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On the Preservation of Illegal Street Art

Abstract: Protecting street art faces significant hurdles. To overcome them, Salib, P.N. (2015. The law of Banksy: Who owns street art? The University of Chicago Law Review, pp. 2293–2328) proposes to unbundle the various rights that art ownership usually implies. Specifically, he proposes to treat the finder of a street art piece as a minority shareholder in this piece, granting him some percentage of its value. We provide an economic analysis of this proposal by refining a simple discovery process model involving street art finders and the owners of the premises where street art is found. We consider both the optimal number of researchers and the share of the street art value that should accrue to a finder. We also pay attention to the co-determination of the numbers of seekers and street artists. We find that a change in the share of the value of discovered street art has an ambiguous effect on the numbers of seekers and street artists. Moreover, relying on this share alone cannot guarantee that the equilibrium values of the numbers of seekers and street artists are equal to their socially optimal values.

Keywords: discovery process, preservation, property rights, street art

JEL Classification: K11, K12, L00, Z11, Z18

1 Introduction

On Thursday, February 13th 2020, a new street artwork appeared on the side of a house in Marsh Lane, Bristol. It featured a stenciled image of a girl firing an explosion of red flowers and leaves into the air using a slingshot, and it included ephemeral ivy spray-painted red. The new mural attracted plenty of visitors. To many of them, this mural appeared as a message of love and peace

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for Valentine's Day. There was a lot of debate on whether it was a Banksy or not.[1] Without waiting for Banksy's confirmation that he was the author, the owner of the house, attempted to protect the mural by placing a Perspex panel over it. In the early hours of "Valentine's Day", i.e., on Friday, February 14, 2020, Banksy confirmed that the piece was actually his by posting two images of the work on his official Instagram account. His artwork, despite the Perspex panel, was vandalized within 48 h of its appearing in Bristol.[2]

The destruction or defacement of a valuable work of street art causes a substantial net social loss.[3] Vandalism is not, however, the only risk that hangs over such pieces. Besides rapid deterioration of street art due to extreme uncontrolled outdoor conditions, thus explaining its ephemeral nature, numerous other types of risks exist, three of which are particularly important. First, there is the risk of auto-iconoclasm: a street artist can go to extreme lengths to resist commodification, even to the point of destroying his own work. Second, there is the risk of theft. Third, even when street art is extremely valuable, many property owners often fail to recognize its value. It is, therefore, very hard to protect street art, especially when it is produced by artists less famous than Banksy.[4]

Bargaining cannot resolve these difficulties. Successful seekers of street art are unlikely to be able to sell their knowledge about valuable artwork to property owners. If finders tell owners that they are selling information about valuable artwork on the owners' property, owners are likely to investigate the art themselves, discover its value, and avoid paying the finders. Moreover, property owners who have no idea what finders wish to sell them are unlikely to pay for unknown information.

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1 Banksy is an anonymous street artist who got his start in Bristol. He is also a political activist and film director.

2 The articles written by Morris and Fisher (2020), and PA Media (2020a, 2020b) in *The Guardian* supplied us with the materials from which we have built the narrative of this Banksy/Bristol case.

3 In contrast with graffiti, which focus on words, and their repetitive display on all kinds of surfaces, street art is mostly images. It can be produced by spray cans, stencils, stickers, posters, photographs or a mix of all the above. As pointed out by Avramidis and Tsilimpounidi (2017), street art and graffiti are, however, close cousins: (1) they both entail creative, aesthetic, and politically engaged interventions in public space; (2) they are both often unsolicited and illegal practices; (3) they have both grown into an international movement disseminated around the globe in wealthy as well as impoverished metropolitan areas.

4 The critical nature of the conservation problem faced by the owner of street art works is beyond doubt. As pointed out by Bonadio (2019a, 39), "preserving a piece, either *in situ* with protective glass or ex situ (for example, via a surgical removal of the mural from the wall), or even through photographs, has always a negative impact on its authenticity (albeit, with different degrees of intensity)."

No one has any incentive to alert high-value users to the existence of street art. Then the art is likely to languish and be destroyed. Hence, it is in the public interest to define legal rules such that they help overcome these difficulties.

