frac{2}{3}(\sqrt{\frac{1-d}{d}} - 1).$$

Proposition 2 is restated as the following Lemma.

Lemma 1. *Assume that we're in the base case. Then, in equilibrium, both providers select to be for-profit if $T > \tilde{T}_1$, and exactly one provider selects to be not-for-profit otherwise. Now, assume that we are in the alternative case. Then, in equilibrium, both providers select to be for-profit if $T > \tilde{T}_1$, and exactly one provider selects to be not-for-profit if $T \in (\tilde{T}_2, \tilde{T}_1)$ or if $T < \tilde{T}_3$. Both providers will be not-for-profit if $T \in (\tilde{T}_3, \tilde{T}_2)$.*

Proof. First, note that the function $V_1(T, d)$ crosses the T-axis at exactly one point, denoted $\tilde{T}_1$, as illustrated in Figure 2. In particular, $V_1(T, d)$ is strictly positive at values of T lower than this, and strictly negative at values of T higher than this. To see this, note that for a small enough value of T , $V_1(T, d)$ is positive, as $\lim_{T \to 0} V_1(T, d) = +\infty$, and for a large enough value of T, $V_1(T, d)$ is negative, as $\lim_{T \to \infty} V_1(T, d) = -\infty$. Since V_1 is continuous it follows from the intermediate value theorem that $V_1(T, d) = 0$ for some T. Since the first derivative is strictly negative ($\frac{\delta V_1}{\delta T} < 0$) this value is unique.

Second, note that $V_2(T, d) < 0$ for all T if, and only if, the conditions for the base case are satisfied. To see this, note that $V_2(T, d)$ is strictly concave, which we can see by noting that the second derivative is strictly negative $\frac{\delta^2 V_2}{\delta T^2} = -\frac{(1-d)^2}{d}(\frac{mb}{3})^2 \frac{1}{T^3} < 0$. The global maximum is located at $\bar{T} = \frac{mb}{3T}\sqrt{\frac{1-d}{d}}$, and is given by $V_2(\bar{T}) = \frac{1-d}{d}(\frac{2}{3}mb(1 - \sqrt{\frac{1-d}{d}}) + \frac{b^2}{d})$, which is negative if, and only if, we are in the base case.

Third, when we are not in the base case, $V_2(\bar{T}) > 0$. Thus, there exists $\tilde{T}_3 < \tilde{T}_2 < \tilde{T}_1$ such that $V_2(T, d)$ is greater than zero if $T \in [\tilde{T}_3, \tilde{T}_2]$, and strictly negative otherwise. To see this, recall that the function$V_2(T, d)$ is continuous, strictly concave, and negative at the limits, $\lim_{T \to 0} V_2(T, d) = -\infty$ and $\lim_{T \to \infty} V_2(T, d) = -\infty$. The maximum is strictly positive since the base case conditions are violated. That $\tilde{T}_2 < \tilde{T}_1$ follows from the fact that $V_1(T, d)$ is strictly greater than $V_2(T, d)$ for all values of T.

The Lemma follows immediately from these three properties, as can easily be verified by inspecting Figure 2.

□

Appendix B Expanded Proofs

This section expands on a few proofs in the main text

Proof that $V_1(T,d) > V_2(T,d)$

Here, proof is shown that the value added of switching to NP status is always higher if the competitor is FP than if the competitor is NP

$$
\begin{aligned}
V_1 &> V_2 \\
\frac{(1-d)}{2}[\frac{2}{3}mb(1+\frac{mb}{6T}\frac{1-d}{d}) - T - \frac{b^2}{d^2}(1-d)] &> \frac{(1-d)}{2}[\frac{2}{3}mb(1-\frac{mb}{6T}\frac{1-d}{d}) - T - \frac{b^2}{d^2}(1-d)] \\
\frac{2}{3}mb(1+\frac{mb}{6T}\frac{1-d}{d}) - T - \frac{b^2}{d^2}(1-d) &> \frac{2}{3}mb(1-\frac{mb}{6T}\frac{1-d}{d}) - T - \frac{b^2}{d^2}(1-d) \\
\frac{2}{3}mb(1+\frac{mb}{6T}\frac{1-d}{d}) &> \frac{2}{3}mb(1-\frac{mb}{6T}\frac{1-d}{d}) \\
\frac{mb}{6T}\frac{1-d}{d} &> -\frac{mb}{6T}\frac{1-d}{d} \\
\frac{mb}{3T}\frac{1-d}{d} &> 0.
\end{aligned}
$$

This holds over the parameter space, where all deep parameters are positive and where $d \in (0,1)$.

Critical values $\tilde{T}$

This proposition dictates that there are values of T at which the equilibrium switches in the following manner: $\{N,F\} \to \{N,N\} \to \{N,F\} \to \{F,F\}$.

First, study the curvature to determine the shape of the function.

$$
\begin{aligned}
\frac{V_1^2}{T^2} &= \frac{(mb)^2}{9t^3}\frac{1-d}{d} > 0 \\
\frac{V_2^2}{T^2} &= -\frac{(mb)^2}{9t^3}\frac{1-d}{d} < 0
\end{aligned}
$$

Over the parameter space, V_1 is strictly concave. In the same way, V_2 is strictly convex. This will imply that any stationary point in V_2 will be a maximum. Recall that a prior result is that $V_2 > V_1$. These two results together imply that we can use the roots of the original equation to find the critical values.

$$
\begin{aligned}
0 &> \frac{2}{3}mb(1-\frac{mb}{6t}\frac{1-d}{d}) - T + \frac{b^2}{d} \to \\
T &< \frac{1}{3}mb + \frac{1}{2}\frac{b^2}{d} - \frac{1}{2}\sqrt{(\frac{2}{3}mb)^2 + \frac{4}{3}\frac{mb^3}{d} + \frac{b^4}{d} - (\frac{2}{3}mb)^2\frac{(1-d)(1+d)}{d}} && = \tilde{T}_1 \\
T &> \frac{1}{3}mb + \frac{1}{2}\frac{b^2}{d} + \frac{1}{2}\sqrt{(\frac{2}{3}mb)^2 + \frac{4}{3}\frac{mb^3}{d} + \frac{b^4}{d} - (\frac{2}{3}mb)^2\frac{(1-d)(1+d)}{d}} && = \tilde{T}_2
\end{aligned}
$$

And later

$$
T > \frac{1}{3}mb + \frac{1}{2}\frac{b^2}{d} + \frac{1}{2}\sqrt{2(\frac{2}{3}mb)^2 + b^3\frac{1-d}{d}(\frac{4}{3}m + b*\frac{1-d}{d})} \qquad = \tilde{T}_3
$$

The equilibrium will have the form:

$$
\begin{aligned}
T &< \tilde{t_1} && \to \text{Mixed market} \\
T &\in (\tilde{T_1}, \tilde{T_2}) && \to \text{NFP market} \\
T &\in (\tilde{T_2}, \tilde{T_3}) && \to \text{Mixed market} \\
T &> \tilde{T_3} && \to \text{FP market}
\end{aligned}
$$

Appendix C Local monopolies

A condition that must be kept in mind is that, if the degree of competition becomes too weak, then the Hotelling competition can degenerate into two local monopolies. The conditions for when this occurs can be derived by inserting the results of the optimization into the original utility functions. The utility of the marginal user must be no smaller than zero, assuming no outside option.

Both providers are for-profit

In this case, we have:

$$P_1 = P_2 = T + c$$
$$Q_1 = Q_2 = \frac{1}{2}$$
$$q_1 = q_2 = b$$

And the utility will solve for:

$U_m = z + mb - T - c - \frac{1}{2}T > 0 \rightarrow T < \frac{2}{3}(z - c + mb) = \hat{T}_{F,F}$

Both providers are not-for-profits In this case, we have:

$$P_1 = P_2 = T + c$$
$$Q_1 = Q_2 = \frac{1}{2}$$
$$q_1 = q_2 = \frac{b}{d}$$

And the utility will solve for:

$U_m = z + m\frac{b}{d} - T - c - \frac{1}{2}T > 0 \rightarrow T < \frac{2}{3}(z - c + \frac{mb}{d}) = \hat{T}_{N,N}$

The equilibrium is in mixed markets

In this case, we have

$$P_N = T + c + \frac{mb}{3}\frac{1-d}{d}$$
$$Q_1 = \frac{1}{2} + \frac{mb}{6t}\frac{1-d}{d}$$
$$q_N = \frac{b}{d}$$

Insert these into the utility function to derive:

$$U_m = z + m\frac{b}{d} - T - c - \frac{mb}{3}\frac{1-d}{d} - T(\frac{1}{2} + \frac{mb}{6t}\frac{1-d}{d}) > 0 \rightarrow$$
$$T < \frac{2}{3}[z - c + \frac{mb}{2}\frac{1+d}{d}] = \hat{T}_{N,F}$$

We also observe that since $d < 1$ and $\frac{1+d}{2} < 1$, the limits will be ordered in the following way: $\hat{T}_{F,F} < \hat{T}_{N,F} < \hat{T}_{N,N}$

Markets with more not-for-profits can survive in lower competition environments without degrading into local monopolies.

References

AHA. (2017). *Fast facts 2017.* Retrieved from http://www.aha.org/research/rc/stat-studies/fast-facts.shtml

Brekke, K. R., Siciliani, L., & Straume, O. R. (2011). Hospital competition and quality with regulated prices. *The Scandinavian Journal of Economics*, *113*(2), 444–469.

Brekke, K. R., Siciliani, L., & Straume, O. R. (2012). Quality competition with profit constraints. *Journal of Economic Behavior & Organization*, *84*(2), 642–659.

Chou, S.-Y. (2002). Asymmetric information, ownership and quality of care: an empirical analysis of nursing homes. *Journal of Health Economics*, *21*(2), 293–311.

DeVaro, J., Maxwell, N., & Morita, H. (2017). Training and intrinsic motivation in nonprofit and for-profit organizations. *Journal of Economic Behavior & Organization*, *139*, 196–213.

Ghatak, M., & Mueller, H. (2011). Thanks for nothing? not-for-profits and motivated agents. *Journal of Public Economics*, *95*(1), 94–105.

Glaeser, E. L., & Shleifer, A. (2001). Not-for-profit entrepreneurs. *Journal of public economics*, *81*(1), 99–115.

Keeler, E. B., Melnick, G., & Zwanziger, J. (1999). The changing effects of competition on non-profit and for-profit hospital pricing behavior. *Journal of Health Economics*, *18*(1), 69–86.

Lakdawalla, D., & Philipson, T. (1998). *Nonprofit production and competition* (Tech. Rep.). National Bureau of Economic Research.

Malani, A., & David, G. (2008). Does nonprofit status signal quality? *The Journal of Legal Studies*, *37*(2), 551–576.

Malani, A., Philipson, T., & David, G. (2003). Theories of firm behavior in the nonprofit sector. a synthesis and empirical evaluation. In *The governance of not-for-profit organizations* (pp. 181–216). University of Chicago Press.

Maun, A., Wessman, C., Sundvall, P.-D., Thorn, J., & Björkelund, C. (2015). Is the quality of primary healthcare services influenced by the healthcare centre's type of ownership? an observational study of patient perceived quality, prescription rates and follow-up routines in privately and publicly owned primary care centres. *BMC health services research*, *15*(1), 1.

Mckeever, B. (2015, October). *The nonprofit sector in brief 2015.* Retrieved 2017-02-17, from http://www.urban.org/sites/default/files/publication/72536/2000497-The-Nonprofit-Sector-in-Brief-2015-Public-Charities-Giving-and-Volunteering.pdf

Molander, P. (2017). Dags för omprövning–en eso-rapport om styrning av offentlig verksamhet. *Rapport till Expertgruppen för studier i offentlig ekonomi*, *1*.

NAICU. (2014). *About u.s. higher education and private nonprofit colleges.* Retrieved from AboutU.S.HigherEducationandPrivateNonprofitColleges

Newhouse, J. P. (1970). Toward a theory of nonprofit institutions: An economic model of a hospital. *The American Economic Review*, *60*(1), 64–74.

Overgaard, P. B. (1993). Price as a signal of quality: A discussion of equilibrium concepts in signalling games. *European Journal of Political Economy*, *9*(4), 483–504.

Pauly, M., & Redisch, M. (1973). The not-for-profit hospital as a physicians' cooperative. *The American Economic Review*, *63*(1), 87–99.

Powell, W. W., & Steinberg, R. (2006). *The nonprofit sector: A research handbook.* Yale University Press.

Siciliani, L., Straume, O. R., & Cellini, R. (2013). Quality competition with motivated providers and sluggish demand. *Journal of Economic Dynamics and Control*, *37*(10), 2041–2061.

Sivesind, K. H., & Trætteberg, H. S. (2017). Does out-contracting of welfare services promote active citizenship? In *Promoting active citizenship* (pp. 1–31). Palgrave Macmillan, Cham.

Svendsen, I. (1993). *Empirical tests of the formation of expectations.* Statistics Norway.

Svensson, S., & Wingborg, M. (1991). Ideburna skolor och fristående huvudmän. *Report*.

Chapter 2

Should private providers of public services be paid less?

Sebastian Larsson

Abstract

Public services (e.g., healthcare and education) have multiple dimensions of quality. Some of these are observed by the users but not by the local government. By allowing user choice, providers can be induced to provide quality. Based on a model where all schools operate under a voucher system where the local government must finance public and private providers at an equal rate, the best result will always be obtained by having either only private or only public providers. However, this can change if the local government is allowed to shift funds from private to public providers. Under some conditions this will result in an outcome which is better than having only public or only private providers. This does however come with its own problems, since it will tend to disadvantage users of the private provider.

Keywords: Public Services, Quality, Competitive neutrality, Voucher markets
JEL Classification: D43, H75, L32, L33

1 Introduction and literature review

This paper studies competition in quality, specifically applied to schools. A common factor in education sectors today is the presence of both private and public providers competing for the same students. The merits of allowing private actors to provide public services are contentious, and one thing I will study here is whether education districts with only private schools can perform better than education districts with only public schools. The main focus is whether, starting from a principle of competitive neutrality, there are possible welfare gains from allowing the local government to set different voucher prices for private and public schools. In particular, I will study whether the ability to discriminate in prices could make having both private and public schools the best possible structure.

Many public services today are provided by both private (for-profit) and public (non-profit) providers. In Sweden, around 33% of high schools and around 17% of primary schools are run by private actors (Holmström, 2019). Another sector with a similar structure which could be analyzed in a similar way is primary healthcare. Swedish private schools are run on a for-profit basis, even though they are paid by the state. This has been criticized by various groups, particularly since there are no real restrictions on the possibilities for private providers to take out profits in Sweden (Hartman, 2011).

An advantage of allowing private actors to provide public services is that they may be more cost-effective, and their drive to obtain a higher share of the market can cause them to provide desirable services (Heyman, Norbäck, & Persson, 2012). However, there are complications if quality is non-contractible, i.e., where the exact level and type of quality a school provides cannot be guaranteed. While a private provider can have strong incentives to both improve quality and reduce costs, the incentives to cut costs (for example by downsizing the staff) are typically too strong. The reason is that private provider often disregards or undervalues the negative effects this may have on non-contractible quality (Hart, Shleifer, & Vishny, 1997). A possible example of ignoring investments in quality could be that private providers instead make use

of "gimmicks" such as free tablets to attract students. This may also compel public actors to adopt similar gimmicks rather than investing their resources in quality. So, there are legitimate concerns that allowing private actors into the education sectors can decrease the quality of services.

Public actors could instead be assumed to have more pro-social motivations, rather than being driven primarily by the profit motive, and should therefore be less sensitive than private providers to the trade-off between investing in quality and achieving greater profits. However, a concern about having only public actors is that they may not invest in making services more efficient and that they may be less inclined to innovate. Entry by a private for-profit actor can put pressure on them to innovate, alleviating some of these issues, as long as the entrant is sufficiently cost-efficient (Besley & Malcomson, 2018).

It is not always clear what combination of providers will result in the highest levels of welfare, however. Some studies suggest that a public monopolist will generally produce better welfare than any combination of providers under competition, unless the cost-disadvantage of the public school is very large (Bennett & La Manna, 2012). Others state that neither fully public nor fully private providers will result in the highest welfare, but rather that a mix of private and public ownership of providers is the best (Nakamura & Takami, 2015).

In many countries, neither private nor public schools are allowed to charge their students tuition fees. Instead, they are voucher markets, where the voucher price is typically set by the local/municipal government. In for example France and Sweden, private schools are funded in the same way as public schools. This results in competition even among public schools since funding is usually tied to the number of enrolled students (OECD, 2019). There is also a tendency in public policy to favor competitive neutrality, i.e., not favoring state-owned enterprises. The rationale is that if an enterprise is state owned, it should not receive an undue advantage over private actors who might be able to provide the goods or services in a more efficient way, since that would lead to inefficient provision in the market. This is even formally stated by organizations such as the OECD. There is however a provision made for

governments favoring public enterprises if they provide "public interest activities." The definition provided is written to be fairly broad, and depends among other things on whether the enterprise can be considered "economic" or "non-economic" in nature. The army and police are generally considered non-economic, since they are not focused on selling products or services. In contrast, healthcare, social security, and education can be considered economic or non-economic depending on how the sectors are organized and structured (OECD, 2012).

Optimal regulation may require that the local government violate competitive neutrality, by providing public actors with better funding than private ones(Stennek, 2017). This allows planners a greater degree of flexibility to customize their districts according to their preferences when there are schools with different underlying motivations present. This is not currently allowed in Sweden, as the local governments are required to finance private and public schools in the same way[1]. A similar principal is in place in many other parts of the world.[2] A philosophical argument for violating the principle of competitive neutrality could be that private and public actors do not necessarily provide the same services. This is very clearly the case in my model, since there is a specific type of quality that is only provided by public actors, which can justify setting a different voucher price to them than to private actors.

Users (i.e., parents and students) in many countries have the right to choose which school they attend. In a voucher-based system, schools are not able to set prices to attract students, and must therefore use other means if they want to attract students. Free choice of schools is thus thought to improve the quality of education, as schools seek to become better than their competitors in an attempt to attract more students. Schools that fail to do so might be driven from the district, which means that the quality of the schools that remain tend to be higher. However, the benefits of competition might not be realized if there is information asymmetry between users and providers.

[1]Skollagen 2010:800, c. 16 §52-55

[2]In some places private actors can compliment their funding with contributions from businesses or parents. In for example the Netherlands, this has led to private schools often receiving more money per student than public actors do (OECD, 2017).

