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THE CON GAME: Explaining the Existence of Con-Artists

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Abstract

This paper tries to add an economic perspective to the academic analysis of con-artists. While extensive psychological literature discusses why con-artists thrive in human societies, no research has been done to discuss economic incentives for con-artists. This paper proposes a simple game theoretical model to see when con-artist arise and what drives their decisions in the context of a simple investment game. It finds that in equilibrium, there is always room for con-artists to enter the market, and that the main driver for clients to invest is the rate of return, while the con-artist relies on the invested amount and his costs of set-up to guide his decisions.

Introduction:

Everybody knows of Bernard Madoff, who was sentenced in 2009 to 150 years in prison for various counts of fraud and theft, having essentially “conned” his thousands of clients out of 65 billion US dollars. In order to do so, he used an already well-known so-called *Ponzi scheme*, which is set up by promising investors a very important return on investment over a relatively short period of time. In the initial *Ponzi scheme*, Charles Ponzi told his investors that, using arbitrage on international postal coupons, he could double the worth of their investment in 90 days. In fact, he never traded in these international postal coupons, instead using his personal reserves – which were made of the other investments he received – to pay off investors. As the few investors that “cashed out” were paid with the money from the total investment pool, the scheme seemed legitimate, and most clients kept reinvesting (Zuckoff, 2005).

Although stories such as Madoff’s, or Ponzi’s, have always fascinated the public, not much has been done in the field of economics to explain the *rationale* behind their schemes. In fact, economists seem to have largely ignored, or forgotten about con-artists in general. Although their schemes are based on deception and lies, and are, of course, illegal, their recurrence in most aspects of modern society seems to point towards their effectiveness and viability in substituting traditional, legal sources of revenue.

A possible explanation for the lack of research in this area could be the very unusual nature of the con-artist’s schemes. Unlike “traditional” types of illegal activities, such as corruption, contraband, and all types of fraud, cons are based on emotional or intellectual manipulation of the targeted population (Konnikova, 2016). However, this paper will show that con artists can exist even when people cannot be emotionally or intellectually manipulated..

This paper introduces, to my knowledge, the first economic model relating to con-artists. The model will reach an equilibrium share of con-artists for a situation in which the con mimics an investment opportunity for the client. It shows that con-artists can exist even in a setting where all investors are rational Bayesian updaters. Furthermore, the game will consider both the conditions for the con-artist to set up his con, and the conditions for the client to trust the con-artist, in order to get a complete overview of what is required for con-artists to appear.

Bringing an economic perspective to a phenomenon that was mainly dealt with in psychology thus far will be the main contribution of this paper. More broadly, it will provide an economic basis for further theoretical or empirical research on the topic of con-artists.

First, a related literature section will discuss previous psychological and game theoretical analysis of trust, in order to justify the key assumption of the model, as well as a brief overview of the concept of pandering, which will be central to the game. Next, the model will be set up, after which the main propositions will be discussed. An analysis of the obtained conditions and results will follow, as well as an overview of various possible extensions of the model. Finally, conclusions and implications will be drawn from the research, and suggestions for further research will be discussed.

Related Literature:

A. Trust in Psychology and Economics

Although con-artists have not been subject to much academic research or analysis, various determinants of the con-artist's existence have been discussed more extensively. For instance, in *The Confidence Game*, Konnikova (2016) argues that trust is the main reason for the con-artist's existence. In other words, she says that con-artists exist because human beings want, and are inclined to trust each other.

The claim that human beings are inclined to trust each other is supported by Tedeschi (1974), who discusses the trade-off between trust and power. He states that without trust, "not much business would be done", as everyone would need to rely on institutions yielding power, such as government, to enforce contracts. Simultaneously, governments themselves would not be able to strive without trust, in negotiations, for instance (Tedeschi, 1974).

He goes on to show that, beyond being necessary to reach agreements and progress, displaying trust is also necessary to be perceived as "trustworthy", and thus to improve one's own well-being. Especially in the context of an already existing society, with rules, institutions, and predetermined dynamics of power, trusting is inevitable, as complete self-reliance is not sustainable (Tedeschi, 1974).

Schelling (1960) agrees, in his *Strategy of Conflict*, and interjects, by setting up simple coordination games, that humans are better off by trusting each other. He first suggests that, although trust between two players of a certain game shouldn't be taken for granted, it cannot be ruled out either. Trust would be achieved overtime, as both parties recognise that it is the most profitable alternative, and as breaking trust would only result in both parties being worse off, *in the long run* (Schelling, 1960).