A potential solution to this problem was proposed in Salib (2015). According to him equitable division can help protect street art by functioning as follows: A court would grant the finder something less than full co-ownership, unbundling the various rights that art ownership usually implies. It would treat finders as a minority shareholder in the piece, granting them only some percentage of the value of the work. "Under such a system, the finder's only right with regard to the street art would be the right to collect some percentage of the work's sale price should the property owner ever choose to sell it. That right would rest only upon a work's sale, so the finder would collect nothing if the work never sold or was destroyed. The underlying-property owner would retain the power to make all other decisions regarding the artwork and its underlying property, including decisions about artwork placement, alienation, and even destruction" (*ibid*. 2325).[5] The aim of this paper is to provide an economic analysis of Salib's proposal.

To achieve this aim, we propose a simple discovery process model involving street art finders (à la Salib), street artists and the owners of the premises where street art is located. We obtain different kinds of results. First of all, we focus on the case where the production of street art is considered as given. We use our model of discovery to determine the socially optimal number of researchers and the share of the street art value that should accrue to a finder (the value of this share is such that the number of seekers obtained in a free-entry equilibrium is the socially optimal one). Secondly, we pay close attention to the street artists' behavior. In this connection, street artists' income stems from the sale of their moral rights (and not from the sale of pieces of art). We study the co-determination of the numbers of seekers and street artists for a given value of the share. These numbers correspond to the numbers obtained in a free-entry equilibrium. We show that a rise in the share increases the number of seekers if their number has a negative influence on the values of the street artists' moral rights. In that case, the rise of the share also decreases the number of street artists. When the number of seekers has a positive effect on

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5 As pointed out by Salib (*ibid*., 2326), "The only duty that the property owner would owe to the finder would be a duty not to fraudulently deprive the finder of her fair share of a sale should such a sale take place. For example, such an artwork could be attached to a home, and the property owner might wish to sell the entire home, including the artwork. The property owner would then have to pay the finder the latter's share of the home's sale price that was driven by the artwork. Such an amount could be easily calculated by having the artwork appraised."

the street artists' moral rights, the effect of a rise in the share on the equilibrium numbers of seekers and street artists is indeterminate. We also study the socially optima values of the number of seekers and street artists and we show that we cannot rely on Salib's proposal alone to ensure that these optimal values are equal to the equilibrium ones.

The remaining part of the paper unfolds as follows. In the next section, we present Salib's proposal. In Section 3, we lay out a simple discovery process model involving street art finders and the owners of the premises where street art is located. In Section 4 we first study the co-determination of the numbers of seekers and street artists for a given value of the share. We then consider the socially optimal values of the numbers of seekers and street artists. Some brief concluding remarks are given in Section 5. Technical proofs are relegated to an Appendix.

2 Salib's Proposal

To understand Salib's proposal we have to acknowledge that once a street art work is found, three parties may claim ownership right: (1) the street artist who did this work; (2) the finder(s) of this piece of street art; (3) the owner of the property where this street art is located. The street artist does not seem, however, to be the most probable candidate for such a role. Indeed, in the legal literature, street art practices "are commonly defined with reference to the art/crime nexus" (Hansen 2019). As vandalistic practices, they are examined with reference either to the "broken windows theory" or to the "(un)clean hands doctrine." According to the broken window theory (Kelling and Wilson 1982), clean-up of street art images should always be undertaken because little things matter: small disorder may lead to larger ones, and perhaps even to crime. According to the (un)clean hands doctrine,[6] street artists' moral claims to ownership are canceled by their illegal use of another person's property as the site of their creations: a street artist is in no position to assert any rights because the way in which his artwork was produced was illegal.[7]

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6 The (un)clean hands doctrine is a defense available to defendants involved in litigation against unethical plaintiffs. In a case involving street art, the argument is that the creation of the street art work was an act of damage to property subject to civil and criminal sanctions and that the artist therefore cannot seek to enforce his rights in his work against a defendant who, for instance, has exploited the work without permission (see Seay 2012).

7 There is, however, no express provision in the French Civil Code denying protection to illegal works, and, in numerous common law countries, the Court often does not regard illegality as any obstacle when considering the originality of a street art work.