In my analysis I will assume that quality is multi-dimensional and that different quality dimensions are differently observable by users. This will define how competition works in districts. My analysis has three main parts. The first part concerns in what circumstances an education district is best served by private and public actors, respectively. The second part deals with whether a district can be better served by a mix of private and public actors, assuming competitive neutrality. The third part concerns whether mixed districts can be made better by allowing for price discrimination, i.e., by allowing the local government to set different voucher values for private and public schools.

2 Modeling competition in different quality dimensions

All schools operate under a voucher system, where the education district has a budget B per student. In the first part of the analysis, funding is divided among schools based solely on student enrollment. This is referred to as *competitive neutrality*. In the second part, I will allow the local government to assign different "voucher prices" for private and public schools. This is referred to as *price discrimination*. The budget is assumed to be fixed in the short-medium term as the local government is restricted in its ability to restructure its spending or raise taxes. This is roughly equivalent to how schools are run in many places, where the local government is for example a municipality.

Education is a local "market", with a limited number of schools per district, two in my model. The schools can have private (for-profit, denoted by f) or public (non-profit, denoted by n) ownership, and provide quality in two dimensions. One of these is easier for the users to observe prior to choosing schools than the other. These two types of quality are denoted $Q_i \geq 0$ and $q_i \geq 0$ respectively.

The first quality dimension, denoted $Q_i \geq 0$, is not observable at all (i.e., a credence good). An example of this might be how well the school prepares their students

for life, e.g., the level of general knowledge, critical thinking, and life skills they teach. This will typically become apparent after completing the education, perhaps years after. Student entering a university program will for example not really realize how well their secondary education prepared them for university life until they have attended the program for a while.

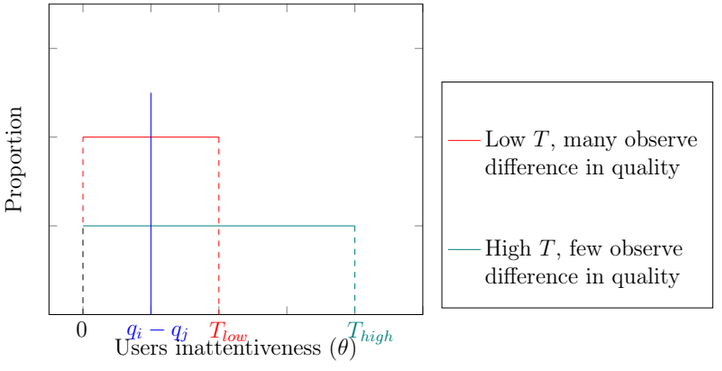
The second quality dimension (q_i) is observable to users if the difference in quality between providers is sufficiently large and/or the user is sufficiently observant. Examples of this type of quality include the courses offered by the school, the proportion of students receiving the highest grade, the condition of the school facilities, and promotional materials like tablets.[3] In this set-up, students compare the quality of different schools before choosing which one to attend. This combination of two types of quality should give a robust description of the district.

Users select schools based solely on observable quality q_i.[4] For this reason q_i will be the only variable schools compete in. A user observes the difference in quality if and only if $|q_i - q_j| \geq \theta$, where θ is consumer specific and follows the distribution $\theta \sim U[0,T]$. Here, T is the upper limit on how inattentive users are. A large T means that few users observe even a fairly large difference in quality, while a smaller T means that many consumers observe even small deviations in quality. For a visual illustration of how many consumers observe a given difference in quality, see Figure 1. The figure shows a given difference in quality and two levels of T. If school i produces the highest quality, we know that $q_i - q_j \in [0,T]$. With this difference in quality, a fraction $s = \frac{q_i - q_j}{T}$ of the population observes that school i produces higher quality, and this fraction all attends school i. The remaining fraction $1-s$ will randomly attend school i or school j. From this we can derive the proportion of students going to each school (i.e., the demand), which becomes $d_i = \frac{1}{2} + \frac{q_i - q_j}{2T}$. If the difference in observable quality between the two schools becomes so large that the

[3] An alternative way to think about this is that the measure really captures a "basket" of qualities, some of which are easy to observe and some which are harder. Users who are more observant may be so because they have an easier time weighing the different benefits of these different quality types.

[4] I assume there is no signaling function of ownership or forming of rational expectations

Figure 1: Distribution of user observation and which consumers do or do not observe the difference in quality



demand for one of them is negative, i.e. that $|q_i - q_j| \leq T$, the model will collapse into a corner solution. We can now see that this is the same as a Hotelling model with competition in quality, where a higher level of T is equivalent to a lower degree of competition(Stennek, 2017).

Quality is measured such that marginal costs of quality investment are the same for any type of quality improvement a school wishes to make, but some schools are more cost efficient in their investments. I will assume that private schools have lower marginal costs than public schools. This would be a main motivation for the local government to allow private schools, and also has support in the literature (Hart et al., 1997). Denote the (baseline) marginal cost of quality investment for a public school c. A private school is more cost efficient and has the marginal cost of quality investment γc, where $\gamma < 1$.

Users, public providers, and the local government value both types of quality, but not equally, and only q is observable by users. A consequence of this could be that users have a hard time valuing Q, which would make it difficult for policy makers to base decisions directly on maximizing user welfare. The local government and schools

must still set policy and allocate resources, and I instead assume that they use a paternalistic welfare/utility function where they value quality provided intrinsically. The schools and local government place a "baseline" value of 1 on observable quality. The local government values unobservable quality Q_i more than observable quality q_i to a degree captured by β. Public providers value unobservable quality $\alpha > 1$ times more than q_i. While it is not really a part of my analysis, it is interesting to discuss the relationship between α and β. If $\alpha > \beta$, the schools value Q more than the local government does. An example of this can be that schools have values that the government considers "archaic", such as focusing on 1700s poetry instead of more practical skills. A consequence of this could be that the government thinks public schools "over-invest" in quality Q. If $\alpha < \beta$, the local government values quality more than schools do. This could reflect the local government being more aware of the long-term benefits of education, while schools are more sensitive to the current wishes of the student body. This is believable, since the local government will typically reap more of the benefits of higher education quality, such as a more high-skilled labor base.

Public schools care about the quality of the education they provide to the district, and only care about their budget as a means of attaining this. As said, they place a greater value on the unobservable quality Q than observable quality q, captured by the parameter $\alpha > 1$.[5] The reason for this difference might be that the schools are more (or less) informed about the relative value of the two types of qualities than the local government. It could also be caused by the non-profit oriented mission of the public schools attracting more socially oriented teachers/staff compared with private schools, leading them to provide a different quality profile (Auriol & Brilon, 2014). The utility function of a public school is $V_n = (q_n + \alpha Q_n)d_n$. Public schools must also satisfy a budget restriction, such that $(B - cq_n - cQ_n)d_n = 0$ or equivalently $B = c(q_n + Q_n)$. The public school will set $q_n \geq 0$ and $Q_n \geq 0$ to optimize weighted quality:

$$\max_{q_n, Q_n} q_n + \alpha Q_n \text{ s.t. } B = c(q_n + Q_n)$$

[5] If this were not the case, no Q would ever be produced.

Standard maximization produces the best-response functions detailed in equation 1

$$q_n = \begin{cases} \frac{1}{2}[\frac{\alpha}{\alpha-1}\frac{B}{c} - T + q_{-i}] & \text{if } \frac{\alpha}{\alpha-1}\frac{B}{c} + q_{-i} \geq T \\ 0 & \text{otherwise} \end{cases}$$
$$Q_n = \begin{cases} \frac{B}{c} & \text{if } T > \frac{\alpha}{\alpha-1}\frac{B}{c} + q_{-i} \\ \frac{1}{2}[\frac{\alpha-2}{\alpha-1}\frac{B}{c} + T - q_{-i}] & \text{if } T \in (q_{-i} - \frac{\alpha-2}{\alpha-1}\frac{B}{c}, \frac{\alpha}{\alpha-1}\frac{B}{c} + q_{-i}) \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

A public school responds to increased quality among its competitors with an increase in its own q_i (strategic complements). The Q of a competitor does not have affect how much a public actor invests in unobservable quality, but the q of a competitor will decrease investment in observable quality. A higher budget B causes public actors to invest more in q_i, but less in Q_n if the school values the unobservable quality sufficiently low ($\alpha < 2$). A high budget could cause public schools to invest less in unobservable quality, as hard policy instruments (such as money) tend to have a greater effect on services that can be monetized than on services that are provided for the social good. An intuition of this is as follows: if the budget becomes higher, the public actor can choose to invest more in unobservable quality (providing better quality to students), or to invest in observable quality (getting a higher share of the students), both of which are valued by the school. Unless the school values unobservable quality sufficiently, it will be better to try to get a higher share of students than to invest more in observable quality. But this can trigger competition for students between schools, forcing public schools to actually decrease investment in unobservable quality.

A private school cares only about maximizing profits and uses quality only as a means to attract students. Consequently they will ignore all aspects of quality that they cannot monetize. Private schools will set $q_f \geq 0$ and $Q_f \geq 0$ to maximize profits according to:

$$\max_{q_f, Q_f} \Pi = (B - \gamma c(q_f + Q_f)) * (\frac{1}{2} + \frac{q_f - q_j}{2T}).$$

Standard maximization produces the best-response functions in equation 2, where a private school f responds to a school j, which can be either private or public.

$$\begin{aligned} Q_{f|j} &= 0, \\ q_{f|j} &= \begin{cases} \frac{1}{2}[\frac{B}{\gamma c} - t + q_j] & \text{if } \frac{B}{\gamma c} + q_j \geq T \\ 0 & \text{otherwise.} \end{cases} \end{aligned} \tag{2}$$

The private school will never produce any unobservable quality, regardless of what the other school does or how high the education budget is. It will however produce observable quality q_i, except in the case of very low competition, and responds to an increase in the quality of their competitors (q_{-i}) by increasing their own (i.e. strategic complements). Also, the higher the education budget, the higher the level of qi it will set.

There are three unique combinations of school types, giving three different district structures: the first where both schools are public, the second where both are private, and the third where one school is private and the other is public (i.e., a mixed district). The first two of these are interesting on their own and provide a good baseline with which to compare the mixed district, which is my focus. The equilibrium levels of both q_i and Q_i will be contingent on the combination of schools in a specific district.

Unregulated competition is a good policy under certain conditions, for example when the social planner is uncertain about technological efficiency and other relevant aspects of the district. In other cases, it can be optimal for the policy maker to make a direct intervention, e.g., by dividing a district into local monopolies (Wolinsky, 1997). For example, if the local government can contract on quality, the first best outcome will always be to have private (cost-efficient) actors serving the district, with the contract specifying that they must only provide the highest valued quality. This will provide the maximum amount of quality with the highest value to the district. However, since quality is not contractible in my model, this is not possible. A second-best outcome can potentially be achieved by allowing price discrimination,

improving on the base case of competitive neutrality.

Assume that the local government values the aggregate quality provided to the district and does not factor in the profits of actors in any way. They evaluate welfare based on the quality provided to the district, instead of basing it directly on student utility. In other words, they have paternalistic preferences. This could be because they (correctly or not) believe that users cannot make fully rational choices regarding education (Thaler & Sunstein, 2003). The values placed on observable and unobservable quality are 1 and $\beta > 1$, respectively. I will refer to the function showing how much value the local government derives from the aggregate quality provision in the district as the local governments **welfare functions**, which is detailed in equation 3.

$$W = \sum_{i \in I} q_i d_i + \beta \sum_{i \in I} Q_i d_i \tag{3}$$

This is a gross welfare level, which does not factor in the size of the education budget. The reason is that the budget is assumed to be fixed (at least in the short to medium term) and will then not make a difference in the welfare comparison. This feels like a reasonable assumption, since education works on a voucher system and financing comes from taxes, restricting the local governments ability to adjust the budget.

2.1 Pure private and pure public education districts

This section will analyze districts with only public or private actors and under what conditions a pure private district might actually result in higher welfare than a pure public district. An analysis of districts where both types of schools are present will be conducted in Section 2.2.

2.1.1 Districts with only public schools

In a district with only public schools, there is a unique and symmetric equilibrium, derived from equation 1 above. The two schools in such a district will produce quality at the values detailed in columns 2 and 3 of Table 1.

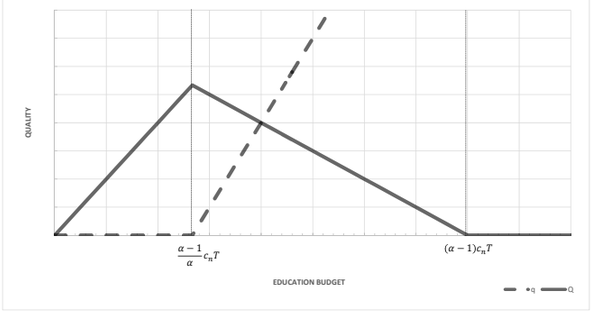
Table 1: Quality and Welfare in pure public districts

Condition	q	Q	Welfare
$B < \frac{\alpha-1}{\alpha}cT$	0	$\frac{B}{c}$	$\beta * \frac{B}{c}$
$B \in [\frac{\alpha-1}{\alpha}cT, (\alpha-1)cT]$	$\frac{\alpha}{\alpha-1}\frac{B}{c} - T$	$T - \frac{1}{\alpha-1}\frac{B}{c}$	$(1 - \frac{\beta-1}{\alpha-1})\frac{B}{c} + (\beta-1)T$
$B > (\alpha-1)cT$	$\frac{B}{c}$	0	$\frac{B}{c_n} - T$

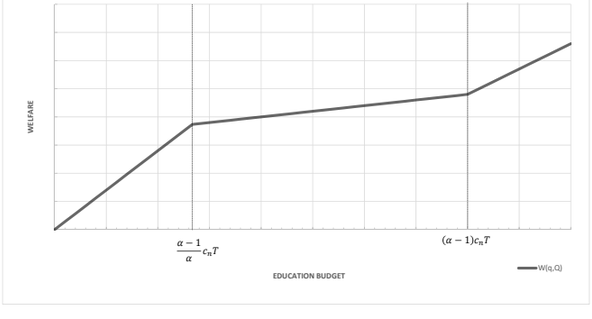
If $\frac{\alpha}{\alpha-1}\frac{B}{c} < T$, public schools provide 0 units of q_n, and instead invest all funds in Q_n, and will produce a non-zero level of Q_n as long as they receive any funding. If $\frac{\alpha}{\alpha-1}\frac{B}{c} > T$ the public schools invest progressively less in Q_n and more in q_n the higher the education budget. The reason is that at higher budget levels it becomes more attractive for public schools to start competing for students, and hopefully provide quality to more students. This increases competition and causes a shift in resources from Q_n to q_n. At some point this effect becomes so extreme that even the public schools will invest all their resources in observable quality. The relationship between quality (Q_i and q_i) and the voucher price is outlined in Figure 2. Also, in districts with many unobservant students (i.e., higher levels of T), public schools invest more in Q and less in q, while they tend to invest less in Q_n and more in q_n if there are many observant students (i.e., a low value of T).

This shows that monetary incentives, as captured by the voucher price, tends to crowd out social investments, i.e. unobservable Q, in favor of incentives that are more strongly tied to prices, i.e. the observable quality q. A parallel to this is contract literature, where incentive-based schemes can cause agents to divert resources away from difficult-to-observe tasks in favor of ones that are easier to discern (Holmstrom, 1991). There is also empirical support for this finding from different sectors, including

Figure 2: Relationship between quality and the education budget in a pure public district



(a) Quality levels



(b) Welfare

education (Gneezy, Meier, & Rey-Biel, 2011).

I insert these equilibrium quality levels into the local government's welfare function. If the users are not very observant or the budget is set low, the providers will only invest in unobservable quality. If the users are observant enough or the budget is set high, the public schools will produce both $q_{n|n}$ and $Q_{n|n}$. However, if the budget is set high then only observable quality will be produced. See column 4 in Table 1.

In some cases welfare might be higher at lower budget levels, since this is the situation where the two providers invest the most in unobservable quality. However, in other cases welfare might be higher at high budget levels. See Figure 2 b for an illustration of this.

An interesting point to introduce here is the case where one public actor serves the entire district, i.e., a monopoly. A public actor not facing any competition would invest all of its financing in producing unobservable quality Q, since this is valued higher than q, by $\alpha > 1$. Because this type of quality is valued higher by both the provider and the planner this will in most cases be the first-best outcome. In the case where the education budget is low, there will not be any difference between two public schools and a public monopolist. If the public schools start investing any part of their budget in observable quality, this incurs a welfare cost, because $\alpha > 1$ and $\beta > 1$. This is clear to see if the two public actors were to invest their entire budget in the less valuable observable quality. It is also fairly simple to show that it will also be true when the two public actors invest in both quality types, from setting $\beta\frac{B}{c} > (1 - \frac{\beta-1}{\alpha-1})\frac{B}{c} + (\beta - 1)T$, which simplifies to $B > \frac{\alpha-1}{\alpha}cT$. This is satisfied by the boundary condition from Table 1 col. 4.

I will now use the above fact and Table 1 to define Lemma 2.

Lemma 2. *In a district with only public schools, low competition (a high value of T) leads to higher welfare. While welfare does not increase linearly with the education budget, beyond a point a higher education budget will mainly cause providers to change quality investment. Finally, a district with two public providers will never outperform a district with only one provider.*

Because local government values unobservable quality higher than observable quality ($\beta > 1$), welfare will be higher when T is large and competition is low, suggesting that the local government would not wish to help users compare the quality (q_i) between different public schools. This is similar to previous research suggesting that, under pure public ownership, welfare is highest when users are immobile and competition is low. This suggests that the local government is motivated to conceal information in public districts (Stennek, 2017).

2.1.2 Districts with only private schools

In districts where there are only private schools, there is a unique and symmetric equilibrium in qualities. The two private actors will each produce quality as detailed in Table 2.

Table 2: Quality in districts with only private providers

Condition	$q_{f\|f}$	$Q_{f\|f}$	Welfare
$\frac{B}{\gamma c} < T$	0	0	0
$\frac{B}{\gamma c} > T$	$\frac{B}{\gamma c} - T$	0	$\frac{B}{\gamma c} - T$

In a pure private district, only one type of quality is produced, i.e., that which is ex-ante observable. If $\frac{B}{\gamma c} < T$ then 0 units of quality will be provided. The intuition is that if T is very large, (i.e., there are many users who are very unobservant), the costs of attracting one more user is larger than what the provider would recoup, and it will be optimal for both providers to provide 0 units of q_i. Recall that the same quality needs to be provided for the entire student body at a school. If $\frac{B}{\gamma c} > T$, some level of q_i is produced, the amount of which is increasing in the size of the budget. Also, as users become more observant (i.e., T decreases) the level of quality provided also increases. Figure 3 (a) illustrates the relationship between the budget and level of quality provided by the two providers in a pure private district. The total level of

welfare in a district with only private actors is then detailed in column 4 in Table 2. Figure 3 (b) shows the relationship between the value of quality and the size of the budget.