Dodge (2012), in his analysis of Schelling's work, argues that Schelling's cooperation is not in fact dependent on "trust", but merely on the duration of the game. He argues that repeated games with (or against) the same player will result in cooperation, as this is more profitable as long as there are more games to be played. However, an isolated case of a particular game would still result in the Nash Equilibrium of both players playing their utility maximising strategy, even if this means betraying each other (Dodge, 2012).

One thing all of the previously mentioned authors agree upon is that trust seems to be the norm in human interactions, in that it is an essential ingredient for the creation of a stable society. In the case of Dodge's argument, this simply means that society is set up in such a way that all people evolving in it expect to play an undetermined amount of games, which results in the same phenomenon as what the others call trust. However, another thing that all of them recognise is that trust involves risk.

Although trusting seems more profitable than not trusting, the possibility that the *trustee* proves not to be worthy of trust exists (Tedeschi, 1974). This is where the con-artist comes in. The con-artist, in fact, exists because of people's necessity to trust, and because there is the possibility to betray this trust (Konnikova, 2016). The con-artist strives because a majority of the population is trustworthy, which makes people more inclined to trust than to remain self-reliant.

It is interesting to note that part of this trust is almost imposed upon individuals in the context of a complex society such as ours. Indeed, complete self-reliance is not sustainable unless one lives in complete isolation. Therefore, the dynamics of power, as Tedeschi describes, imply that every individual evolving in society is forced to display at least some degree of trust, hence making the con-artist a possible occurrence *by construction*.

B. Pandering

Besides trust, one of the main features of the model that will be discussed in this paper is one that incorporates a key aspect of the Ponzi scheme, as described in the introduction. In this scheme, the con-artist collects multiple investments, and pays early investors back with the money received from more recent investors. As long as this goes on, the con-artist pretends to be a trustworthy agent, by not only offering an indistinguishable deal, but also by acting as trustworthy when it comes to providing the clients with their return on investment. This behaviour is called *pandering*, and allows the con-artist to expand his con and reap more benefits while reducing the risk of getting caught.

The notion of *pandering* is typically used in political economics, and tends to describe the behaviour of a politician whose preferred action differs from that of the majority of the voters, but who chooses to execute the voter's preferred action in order to improve his chances of getting re-elected (Maskin & Tirole, 2004). Despite the different context, this notion of pandering, in the sense that the individual initially forgoes the option that increases his utility most in order to maximise it at a later stage of the game, fits this model perfectly. In addition, the client in this model and the voter in Maskin and Tirole are comparable in the power they wield by deciding, for one, to reinvest in the con-artist, and for the other, to re-elect the pandering politician.

In the context of this model, the main benefit of pandering, for the con-artist, is that it gives him the possibility to expand his con to more investors, without raising suspicion, but also to gain the trust of the client that receives his return on investment.

Model:

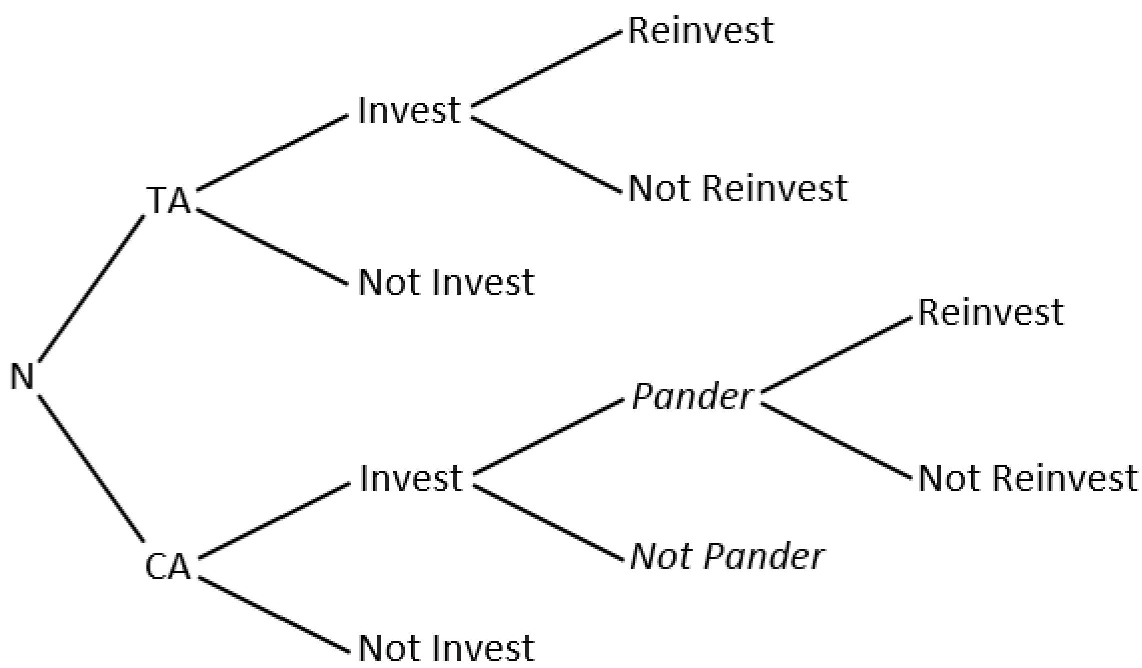
For the purpose of this paper, a simple investment game will be modelled. The game works as follows: it is assumed that in this society, one investment opportunity exists, consisting of an amount α to invest and a return r. The reason behind this initial assumption is that, in order to successfully set up his con, the con-artist needs to mimic the investment that the trustworthy agent offers. A single investment option is thus chosen for simplicity[1].