There remain, therefore, two parties—the finder and the owner— who may claim ownership rights,[8] and whose interactions can be studied. According to Salib (2015), the traditional doctrines of property law are ill-equipped to decide questions of street-art ownership. Salib (*ibid*., 2295) contends "that courts should employ their equitable powers to divide street-art ownership, thereby overcoming all relevant doctrinal and policy problems." He adds "that courts should attempt to coalesce around a more or less uniform percentage divide in order to avoid the unpredictability of an ad hoc regime" (*ibid.*, 2325), but he takes no position on what the proper percentage should be. He states in a footnote, however, "that under the German system, finders of lost property are usually entitled to a finder's fee of just 5 percent of the found property's value, Bürgerliches Gesetzbuch [BGB] (the German Civil Code, as amended Jan 2, 2002), 971, [and that] this amount has presumably proved to be enough to incentivize finders" (*ibid.*).

Four comments are in order. Firstly, to incentivize finders, one must take into account that street art seekers would have to understand the way street artists choose the spots in which to place their work.[9] This is not always an easy task.[10]

Secondly, in relation to the first comment, the determination of the proper percentage should take into account the difficulty that a would-be seeker would face to find valuable street art. To solve the problem of the determination of the proper percentage perceived by successful seekers, we may study the way some finders (other than street art finders) are paid. Let us consider, for instance, salvors. A salvor is someone who offers his services to save a ship in distress. Maritime salvage law grants a reward to a salvor: "Salvage rules under maritime law allows for a division of the spoils (sunken ships and their cargo) between the finder and the former

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8 See, however, the decision of the US Court of Appeals in the 5Pointz case, which was delivered on February 20, 2020 (Bonadio and Jean-Baptiste 2020 and Gonsowski 2018) and the analysis of the implications of the federal Visual Artists Rights Act (VARA) in Bonadio (2018).

9 Presumably, street art seekers would have some academic knowledge of street art. The study of the street art world is an academic discipline, in which practitioners are experts in various fields, such as architecture, urban studies, and visual cultures (see, *e.g*., Avramidis and Tsilimpounidi 2017) as well as scholars in different social sciences, such as sociology, criminology, and law (see, *e.g*., Baldini 2018, and Bonadio 2018, 2019a, and 2019b). For a description of the current state of scholarship on graffiti and street art, see, *e.g.*, Ross et al. (2017), which is an attempt to outline and contextualize a number of recurrent challenges facing researchers of graffiti and street art, as well as developments that have taken place in this scholarly field.

10 Such an affirmation is in line with the statement by Kalliopi and Thomas, (two Greek street art hunters), according to whom:"The biggest challenge for us is to find all the locations of these awesome hidden gems that you will find inside abandoned places all over Athens. Or to persuade the street artists reveal their secret spots!" (Available at https://medium.com/street-art-cities/on-the-hunt-hunterview-with-kalliopi-and-thomas-athens-greece-93b73508c127).

owner. Salvage law does not recognize the relinquishment of rights by the original owner, so the finder ("salvor") does not receive title, but rather some salvage reward" (Lueck 1995, 413). The "Lloyd's Standard Form of Salvage Agreement"[11] (commonly referred to as the Lloyd's Open Form or LOF) is the most commonly used form contract for a proposed marine salvage operation. It is a binding contract. It is called "open" because it is not a contract for services, but an agreement to provide a service in the hope of a reward to be determined later by arbitration.

Thirdly, street artists may be hostile to the discovery/protection of their art. Where street artists are hostile to the protection of their art, the discovery of the latter is more difficult, and the percentage perceived by a successful seeker must reflect this fact.

Fourthly, in numerous circumstances, one should take into account the residents of the neighborhood of the premise on which lay street art works. The community of the residents often recognizes the artwork as a community asset and actively preserves it from vandalization or defacing. Yet, this preservation seems to lack legal foundations, as the community does not own the artwork.

The comments above underline the complexity of the issue of street art protection and the number of factors that must be taken into account to assess the interest of Salib's proposal. In the next section, we undertake an assessment of the proposal from an economic viewpoint. In so doing, we follow what we believe is the simplest approach of the issue at hand.