It is worth noting that, unlike the case where only public schools serve the district, competition is necessary for the private schools to produce any quality. A single private actor will not invest anything in improving quality, since they only value q as a way to get a higher share of the students in their district. Use this fact, along with Table 2 to define Lemma 3 below.

Lemma 3. *In a district with only private actors, welfare is lower when competition is low. This is true either if the students are unobservant or the budget is low. Additionally, a district with only one private provider will never outperform a district with two private actors.*

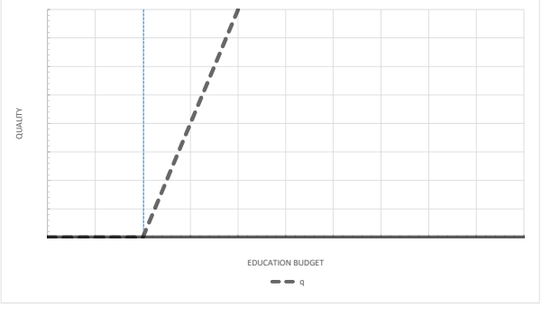
2.1.3 Optimal pure district structures, public vs. private

Recall that the education budget is fixed in a district, and districts have specific valuations of Q. By taking the results derived in Tables 1 and 2 I derive a condition for when the welfare level produced by two private providers is greater than the welfare level provided by two public actors, detailed in Equation 4. This covers the case where both observable and unobservable quality is produces. If only q is produced districts with only private actors always outperform districts with only public actors. If only Q is produced the reverse is true.

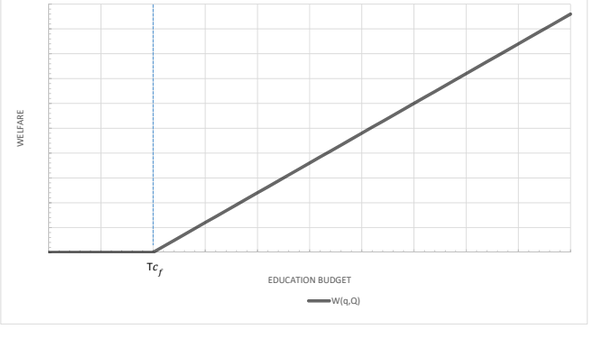
$$W_{F,F} \geq W_{NN} \rightarrow \frac{1-\gamma}{\gamma} \geq \beta\frac{Tc}{B} - \frac{\beta-1}{\alpha-1}. \tag{4}$$

Equation 4 details the condition under which districts with only private actors produce higher welfare than districts with only public actors, all else equal. There are some notable conditions when this happens. First, if the users are sufficiently observant (T is low) the welfare generated by private actors will tends to be better. Second, if the education budget is larger (B is high), the welfare generated by private

Figure 3: Relationship between quality and the education budget in a pure private district



(a) Quality levels



(b) Welfare

actors tends to be better. Third, if public actors are indifferent between producing the observable and unobservable qualities ($\alpha \approx 1$), then the welfare generated by private actors tends to be better (because the cost-effectiveness of private actors becomes more important). Fourth, as the private school becomes more cost efficient (γ lower), then the welfare generated by private actors tends to be greater. The above analysis gives proposition 1.

Proposition 1. *The welfare attained in a district with only private schools is higher than the welfare in a district with only public schools if 1) competition is intense enough, 2) the private schools are very cost-efficient compared with the public schools, or 3) if the public school is sufficiently indifferent between observable and unobservable quality, all else equal.*

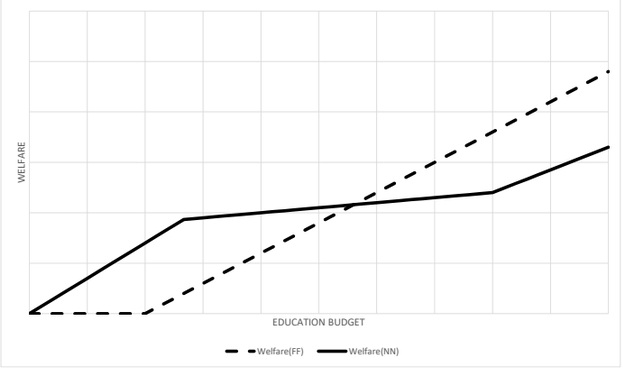
A second interesting result concerns how competition affects welfare in the two types of pure districts. The local government in pure public and pure private districts will need to set different policies to manage competition, transparency, and budgeting in their respective districts. Take the results from Lemmas 2 and 3 to define Proposition 2 below.

Proposition 2. *In districts served by public actors only, welfare is highest when served by a monopolist, otherwise when competition is as low as possible, i.e. when users are unobservant. In districts served by private actors only, welfare is higher the higher the competition, i.e. when users are very observant.*

Figure 4 illustrates how the welfare level in the two types of configurations varies with the size of the education budget. When the budget level is low enough welfare generated by two public providers is greater than the welfare generated by two private actors, but if the budget is high enough then the opposite is true. The public and private schools respond differently to the size of the budget or degree of competition, although generally both will tend to display higher investment in observable quality q_i at higher budget levels, i.e., a higher budget fuels competition. Generally, the private school will increase q_f more on the margin than public schools will increase q_n, because the private schools are more cost-efficient.

An interesting finding about this welfare relationship is that it feels at odds with the

Figure 4: Welfare comparison



motivation of allowing private actors to provide public services, that is because they are more cost-efficient. While two private providers will, all else equal, produce more observable quality compared with two public providers, the welfare is higher at high levels of the education budget, which does not really enable the local government to save money. This clashes with the idea of saving money by allowing private actors in a district.

2.2 Districts with both types of education providers

In many districts both private and public schools are present, and it is important to look at the welfare consequences of this. If there is some synergy effect, for example if a private school can be used as "leverage" to get public schools to provide better quality and vice versa, the mixed district could outperform both other forms. If this is not the case, there will be dead-weight losses caused by the district being served by inefficient types of providers.

Entering policy analysis, I will first focus on mixed districts without allowing for price discrimination. After analyzing this case, and seeing if the welfare can outperform both pure district types, I will allow for price discrimination.

2.2.1 Mixed districts under competitive neutrality

I will assume that public actors place quite a high value on Q compared to q and that the private actor is quite cost efficient, translated as $\frac{\alpha-1}{\alpha} > \gamma$. It follows that 1) the public school values unobservable quality a lot more than observable quality and 2) the private school is very cost-efficient compared with the public school. Another consequence is that the private provider will generally invest more than public providers in q if the budget is increased. In this case, both the private and public schools have characteristics that the local government values, and the benefits derived from a mixed market should be as high as possible. Note that this does not mean that the mixed district will be better than the alternate cases. For example, if the public actors value Q a lot more than the local government does, the public actors might invest inefficiently much in Q. However, this is also the case in pure public districts, which may well result in the pure private district being the optimal structure. The private school has the advantage that its costs are low compared with the public school, and it can produce quality efficiently. The public school has the advantage that it values unobservable quality highly compared with observable quality.

In the mixed-district equilibrium, schools invest in the two qualities to different degrees. Assuming competitive neutrality, these quality investments are presented in Table 3. As in the pure public district, the public school tends to invest away from Q_i and towards q_i as competition becomes more intense (as T becomes smaller). This result then holds regardless of what type of school the public actor is competing with.

To compare to the two pure and private district types, see Figure 5. The graph clearly shows that at the point where $Q_{n|f}$ is the highest, there will also be more

Table 3: Quality levels in districts with both private and public providers

Conditions	$q_{f\|n}$	$q_{n\|f}$	$Q_{n\|f}$	$Q_{f\|n}$
Case 1: $B < T\gamma c$	0	0	$\frac{B}{c}$	0
Case 2: $B \in (T\gamma c, \frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma})$	$\frac{1}{2}(\frac{B}{\gamma c} - T)$	0	$\frac{B}{c}$	0
Case 3: $B \in (\frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma}, \frac{T\gamma c}{\frac{1}{3}-\frac{\alpha-3}{3(\alpha-1)}\gamma})$	$(\frac{1}{3}\frac{\alpha}{\alpha-1} + \frac{2}{3}\frac{1}{\gamma})\frac{B}{c} - T$	$(\frac{2}{3}\frac{\alpha}{\alpha-1} + \frac{1}{3}\frac{1}{\gamma})\frac{B}{c} - T$	$(\frac{\alpha-3}{3(\alpha-1)} - \frac{1}{3}\frac{1}{\gamma})\frac{B}{c} + T$	0
Case 4: $B > \frac{T\gamma c}{\frac{1}{3}-\frac{\alpha-3}{3(\alpha-1)}\gamma}$	$(\frac{1}{3}\frac{\alpha}{\alpha-1} + \frac{2}{3}\frac{1}{\gamma})\frac{B}{c} - T$	$(\frac{2}{3}\frac{\alpha}{\alpha-1} + \frac{1}{3}\frac{1}{\gamma})\frac{B}{c} - T$	0	0

q supplied in the district compared with the case with only public providers. This condition is contingent on private schools being more efficient in service provision compared with public ones. Whether or not this results in a net welfare increase depends on how strongly the district is divided between private and public schools. If demand shifts greatly away from the public school to the private school, the net welfare effect will most likely be negative. If the shift in demand is negligible (i.e., because of lower competition), the welfare change will likely be positive.

The total welfare produced in a district with one private and one public provider can be expressed as:

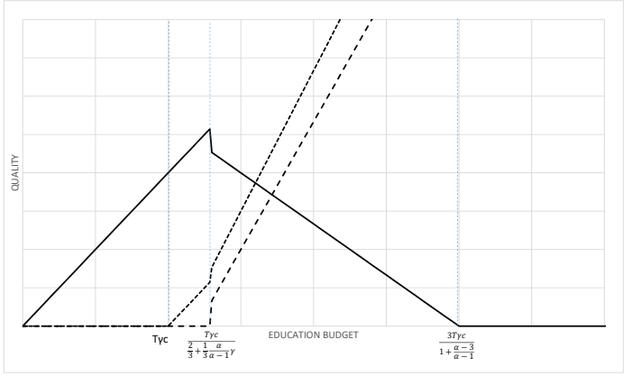
$$W = q_{f|n} * d_f + q_{n|f} * d_n + \beta * Q * d_n.$$

As in the case with pure public districts, there are several different outcomes depending on the size of the education budget and how observant the students are, among other things. By analyzing these outcomes, it is possible to show that there is no case where a mixed district can outperform both types of pure districts under competitive neutrality. This results in Proposition 3.

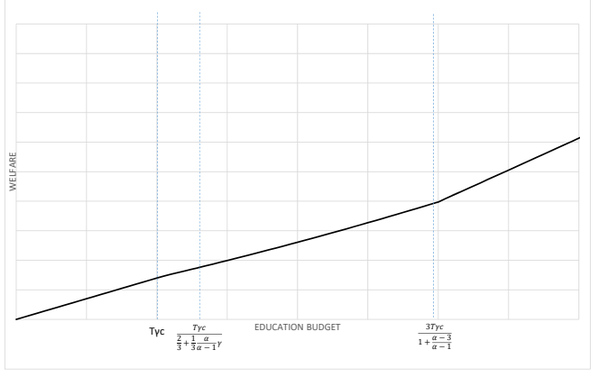
Proposition 3. *If there is no price discrimination, a mixed district can never generate higher welfare than both types of pure districts.*

The proposition implies that, without price discrimination, welfare is highest when

Figure 5: Mixed district responses



(a) Quality levels



(b) Welfare level

each district contains only the "best" type of provider, i.e., only private or public providers.

The proof is as follows. Looking at districts containing a mix of private and public providers there will be four different "cases," similar to the different cases in Table 3. The first is where there is no q produced and the public school produces some Q. The second case is where the private school produces some q and the public school produces only Q. In the third case, both schools produce q and the public school produces Q as well. In the fourth case, only q is produced. See Figure 5 for an illustration of these cases.

The simplest way to show whether a mixed district without price discrimination can improve welfare is to look at each unique case and compare it with the welfare levels achieved in either of the alternative situations, i.e., in a situation with only private or only public actors. I will summarize the proof here, but the full proof will be presented in Appendix A.

Consider first the two "extremes," i.e., where the budget is low and only Q_n is produced, and where the budget is high and only $q_{n|f}$ and $q_{f|n}$ are produced. If only Q_n is produced, the two schools are not actively competing and the students split equally between the two schools. The public school does not produce more quality than it would have in the pure public district, but in that case the investment in quality would benefit all students living in the district. In this case a pure public district will always be better than a mixed district. The opposite is true if only $q_{n|f}$ and $q_{f|n}$ are produced. In this case, both schools invest their resources in q_i, but the private school is more cost-efficient and will get more out of it than the public school. Thus, here the district with only private actors will always perform better than the mixed district.

In the cases between the two extremes, the analysis is less intuitive. However, in each case it is possible to show that the observable quality will always be between the highest and lowest value produced in the two pure district structures. Also, the welfare produced by the public schools in mixed districts is lower than the welfare

produced by public schools in pure public districts, i.e., there is no leverage effect. It is not clear which pure district produces the highest welfare, but it is possible to show that the mixed district welfare will always be between the two.

2.2.2 Mixed districts under price discrimination

I will now relax the competitive neutrality condition, i.e., the local government is now allowed to set one voucher price for public schools and another for private schools. The education budget must still balance for the district. The best way to think of these prices is as per-student voucher prices set by the planner for the private and public schools, with the restriction that $B = P_n * d_n(P_n, P_f) + P_f * d_f(P_n, P_f)$. Since demand is normalized to 1, the budget can then be interpreted as the *average* per-student voucher price in the district. Allowing price discrimination can increase welfare by allowing the planner to access a wider variety of outcomes. In fact, the case where prices are the same could be considered a special case of price discrimination, and price discrimination cannot per definition achieve a lower maximum welfare level than competitive neutrality. In other words, it allows the planner to more efficiently use the strengths and weaknesses of each type of actor.

Allowing price discrimination gives the local government a degree of control over the quality produced by the two schools, and will potentially allow for higher levels of welfare than competitive neutrality. Using the response functions defined in Equations 2 and 1, the levels of quality provided by the private and public school can be derived as follows, and will depend on both prices, as defined in Table 4.

Table 4: Quality in districts with both private and public providers, under price discrimination

	q_n	q_f	Q_n	Q_f
$q_f, q_n = 0$	0	0	$\frac{P_n}{c}$	0
$q_f > 0, q_n = 0$	0	$\frac{1}{2}(\frac{P_f}{\gamma c} - T)$	$\frac{P_n}{c}$	0
$q_f = 0, q_n > 0$	$\frac{1}{2}(\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T)$	0	$\frac{P_n}{c} - q_n$	0
$q_f = 0, q_n > 0$	$\frac{1}{3}\frac{P_f}{\gamma c} + \frac{2}{3}\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T$	$\frac{2}{3}\frac{P_f}{\gamma c} + \frac{1}{3}\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T$	$Max\{0, T + \frac{1}{3}\frac{\alpha-3}{\alpha-1}\frac{P_n}{c} - \frac{1}{3}\frac{P_f}{\gamma c}\}$	0

There are several reasons why competitive neutrality might be an inefficient principle in school management. One reason is that private and public schools respond differently to changes in the voucher price, and allowing local governments to set school-specific prices can allow them to derive maximum benefit from both types of schools. A related reason is that private and public actors do not fundamentally provide the same type of service, as made especially clear in my model. This begs the question of whether it would even be accurate to describe setting different prices for the two as *price discrimination* since *price discrimination* means setting different prices for the same good or service.

To further investigate this, it is helpful to understand the effects of shifting resources from the private to the public school. First, assume that all types of quality are produced, as in Case 3 defined above. Assume also that the public and private schools are equally competitive, initially have the same voucher price, and divide the district equally between them ($d_f = d_n = \frac{1}{2}$). This occurs when the two schools produce the same level of observable quality, $q_f = \frac{1}{\gamma c} - T = \frac{\alpha}{\alpha-1}\frac{1}{c} - T = q_n$, or when $\frac{1}{\gamma} = \frac{\alpha}{\alpha-1}$. This means that the advantage the public school obtains from valuing unobservable quality is equal to the advantage that the private school obtains from having high cost-efficiency. Under competitive neutrality, both the private and public school provide the same level of observable quality q. In the analysis that follows, it is also helpful to recall the best-response functions derived in Equations 1 and 2.

Now, assume that the policy is changed so that the local government is allowed to set different prices to private and public schools. This is done on the margin, for example by moving 1 unit of money (e.x., € 1) per student away from the private school and giving it to the public school, so the shift in resources will not drastically change the type of the market. The analysis is simplified by the fact that equally many students attend each school initially. Starting with the welfare function $W = q_n * d_n + q_p * (1 - d_n) + \beta Q d_n$, the differential caused by a change in the budget

becomes:

$$dW = q_n * dd_n - q_p * dd_n + \beta Q dd_n + dq_n * d_n + (1 - d_n) * dq_p + \beta dQ * d_n.$$

Recall that $d_n = 1 - d_n$, since schools initially divide the district equally. Also, by the conditions defined above, $dq_n = -dq_p$ meaning that the private school's investment in quality will go down by $\frac{1}{2}\frac{1}{\gamma c}$ and the public schools investment in quality will increase by $\frac{1}{2}\frac{\alpha}{\alpha-1}\frac{1}{c}$, which means that the extra welfare gained by the public school will exactly offset the loss in welfare from the private school. Finally, $q_f = q_n$ because the initial investment in quality is the same for the two schools. We can use these three observations to simplify the differential, since $dq_n * d_n + (1 - d_n) * dq_p = dq_n * d - d * dq_n = 0$ and $q_n * dd_n - q_p * dd_n = 0$. The differential can now be written:

$$dW = \beta Q dd_n + \beta * dQ * d_n.$$

The first part of this is the change in welfare from the influx of new students to the public school. This always leads to an increase in welfare, since these students now get additional unobservable quality Q that they did not get before. The second part comes from the change in unobservable quality, and this effect can go both ways. If α is very small, this effect is negative. But if α is large enough then this effect is also positive. Thus, if α is not too small, the total net effect is positive. If the value of unobservable quality β is large enough, this change can result in a large enough increase in the welfare level to not only surpass the competitive neutrality case but also both pure districts.