[1] Note that this single investment option is not a necessary condition. Investment possibilities could be multiple, or even infinite, within a certain range, as long as the con-artist offers an investment that could also be offered by a trustworthy agent, and that the trustworthy agent cannot offer any investment that couldn't

From the previously discussed features of trust and human society, the main assumption of the model can be justified: people are inclined to trust each other, as this is, on average, more profitable. This implies that, at any point in time, there is no reason to believe that the client would put more weight on the share of con-artists than on the share of trustworthy agents. In the model, the share of trustworthy agents is given by π. The share of con-artist is thus $(1-\pi)$.

The game itself is composed of two main decision trees. First, nature distinguishes between the trustworthy agents and the con-artist. As mentioned previously, the shares of each of these types in the total agents pool will be given by π and $(1-\pi)$ respectively. Once this distinction is made, the next step consists of the decision of the client to invest. This decision does not depend on the type of agent, since the client cannot distinguish between the con-artist and the trustworthy agent. In the first part of the analysis, the probability that the client invests is given by p_1.

Figure 1: Complete Investment Game



In italics are the decisions made by the con-artist. Investment decisions are all made by the client. TA = Trustworthy Agent; CA = Con-Artist.

After the client's decision to invest, the options change depending of the type of agent. If the agent is trustworthy, the client receives his payoff, and then has the possibility to reinvest, which is given by p_2. It is important to note that p_2 is different from p_1, since the client's decision is now also influenced by the action of the agent giving him his payoff. Hence, p_2

be offered by the con-artist, such that the "client" cannot distinguish between the con and the real investment before making his decision.

now depends on the client's evaluation of the agent's behaviour on top of p_1. In the decision to reinvest, the client would invest an amount $m\alpha$, which is larger than α, with $m > 1$.

If the agent is a con-artist, he has the possibility to pander, which was previously discussed in the related literature. If he decides to pander, the con-artist mimics the behaviour of the trustworthy agents, and gives the client his return on investment. Similarly to the case of the trustworthy agent, this might increase the client's trust in the agent, and induce him to invest more, in which case he has the choice between not investing again and investing $m\alpha$, where $m > 1$. The probability that the con-artist panders will initially be given by x, but will be further discussed later, when determining the optimal course of action for the con-artist. Conversely, pandering constitutes a risk for the con-artist, as there is a possibility that the client decides not to invest again, in which case the con-artist makes a loss equal to the return on investment, which he has to draw from his personal reserves. The probability that the client reinvests is once again given by p_2. If the con-artist decides not to pander, the agent suffers a loss of α.

The previously mentioned variables will allow the game to reach an equilibrium share of con-artists, however, when it comes to determining the conditions for the con-artist to pander, which will be discussed subsequently, a few additional variables are added to fully capture the con-artist's utility trade-offs.

When the con-artist panders, he has no chance of getting caught by the authorities. However, once he stops pandering, and "disappears" with the client's money, the client will report the con with a probability δ, which depends on the invested amount, such that $\delta(\alpha)$ is a reactive function of α:[2]

$$\delta(\alpha) = R\alpha$$

Where:

$$R = \frac{\varphi}{\alpha_T}$$

such that for any α, α_T is the individual's total wealth, and φ belongs to $(0, 1)$[3]. It follows that for any amount, $\delta(\alpha)$ belongs to $[0, 1]$, and $\delta(\alpha)$ increases in α. Furthermore, R follows a normal distribution around a mean that is known to the con-artist. Since the amount invested is allowed to vary, this implies that the con-artist faces some kind of trade-off between the amount he subtracts from the client and the risk of getting caught. If the con-artist gets caught, he will suffer a utility loss of β[4]. It is assumed that β cannot exceed the individual's total wealth, α_T, so that the con-artist always pays the full extent of the punishment.