3 A Simple Model of Street Art Discovery

Our analysis builds on the economics of invention by adapting a model introduced by Wright (1983) (see also Carlton and Perloff 1995, chapter 16, pp 563–583). Let V be the *expected* value of street art discoveries when there are n seekers.[12] For mathematical convenience, we suppose that n can be any value in the set of non-negative real numbers $\mathbb{R}_+$. We further suppose that $V(\cdot)$ is a smooth increasing strictly

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11 Available at: http://www.lloyds.com/&tnqx223c;/media/Files/The%20Market/Tools%20and %20resources/Agency/Salvage%20Arbitration%20Branch/Agency_LOF_2011.pdf.

12 This expected value includes for instance the sales price of the discovered pieces of art, or the increase in the value of the premises due to the pieces of art if the premises (but not the pieces of art) are sold. We do not construe V as a share of the revenue stream that could be collected from spectators, TV rights and so on. Nor do we view V as a compensation society has to pay to the finder, *e.g.*, out of tax money, because, say, street art enhances tourism. In the first case, we believe that these incomes should be shared with street artists who own the moral rights on their works (moral rights are considered in Section 4). We do not deny the interest of the second case, which is likely to increase the value of V, but to keep the analysis as simple as possible we shall disregard it.

concave function of n that is upper bounded. These assumptions capture the idea that the higher the number of seekers, the higher the value of these discoveries, but the lower the expected marginal value of street art discoveries. In addition, there is a limit to the value of the pieces of art that can be discovered (this is an innocuous simplifying assumption).

Under the assumptions above, the expected value of street art discoveries only made by the seekers, $R(n)$, satisfies: $R(n) = V(n) - V(0)$. Hence, $R(n)$ inherits all the properties of V (except that $R(0) = 0$, whereas the expected values of discoveries made by the owners when there are no seekers, $V(0)$, can be positive).

We, furthermore, suppose that all seekers are identical and that each of them bears a positive search cost equal to c and that $R(1) > c$ (that is, if there were only one seeker, seeking street art would be profitable).

3.1 Equilibrium Number of Seekers

Let the share s of the expected discoveries accruing to the seekers be given ($0 < s < 1$). We define the equilibrium number of seekers as a number n^e such that

$$s\frac{R(n^e)}{n^e} = c. \tag{1}$$

In the above expression, $s\frac{R(n^e)}{n^e}$ is the expected income obtained by a seeker (all seekers being similar, there is a probability $1/n^e$ that they received the value of the discoveries). equation (1) is a no-profitable entry condition for the seekers. That is, the number of seekers increases whenever $s\frac{R(n)}{n} > c$ and ceases to grow when equation (1) holds (that is, when the expected income obtained by a seeker is just equal to the search cost). The existence and (uniqueness) of an equilibrium number of seekers is proved in the Appendix under the assumption that $sR(1) > c$, i.e., the expected net income of a unique active seeker is positive (see Lemma 1 in the Appendix).

3.2 The Socially Optimal Number of Seekers

Assume that the social objective is to maximize the expected *net* value of street art, that is,

$$\max_{n} V(n) - nc.$$

This objective takes into account the fact that while society aims to preserve street art, it also pays attention to the cost of collecting this kind of art. In our setting, this cost is just equal to the resources devoted to find street art (the conservation cost are thus neglected).

Given the assumptions made on $V(n)$, the socially optimal number n^* of researchers satisfies the following first-order condition

$$V'(n^*) = c. \tag{2}$$

This optimal number is such that the expected marginal value of discoveries is equal to the cost of employing an additional seeker.

3.3 Decentralization of the Socially Optimal Number of Seekers

The socially optimal share s^* is the value of s that decentralizes the optimal number of seekers. Thus, its value is such that the no-profitable entry condition (1) is satisfied when n is equal to the optimal number n^* of seekers.

Using equations (1) and (2), we get

$$s^* = \frac{n^* V'(n^*)}{R(n^*)} = \frac{n^* c}{R(n^*)}. \tag{3}$$

We can check that s^* is increasing with the search cost c as well as in the optimal number of seekers.[13] Where the optimal number of seekers is low, finding street art must not be too rewarding.