As for the question of whether a mixed district can ever outperform all other types, it is possible to narrow down the analysis somewhat. The reason is that, both when the budget is high and when it is low, the mixed district will not be able to outperform both other types. If the budget is low, we run into the same problem as under competitive neutrality, that the private school does not produce any quality. When

the budget is high, the public school does not invest anything in Q. Since the private provider is more cost-efficient, and this is the only difference between the two schools, the district would be best served by two private providers.

I will now use numerical analysis to prove that price discrimination can not only improve upon competitive neutrality, but can even increase welfare to the degree that a mixed district can result in higher welfare than all other structures. This will lead to Proposition 4.

Proposition 4. *When a district is served by both private and public actors, the welfare generated can be greater than both in a district served only by private providers and one served only by public providers.*

Proof: The proof comes from numerical analysis. For example, set $\alpha = 3$, $\beta = 7$, $\gamma = 0.4$,$c = 3$ and $T = 1$. Set the budget to $B = 3.5$ and the voucher-prices $P_f = 0.6$ and $P_n = 4.32$, which will balance at the realized demands. The welfare levels in each type of district are $W_{f|f} = 1.91$, $W_{n|n} = 3.6$ and $W_{n|f} = 5.01$, and the mixed district with price discrimination has the highest level of welfare provided, QED.

So numerical analysis finds some cases where a mix of private and public actors can outperform both types of pure districts at a given budget. Equally interesting is that there are some common threads for the cases where this happens. One is that the education budget should not be too high. If this happens, the private actors tend to outperform other types, all else equal. Second, the voucher price allocation needs to favor the public actor, while setting a low voucher price for private actors. Finally, how likely it is that a mixed district will be the best structure depends on how the public actor values unobservable quality over observable (α), and how inattentive the users are (T). These cases will be analyzed in more detail below. This final condition merits some closer examination.

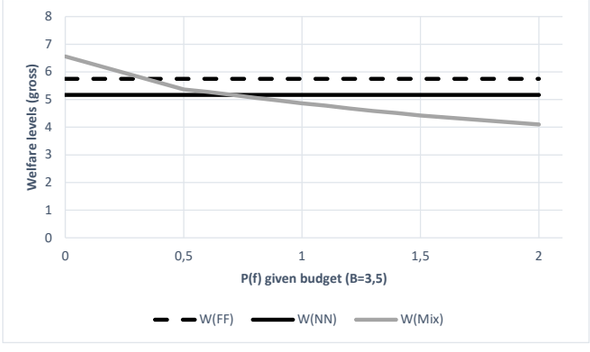
First, the set of prices at which a mixed district can out-perform both of the districts covered by only private/public actors will vary by α. When the public providers are indifferent between the two types of quality, i.e. $\alpha \approx 1$, there will not be any possibility for the mixed district to be best, since the public school would tend to only

provide observable quality. In these cases, districts with only private schools tend to provide higher welfare. As α increases, there will come a time when a mixed district becomes the best option, and the set of prices where this is the case will increase as α increases. However, the welfare provided in a pure public district will also increase, and when the public actors value Q over q to a sufficiently large degree, the welfare generated by two public actors will start to dominate. For an example of when this can happen, see Figure 6. It shows how the welfare generated by pure private, pure public, and mixed districts changes by voucher-price allocations at different levels of α.

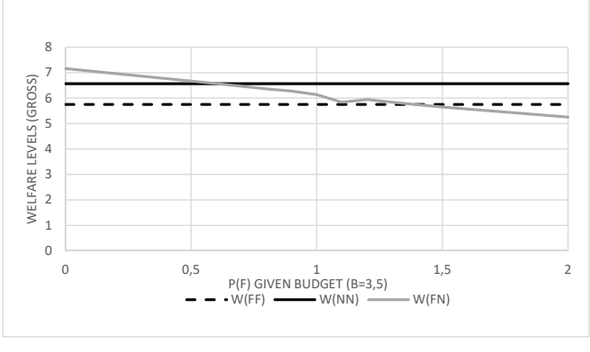
Second, how attentive users are to the difference in quality between providers will determine how beneficial a mixed district can be. We can see that if consumers are very unobservant (i.e., T is high), a mixed district will never out-perform all other forms and the pure public district provides higher levels of welfare. Conversely, if the users are very observant (i.e., T is low), the utility provided by a mixed district will decrease and a pure private district will always be optimal. At interim levels, there will be a set of prices such that the mixed district can be the best choice. See Figure 7 for an illustration of this, at comparatively high and low levels of T.

The above results come with some interesting implications. One is that while price discrimination in mixed district environments can yield higher levels of welfare compared with what could be achieved in a pure public or pure private district, it does so at the expense of the students attending the private school. What the local government is doing is allowing the public provider to adopt some monopolistic characteristics as well as to receive a higher than average per-student voucher price than it could in a pure public district. This allows it to invest more in producing Q than otherwise possible. In case the planner values Q sufficiently high, this can result in large welfare gains. However, this comes at a welfare cost of having the private school produce very little quality and generate very little welfare. Essentially, the private school is taking advantage of the fact that a proportion of students will attend the (now underfunded) private school regardless of quality level. This is seen by the fact that the set of prices that this can be achieved at increases when the degree

Figure 6: Welfare under different sets of prices and schools' valuation of unobservable quality α

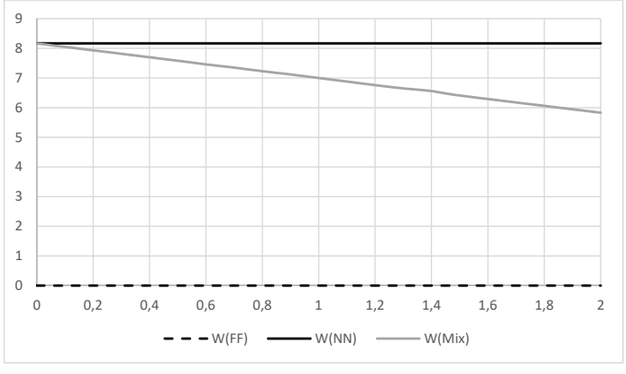


(a) With a low valuation of α

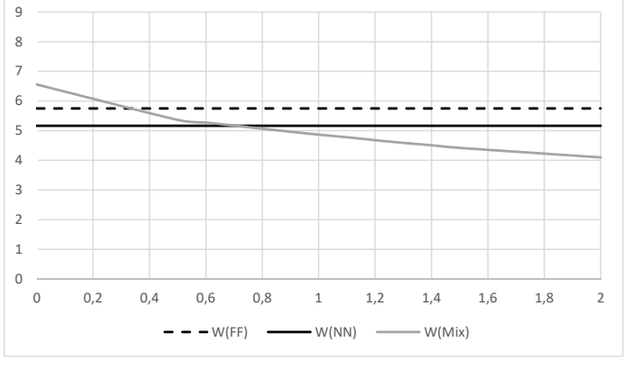


(b) With a high valuation of α

Figure 7: Welfare under different sets of prices and degree of competition T



(a) With a low level of competition



(b) With a high level of competition

of inattentiveness is high, at least up to a point. The district now is comprised of a quasi-monopolist public actor and a welfare-loss private actor. Recall that this will at most be second best, since the first-best is achieved by either a single public monopolist or two private actors, depending on the characteristics of the given district.

3 Possible Extensions and future research

There are, as in all theoretical models, extensions and venues I have not been able to explore here. In this section I will discuss some of these and theorize around the implications of introducing other factors into the model.

In the model, I assume that the private schools are cost-efficient enough to always increase unobservable quality more on the margin as the budget increases than public schools will, a consequence of $\frac{\alpha-1}{\alpha} > \gamma$. However, a sufficiently quality-indifferent public school paired with a not very cost-efficient school can result in situations where this is not the case. While I do not believe this would change the larger results, it could lead to cases where it would be better to get the public schools to behave more like private actors than public monopolies, increase information to students, and encourage harder competition even in mixed districts.

A second extension is allowing the local government to set the budget strategically. To do this, it would be necessary to introduce a welfare cost of changing the budget, for example an exponential cost function. Then, instead of a welfare level contingent on the budget, there will be an optimal budget set in each district. Comparing the welfare in pure private vs. pure public districts the results would be similar to what I have shown here, where the optimal welfare level in private districts is higher than in otherwise identical public districts under similar conditions. In mixed districts without price discrimination, the results will also be the same since this strongly shows that the mixed district can never outperform both pure district types. It is hard to state what would happen in a mixed district without price discrimination, since the

optimization in multiple parameters would then be much more complicated.

A third interesting expansion is what would change if there were more than two schools present in each district. Some results would probably be the same, for example that introducing more private schools in a private district would tend to increase welfare through higher competition, while it would be bad to introduce more public schools in pure public districts for the same reason. Also, in a mixed district with price discrimination, it should be possible to "leverage" the public actors in a similar way, although the ability to do so would decrease as more private schools enter the district.

4 Conclusion

In this paper I have studied how competition in quality between either public, private, or both public and private actors affects investment in quality in voucher-based education districts. Competition is a function of how easily students can observe quality differences between the services of the two providers. The first main point of interest is under what conditions public districts perform better than private districts, and under what conditions the opposite is true. The second is whether a district with both types of actors can be even better. The third is whether this result changes when introducing price discrimination.

The amount of welfare generated in the two types of districts will depend on the characteristics not just of the providers but also of the district. For example, if users are more observant, private schools tend to do better than public schools . There is no case under competitive neutrality where a district with both private and public providers will perform better than both districts with only private providers or with only public providers.

Under some conditions, when a district opens up for price discrimination, and the local government shifts resources away from the private school to the public school, the private school will increase investment in observable quality. This means that the

new students attending the public school now get additional unobservable quality, in addition to getting more observable quality. This will result in a net increase in welfare. If the public school also places a high enough value on unobservable quality, it will also increase investment in this type of quality. This will result in a net welfare gain for both the new and previous students enrolled at the public school. There will be a welfare loss from the decrease in quality at the private school, but this will typically be offset by the increase in quality to the students attending the public school. Under these circumstances introducing price discrimination can increase welfare so much that having a mix of private and public schools will be the best structure.

This has interesting implications for policy. Firstly, it provides an argument in favor of allowing price discrimination between private and public welfare providers, which may not be allowed in some countries. However, it also points to shortcomings of allowing private and public actors to operate in the same district. First, without price discrimination this will never be optimal. Second, even allowing for price discrimination, optimal mixed districts tend to disadvantage students attending underfunded private schools, which can cause further social and economic inequality later in students' lives. My paper therefore reveals a trade-off of price-discrimination in that it can increase welfare, but at the cost of less equitable education.

Appendix A Proof that quality is always lower in mixed markets under competitive neutrality

The proof comes from analyzing each case, rank-ordering the quality produced in these cases, and showing that there is no synergy here, i.e., that there is no case where an actor is prompted to produce more quality by having a different type of competitor. To facilitate this analysis, I will sometimes focus on the welfare generated by private/public actors in a mixed market, defined for school i as $\tilde{W}_{ij}$.

Case 1: If the education budget is set at a low level, no q is produced by either school, and students are split evenly between the two. Only the public school produces any quality, the same as it would produce in a pure public market if it did not produce any q_n. However, this quality only benefits students attending the public school! So $Q_{nf}(B) = Q_{nn}(B)$, $q_{nf} = q_{fn} = 0$ and $d_{nf} < d_{nn}$ This is directly worse than the pure public market in the same condition, where all students get Q, so case 1 can never be better than the pure public school.

Case 2: As the education budget increases, both q_f and Q_n are produced, but no q_n. The private school invests less in quality than it would have if they were competing with another private school $0 = q_{nf} < q_{fn} < q_{ff}$[6], and these students will receive an education of lower quality than it would in a pure private market. The Private school will also capture a majority of the market. As in *case 1*, the public school will provide the same quality as it would if it competed with another public school. This means that $W_{nn} = \tilde{W}_{nf}$ and welfare generated by public schools is the same as in the pure public market. Thus, in *case 2* there cannot be a price such that the mixed market generates higher welfare than both of the pure markets either. The logic is that for the mixed market to be better at a given budget, at least one of the providers must do better in the mixed market than in their pure market, which is not the case here.

[6]Because $(\frac{B}{\gamma c} - t > \frac{1}{2}(\frac{B}{\gamma c} - t))$

Case 3:Knowing that $\frac{\alpha-1}{\alpha} > \gamma$, we can rank-order observable quality in all markets by size as $0 < q_{nn}(B) < q_{nf}(B) < q_{fn}(B) < q_{ff}(B)$. The for-profit school always produces more of q, in particular when they are competing with another for-profit school . From this follows that $\tilde{W}_{fn}(B) < W_{ff}(B)$. The public school always produces less q, but will produce somewhat more when they are competing with a private school . The public school invests less in unobservable quality when competing with a private school $Q_{nf}(B) < Q_{nn}(B)$. If the welfare provided by public schools in a mixed market is lower than that provided in a pure public market, it is a sufficient condition to prove that the mixed market can never be the best outcome. This condition can be shown to be $(\beta - 1) * (\frac{\alpha}{\alpha-1} - \frac{1}{\gamma})\frac{B}{c} > 0$, which is always true by our assumptions. Now we can show that welfare here cannot be higher than in both pure market situations. If the welfare generated by the private school is higher than that of a public school in a mixed market $\tilde{W}_n < \tilde{W}_f$, welfare from both schools would be higher in a pure private market, since $\tilde{W}_f < W_{ff}$. If welfare generated by the public school is higher than that of a private school in a mixed market $\tilde{W}_f < \tilde{W}_n$, welfare from both schools would be higher in a pure public market, since $\tilde{W}_n < W_{nn}$.

Case 4: Only q_f and q_n are produced. It is fairly easy to show that if both schools produce q in a mixed market, the total amount of quality will lie between the total amount of q produced in either pure market at the same price. Then, at any given level of the education budget, it will always be better if the market is served by two private schools, since they provide the most q_i. Assuming here that $q_{ff} > q_{nn}$, the pure private market produces more quality at the same price, which will give a higher welfare level. Further, since this price is a valid choice in the pure private market, if the local government chooses a different one $B^*_{fn} \neq B^*_{ff}$, this must be because the welfare is better. So even in case 4 it is impossible for the mixed market to get better welfare than both pure markets.

Appendix B Equilibrium quality in pure public, pure private, and mixed markets

This section summarizes the equilibrium quality level in all three market structures.

Public markets

$$q_{n|n} = \begin{cases} 0 & \text{if } B < \frac{\alpha-1}{\alpha} cT \\ \frac{\alpha}{\alpha-1}\frac{B}{c} - T & \text{if } B \in [\frac{\alpha-1}{\alpha} cT, (\alpha-1)cT] \\ \frac{B}{c} & \text{if } B > (\alpha-1)cT \end{cases}$$

$$Q_{n|n} = \begin{cases} \frac{B}{c} & \text{if } B < \frac{\alpha-1}{\alpha} cT \\ T - \frac{1}{\alpha-1}\frac{B}{c} & \text{if } B \in [\frac{\alpha-1}{\alpha} cT, (\alpha-1)cT] \\ 0 & \text{if } B > (\alpha-1)cT. \end{cases}$$

Private markets

$$q_{f|f} = \begin{cases} \frac{B_f}{\gamma c} - T & \text{if } \frac{B_f}{\gamma c} > T \\ 0 & \text{otherwise,} \end{cases} \tag{5}$$

$$Q_{f|f} = 0.$$

Mixed

$$q_{f|n} = \begin{cases} 0 & \text{if } B < T\gamma c \\ \frac{1}{2}(\frac{B}{\gamma c} - T) & \text{if } B \in (T\gamma c, \frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma}) \\ (\frac{1}{3}\frac{\alpha}{\alpha-1} + \frac{2}{3}\frac{1}{\gamma})\frac{B}{c} - T & \text{otherwise} \end{cases}$$

$$Q_{f|n} = 0$$

$$q_{n|f} = \begin{cases} 0 & \text{if } B < \frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma} \\ (\frac{2}{3}\frac{\alpha}{\alpha-1} + \frac{1}{3}\frac{1}{\gamma})\frac{B}{c} - T & \text{otherwise} \end{cases}$$

$$Q_{n|f} = \begin{cases} \frac{B}{c} & \text{if } B < \frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma} \\ (\frac{\alpha-3}{3(\alpha-1)} - \frac{1}{3}\frac{1}{\gamma})\frac{B}{c} + T & \text{if } B \in (\frac{T\gamma c}{\frac{2}{3}+\frac{1}{3}\frac{\alpha}{\alpha-1}\gamma}, \frac{3Tc}{\frac{1}{\gamma}-\frac{\alpha-3}{\alpha-1}}) \\ 0 & \text{otherwise} \end{cases}$$

$$q_f = \begin{cases} \frac{2}{3}\frac{P_f}{\gamma c} + \frac{1}{3}\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T & \text{if } \{q_f, q_n\} > 0 \\ \frac{1}{2}(\frac{P_f}{\gamma c} - T) & \text{if } q_f > 0, q_n = 0 \\ 0 & \text{otherwise} \end{cases}$$

$$q_n = \begin{cases} \frac{1}{3}\frac{P_f}{\gamma c} + \frac{2}{3}\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T & \text{if } \{q_f, q_n\} > 0 \\ \frac{1}{2}(\frac{\alpha}{\alpha-1}\frac{P_n}{c} - T) & \text{if } q_n > 0, q_f = 0 \\ 0 & \text{otherwise} \end{cases} \tag{6}$$

$$Q = \begin{cases} \frac{P_n}{c} & \text{if } q_f \geq 0, q_n = 0 \\ T + \frac{1}{3}\frac{\alpha-3}{\alpha-1}\frac{P_n}{c} - \frac{1}{3}\frac{P_f}{\gamma c} & \text{if } \{q_f, q_n\} > 0 \\ \frac{P_n}{c} - q_n & \text{if } q_f = 0, q_n > 0 \end{cases}$$

Under the condition that:

$$B = P_f * d_f + P_n(1 - d_f)$$

References

Auriol, E., & Brilon, S. (2014). Anti-social behavior in profit and nonprofit organizations. *Journal of Public Economics*, *117*, 149–161.

Bennett, J., & La Manna, M. (2012). Mixed oligopoly, public firm behavior, and free private entry. *Economics Letters*, *117*(3), 767–769.

Besley, T., & Malcomson, J. M. (2018). Competition in public service provision: The role of not-for-profit providers. *Journal of Public Economics*, *162*, 158–172.