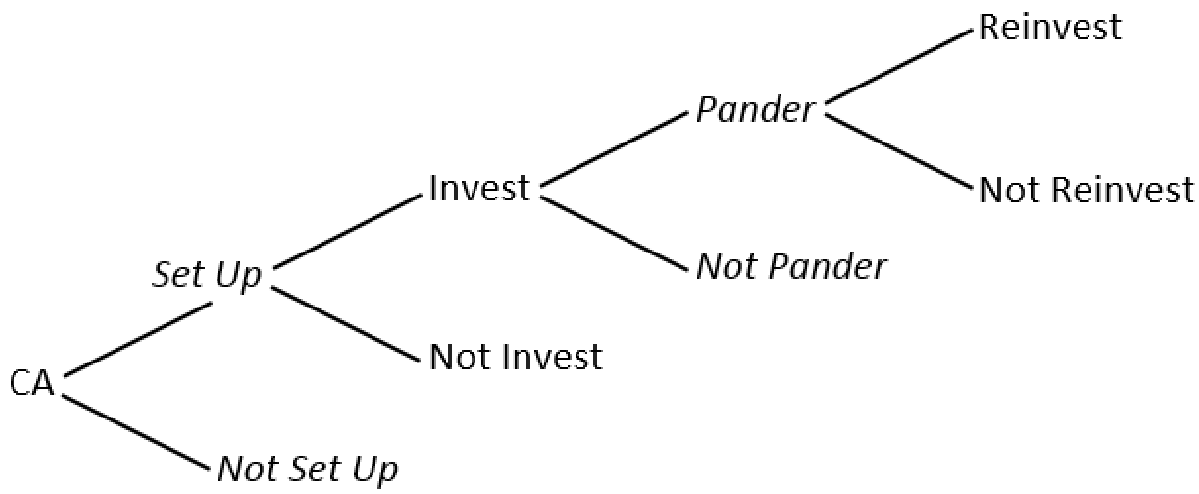
[2] Intuitively: the higher α, the more likely the client is to report the con-artist. It follows that, if the con-artist gets caught with a fixed probability when he is reported, the probability of getting caught increases as α increases as well. It is thus sufficient to make the probability of getting caught a reaction function of α.

[3] It is important to note that φ cannot take the value of 0 or 1, but can take any value in between. This depends on the individual and follows a distribution known by the con-artist for the population.

[4] One can think of β as the punishment that the con-artist receives. This con-artist may receive a fine, end up in jail, and/or suffer from negative publicity due to the exposure of his con. β incorporates all the drawbacks of getting caught.

Finally, the model is expanded in order to incorporate the cost of setting up the con. This is done by considering a stage in the game at which the con-artist can decide whether to pursue the con or not. If the con-artist decides to set up the con, he will incur a cost c, while his utility will remain 0 if he does not set up the con. All the previously mentioned additions result in the game as pictured in Figure 2:

Figure 2: The Con-Artist's Game



In italics are the decisions made by the con-artist.

Implications:

I. Bayesian Equilibrium

Now that the characteristics of the game have been fully explained, the implications of the model can be discussed. As mentioned previously, the first and main objective of this study is to reach an equilibrium share of con-artist in the context of this game. To reach this equilibrium, one needs to look at the initial game tree, as presented in Figure 1 (see Model). The game will be solved using backwards induction, after which a Bayesian Nash Equilibrium will be reached.

Using the previously described features of the model, it is possible to determine the expected utility each player will receive from the outcomes of both branches of the game tree. Since backwards induction will be used, the first outcomes to consider are the ones resulting from the last decision that needs to be made in game presented in figure 1. This is the client's decision on whether or not to reinvest. If the game reaches this stages, there will be three possible outcomes: if the client decides not to reinvest, his utility will be αr regardless of which type of agent he is facing. If the client were to reinvest, on the other hand, his utility will be determined by the type of agent. If the agent is trustworthy, his utility will be:

$$U_{ATr} = \alpha r + m\alpha r$$

However, if the agent is a con-artist, his utility of reinvesting will be:

$$U_{ACA} = \alpha r - m\alpha$$

Since the client does not know which type of agent he is facing, his decision will depend on the probability that the agent is trustworthy, *given that* the client was given the option to reinvest. For simplicity, the model assumes that trustworthy agents always give the option to reinvest, while the con-artist only does so if he decides to pander, hence the probability that the agent is trustworthy *given that* the client was given the option to reinvest is[5]:

$$\mathrm{P} = \frac{\pi}{\pi + (1-\pi)x}$$

Using this probability, it is possible to determine the expected utility of reinvesting taking into account the outcomes of both branches of the game tree. Intuitively, the client will reinvest if the expected return of reinvesting is greater than that of not reinvesting, which results in:

$$\frac{\pi}{\pi + (1-\pi)x}\alpha r(m+1) - \frac{(1-\pi)x}{\pi + (1-\pi)x}\alpha(m-r) > \alpha r$$

$$\Leftrightarrow \pi r > (1-\pi)x$$

$$\Leftrightarrow x < \frac{\pi r}{(1-\pi)}$$

From this inequality, it becomes evident that, for instance, the client becomes less likely to reinvest as the share of con-artists increases. Similarly, as the rate of return increases, reinvesting becomes more attractive, as the client's opportunity cost of not reinvesting while the agent is trustworthy becomes higher. In addition, an increase in pandering on the side of the con-artist also makes the client less likely to reinvest.