4 On the Value of the Optimal Share and the Number of Street Artists

So far, we have paid no attention to street artists' behavior. But studying this behavior is important since the expected value of street art discoveries most likely depends on the number of street artists and Salib's proposal could affect this number.

Assume then that the expected value of street art discoveries depends on both the number of seekers n and on the number of street artists a. For mathematical convenience again, we suppose that a can take any value in the set of non-negative real numbers $\mathbb{R}_+$. Consequently, to study the equilibrium number of seekers, we must consider what determines the number of street artists. Assume also that this number is determined like the number of seekers by a no-profitable entry condition. Moreover, observe that while street artists generally do not own their pieces

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13 That is because, $R(n)/n$, the average expected value of street art discoveries made by the seekers, is decreasing with respect to n (see the proof of Lemma 1 in the Appendix).

of art, they do own the moral rights of their works. Let then V^a be the expected value of these rights. Also suppose that $V^a(.)$ is a smooth increasing concave function of n^a that is upper bounded. Assume, furthermore, for the sake of simplicity that street artists are all alike and that each of them bears a cost c_a to perform her/his art. Under these assumptions, the equilibrium number a^e of street artists solves the following no-profitable entry condition

$$\frac{V^a(a^e)}{a^e} = c_a.$$

The interpretation of this condition is similar to that giving the equilibrium number of seekers. In the equation above, however, we have neglected to take into account the possible influence of the number of seekers on the expected value of street artists' moral rights. In relation to this influence, two cases should be considered. On the one hand, the expected value V^a of street artists' moral rights may be an increasing function of the number of seekers. This case arises when, for instance, the higher the number of seekers, the higher the probability that pieces of street art are discovered, and the higher the expected value of the moral rights of street artists. On the other hand, street artists may actually not be interested in preserving street art. Ernest Pignon-Ernest, a French street artist, is a case in point, as this artist considers it normal, and almost necessary, that street art should vanish. Other artists, such as BLU, an Italian street artist, took an active part in the destruction of their art (see, *e.g.*, Carver 2018; Henke 2015). These behaviors suggest that V^a might not always be increasing with the number of seekers.

The discussion above leads us to assume that V and V^a are two real-valued functions of (a, n) which are defined on $\mathbb{R}^2_+$, take nonnegative values and are both bounded above and smooth. We also assume that V and V^a are strictly concave with respect to n and a, respectively, and that V is increasing with respect to a (a reasonable assumption).

4.1 Simultaneous Determination of the Equilibrium Numbers of Seekers and Street Artists

Whatever the net effect of the number of seekers on the expected value of street artists' moral rights, the number of seekers and of street artists can be construed as being *simultaneously* determined. Therefore, a value of the share s being given, the equilibrium numbers of seekers and street artists satisfy the next two no profitable-entry conditions

$$s\frac{V(a, n)}{n} = c \tag{4}$$

$$\frac{V^a(a, n)}{a} = c_a. \tag{5}$$

Lemma 2 in the Appendix shows that there exist equilibrium values a^e and n^e for the numbers of street artists and of seekers.[14] The following result addresses the effect of a change in the share s on these numbers.

Proposition 1. *(i) When the expected value of moral rights V^a is a decreasing function of the number of seekers, the equilibrium number of seekers increases with the value of the share s while the equilibrium number of street artists decreases with s.*

(ii) When the expected value of moral rights V^a is an increasing function of the number of seekers, an increase in the share s has an indeterminate effect on the equilibrium value of this number. However, the equilibrium values of the numbers of seekers and street artists change in the same way.

When the share of seekers in the value of street art discoveries increases, there is a direct positive stimulating effect on their number because it is more profitable to seek. But as the number of seekers increases, an indirect effect arises. To wit, when the expected value of street artists' moral rights V^a depends negatively on the number of seekers, the number of artists decreases. As a consequence, the initial rise in the expected income of the seekers is reduced. The net effect of an increase in s on the number of seekers is then lesser than the direct one, but it turns out that it is positive.