Gneezy, U., Meier, S., & Rey-Biel, P. (2011, December). When and why incentives (don't) work to modify behavior. *Journal of Economic Perspectives*, *25*(4), 191-210. Retrieved from http://www.aeaweb.org/articles?id=10.1257/jep.25.4.191 doi: 10.1257/jep.25.4.191

Hart, O., Shleifer, A., & Vishny, R. W. (1997). The proper scope of government: theory and an application to prisons. *The Quarterly Journal of Economics*, *112*(4), 1127–1161.

Hartman, L. (2011). Konkurrensens konsekvenser. *Vad händer med svensk välfärd*, *2*.

Heyman, F., Norbäck, P.-J., & Persson, L. (2012). Konkurrens och effektivitetseffekter av privatiseringar. *Konkurrensverkets rapportserie*, *4*.

Holmström, C. (2019). *Friskolor i sverige.* Retrieved 2019-09-06, from https://www.ekonomifakta.se/Fakta/Valfarden-i-privat-regi/Skolan-i-privat-regi/Antal-friskolor-i-Sverige/

Holmstrom, P., Bengt Milgrom. (1991). Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design. *Journal of Law, Economics and Organization*, *7*, 24.

Nakamura, T., & Takami, H. (2015). Nash bargaining and partial privatization in mixed oligopoly. *Economic Modelling*, *46*, 315–321.

OECD. (2012). *Maintaining a level playing field between public and private business.* Author.

OECD. (2017). *School choice and school vouchers: An oecd perspective.* Organization for Economic Development and Cooperation Paris. Retrieved from http://www.oecd.org/education/School-choice-and-school-vouchers-an-OECD-perspective.pdf

OECD. (2019). *Balancing school choice and equity.* Organization for Economic Development and Cooperation Paris. Retrieved from https://www.oecd-ilibrary.org/content/publication/2592c974-en doi: https://doi.org/https://doi.org/10.1787/2592c974-en

Stennek, J. (2017). Competitive neutrality and the cost and quality of welfare services. *GUPEA Working Papers*.

Thaler, R. H., & Sunstein, C. R. (2003). Libertarian paternalism. *American economic review*, *93*(2), 175–179.

Wolinsky, A. (1997). Regulation of duopoly: managed competition vs regulated monopolies. *Journal of Economics & Management Strategy*, *6*(4), 821–847.

Chapter 3

Does competition cause grade inflation in Swedish schools?

Sebastian Larsson

Abstract

In this paper, I study the upper secondary education sector in Sweden 2012-2016 and use a spatial panel method to investigate whether competition among private and public schools is causing them to inflate their grades. The first result is that schools in high competition environments do not generally have higher grade inflation than schools in low competition environments. There is some indication that private schools in high competition environments may have higher grade inflation, but this result is not very robust. The second result is that a school inflating grades does not cause a grade inflation response in its competitors. The third result is that private schools may inflate grades more than public schools, which seems to be driven by schools that open or close during the period.

Keywords: Education, Grade inflation, Spatial Econometrics, Panel data
JEL Classification: C21, C23, C57, H57, I21

1 Introduction

The Swedish school system has in recent years been criticized for generating a high degree of grade inflation, i.e., students receiving higher grades without a corresponding increase in their demonstrated knowledge and skill. An example of this is that while students' grades have gone up, PISA scores in Sweden have dropped (Schleicher & Halgreen, 2016). Two suggested causes of the grade inflation, both of which were introduced in connection with the private school reform of 1992, are the prevalence of private schools and the competition between providers over students (Vlachos, 2010). In the present paper, I test whether these claims are justified and how large the problem is. My paper also serves as an evaluation of the consequences of the 1992 private school reform, since the process of privatization and introduction of competition stems directly from there. The topic is current (It is actively debated in media at the time of writing) and policy relevant, with government agencies working to find effective policies to offset the problems of grade inflation.

My first question is whether schools that face high levels of competition have higher levels of grade inflation compared with schools that face less competition. I capture this by measuring the geographical distance between competing schools. A short distance implies a high level of competition. I use three different measures of distance: the distance to the nearest competitor, the average distance to other schools, and the weighted average distance. The second question is whether grade inflation is "contagious", i.e. whether grade inflation tends to spread to nearby schools. I test this by seeing whether a school's level of grade inflation is correlated with the grade inflation at nearby schools. Throughout I will also look at whether schools with private ownership inflate grades more than schools with public ownership.

To measure grade inflation, I compare students' national test grades with their final grades. Without grade inflation, the distribution of final grades should look roughly the same as the distribution of national test grades, while if students receive significantly better final grades than national test grades, grade inflation has taken place. I use data from the Swedish Higher Education Authority for the period 2012-2016.

This data also contains important controls, i.e., school size (number of teachers and number of students) and demographic characteristics of the student body (share of male/female students, share of students with at least one parent with a university degree, and share of students with a non-Swedish background).

Previous research (e.g., Vlachos, 2010) has used predefined geographic districts, e.g., municipalities, to decide how much competition schools face. However, in countries like Sweden where families can choose freely which schools to attend, doing so may potentially bias the measure of competition. This is for two primary reasons: first, it assumes that schools only compete within their districts, while in Sweden students are free to attend schools outside their home municipality, and second it assumes that all schools compete equally with schools within their respective districts, while in reality schools in small districts compete more intensely with each other than schools in large districts. I solve these problems using a spatial econometrics framework, which instead uses geographic distance to measure which schools compete with each other. In this way, I can both create a more accurate measure of competition and see whether a school's level of grade inflation depends directly on its competitors' corresponding levels. I will use the spatial autoregressive model to this end.

I use three models, a pooled model, a spatial auto-regressive panel model, and a model where private and public actors respond differently to private and public competitors. My main results are as follows.

First, the tests on whether schools that face high competition have higher levels of grade inflation are inconclusive. There does seem to be a positive correlation between distance to the nearest competitor and grade inflation, i.e., the shorter the distance, the higher the level of grade inflation, in particular for private actors. This lends support to the popular opinion that both competition and the prevalence of private schools are driving grade inflation. However, this effect is not very robust, and when including more than the nearest competitor, it is no longer clear whether this correlation exists. Uncertainty analysis also indicates that the potential effects may be quite large.

Second, my results indicate that grade inflation is not contagious, i.e., that a school's grade inflation is not spread to nearby schools. As opposed to the effects of competition, this result seems very robust. Even assuming the estimated effect to be at the upper end of the confidence interval, the resulting effect on grade inflation is fairly small.

Finally, privately owned schools have higher levels of grade inflation than public schools. One driver of this finding seems to be that private schools that enter/leave the market within the sample period have higher grade inflation than established schools do. However, the effects, when significant, unanimously point to private schools having higher levels of grade inflation than public schools do, and they generally go in the same direction also when they are insignificant.

In summary, there seems some justification for the worry that competition in education and the prevalence of private schools drives grade inflation. However, these effects are less extreme than the debate seems to suggest. Also, while some people have raised concerns that grade inflation is outright contagious, I find no evidence that this is the case.

2 Background and literature review

In this section I will discuss the hypothesized origins of grade inflation and why competition between schools is thought to be a driving factor. After that I will discuss some previous research on the relationship between competition and grade inflation, and explain how I add to the literature. The theoretical and empirical model will be presented in the following section.

Grade inflation can arise from schools wanting to appear better than they really are (i.e., creating fake prestige) or to attract a larger number of students. It could also arise for more benign reasons. For example, the national tests measure fairly "hard" skills, but schools might put a greater emphasis on other factors, such as discussion and critical thinking skills. If teachers factor such skills into the final grades, it may

result in students receiving higher final grades than their national test grades.

If it is not possible for outside actors to observe whether high grades are due to talented students or grade inflation, incentives to artificially increase grades can increase. Additionally, once a school starts inflating/exaggerating grades, it can increase incentives for other schools to increase their grades as well. For example, a competing school may have to increase grades in order to maintain a critical number of students. In other words, grade inflation is contagious (Chan, Hao, & Suen, 2007). Finally, schools are concerned with rankings, both to increase their reputation in general and to attract students. Grade inflation, at least in moderation, may be a way to artificially boost rankings (Neves, Pereira, & Nata, 2014).

While it may seem like a good deal for students, grade inflation may cause problems for them in several ways. One is that they may not be as prepared for higher education as their grades indicate. Similarly, students' grades may no longer be a valid signal of their ability. This creates an unfair labor market, both between students currently enrolled in schools that do or do not inflate their students' grades and between current and previous students, due to the obvious time aspect of grade inflation. Grade inflation has even been argued to increase discrimination; if grades become less credible as merit-based indicators of student ability, then other measures may instead be used to select individuals for academic programs and jobs, measures that may be biased against certain groups of people, such as individuals from low socioeconomic backgrounds (Schwager, 2012).

2.1 The 1992 private school reform

In Sweden user choice and competition were introduced with the Private School Reform (Friskolereformen) in 1992, which has since been expanded and molded by subsequent governments. The reform had two parts.

The first part of the reform introduced competition by allowing students the freedom to choose their school, instead of schools pulling their students almost exclusively

from designated municipalities.[1] Under this system, funding is allocated according to a voucher program, where municipalities determine an amount of money that the schools receive per enrolled student. This amount is meant to cover all of the schools' per-student expenses, e.g., the cost of teachers' salaries, school lunches and maintenance of school premises. Municipalities may grant additional funding to schools to help them cover extra costs for having students with special needs, but otherwise they are not allowed to give different per-student amounts of money to different schools.[2]

The main rational behind this part of the reform was that that the freedom to choose schools would lead to the providers increasing the quality of their education in order to attract students, and to an increased variety of education providers. However, there are downsides with this policy as well. Specifically, if educational quality is hard to observe before choosing a school, education providers may invest in something that is more observable. For example, given that students value receiving high grades, introducing grade inflation (i.e., giving students higher grades for lower effort) might make students more attracted to a certain school or more likely to stay at that school instead of switching to another provider. Aside from this, tying funding to enrollment figures may increase a school's incentives to inflate grades, and thus, "good" schools may feel forced to follow suit in order to attract enough students to stay open.

The second part of the reform opened up for privately owned schools to operate in the education sector on the same terms as public ones, i.e., tuition free and merit based. Prior to 1992, only a small fraction of students attended private schools, and these schools were restricted to very specialized actors such as Waldorf schools. Afterwards, the proportion increased steadily, and in the 2018-2019 school year 27.6% of Swedish students attended a private school, while private schools made up 33.2% of all schools. Of all students attending private schools, about 75.9% attend schools run by corporations (Aktiebolag). (Carlgren, 2017). Moreover, municipalities are

[1] I will still refer to competition as being local, since students are typically not able to move to other parts of Sweden to change schools, but will choose one within a certain radius of their home.

[2] Skollagen (2010:800) 52-55§§

not allowed to discriminate against private providers by giving them a different per-student voucher amount than that given to public actors (a condition explicitly introduced in 2011). One reason for passing this policy was that it would open up for a more diverse range of education providers (Regeringens Proposition 1991/92: 95). However, private actors are free to use the municipal funding to generate profits, and hence they have an incentive to attract more students without providing an adequate level of educational quality. There is evidence that private schools inflate grades more than public counterparts (Hinnerich & Vlachos, 2017) and that the profit motive indeed is strong for them, as they are more likely to open in areas where the economic gains of running a school are higher (Angelov & Edmark, 2016).

2.2 Previous research

Both the evidence and opinions are divided regarding the benefits of between-school competition, in particular when including private education providers. However, recall that as long as the funding schools receive is tied to enrollment numbers, the competition will affect not only private providers but also public ones (Millimet & Rangaprasad, 2007). A potential positive effect of competition is that it may increase school performance. There is some support for this, since in municipalities with a larger number of private schools the students international test results were found to have deteriorated less compared to municipalities with few private actors (Böhlmark & Lindahl, 2015). However, there is also evidence that it can cause stratification (sorting of students according to non-academic standards) and grade inflation (Urquiola, 2016). In the extreme case, grade inflation could even increase discrimination. These problems become even more of a concern when considering that private schools in many countries are primarily accessible to students from wealthy backgrounds. Since grade inflation tends to be more prevalent in these schools, wealthy students get better access to the top-paying university programs, ensuring greater socioeconomic positions later in life and cementing inequality (Nata, Pereira, & Neves, 2014).

While the effects of introducing competition in education on grade inflation have been widely discussed, the empirical research on the topic remains fairly scarce. Most existing studies use some form of school districts to define competition, with schools competing only with other schools in these areas. For example, competition can be measured as the total number of schools or number of schools per student in a municipality. These studies do not point toward an effect of competition on grade inflation in a robust manner. Private schools were found to inflate grades more than public ones, but the size of the effect was not large. One factor that these studies do not measure is that grade inflation may be *contagious*, meaning that schools may strategically inflate their own grades when their competitors have high grade inflation in order not to lose students to them (Vlachos, 2010). An alternative way to measure competition is to look at municipalities with only public schools, and compare them with different constellations of schools, for example municipalities with one private school or municipalities with several private schools, etc. By comparing the conditional means of grade inflation for these different constellations, it could be possible to identify the effects of competition and ownership type on grade inflation. However, this has similar flaws to looking at the number of actors, ignoring the fact that different districts may differ in how competitive the environment is. (Wikström & Wikström, 2005). An interesting study using a traditional competition measure (the Herfindal-Index) for schools at the municipal level and using the bankruptcy of a large group of private schools as an instrument for school competition, an other study finds a significant effect of competition on the level of grade inflation (Sporre, 2016).

Also some non-Swedish studies have looked at the relationship between competition, grades, and quality of education. The results of these are ambiguous, too. They have for example found that the grading standards seem lowered by competition, but that the assigned final grades do not seem to be significantly affected by this intervention (Walsh, 2010). A Mississippi-based study did use spatial econometrics to show whether public schools become better when introducing competition for private schools, for which some support was found, lending credence to the theory

that competition increases quality (Misra, Grimes, & Rogers, 2012). However, they focused more on general educational quality rather than the specific issue of grade inflation, and also focused on the specific effects of private on public schools. It is however the closest paper I have found to using the same general methodology as I do.

A common issue with past studies is that focusing on municipalities as the district where schools are active ignores competition across municipalities, and that they tend to assume that all competition within a municipality is of the same strength. Moreover, such district-based division potentially introduces bias in the model. This bias tends to cause underestimation of the effects of competition in two ways. First, students are free to choose schools outside of their district. This means that schools are competing not just with other schools in the district, but with schools in nearby municipalities. The competition a school faces is thus actually more extensive than a municipal model indicates. For example, consider a small and a large municipality, each with two schools. A district division would suggest they face the same level of competition. However, the schools in the small municipality will likely be close to schools in other municipalities. If competition increases grade inflation, the schools in the small municipality should have a higher level of grade inflation than those in the large municipality. However, since they are assigned the same level of competition, the model will write this off as individual variation rather than competition. Second, the model also underestimates the effects of competition within a district. To see this, consider a district with two schools. If the district is large, competition is actually quite lax, since the costs for the students to switch schools is high. But if the district is small, the costs of switching is low and the two schools therefore compete intensely with each other. But a traditional model does not account for this at all. This means that regardless of size, the effect of competition becomes underestimated. Both of these problems indicate that a measure based on distance rather than districts is more appropriate.

3 Data description

Students receive two significant grades. One is the grade they receive at the end of a course, which will go on their transcripts. I will refer to this as the students' *final grade*. Students are also graded on national tests, which they must take in three subjects: Swedish, English, and Math. These tests can be given at several levels, and is obligatory for the last mandatory course in these topics the student will take. These grades are never printed on the students' transcripts, but they are used by the teachers when setting the students' final grades. I will refer to these grades as the students' *national test grades*. I have obtained data on student grades from the Swedish National Agency for Education.[3] The database used contains data on the average final grades of students at each school, the average national test grades of the students, and the proportion of students receiving higher, lower, or the same final grade as their national test grade. It also contains important demographic characteristics of the school, such as the size of the student body, the number of teachers employed by the school, and the socioeconomic characteristics of the student body. The data is presented annually on a per school basis. Since the grading system changed in the fall semester of 2011, I only use data from after this point in time. The current grading system consists of six possible grades: one failing (F) and five passing ones (E-A). I define grade inflation (G_i) as the proportion of students who receive higher final grades than their corresponding national test grades, p^+, less the proportion who receive lower final grades, p^-, i.e. $G_i = p^+ - p^-$. National tests are set on the national level, and should test the overall knowledge base to a common baseline. First, consider the case without any grade inflation. On average, there should be no difference between final grades and national test grades. However, whereas the national tests are given on one specific day, students take several months or more to complete a course under the supervision of a teacher. Consequently, the course teachers end up gathering much more information about a student's knowledge and skills than the national government possibly can from merely looking at national test response sheets, and the students' final grades of course

[3] At the time of writing, collected from the database Siris, which has since closed

reflect all of this additional information. For this reason, some students are awarded a higher final grade than national test grades, and vice versa. In a well-functioning system, there should be about the same proportion of schools getting higher final test grades than lower, and the distribution of G_i should be symmetric around the mean. Now consider what happens when there is grade inflation. Under grade inflation, schools are much more likely to set final grades at least at the level of the national test grades. Because of contagion, the grade inflation may also increase over time. For this reason, there will consistently be a lower p^- than p^+ for these schools in a given year. This will tend to shift the distribution away from the mean and skew it toward more students getting final grades than national test grades (consider that G_i must be bound between -1 and 1, reflecting that no or all students receive higher final grades than national test grades, respectively). Figure 1 illustrates how the distribution of G_i should look, with and without evidence of grade inflation.

Figure 1: Illustration of grade inflation distribution, with and without grade inflation

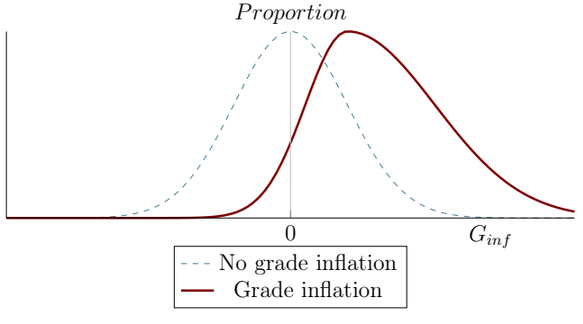


Table 1 lists the variables I will use in my analysis and describes what they measure. Most of the variables are collected directly from the Swedish Higher Education Authority, and the grade inflation measure is calculated directly from this data. However, there is no data on how much competition a school faces in a given year. This I will calculate later.