This first finding also suggests that, when $\frac{\pi r}{(1-\pi)} > 1$, the client will always reinvest. However, when this is not the case, the client will be indifferent between reinvesting and not reinvesting in equilibrium. Thus, in equilibrium, the following equality holds:

$$x = \frac{\pi r}{(1-\pi)}$$

Furthermore, this equality indicates that, in equilibrium, x can never be equal to 0, since neither the share of trustworthy agents nor the rate of return can be equal to 0 in order for the client to invest. Hence, in equilibrium, con-artists will always pander with a positive probability.

Still using backwards induction, the next decision to consider is that of the con-artist, when he decides whether or not to pander. This time, the outcome of this decision will also depend on the previously discussed decision on the side of the client, however, there is an important difference between the decisions of the client and those of the con-artist, in that the con-artist has no uncertainty regarding the part of the game tree he is in. Hence, the only

[5] As mentioned in the description of the model, π is the share of trustworthy agents, and x is the probability that the con-artist panders.

uncertainty that the con-artist faces is captured by the probability p_2 that the client reinvests. If the con-artist decides to pander, and the client reinvests, his utility will be:

$$U_{PR} = (m - r)\alpha - c$$

However, if the con-artist panders, but the client decides not to reinvest, his utility will be:

$$U_{PnR} = r\alpha - c$$

In order to find out when the con-artist will pander, the expected utility resulting from pandering needs to be compared to the utility of not pandering, which is always $\alpha - c$. Hence, the con-artist will pander when:

$$p_2(m - r)\alpha - (1 - p_2)r\alpha - c > \alpha - c$$

$$\Leftrightarrow p_2 m > 1 + r$$

$$\Leftrightarrow p_2 > \frac{1 + r}{m}$$

From this condition for pandering, one can see that the con-artist becomes less likely to pander as r increases, while he becomes more likely to pander as m or p_2 increases. In addition, it is interesting to note that, when $m < 1 + r$, the con-artist will never pander, as p_2 is a probability, which cannot exceed 1. From an economic standpoint, this makes sense, since, when $m < 1 + r$, the utility of pandering, even when the client always reinvests, is always lower than the utility gained from not pandering.

Similarly to the first decision that was considered, the con-artist is indifferent between pandering and not pandering when:

$$p_2 = \frac{1 + r}{m}$$

These two first steps in reaching the Bayesian Equilibrium result in a first mixed equilibrium, which gives the probabilities of pandering and of reinvesting for which both the client and the con-artist are indifferent. Given this first mixed equilibrium, a few conclusions regarding the state of the game can be drawn.

As was mentioned earlier, when $m < 1 + r$, the condition for pandering will never be satisfied, and the con-artist will never be indifferent between pandering and not pandering. Hence, in order to reach this mixed equilibrium, it is necessary that $m > 1 + r$. If this condition is not satisfied, then a mixed equilibrium cannot be reached. The reason for this is quite intuitive: if the con-artist never panders, then an opportunity for reinvesting will always mean that the agent is trustworthy, hence, there is no longer a trade-off from the client's perspective, as he will always be better off investing. Hence, in this part of the game tree, when $m < 1 + r$, there will be a pure equilibrium, in which the con-artist never panders and the client always reinvests.

Besides this first mixed equilibrium, two more decisions need to be considered: whether the client will invest in the first place, and whether the con-artist will set up the con before the game begins. The equilibrium values of π and p_1 can be derived from these decisions. This leads to this paper's first proposition:

Proposition 1: *In equilibrium, the share of trustworthy agents is strictly lower than 1.*

In other words, this first proposition states that there is always room for con-artists to arise, which is something that was already conveyed in the related literature section. The idea is to show that con-artist are an inevitable occurrence in this type of investment game, as the necessity to trust the agent on the side of the client creates room for people to take advantage of that trust.