When the value of street artists' moral rights V^a is an increasing function of the number of seekers, however, the net effect of an increase in s upon the number of seekers is ambiguous. On the one hand, a rise in s directly increases the number of seekers. This increase benefits the street artists and thus enhances their number. This yields a second positive effect on the number of seekers. On the other hand, the increases in both the number of seekers and of street artists diminish their respective incomes, which brings about a negative indirect effect on their numbers. Yet, one cannot decipher whether the net effects are positive or not.

We conclude that there may be a genuine difficulty in using the kind of sharing proposal proposed by Salib as we do not know *a priori* how the number of

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14 In the lemma, we assume that $\frac{sV(1,1)}{c} > 1$ and $\frac{V^a(1,1)}{c_a} > 1$, and that $\frac{V^a(1,n)}{c_a} > 1$ for all n if $V^a(a, n)$ is decreasing with respect to n. The assumptions regarding V^a are rather mild. They mean that street art would be worthwhile if there were only one street artist, whatever the number of seekers.

seekers affects that of street artists. But there is a further difficulty if one wants to implement the socially optimal number of seekers.

4.2 Reconsidering the Socially Optimal Number of Seekers

To understand this additional difficulty, notice that the study of the street artists' behavior leads us to reconsider the determination of the socially optimal number of seekers. That is because, as was seen above, one cannot analyze the number of seekers independently of the number of street artists. To study the optimal values of these numbers, we have to modify the social welfare function in order to take into account the expected value of the street artists' moral rights. We are thus led to consider the following problem

$$\max_{a,n} V(a,n) + V^a(a,n) - c_a a - cn.$$

The first-order conditions satisfied by the solution to this problem read

$$\frac{\partial V(a^*, n^*)}{\partial n} = c$$

$$\frac{\partial V^a(a^*, n^*)}{\partial a} = c_a.$$

We see immediately a difficulty in the implementation of the socially optimal number of seekers and street artists. That is because, we only have one policy instrument, namely the share s. We can choose the value of s to obtain the optimal number of seekers using equation (4). But we cannot ensure that the equilibrium condition (5) for the street artists is satisfied.[15]

5 Conclusion

Protecting street art faces significant hurdles. Salib (2015) proposes a potential solution to this problem. Unbundling the various rights that art ownership usually implies, he proposes to treat the finder of a street art piece as a minority shareholder in this piece, granting this finder some percentage of its value. In this paper, we have provided an economic analysis of Salib's proposal by refining a simple discovery process model involving street art finders and the owners of the premises where street art is found. We have determined both the socially optimal number of researchers and the share of the street art value that should accrue to a finder. We

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15 We could, however, study a second-best optimum, by using the socially optimal behavior of street artists as a function of the number of seekers.

have also studied the co-determination of the equilibrium numbers of seekers and street artists. We have also argued that as seekers are likely to influence the value of the street artists' moral rights and as street artists influence the value of the pieces of art found by the seekers, it is necessary to study the co-determination of the numbers of seekers and street artists. We have performed this study and found that a change in the share of the values of street art discoveries received by their finders may have an ambiguous effect on the number of seekers and street artists (when the effect is clear-cut, a rise in the share increases the number of seekers but decreases the number of street artists). We have also noticed that one cannot rely on this share alone to guarantee that the equilibrium values of the number of seekers and street artists are equal to the socially optimal ones.

There are at least three avenues for future research. Firstly, we have assumed that all seekers contribute in the same way to the discoveries. This is a simplifying assumption that can affect some of our results. For instance, it might be optimal to only allow seekers who have a minimum knowledge of street art (perhaps an art degree). Secondly, we have overlooked the fact that the destruction of a valuable albeit illegal piece of street art by its creator may enable the property owner to sue the former for damages.[16] Thirdly, we have not taken into account the positive effects of street art on certain activities like tourism.

Appendix:

Lemma 1. *Let s be given such that sR(1) > c. Then there exists a unique equilibrium, i.e., a unique number n^e such that*

$$s\frac{R(n^e)}{n^e} = c.$$

Proof. By assumption $sR(1) > c$.