Table 1: Variables, description, and summary statistics for school i in year y

Variable	Description	Mean	Standard Deviation	N
$p_{final>national}$	Proportion of students receiving a higher final grade than national test grade	29.90	19.92	1,292
$p_{final<national}$	Proportion of students receiving a lower final grade than national test grade	11.81	9.79	1,292
g_{inf}	Difference between $p_{final>national}$ and $p_{final<national}$	31.02	14.19.89	1,292
$Distance_n$	Distance to the nearest competitor of the school, within a 60km radius	5.42	9.78	1,292
$Distance_a$	Harmonic mean distance to the competitors of the school, within a 60km radius	15.85	17.92	1,292
$Distance_w$	Harmonic mean distance to the competitors of the school weighted by student body, within a 60km radius	76.45	70.78	1,292
$Totstud$	Total student body	302.30	269.91	1,292
$Teachers$	Total number of teachers	27.23	21.76	1,292
$Foreignb$	Prop. of student body with foreign background	26.62	16.67	1,292
$Educated$	Prop. of student body with (at least one) university-educated parent	46.07	17.43	1,292
$Female$	Prop. of students at the school who are female	47.57	18.00	1,292
$Private$	An indicator that the school is privately owned	0.61	0.48	1,292
$Year$	Indicates year of observation	2014.5	1.11	1,292

Figure 2 shows the distribution of grade inflation in the pooled subjects (2a), and for each subject individually (2b - 2d). Of particular interest is figure 2d describing grade inflation in Math. This distribution is very skewed towards students having higher final grades than national test grades. One explanation is that there is more grade inflation in mathematics courses. However, there is a more likely explanation. National tests are set at a national level, but graded at the school level by the same teachers that grade normal exams. For Swedish and English, where the tests focus on writing, it can be easy for these teachers to inflate national test grades as well. However, mathematics focuses more on problem solving, and it is much more difficult to artificially inflate grades. There is empirical evidence of this presented in a report by the Swedish School Inspectorate, where they found differences in students' national-test grades when graded by an impartial grader. The differences were particularly large in tests where the student had to write a long text (Skolinspektionen, n.d.). I will thus look at just mathematics for my primary analysis, and use the other national test grades as a robustness check.

Figure 2: Histograms of Grade inflation*

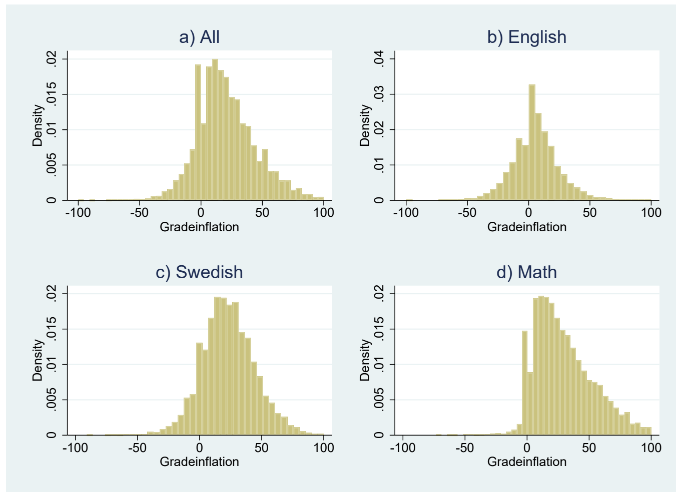
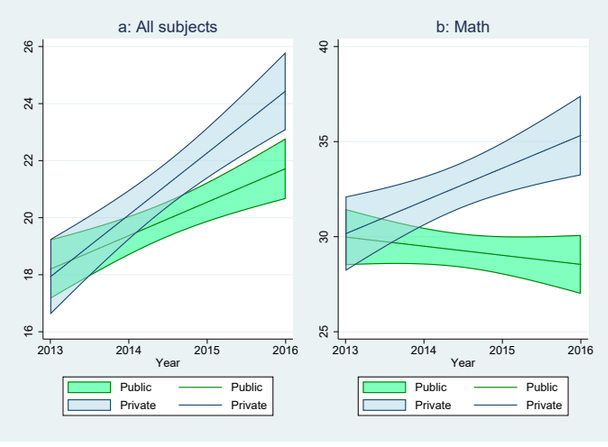


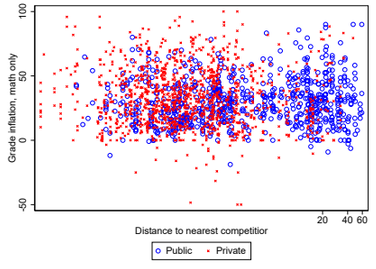
Figure 3: Grade inflation over time, with confidence intervals



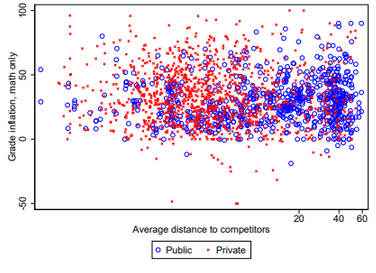
I use spatial characteristics to calculate the levels of competition schools face. The locations of the schools, which are measured by geographic coordinates, are obtained from the Swedish Geodata portal. By using coordinate geometry I calculate the distance between any two schools in the data. I use three different variables to measure how intense the competitive environment is, all of which are in some way based on the average distance to a school's competitors. The three measures are: 1) the distance to the nearest competitor $comp_1 = d_{nearest}$, 2) the harmonic mean distance to all competitors $comp_{2,i} = 1/\sum_{-i} \frac{1}{d_{ij}}$, and 3) the harmonic mean distance to all competitors, weighted by the students the actors compete for $comp_{3,i} = 1/\sum_{-i} \frac{Totstud_i}{Totstud_j * d_{ij}}$.

Let us suppose that schools inflate their own grades as a strategic response to increased grade inflation among their competitors. We may then expect the grade inflation to increase over time, as it should trigger a grade inflation "war". While I study only a fairly short time span, there does seem to be an upward trend in the level of grade inflation, particularly among private schools. This development is detailed in Figure 3. The figure also includes 95% confidence bands, which shows

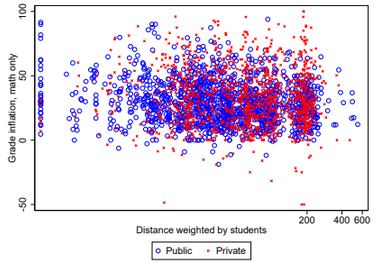
Figure 4: Grade inflation by distance measures*



A) Distance to nearest competitors



B) Average distance to competitors



C) Average distance to competitors, weighted by students

*Logarithmic scale

that (at least in the later years) private schools inflate grades significantly more than public schools do. The difference in grade inflation is particularly large for math courses.

If competition varies between private and public actors, we should expect this to be reflected in the data, both from the average levels and from the distribution. Differences between private and public actors can express themselves in several ways. First, if private schools on average inflate their grades more than public schools, it should be reflected in a shift in the distribution. Second, even if the average private school might have the same grade inflation levels as public ones, if some private schools inflate their grades a lot more, the distribution should be flatter/more skewed. Aside from this, because of the different incentives, private schools may respond differently than public schools to being in a more competitive environment. For example, the private schools may care more than the public ones about profits, making them more likely to compete aggressively. Figure 4 shows the relationship between competition and grade inflation (both for the pooled subjects and for only math courses), divided up by private and public schools. There seems to be no relationship between how much competition a school faces and how much it inflates its grades. Also, private schools do not seem to inflate grades more than public schools. The scatter plots do indicate that the private schools seem to be located primarily in areas where the average distance to competitors is short, e.g., in cities.

4 Model

In this section, I will motivate my choice of a spatial autoregressive model and why traditional models may cause bias. Section 4.1 introduces the theoretical framework I will use as motivation for the empirical analysis, and why this is a relevant model to use. Section 4.2 introduces the empirical framework and estimation equation and how this framework would correct for the potential biases discussed above.

4.1 Theory

I will use a multi-actor Hotelling model with competition in quality. Students must travel to their chosen school, which means that its distance from their homes is a very relevant factor when a school is chosen. Schools in Sweden and many other countries are operated using a local voucher system, i.e. the voucher-prices are determined and payed by the respective local governments. Schools can use different methods to attract students. For example, they can provide good education or extra benefits like Tablets or higher grades.[4] Assume that there are N schools competing for students. Students live on "streets" connecting the various schools, where M_{ij} denotes the students living between school i and j. The students consume only one unit of schooling, for which they receive utility U. Schools determine their extra benefits, or grade inflation level, to optimize their value function (denoted Π). Doing this incurs a cost c_i but will attract more students to the schools. There are a few different ways to interpret this cost. One is to tie it to a loss of professional ethics and/or to a loss of the school's reputation. A second interpretation is that the cost is tied to the students, either directly through internalizing a sense of "guilt" they experience from receiving an unearned grade, or indirectly through the decrease in students' body of knowledge (Finefter-Rosenbluh & Levinson, 2015).

Equation 1 presents the optimization function of a generic school with a fixed number of competitors. By inflating their grades, the schools attract a higher share of the students living between them and each of their competitors. They attract more students from a certain competitor if a) the schools are closer to each other and/or b) there are more students living between them.

$$\Pi_i = (p - c_i * G_i) * \sum_{j \neq i} M^{ij} * [\frac{1}{2} + \frac{1}{2t}\frac{G_i - G_j}{D^{ij}}] \tag{1}$$

Since this is a voucher market (i.e. the local municipality sets prices) and schools are

[4] A case could even be made that if students put in less effort for higher grades, this is equivalent to a lower price, since time is also a limited resource

fixed in their location, the only variable schools have control over is grade inflation. By performing the optimization, we can derive the best-response function for the level of grade inflation a school sets (see Appendix A). The model predicts that, for a school i the level of grade inflation G_i is

$$G_i = \alpha_i - \beta \bar{D}_i + \rho \bar{G}_i,$$

where $\bar{D}_i = \frac{1}{\sum_{i \neq j} \frac{M^{ij}}{\sum_{i \neq k} M^{ik}} * \frac{1}{D^{ij}}}$ is the weighted harmonic mean distance to competing schools, and $\bar{G}_i = \sum_{i \neq j} \frac{\frac{M^{ij}}{D^{ij}}}{\sum_{i \neq k} \frac{M^{ik}}{D^{ik}}} G_j$ is the weighted average grade inflation of nearby schools.

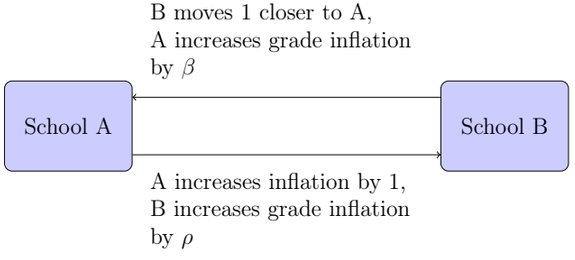
The first prediction of the model is that schools tend to inflate grades more when they face a grater degree of competition, which happens when the competing schools are located closer to each other. The strength of the response is captured by β. When D_i is smaller, the average distance between the school and its competitors is shorter, which implies that the school is facing more intense competition. The model predicts that as the competition a school faces becomes more intense, the optimal degree of grade inflation increases. An attractive feature of the harmonic mean as a measure of competition is that schools located far away have a smaller effect than nearby schools on the mean , neatly capturing that some schools are competing with greater intensity than others. A downside is that if new schools open up, it can lead to perceived lower competition[5]. I will account for this fact in the empirical model.

The second prediction of the model is that a school will increase its grade inflation if its competitors also inflate their grades. The strength of this response is captured by ρ. In other words, grade inflation may be contagious, and a school's optimal level of grade inflation increases when its competitors inflate their grades more. In game theory terms, grade inflation by competing schools are strategic complements.

[5]What can happen is that if a new competitor enters sufficiently further away than the average distance, the average distance will increase, which is interpreted as lower competition.

The simplest way to think about what the model says is to consider only two schools (i and j) competing with each other. If school j increases its grade-inflation by 1 unit, school i will respond by inflating its own grades by ρ units. In the same way, if school j moves 1 distance unit closer to school i, school i will respond by inflating its grades by β unit. See Figure 5 for a simple illustration of how this would work for the two competing schools.

Figure 5: Competition Illustrated



In summary, from this model and the debate surrounding grade inflation, I will focus on three potential determinants of grade inflation, namely:

1. **Status**, i.e. whether the school in question is Private or Public
2. **Distance**, i.e. how close the competitors of the school are, which is a measure of the intensity of competition a school faces
3. **Competitors Grade Inflation**, i.e. How does the school respond to having competitors that inflate grades (contagiousness)

4.2 Empirical model

The theoretical model suggests that the grade inflation a school has is not independent of the grade inflation of other schools in the data, known as spatial auto-

correlation. For this reason, using an OLS style model will be biased, since it does not account for the spillover effects of grade inflation. This is solved by using a spatial model, which takes this spillover into account. The model I use is the spatial auto-regressive model, which accounts for spatial auto-correlation in the dependent variable. By using a spatial-regression model, we can control for the unobserved factors potentially caused by actors strategically responding to their competitors grade inflation.

However, this may not be enough to accurately analyze the effect of competition in schools, since other factors, such as the leniency or strictness of the school administration, can also cause bias in our estimators. We must find another method to control for this type of heterogeneity. Since multi-year data is available for schools, panel-data econometrics using fixed effects can remove unobserved factors that are school specific and constant over time. Some examples of this are the general attitudes of teachers/principals and political pressures. After controlling for all these factors, I should be able to find unbiased estimates of the effects of competition on grade inflation, on whether grade inflation is contagious, and on whether private schools inflate grades more than public schools.

According to the theory, schools respond strategically to the grade inflation of competing school but do not take the status or characteristics of their competitors into account. The spatial estimator that is most consistent with the theory derived above is the *spatial autoregressive model*. An alternative model would be the spatial Durbin model, which also allows for spatial auto-correlation in the independent variables. This is not in line with the theoretical model, and when I tested it the results were in line with those obtained in the SAR model. In the SAR model, the grade inflation of school i is directly dependent on that of their competitors, such that $G_{i,t} = f(G_{-i,t})$. This reflects the *strategic response* of schools. The spatial weight matrix is also used to create the measure of *Distance*. Thus this is also a function of the spatial data, but it is not a spatial econometric model component in the formal sense. The regression equation used is specified in equation 2 below. The variable $Private_i$ is a binary variable indicating that the school is privately owned, $\bar{D}_i$ is the distance to

the competitors of the school, W is the spatial weight matrix, G is a vector of the grade inflation of all schools, and $\mathbf{X}$ is a vector of control variables, with a vector of coefficients $\mathbf{B}$. There are unobserved time invariant characteristics (such as the motives of the principal and/or owner of the school) which are captured by ψ_i.

$$G_{it} = \alpha_{it} + \gamma * Private_{it} + \beta * Distance_{it} + \rho * W\mathbf{G} + \mathbf{XB} + \psi_i + \epsilon_{it} \qquad (2)$$

It is of course not likely that all schools compete with each other with equal intensity. For example, schools compete intensely with nearby competitors but very little with competitors located far away. Some schools are so far away they are not able to compensate students for the long cost of travel, and therefore do not compete at all. In my main model, I assume that schools within a 60 km radius compete with each other to some degree while schools further away do not compete at all. This may seem like a great distance, but because I use the harmonic mean distance, competitors located far away get a very small weight in the mean and hence have a relatively small effect on the results. I tested other distance limits as well, but the results did not differ significantly from using the 60 km cutoff. I also ran robustness checks under the assumption that schools compete with the k nearest schools, but the results did not change then either.

To create the spatial weight matrix and the distance measure, I use geographic data from the Geodata portal, which contains coordinates for all Swedish high schools. Consider a simple example with four schools. School 1 competes with schools 2 and 3. School 2 competes with schools 1 and 3. School 3 competes with all other schools. School 4 only competes with school 3. The spatial weight matrix for this case is presented below, where the first part is the row-normalization operator and the second part is the inverse distance between all competing schools. Note that the matrix used in the spatial regression is normalized, so that each row will sum to one. The matrix is constructed so that it will have zeroes along the diagonal, since this

space would be taken up by the inverse distance between the school and itself.

$$W = \begin{bmatrix} \frac{1}{\frac{1}{d_{12}}+\frac{1}{d_{13}}} & 0 & 0 & 0 \\ 0 & \frac{1}{\frac{1}{d_{12}}+\frac{1}{d_{23}}} & 0 & 0 \\ 0 & 0 & \frac{1}{\frac{1}{d_{12}}+\frac{1}{d_{23}}+\frac{1}{d_{34}}} & 0 \\ 0 & 0 & 0 & \frac{1}{\frac{1}{d_{34}}} \end{bmatrix} * \begin{bmatrix} 0 & \frac{1}{d_{12}} & \frac{1}{d_{13}} & 0 \\ \frac{1}{d_{12}} & 0 & \frac{1}{d_{23}} & 0 \\ \frac{1}{d_{13}} & \frac{1}{d_{23}} & 0 & \frac{1}{d_{34}} \\ 0 & 0 & \frac{1}{d_{34}} & 0 \end{bmatrix}.$$

5 Results

I use three sets of models to derive the results: first, a spatial model without any panel effects; second, a spatial autoregressive panel model; and third, a model where private and public actors respond differently to private and public actors. I also use three different measures to capture the distance to competitors, i.e., the distance to the nearest competitor of each school, the harmonic mean distance to competing schools, and finally the weighted harmonic mean, where weights are determined by how large a share of the joint student pool they have.

Throughout this section, I will present only a summary of the results for the sake of clarity. See Appendix A for the full regression results. Specifically, I will present regression results for the *distance* measure, the *contagiousness* measure, and the *Private* measure. Unless stated otherwise, I have in all regressions included control variables for size of the student body, number of certified teachers at the school, student/teacher ratio, proportion of female students, proportion of students with at least one non-Swedish parent, and proportion of students with at least one parent with a university education. Also, unless stated otherwise, the grade inflation measure used is the one for math courses only.

For the first set of regressions, I pool all the data into individual averages and then set up a spatial autoregressive model. The reason I do this is to use data on all schools during the period, while the other models require balanced data. It also enables me to study the effect of status (private vs. public). The price I pay for

doing this is that I lose some detail in the data by pooling information across the years. The summarized findings are presented in Table 2.