The intuition behind this proposition can be found in the following example: if every agent was indeed trustworthy, then all clients would always invest, since investing in a trustworthy agent is more profitable that not doing so. If, in such a situation, an additional agent, a con-artist, would enter the market, this agent would benefit from the same trust all the other agents receive, hence, all the clients he would propose an investment to would accept, regardless of the amount. Knowing this, there will always be an amount for which the con-artist's condition to enter the market is satisfied, and thus, an equilibrium without con-artists should be ruled out.

Using backwards induction, the next step is therefore to find out when the client will invest for the initial investment opportunity. The payoffs associated with this decision are the same ones as were discussed previously, when looking at the probability that the client reinvests. In addition, if the client decides not to invest at all, his utility will be 0. The client will invest if his expected utility of investing is larger than the utility of not investing, hence[6]:

$$EU_{CL} > 0 \Leftrightarrow (1-\pi)(x(\alpha r - p_2 m\alpha) + (1-x)(-\alpha)) + \pi(\alpha r + p_2 m\alpha r) > 0$$

$$\Leftrightarrow (1-\pi)(x(r - p_2 m) - 1 + x) + \pi(r + p_2 mr) > 0$$

Substituting the values from the mixed equilibrium:

$$\Leftrightarrow (1-\pi)(\frac{\pi r}{(1-\pi)}\left(r - \frac{1+r}{m}m\right) - 1 + \frac{\pi r}{(1-\pi)}) + \pi(r + \frac{1+r}{m}mr) > 0$$

$$\Leftrightarrow \pi + \pi r - \pi r + \pi(2+r)r > 1$$

$$\Leftrightarrow \pi > \frac{1}{1+2r+r^2}$$

This result shows that the probability that the client initially invests depends positively on r and on the share of trustworthy agents. As expected, these two variables either increase the potential return for the client or reduce his risk of losing everything to a con-artist.

Similarly to the previously considered decisions in the game, the equilibrium value of π is reached when the client is indifferent between investing and not investing, which happens when:

[6] The full proof can be found in the appendix, under proposition 1.

$$\pi = \frac{1}{1 + 2r + r^2}$$

This equilibrium value confirms proposition 1. Indeed, given that $r > 0$, *by construction*, the share of trustworthy agents is strictly lower than 1 in equilibrium. This confirms the idea that under normal conditions, there is always room for con-artists. In fact, since the client's condition to invest depends only on the share of trustworthy agents and on the rate of return, given how both these variables interact, this investment condition assures that there is always room for con-artists to arise.

The final step in finding the complete Bayesian Equilibrium is to look at the very first decision in the game, which is the con-artist's decision to set up the game. The decision is not incorporated in the game tree of figure 1, as it is one that determines the share of con-artists as it is considered by the client. Hence, for this part, the game tree of figure 2 is considered (see Model). Similarly to the con-artist's previous decision, there is no uncertainty regarding the other player's type, so it depends only on the client's probability of (re)investing.

The payoffs that correspond to the outcomes of the game are known, and are combined to show the con-artist's expected utility of setting up the con. This expected utility is compared to the utility of not setting up the con, which is equal to 0. Hence, the following inequality captures the condition for setting up the con:

$$EU_{CA} > 0 \Leftrightarrow xp_1(p_2 m\alpha - \alpha r) + (1 - x)p_1\alpha - c > 0$$

$$\Leftrightarrow \; xp_1p_2m\alpha - xp_1\alpha r + p_1\alpha - xp_1\alpha - c > 0$$

Substituting the previously found mixed equilibrium values:

$$\Leftrightarrow \; \frac{\pi r}{(1-\pi)}p_1(1+r)\alpha - \frac{\pi r}{(1-\pi)}p_1\alpha r + p_1\alpha - \frac{\pi r}{(1-\pi)}p_1\alpha - c > 0$$

$$\Leftrightarrow p_1 > \frac{c}{\alpha}$$

From this condition for setting up the con, it can be said that the con-artist's decision depends negatively on the costs of set-up, while the invested amount has a positive effect on the likelihood that he sets up the con. Intuitively, the probability that the client invests in the first part of the game also increases the chances that the con-artist will go through with it. It follows that, in equilibrium,

$$p_1 = \frac{c}{\alpha}$$

This result implies that the costs of setting up the con need to be smaller than the invested amount in order for the con artist to be willing to set up the con. This is an interesting result, as it points towards the fact that, despite the existence of pandering, the con-artist will never set up the con if his costs exceed the initial amount of the investment, hence naturally limiting the number of con-artists to those that have costs of set-up that satisfy this condition. By extension, this shows that the only condition for con-artists' existence is that the cost of set-up is low enough to make the ratio of cost over invested amount match the probability that the client invests.