Moreover, observe that $R(n)/n$ is decreasing with respect to n. Indeed,

$$\frac{\mathrm{d}}{\mathrm{d}n}\left(\frac{R(n)}{n}\right) = \frac{nR'(n) - R(n)}{n^2}.$$

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16 We thank Paul-Antoine Crettez for suggesting the investigation of this issue.

Since $R(n)$ is strictly concave and $R(0) = 0$, it holds that

$$R(0) - R(n) < R'(n)(0 - n)$$

which implies that $\frac{d}{dn}\left(\frac{R(n)}{n}\right) < 0$. Since V is bounded above so is R and when the number of seekers is large enough we get that $s\frac{R(n)}{n} < c$. As $s\frac{R(n)}{n}$ is continuous on $[1, +\infty)$, there is a unique value n^e of n such that

$$s\frac{R(n^e)}{n^e} = c.$$

Lemma 2. *Assume that $\frac{sV(1,1)}{c} > 1$, $\frac{V^a(1,1)}{c_a} > 1$ and that $\frac{V^a(1,n)}{c_a} > 1$ for all n if $V^a(a, n)$ is decreasing with respect to n. Further, assume that both $V(a, n)$ and $V^a(a, n)$ are bounded and continuous and take nonnegative values on $\mathbb{R}_+^2$. Then, there are positive numbers a^e and n^e of street artists and seekers, respectively, such that the following two no-profitable entry conditions are satisfied*

$$s\frac{V(a^e, n^e)}{n^e} = c$$

$$\frac{V^a(a^e, n^e)}{a^e} = c_a.$$

Proof. Consider the application $\varphi \colon [1, \bar{n}] \times [1, \bar{a}] \to \mathbb{R}_+^2$ defined by

$$\varphi(a, n) = \left(s\frac{V(a, n)}{c}, \frac{V^a(a, n)}{c_a}\right). \tag{6}$$

Under the assumption that $\frac{sV(1,1)}{c} > 1$, $\frac{V^a(1,1)}{c_a} > 1$, $\frac{V^a(1,n)}{c_a} > 1$ for all n if $V^a(a, n)$ is decreasing with respect to n and that V and V^a are bounded above, there are positive values $\bar{n}$ and $\bar{a}$ such that whenever $(1, 1) \leq (n, a) \leq (\bar{n}, \bar{a})$, it holds that $\varphi(n, a) \leq (\bar{n}, \bar{a})$. That is, φ maps $[1, \bar{n}] \times [1, \bar{a}]$ into itself. Since φ is continuous and $[1, \bar{n}] \times [1, \bar{a}]$ is a compact convex set, by Brouwer Theorem it has a fixed-point. It is easy to see that this fixed-point gives equilibrium values of the numbers of seekers and of street artists. □

Proof of Proposition 1. Proof. Totally differentiating the equilibrium conditions (4) and (5) we obtain after a few algebra

$$\frac{\partial a}{\partial s} = -\frac{\frac{\partial \left(\frac{V^a}{a}\right)}{\partial n}}{\frac{\partial \left(\frac{V^a}{a}\right)}{\partial a}} \frac{\partial n}{\partial s}, \tag{7}$$

$$\frac{\partial n}{\partial s} = -\frac{V(a,n)}{sn} \frac{1}{\frac{\partial \left(\frac{V}{n}\right)}{\partial n} - \frac{\partial \left(\frac{V}{n}\right)}{\partial a}\frac{\partial \left(\frac{V^a}{n}\right)}{\partial \left(\frac{V^a}{a}\right)}}. \tag{8}$$

Since V^a is strictly concave $\frac{\partial \left(\frac{V^a}{a}\right)}{\partial a}$ is negative and it follows from equation (7) that the signs of $\frac{\partial n}{\partial s}$ and $\frac{\partial a}{\partial s}$ are the same if, and only if, $\frac{\partial V^a}{\partial n}$ is positive. When $\frac{\partial V^a}{\partial n} < 0$, it follows from (8) that $\frac{\partial n}{\partial s} > 0$ and thus that $\frac{\partial a}{\partial s} < 0$. When $\frac{\partial V^a}{\partial n} > 0$, the sign of $\frac{\partial n}{\partial s}$ is indeterminate. □

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