Table 2: Regression results using year averages

All subjects pooled

	Nearest competitor	Average competitor	Weighted average competitor
Private	3.751	3.826	3.361
	(2.85)**	(2.82)**	(2.72)**
Distance to	0.076	48.790	-0.020
competitor(s)	(1.29)	(1.16)	(3.00)**
Competitors' Grade	0.106	0.102	0.088
Inflation	(1.97)*	(1.92)	(1.64)

Only math courses

	Nearest competitor	Average competitor	Weighted average competitor
Private	6.121	5.822	6.733
	(3.35)**	(3.09)**	(3.90)**
Distance to	-0.068	-61.201	-0.014
competitor(s)	(0.82)	(1.05)	(1.54)
Competitors' grade	0.088	0.090	0.088
inflation	(1.67)	(1.72)	(1.69)

Clustered standard errors in parentheses, * $p < 0.05$; ** $p < 0.01$

Table 2 shows no strong evidence for a correlation between the distance to a schools competitors and its level of grade inflation, with only one measure being significant. Second, there is no strong evidence for contagiousness, or that competitors grade inflation spreads to other schools (although the one significant result might imply this). The final notable result is that private schools have significantly higher grade inflation than public schools, both in mathematics and among the pooled subjects.

Next, I will run the spatial auto-regressive model with panel data. To run this model, the panel must be very strongly balanced. There are two ways to achieve this. The first is to simply exclude all observations that cause the panel to be unbalanced and the second is to impute the missing explanatory variables in order to achieve a larger

sample. For the central variables of location, grade inflation, and status, I have chosen to only include schools that are present in the full sample. This excludes schools that open or close during this period, which is unfortunate, but when constructing the measures of competition I have used the full sample of schools. However, to fill in missing values for some of the control variables, I have imputed the missing values. To see if this causes bias I have run the regressions on only schools with no missing values in any variable during the period as well, and the results do not differ in terms of sign and significance.

Table 3 presents results from the full spatial autoregressive panel model. Columns 1 and 2 present regression results using a *random-effects estimator* that allows me to see whether private schools have a significantly different level of grade inflation than public schools do, as well as generally being less sensitive to a low level of within-variation in the data. Columns 3 and 4 use a *fixed-effects estimator*, which controls for unobserved heterogeneity for example due to pressure from the principal or owners to inflate grades more. To see whether private and public schools differ in their response to competition, columns 1 and 3 include an interaction term between status and the distance measures. This has the added advantage of being observable even in the fixed-effects regressions. For the spatial model, it is also possibly to divide effects in direct and indirect effects. The indirect effect is however very small, and does not change the results in a meaningful way. See Appendix C for a discussion of this.

Table 3 shows no strong or robust indication of distance to competitors inducing grade inflation. Results from Table 3 a col. 3 indicate that there may be some grade inflation caused by schools being close to their nearest competitor, but that this effect might be less extreme for private schools. This result is echoed by Table 3 b col. 2. Table 3 c col. 1 implies that private schools inflate grades more the closer are their competitors, when weighting distance by the size of the competitors. Generally speaking, the signs of the coefficients are also in line with what is expected from the theoretical model.

Nor is there any evidence of grade inflation being contagious, or of schools inflating

Table 3: Panel data estimation: Spatial auto-regressive model

a) Nearest competitor

	(1)	(2)	(3)	(4)
Private	0.969	0.608		
	(2.064)	(1.946)		
Private*Distance	-0.071		1.008	
	(0.248)		(0.428)*	
Distance	-0.088	-0.106	-0.514	-0.182
	(0.095)	(0.093)	(0.257)*	(0.251)
Competitors grad inflation	0.012	0.012	0.027	0.027
	(0.025)	(0.025)	(0.035)	(0.035)
panel model	r.e.	r.e.	f.e.	f.e.

b) Average competitors

	(1)	(2)	(3)	(4)
Private	1.399	-0.622		
	(2.059)	(1.819)		
Private*Distance	-0.098		-0.042	
	(0.071)		(0.129)	
Distance	-0.069	-0.119	-0.060	-0.082
	(0.044)	(0.037)**	(0.074)	(0.073)
Competitors grade inflation	-0.017	-0.017	0.005	0.00
	(0.041)	(0.041)	(0.053)	(0.053)
panel model	r.e.	r.e.	f.e.	f.e.

c) Weighted average competitors

	(1)	(2)	(3)	(4)
Private	4.152	0.250		
	(2.467)	(2.059)		
Private*Distance	-0.254		-0.518	
	(0.106)*		(1.347)	
Distance	0.011	-0.105	-0.053	-0.336
	(0.074)	(0.058)	(0.748)	(0.730)
Competitors grade inflation	-0.004	0.001	0.001	0.002
	(0.042)	(0.042)	(0.052)	(0.052)
panel model	r.e.	r.e.	f.e.	f.e.

Clustered standard errors in parentheses
* p<0.05; ** p<0.01

grades in response to competitors doing so. The results fluctuate between being positive and negative, but generally seem to be very close to zero.

Finally, Table 3 does not seem to indicate that private schools have significantly higher grade inflation than the public schools. This result contradicts the findings in Table 2, implying that the extra grade inflation seen in private schools is not robust and that we should interpret it with some caution. It is also important to mention that I can only study schools who are present in all four years, meaning that this regression is run on a smaller dataset. This seems to be driving the results.[6] Note however that private schools do still seem to inflate grades more than public schools do, even if the effect is not significant.

There are two possible explanations for this result. One is that the true effect is actually very low, i.e., that there really is no significant relationship between the degree of competition a school faces and how much it inflates its grades. This means that grade inflation is driven by some other factor and not by competition. The second explanation is that the estimated parameter is so imprecise that it is not possible to generate a significant estimate. It is not possible to definitively answer which of these explanations are true, since we never accept the null hypothesis. However, using the standard error of the estimates, I can show the range of potential effects of competition on grade inflation. To do this, I will look at the effect of a one standard deviation change in the competition measures (intensity and response) on the level of grade inflation, both for the predicted coefficient of β and ρ and at the maximum value of their confidence interval. This will give an idea of how large the effect of competition on grade inflation is. I will make this comparison using three measures, 1) the increase in units of grade inflation, 2) the increase as a percentage of average grade inflation, and 3) the increase as a percentage of the standard deviation of grade inflation. The second of these measures puts the increase in units in relation to how high the grade inflation tends to be on average. The third of these puts it in

[6] By running the same tests on the full and partial data, I determined that private schools show significantly higher grade inflation in the full dataset, while the effect is insignificant in the partial. The difference in grade inflation between private and public actors is also greater in the full dataset

relation to the variation of grade inflation. The reason is that if grade inflation has a "tight" distribution, a small change might still be a large share of the distribution. For example, a change of 2 units might be small in relation to the average level of grade inflation, but if the distribution of grade inflation is "tight" it could still cover a large share of the variation. This comparison is presented in Table 4.

Table 4 presents some mixed results. Consider the competition measure of "distance to the nearest competitor", the standard deviation of which is 10 km. First, consider the point estimate, $\beta = -0.106$. If a school's nearest competitor is 10 km closer, this means that their average grade inflation level will be around 1 unit higher. This would be an increase of 3.42% from the average grade inflation level. Alternatively, this would capture around 7.47% of the variation around grade inflation. Here we can see that a fairly small increase in grade inflation may not be trivial if it captures a lot of the variation in grade inflation. We can compare this to the same measure when looking at the upper bound of the coefficient estimate, $\beta_{nearest} = -0.271$. This implies that if a school's competitor is 10 km. closer then the school's average level of grade inflation is 2.89 units higher, which is an increase from the average of 9.32% or 20.37% of the variation of grade inflation. This is not a trivial effect, but it is an upper bound.

In summary, the results typically show that if the distance between a school and its competitors decreases by one standard deviation, the school will typically have 4.10% higher grade inflation compared with the average. While not a staggering amount, this increase is not trivial either, in particular when considering that this will typically represent a fairly large degree of variation around grade inflation. In the same way, if the competitors of a school have one standard deviation higher grade inflation, then the school will have 0.4% higher grade inflation compared with the average. This effect is much smaller and also represents a smaller share of the variation of competing schools' grade inflation. This seems to indicate that grade inflation, if it is contagious at all, is not very contagious.

One interesting possibility is that competition between private and public actors occurs with more intricacy than I presented above. It may be the case that pri-

Table 4: The effect of a one standard deviation increase in competition measures on grade inflation

X	Change in X-variable (by one standard deviation)	Resulting change in Grade Inflation		
Nearest competitor		Units	$\frac{\text{Units}}{\text{Average G.I.}}$	$\frac{\text{Units}}{\text{standard deviation of G.I.}}$
Distance, point estimate ($\beta = -0.106$)	-10 km	+1.06	+3.42%	7.47%
Distance, upper bound* ($\beta = -0.289$)	-10 km	+2.89	+9.32%	20.37%
Competitors grade inflation, point estimate ($\rho = 0.012$)	+20.05 units	+0.24	+0.78%	1.70%
Competitors grade inflation, upper bound** ($\rho = 0.0613$)	+20.05 units	+1.23	+3.96%	8.66%
Average competitors		Units	$\frac{\text{Units}}{\text{Average G.I.}}$	$\frac{\text{Units}}{\text{standard deviation of G.I.}}$
Distance, point estimate ($\beta = -0.119$)	-17 km	+2.02	+6.52%	14.26%
Distance, upper bound* ($\beta = -0.194$)	-17 km	+3.25	+10.47%	22.89%
Competitors grade inflation, point estimate ($\rho = -0.017$)	+14.12 units	-0.24	-0.77%	1.69%
Competitors grade inflation, upper bound** ($\rho = 0.064$)	+14.12 units	+0.90	2.89%	6.32%
Weighted Average competitors		Units	$\frac{\text{Units}}{\text{Average G.I.}}$	$\frac{\text{Units}}{\text{standard deviation of G.I.}}$
Distance, point estimate ($\beta = -0.105$)	-15.23 km	1.6	5.16%	11.27%
Distance, upper bound* ($\beta = -0.219$)	-15.23 km	+3.34	+10.75%	23.51%
Competitors grade inflation, point estimate ($\rho = 0.0006$)	+14.12 units	+0.01	+0.03%	0.06%
Competitors grade inflation, upper bound** ($\rho = 0.0838$)	+14.12 units	+1.18	+3.81%	8.34%

* Represents the bound of the estimated β coefficient accounting to the 95% confidence interval
** Represents the bound of the estimated ρ coefficient accouding to the 95% confidence interval

vate/public actors respond to grade inflation by private competitors in a different way than it does to grade inflation by public competitors. The reason for this is that when a school determines its level of grade inflation, it does not only send information to students but also to its competitors, and there may be a difference in the way private and public schools communicate with each other. For example, public schools (particularly within a municipality) might not view each other as competitors in the same way, but rather as mutual providers of education. Conversely, private schools may trigger each other with greater intensity, while largely ignoring public schools. To look at this, I will separate the regression into two parts, which allows me to see how private schools respond to competition from other private and public schools, and similarly for public actors. These results are presented in Table 5, which does so using the distance to the nearest competitor as a measure, and Table 6, which uses the average distance to competitors.

The results present a somewhat different picture than the main regression.Regarding how schools respond to high-competition environments (as measured by distance), the results show different effects for private and public schools. First, a notable result is that private schools significantly respond to being in a high-competition environment by inflating their grades. As seen in Table 5 columns 1 and 2, a private school will inflate their grade more the closer they are to their nearest competitor, in particular the nearest private competitor. Put more concretely, consider a private school. If its nearest private competitor is 9.2 km closer (1 s.d.), it will have on average 16.11 units higher grade inflation. If its nearest public competitor is 5.7 km closer (1 s.d.), its grade inflation will be 4.16 units higher on average. The reaction of private schools to the average distance to competitors overall is more ambiguous. Table 6 column 3 says that the private school will have higher grade inflation if all of its competitors are located closer. However, Table 6 column 1 says that the private school will have a lower level of grade inflation if its private competitors are located closer. This effect is thus not very robust to how we set up the model. There is no indication from any of these models that public education providers inflate their grades more or less depending on the distance to their competitors. There is no

Table 5: How private/public schools react to private/public competitors: Distance to nearest competitor

	A Private school reacting to a:		
	Private competitor	Public competitor	All competitors
Distance	-0.354	-0.369	-0.262
(random effects)	(0.869)	(0.270)	(0.151)
Distance	-1.752	-0.729	-0.302
(fixed effects)	(0.761)*	(0.331)*	(0.237)
Competitors grade inflation	-0.088	-0.135	-0.114
(random effects)	(0.091)	(0.137)	(0.082)
Competitors grade inflation	-0.146	-0.027	-0.135
(fixed effects)	(0.112)	(0.185)	(0.095)

	A Public school reacting to a:		
	Private competitor	Public competitor	All competitors
Distance	-0.024	-0.014	0.043
(random effects)	(0.190)	(0.107)	(0.127)
Distance	-0.296	0.090	0.965
(fixed effects)	(0.361)	(0.276)	(0.742)
Competitors grade inflation	0.050	0.174	0.129
(random effects)	(0.114)	(0.116)	(0.072)
Competitors grade inflation	0.089	0.167	0.117
(fixed effects)	(0.153)	(0.137)	(0.086)

Clustered standard errors in parentheses
* $p < 0.05$; ** $p < 0.01$

Table 6: How private/public schools react to private/public competitors: Average distance to competitors

	A Private school reacting to a:		
	Private competitor	Public competitor	All competitors
Distance	-0.051	-0.286	-0.306
(random effects)	(0.167)	(0.203)	(0.109)**
Distance	1.017	0.139	0.990
(fixed effects)	(0.322)**	(0.613)	(1.67)
Competitors grade inflation	-0.103	-0.168	-0.130
(random effects)	(0.088)	(0.164)	(0.081)
Competitors grade inflation	-0.135	-0.131	-0.146
(fixed effects)	(0.113)	(0.187)	(0.094)

	A Public school reacting to a:		
	Private competitor	Public competitor	All competitors
Distance	-0.055	0.022	-0.018
(random effects)	(0.073)	(0.069)	(0.071)
Distance	0.245	0.046	0.074
(fixed effects)	(0.247)	(0.106)	(0.102)
Competitors grade inflation	0.028	0.181	0.125
(random effects)	(0.117)	(0.112)	(0.072)
Competitors grade inflation	0.114	0.154	0.140
(fixed effects)	(0.160)	(0.145)	(0.093)

Clustered standard errors in parentheses
* $p < 0.05$; ** $p < 0.01$

indication here either that grade inflation is contagious. This supports the results from previous sections.

There is no indication here either that grade inflation is contagious. This supports the results from previous sections.

6 Conclusion and policy implications

This article has studied grade inflation in Sweden, focusing on three specific drivers from theory and discourse: 1) the distance between competitors, being a proxy for the degree of competition schools face, 2) schools' responses to competitors' grade inflation, or contagiousness, and 3) whether schools run by private actors inflate grades more than public schools.

Using a spatial econometrics framework, I was able to account for spatial autocorrelation. Because traditional econometric models assume that observations are spatially independent of each other, not accounting for this autocorrelation will potentially cause bias in the results. Previous research on how competition affects grade inflation has been inconclusive and has not generally used spatial models, which allows me to fill an interesting gap in the literature.

First, I find that there is a week link between the distance to competing schools and the degree of grade inflation displayed by schools. This effect is not very robust, and there is no measure that consistently demonstrates a significant link between the two. However, the coefficient estimates are mostly in line with what the model predicts, i.e., that more intense competition increases grade inflation. Also, when I do an uncertainty analysis, my findings show that if schools were located closer to each other, the effect on grade inflation is potentially very large. For example, if competing schools are one standard deviation closer, grade inflation could increase by 7.23%.

Second, I do not find any evidence of grade inflation being contagious. This implies that grade inflation is not contagious, i.e., that a school that starts inflating its grades will not "spread" that grade inflation to other schools. Even in the uncertainty analysis, my results suggest that the potential increase in grade inflation due to contagion is small. Third, the results generally show that private schools have higher grade inflation than public schools, although the link is not very robust. This question was also tricky to study, since many private schools with high levels of grade inflation seemed to open/close during the period, and I was only able to perform the full analysis on schools that were operating during the entire period. Looking into whether schools with high levels of grade inflation are more prone to closing is an interesting question for future research.

While I do not find grade inflation to be contagious, there is some support for competition and ownership driving grade inflation. One topic I have covered is what implications this may have for policy. If we want to keep the freedom of families to freely choose what schools to attend and continue to allow private actors to run schools, the most effective policy would be to restrict or remove the ability of schools to inflate grades directly. One suggestion is to have a final exam for each course, which can be externally graded and at least factor into the final grade. A similar suggestion is to make the national tests a more prominent part of the final grade, and have these be graded externally. Another suggestion is to require schools to have a long-term distribution of final grades that is similar to that of their national tests. Variations of these suggestions are used in other parts of the world, and in Sweden national tests are planned to be graded externally starting in 2023 (Tholin, Hellewell, Vretbkad, Lundberg, & Grönvik, 2020).

One other area for future research, which I did not have the opportunity to look at here, is whether the degree of competition affects the distribution of grades and grade inflation and not just the average grades/grade inflation. There are some signs of this being the case, since the variance of grade inflation is larger for private than for public schools (which can be confirmed by running an F-test). The motivation for this could be, e.g., that schools are more likely to inflate low-performing students to a level that enables them to pass rather than fail their courses, or that they are

more likely to inflate high-performing students to make the school appear to have a larger share of students graduating with top grades. To study this, I would need more detailed data than I had access to this time.