Having found the equilibrium value for which the player is indifferent between both decisions at every stage of the game, it is now possible to determine the complete Bayesian Equilibrium of the game, which is divided into two stages that both present a mixed equilibrium:

$$\pi = \frac{1}{1 + 2r + r^2};\ p_1 = \frac{c}{\alpha},$$

And

$$x = \frac{\pi r}{(1 - \pi)};\ p_2 = \frac{1 + r}{m}.$$

Both mixed equilibria present certain limitations when it comes to the decisions of the con-artist, as those seem constrained by the parameters of individual games more than the decisions of the client. In both cases, extreme values of r, m, or α can lead to pure equilibria instead of mixed ones, since one of the options in the decision is strictly dominated by the other. However, it is important to note that this only holds for games with very specific, and unlikely, parameters.

II. The Client's Game

Now that the equilibrium of the game has been found and discussed, some emphasis is placed on each individual player (in this case, the client and the con-artist). First, the focus will be on the client's first decision, which is whether or not to invest. The variables of interest are the share of trustworthy agents and the rate of return. From the equilibrium, it became clear that the way the client determines whether or not to invest is different from the first to the second time. Indeed, the first decision relates to the investment opportunity as well as on the client's trust, while the second one depends on the previous decisions from the con-artist. Because of this, it is important to understand how the client behaves in the first decision, and what it depends upon.

In this situation, the condition for the client to invest is dependent on π_p, which is the share of trustworthy agents *as perceived by the client*. As mentioned in the Model, π_p can differ from π, but is normally distributed around a mean π. Note that, given the main assumption of this model, the perceived shares of trustworthy agents and con-artists bear the same weight in the calculation of expected utility, which is realistic if people are not distrusting by nature. Simultaneously, the client is initially thought to be risk neutral, in that he has the same attitude towards potential gains and potential losses.

As was shown when looking for the equilibrium, the client will choose to trust the agent if and only if $EU_C > 0$. The second proposition is derived from this inequality:

Proposition 2: *When the investment offers are indistinguishable, the condition for the client to trust the agent and invest amount α depends only on the rate of return and on his perception of the share of trustworthy agents.*

This proposition suggests that, in this first stage of the model, trust is the main determinant in the decision of whether or not to invest, but that it is not a sufficient condition by itself to justify investing. This, of course, has important implications with regards to the possibilities for con-artists to arise. As determined previously, the assumption that people are inclined to be trusting is a realistic one. Knowing this, proposition 2 essentially implies that the con-artist needs to satisfy only two conditions to be able to set up his con.

First, an investment opportunity should exist. This condition is satisfied *by construction*, as the existence of investment opportunities is inherent to the model, just like it is inherent to modern society. Second, the con-artist needs to be able to mimic the investment opportunity such that his offer is indistinguishable from that of a trustworthy agent. At this stage in the model, this second condition is assumed to be satisfied, since costs of setting up the con are not considered yet. One can think of a situation in which the costs of setting up the con differ per individual[7], such that this condition is only satisfied by a small portion of the population, which is composed of the con-artists. Once these two conditions are satisfied, the client will invest if the rate of return matches his expected share of trustworthy agents.

To verify proposition 2, the condition for which the client will trust the agent and invest α needs to be satisfied. Hence, the expected utility of the client is considered for $EU_C > 0$. This yields[8]:

$$EU_C > 0 \Leftrightarrow \pi > \frac{1}{1 + 2r + r^2}$$

The resulting inequality shows that as the return on investment r increases, the perceived share of trustworthy agents that will satisfy the investment condition decreases. Since the client will take r as given, this implies that the client's decision on whether or not to invest depends predominantly on his perceived share of trustworthy agents. This confirms the idea that the existence of con-artists depends primarily on people's inclination to trust others. Furthermore, it is the rate of return that acts as a necessarily condition for the client to invest, rather than the amount α. This is not surprising in the sense that it is the rate of return that justifies the risk taken by the client.

Relating these finding to the previously found equilibrium, it becomes clear that the probability that the client will invest depends positively on the share of trustworthy agents: as this share increases, the conditions for the client to invest become easier to meet. This goes to show that there is a trade-off occurring between π and p_1, as, while p_1 increases, π will decrease again, thus decreasing p_1. This leads to the conclusion that, in the context of the equilibrium, the balance between the probability of investing and the share of trustworthy agents is determined by r, which is taken as given by all players in the market. This indicates that r plays an important role in reaching the equilibrium share of trustworthy agents, even despite the fact that the con-artist may not always be bound by it.

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[7] For example, cost may differ depending on the individual's moral dispositions (on whether he cares about honesty, or fairness), on his ability to lie and deceive, or on the utility he gets from maximising another individual's utility.

[8] The full proof can be found in the appendix, under Proposition 1 and 2.