Appendix A Deriving the response function of a schools grade inflation

A school i faces N competitors. Between school i and j are M_{ij} students, and the distance between the two schools is D_{ij}. By increasing grade inflation G_i they can attract more students, but do so at the cost c. From a generalized Hotelling framework, they maximize:

$$\max_{G_i} \pi_i = (p - cG_i) * \sum_{j \in N} M_{ij}[\frac{1}{2} + \frac{G_i - G_j}{2tD_{ij}}] - \lambda \frac{1}{2} G_i^2.$$

The first order condition is:

$$\frac{\partial \pi_i}{\partial G_i} = -c \sum_{j \in N} M_{ij}[\frac{1}{2} + \frac{G_i - G_j}{2tD_{ij}}] + \frac{(p - cG_i)}{2t} * \sum_{j \in N} \frac{M_{ij}}{D_{ij}} - \lambda G_i = 0.$$

Expand this function, and rearrange so that G_i is isolated on one side.

$$(\sum_{j \in N} \frac{M_{ij}}{D_{ij}} + t\frac{\lambda}{c})G_i = \frac{1}{2}\frac{p}{c}\sum_{j \in N} \frac{M_{ij}}{D_{ij}} - \frac{1}{2}t\sum_{j \in N} M_{ij} + \frac{1}{2}\sum_{j \in N} \frac{M_{ij}}{D_{ij}} V_j.$$

Now divide both sides by the first factor on the LHS.

$$G_i = \frac{1}{2}\frac{p}{c}\frac{\sum_{j \in N} \frac{M_{ij}}{D_{ij}}}{\sum_{j \in N} \frac{M_{ij}}{D_{ij}} + t\frac{\lambda}{c}} - \frac{1}{2}t\sum_{j \in N} \frac{M_{ij}}{\sum_{j \in N} \frac{M_{ij}}{D_{ij}} + t\frac{\lambda}{c}} + \frac{1}{2}\frac{\sum_{j \in N} \frac{M_{ij}}{D_{ij}} V_j}{\sum_{j \in N} \frac{M_{ij}}{D_{ij}} + t\frac{\lambda}{c}}.$$

This can be simplified to get a testable regression function:

$$G_i = \alpha_i - \beta \bar{D}_i + \rho \bar{G}_i,$$

where $\bar{D}_i = \frac{1}{\sum_{i \neq j} \frac{M^{ij}}{\sum_{i \neq k} M^{ik}} * \frac{1}{D^{ij}}}$ is the weighted harmonic mean distance to competing

schools, and $\bar{G}_i = \sum_{i \neq j} \frac{\frac{M^{ij}}{D^{ij}}}{\sum_{i \neq k} \frac{M^{ik}}{D^{ik}}} G_j$ is the weighted average grade inflation of nearby schools.

Appendix B Full regression tables

This section contains full regression tables for the summary results described in the paper

Table 7: Regression using four-year-averages

$\bar{G}_{inf}$	mean_Private	4.339	4.132	5.562
		(2.16)*	(2.01)*	(2.94)**
	mean_newcompetition_1_	-0.127		
		(1.43)		
	mean_Female	0.119	0.116	0.116
		(3.06)**	(2.98)**	(2.96)**
	mean_Foreignb	0.076	0.076	0.100
		(1.60)	(1.60)	(2.00)*
	mean_Educatied	-0.302	-0.304	-0.283
		(5.70)**	(5.72)**	(5.23)**
	mean_Teachers	0.130	0.129	0.095
		(1.04)	(1.03)	(0.76)
	mean_Totstud	-0.011	-0.011	-0.007
		(1.20)	(1.20)	(0.80)
	_cons	36.174	36.769	33.584
		(7.53)**	(7.45)**	(7.53)**
dobj	$\bar{G}_{inf}$	-0.010	-0.001	0.009
		(0.14)	(0.01)	(0.13)
	mean_competition		-0.094	
			(1.49)	
	mean_competitors_students			-0.013
				(1.25)
/	var(e.$\bar{G}_{inf}$)	196.644	196.563	196.876
		(14.28)**	(14.28)**	(14.28)**
N		408	408	408

* $p < 0.05$; ** $p < 0.01$

Table 8: Nearest competitors

Main	comp_1_	-0.088	-0.106	-0.514	-0.182
		(0.095)	(0.093)	(0.257)*	(0.251)
	1.Private	0.969	0.608		
		(2.064)	(1.946)		
	1.Private#c.comp_1_	-0.071		1.008	
		(0.248)		(0.428)*	
	Totstud	-0.002	-0.003	0.006	0.008
		(0.009)	(0.009)	(0.014)	(0.014)
	Female	0.123	0.123	0.001	0.012
		(0.044)**	(0.045)**	(0.114)	(0.115)
	Foreignb	0.059	0.061	0.118	0.126
		(0.044)	(0.043)	(0.118)	(0.119)
	Educatied	-0.291	-0.289	-0.029	-0.027
		(0.066)**	(0.064)**	(0.180)	(0.182)
	Teachers	-0.028	-0.024	-0.179	-0.185
		(0.116)	(0.116)	(0.186)	(0.184)
	stud_teacher	-0.188	-0.175	-0.791	-0.832
		(0.363)	(0.360)	(0.445)	(0.439)
	2014bn.Year	0.868	0.871	0.787	0.660
		(1.078)	(1.077)	(1.092)	(1.089)
	2015.Year	1.520	1.520	1.088	0.902
		(1.107)	(1.106)	(1.254)	(1.263)
	2016.Year	2.667	2.661	2.198	1.997
		(1.323)*	(1.323)*	(1.658)	(1.674)
	_cons	39.402	39.376		
		(5.293)**	(5.283)**		
Spatial	rho	0.012	0.012	0.027	0.027
		(0.025)	(0.025)	(0.035)	(0.035)
Variance	lgt_theta	0.167	0.163		
		(0.088)	(0.085)		
Variance	sigma2_e			163.025	164.054
				(10.458)**	(10.763)**
	sigma2_e	220.671	220.474		
		(14.344)**	(14.359)**		
R^2		0.11	0.11	0.02	0.05
N		1,292	1,292	1,292	1,292

* $p < 0.05$; ** $p < 0.01$

Table 9: Average competitors

Main	competition	-0.069	-0.119	-0.060	-0.082
		(0.044)	(0.037)**	(0.074)	(0.073)
	1.Private	1.399	-0.622		
		(2.059)	(1.819)		
	1.Private#c.competition	-0.098		-0.042	
		(0.071)		(0.129)	
	Totstud	-0.002	-0.004	0.008	0.008
		(0.008)	(0.008)	(0.015)	(0.014)
	Female	0.123	0.121	0.018	0.015
		(0.044)**	(0.044)**	(0.114)	(0.113)
	Foreignb	0.060	0.062	0.128	0.128
		(0.044)	(0.044)	(0.118)	(0.118)
	Educatied	-0.293	-0.290	-0.036	-0.034
		(0.066)**	(0.065)**	(0.183)	(0.182)
	Teachers	-0.046	-0.033	-0.204	-0.199
		(0.114)	(0.113)	(0.192)	(0.189)
	stud_teacher	-0.238	-0.197	-0.865	-0.854
		(0.370)	(0.362)	(0.443)	(0.437)
	2014bn.Year	0.783	0.823	0.592	0.609
		(1.101)	(1.100)	(1.102)	(1.103)
	2015.Year	1.484	1.481	0.875	0.874
		(1.127)	(1.124)	(1.269)	(1.267)
	2016.Year	2.761	2.815	2.048	2.077
		(1.356)*	(1.355)*	(1.705)	(1.712)
	_cons	42.086	43.214		
		(5.480)**	(5.647)**		
Spatial	rho	-0.017	-0.017	0.005	0.005
		(0.041)	(0.041)	(0.053)	(0.053)
Variance	lgt_theta	0.188	0.184		
		(0.091)*	(0.090)*		
Variance	sigma2_e			164.140	164.158
				(10.986)**	(10.979)**
	sigma2_e	220.471	220.507		
		(14.739)**	(14.712)**		
R^2		0.12	0.11	0.06	0.06
N		1,292	1,292	1,292	1,292

* $p < 0.05$; ** $p < 0.01$

Table 10: Weighted average competitor

Main	comp_weight	0.011	-0.105	-0.053	-0.336
		(0.074)	(0.058)	(0.748)	(0.730)
	1.Private	4.152	0.250		
		(2.467)	(2.059)		
	1.Private#c.comp_weight	-0.254		-0.518	
		(0.106)*		(1.347)	
	Totstud	0.002	-0.002	0.009	0.009
		(0.009)	(0.009)	(0.014)	(0.014)
	Female	0.126	0.123	0.015	0.013
		(0.044)**	(0.044)**	(0.116)	(0.116)
	Foreignb	0.052	0.059	0.117	0.119
		(0.044)	(0.043)	(0.117)	(0.117)
	Educatied	-0.300	-0.294	-0.029	-0.026
		(0.065)**	(0.064)**	(0.181)	(0.181)
	Teachers	-0.079	-0.042	-0.189	-0.186
		(0.116)	(0.116)	(0.191)	(0.189)
	stud_teacher	-0.314	-0.212	-0.852	-0.840
		(0.368)	(0.362)	(0.442)	(0.444)
	2014bn.Year	0.904	0.874	0.685	0.670
		(1.091)	(1.089)	(1.117)	(1.109)
	2015.Year	1.586	1.541	0.961	0.936
		(1.116)	(1.119)	(1.280)	(1.277)
	2016.Year	2.743	2.688	2.048	2.027
		(1.341)*	(1.335)*	(1.710)	(1.706)
	_cons	40.515	41.640		
		(5.442)**	(5.584)**		
Spatial	rho	-0.004	0.001	0.001	0.002
		(0.042)	(0.042)	(0.052)	(0.052)
Variance	lgt_theta	0.189	0.173		
		(0.090)*	(0.086)*		
Variance	sigma2_e			164.340	164.377
				(10.780)**	(10.797)**
	sigma2_e	220.635	220.756		
		(14.405)**	(14.429)**		
R^2		0.12	0.11	0.03	0.02
N		1,292	1,292	1,292	1,292

* $p < 0.05$; ** $p < 0.01$

Table 11: Private/public actors responding to private/public competitors
Distance to nearest competitor

	G_{inf}	G_{inf}	G_{inf}	G_{inf}
Private	7.365	7.731		
	(3.268)*	(3.395)*		
$Publ * Dist_{Priv}$	-0.024		-0.296	
	(0.190)		(0.361)	
$Priv * Dist_{Priv}$	-0.354		-1.752	
	(0.869)		(0.761)*	
$Publ * Dist_{Publ}$	-0.014		0.090	
	(0.107)		(0.276)	
$Priv * Dist_{Publ}$	-0.369		-0.729	
	(0.270)		(0.331)*	
$Publ * Resp_{Priv}$	0.050		0.089	
	(0.114)		(0.153)	
$Priv * Resp_{Priv}$	-0.088		-0.146	
	(0.091)		(0.112)	
$Publ * Resp_{Publ}$	0.174		0.167	
	(0.116)		(0.137)	
$Priv * Resp_{Publ}$	-0.135		-0.027	
	(0.137)		(0.185)	
Totstud	0.000	-0.001	0.009	0.009
	(0.009)	(0.009)	(0.014)	(0.014)
Female	0.123	0.124	-0.003	0.007
	(0.045)**	(0.045)**	(0.117)	(0.117)
Foreignb	0.053	0.063	0.116	0.116
	(0.045)	(0.044)	(0.115)	(0.115)
Educatied	-0.290	-0.285	0.021	-0.014
	(0.065)**	(0.065)**	(0.184)	(0.180)
Teachers	-0.050	-0.045	-0.201	-0.199
	(0.117)	(0.117)	(0.192)	(0.188)
stud_teacher	-0.245	-0.197	-0.863	-0.874
	(0.366)	(0.361)	(0.438)	(0.441)*
2013b.Year	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
2014.Year	0.888	0.913	0.712	0.693
	(1.115)	(1.105)	(1.124)	(1.127)
2015.Year	1.614	1.565	1.049	1.028
	(1.139)	(1.129)	(1.284)	(1.298)
2016.Year	2.530	2.492	2.110	1.734
	(1.349)	(1.300)	(1.662)	(1.645)
$Publ * Dist\_total$		0.043		0.965
		(0.127)		(0.742)
$Priv * Dist\_total$		-0.262		-0.302
		(0.151)		(0.237)
$Publ * Resp\_total$		0.129		0.117
		(0.072)		(0.086)
$Priv * Resp\_total$		-0.114		-0.135
		(0.082)		(0.095)
o.Private			0.000	0.000
			(0.000)	(0.000)
_cons	36.881	35.217	41.421	41.246
	(5.623)**	(5.614)**	(11.989)**	(11.968)**
N	1,292	1,292	1,292	1,292
R^2			0.03	0.02

* $p < 0.05$; ** $p < 0.01$

Table 12: Private/public actors responding to private/public competitors
Average distance to competitors

	G_{inf}	G_{inf}	G_{inf}	G_{inf}
Private	9.543	9.820		
	(3.864)*	(3.618)**		
$Publ * Dist_{Priv}$	-0.055		0.245	
	(0.073)		(0.247)	
$Priv * Dist_{Priv}$	-0.051		1.017	
	(0.167)		(0.322)**	
$Publ * Dist_{Publ}$	0.022		0.046	
	(0.069)		(0.106)	
$Priv * Dist_{Publ}$	-0.286		0.139	
	(0.203)		(0.613)	
$Publ * Resp_{Priv}$	0.028		0.114	
	(0.117)		(0.160)	
$Priv * Resp_{Priv}$	-0.103		-0.135	
	(0.088)		(0.113)	
$Publ * Resp_{Publ}$	0.181		0.154	
	(0.112)		(0.145)	
$Priv * Resp_{Publ}$	-0.168		-0.131	
	(0.164)		(0.187)	
Totstud	0.001	0.000	0.008	0.007
	(0.009)	(0.009)	(0.014)	(0.014)
Female	0.116	0.118	-0.002	-0.009
	(0.045)*	(0.045)**	(0.118)	(0.118)
Foreignb	0.051	0.056	0.109	0.110
	(0.045)	(0.044)	(0.113)	(0.116)
Educatied	-0.300	-0.298	0.008	-0.018
	(0.068)**	(0.066)**	(0.180)	(0.180)
Teachers	-0.064	-0.055	-0.188	-0.186
	(0.118)	(0.118)	(0.189)	(0.187)
stud_teacher	-0.351	-0.317	-0.816	-0.805
	(0.372)	(0.372)	(0.443)	(0.440)
2013b.Year	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
2014.Year	0.883	0.925	0.709	0.674
	(1.126)	(1.110)	(1.131)	(1.128)
2015.Year	1.614	1.602	0.808	1.016
	(1.143)	(1.134)	(1.259)	(1.297)
2016.Year	2.462	2.537	1.757	1.849
	(1.335)	(1.318)	(1.614)	(1.616)
$Publ * Dist\_total$		-0.018		0.074
		(0.071)		(0.102)
$Priv * Dist\_total$		-0.306		0.990
		(0.109)**		(0.593)
$Publ * Resp\_total$		0.125		0.140
		(0.072)		(0.093)
$Priv * Resp\_total$		-0.130		-0.146
		(0.081)		(0.094)
o.Private			0.000	0.000
			(0.000)	(0.000)
_cons	39.900	38.279	32.111	37.652
	(6.222)**	(6.004)**	(12.445)*	(11.646)**
N	1,292	1,292	1,292	1,292
R^2			0.03	0.02

* $p < 0.05$; ** $p < 0.01$

Appendix C Direct and indirect effects

With the spatial models, it is possible to divide the analysis into direct and indirect effects. For example, a direct effect of competition is that a school will increase (or decrease) grade inflation as competitors move closer. However, if there is spatial serial correlation, there will be an additional effect, since nearby schools will increase/decrease their own grade inflation in response. This increase in competitors' grade inflation will additionally affect the school, causing it to inflate/deflate their own grades in addition to the direct effect. I have run some tests with this, and due to the fact that the spatial correlation is so low this indirect effect is very low, and does not change the result in any interesting ways. I have still added some of these tests into Table 13.

Table 13: Direct and indirect effects of competition, and total effect

Competition measure	**Direct effect**	**Indirect effect**	**Total effect**
Nearest (r.e)	-0.111	0.001	-0.111
Nearest (f.e)	-0.185	-0.008	-0.193
Average (r.e)	-0.119	0.001	-0.118
Average (f.e)	-0.080	-0.004	-0.083
Weighted (r.e)	-0.105	0.000	-0.105
Weighted (f.e)	-0.310	-0.013	-0.323

References

Angelov, N., & Edmark, K. (2016). När skolan själv får välja–en eso-rapport om friskolornas etableringsmönster. *Report to the Expert Group on Public Economics*, *3*.

Böhlmark, A., & Lindahl, M. (2015). Independent schools and long-run educational outcomes: Evidence from sweden's large-scale voucher reform. *Economica*, *82*(327), 508–551.

Carlgren, F. (2017). *Friskolor i aktiebolagsform.* Retrieved from "https://www.ekonomifakta.se/Fakta/Valfarden-i-privat-regi/Skolan-i-privat-regi/friskolor-i-aktiebolagsform/"

Chan, W., Hao, L., & Suen, W. (2007). A signaling theory of grade inflation. *International Economic Review*, *48*(3), 1065–1090.

Finefter-Rosenbluh, I., & Levinson, M. L. (2015). What is wrong with grade inflation (if anything)? *Philosophical Inquiry in Education*.

Hinnerich, B. T., & Vlachos, J. (2017). The impact of upper-secondary voucher school attendance on student achievement. swedish evidence using external and internal evaluations. *Labour Economics*, *47*, 1–14.

Millimet, D. L., & Rangaprasad, V. (2007). Strategic competition amongst public schools. *Regional Science and Urban Economics*, *37*(2), 199–219.

Misra, K., Grimes, P. W., & Rogers, K. E. (2012). Does competition improve public school efficiency? a spatial analysis. *Economics of Education Review*, *31*(6), 1177–1190.

Nata, G., Pereira, M. J., & Neves, T. (2014). Unfairness in access to higher education: A 11 year comparison of grade inflation by private and public secondary schools in portugal. *Higher Education*, *68*(6), 851–874.

Neves, T., Pereira, M. J., & Nata, G. (2014). Head teachers' perceptions of secondary school rankings: Their nature, media coverage and impact on schools and the educational arena. *Education as Change*, *18*(2), 211–225.

Regeringens Proposition 1991/92: 95. (1991). Valfrihet och fristående skolor.

Schleicher, A., & Halgreen, T. (2016). *Pisa results from 2015, country note sweden* [Report]. Retrieved 2018-05-09, from https://www.oecd.org/pisa/pisa-2015-Sweden.pdf

Schwager, R. (2012). Grade inflation, social background, and labour market matching. *Journal of Economic Behavior & Organization*, *82*(1), 56–66.

Skolinspektionen. (n.d.). *Samverkan för en likvardig bedomning* [Rapport].

Sporre, H. (2016). A for effort: an empirical analysis of the effect of competition on grade inflation in swedish schools.

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Urquiola, M. (2016). Competition among schools: Traditional public and private schools. In *Handbook of the economics of education* (Vol. 5, pp. 209–237). Elsevier.

Vlachos, J. (2010). Betygets värde. *En analys av hur konkurrens påverkar betygssättningen vid svenska skolor. Uppdragsforskningsrapport*, *6*.

Walsh, P. (2010). Does competition among schools encourage grade inflation? *Journal of School Choice*, *4*(2), 149–173.

Wikström, C., & Wikström, M. (2005). Grade inflation and school competition: an empirical analysis based on the swedish upper secondary schools. *Economics of education Review*, *24*(3), 309–322.

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