III. The Con-Artist's Game

From the previous part of the model and the second proposition, it is evident that trust is indeed a primary condition for con-artists to exist. However, to understand when con-artists decide to set up their con, and how they sustain it, a more in-depth analysis of the con-artist's individual utility function is required. Therefore, in this part, the focus will be on the con-artist's perspective. While previously, the expected utility of the client was considered in order to find out when the client trusts the agent, his decision on whether to invest will once more be given by probability p_1 that $EU_C > 0$.

When discussing the equilibrium, the possibility of getting caught and the punishment term were left out for simplicity, however, since the focus is now solely on the con-artist, they will be incorporated in order to give a more complete overview of the variables and factors that affect the con-artist's decisions. The aim will no longer be to find the equilibrium values of each probability, but rather to discuss the conditions for the con-artist to thrive more generally.

In addition to this new change in perspective, the game as it is considered from the perspective of the con-artist is the one displayed in Figure 2 (see Model). In this part of the game, the con-artist can make a decision at two stages; the first time, when he decides whether to set up the con, and the second time, if the client invest, whether to pander. All other outcomes in the game are determined by the probabilities that have been described previously. Therefore, the analysis will focus on the determining in what situations the con-artist will (1) set up the con, and (2) pander. The model will be solved using backwards induction, hence, the condition for pandering will be discussed first.

For this, the expected utility of pandering will be compared to the expected utility of not pandering. As was mentioned when discussing the equilibrium, there are five possible outcomes that will affect the con-artist's utility. Recalling the expected utility of pandering and not pandering, while including the possibility of getting caught and the punishment that is associated with it, respectively:

$$EU_P = p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c$$

$$EU_{nP} = \alpha - c - \delta(\alpha)\beta$$

Given that he sets up the con, the con-artist will choose to pander if and only if $EU_P > EU_{nP}$. The third proposition can be derived from this conditions.

Proposition 3: *Given that the con-artist sets up the con, the decision on whether to pander depends positively on p_2 and m, and negatively on r, β, and the reaction term of the client (R).*

Since r is taken as given by the con-artist, and R is given by the mean of the population[9], proposition 3 implies that the main determinants of whether the con-artist will pander are

[9] The con-artist has no way of finding out R, since this is known by the client only. Hence, the con-artist has to use fixed estimates of these values in making his decision on whether to pander. This is why R is given by the mean of the population.

given by p_2, m and β. In other words, the decision depends on the probability that the client reinvests, the potential increase in reward and the potential punishment that the con-artist faces.

Using the previously mentioned expected utilities for pandering and not pandering, it is possible to determine for which m and for which β the condition for pandering is satisfied[10]:

$$EU_P > EU_{nP} \Leftrightarrow p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c > \alpha - c - \delta(\alpha)\beta$$

$$\Leftrightarrow \alpha > \frac{p_2\delta(m\alpha)\beta - \delta(\alpha)\beta}{(p_2 m - 1 - r)}$$

$$\Leftrightarrow R < \frac{p_2 m - 1 - r}{(p_2 m - 1)\beta}$$

This condition verifies proposition 3, as it is clear that the chances that the con-artist decides to pander decrease with r, R, and β, while they increase with p_2 and m. More specifically, the m needs to satisfy:

$$m > \frac{r + 1 - R\beta}{(1 - R\beta)p_2}$$

and β needs to satisfy:

$$\beta < \frac{p_2 m - 1 - r}{(p_2 m - 1)R}$$

Intuitively, pandering becomes more likely as the amount of money increases, and less likely as the punishment increases. In this particular model, the punishment does not directly depend on the amount that is subtracted from the client, however, this could realistically be the case. In such a situation, the decision on whether to pander would depend solely on the difference in amounts, and on which effect (the utility decrease in the punishment or the utility increase in the amount) dominates. It is difficult to assess whether the marginal punishment would increase, decrease or remain constant without a more precise context, therefore, no assumption is made in this regard.

The results from testing proposition 3, however, provide valuable insight in the way the con-artist's decision is influenced by the variables that are taken as given within the context of this particular model. For instance, the fact that pandering depends negatively on r allows conclusions to be drawn regarding what would happen if the client could choose between different rates of return. The result implies that, for a higher r, the con-artist is less likely to pander, which means that con-artists might be more inclined to offer lower rates of return if they wish to pander. Conversely, a con-artist who offers a very high rate of return would almost never pander, meaning that if the client chooses an investment with a high rate of return, and receives this return, the probability that he is dealing with an honest agent would increase. This, in turn, would affect the probability of reinvesting, since the share of con-

[10] The full proof can be found in the appendix, under Proposition 3.

artists offering high rates of return whilst pandering would be relatively lower, which would have the opposite effect on the decision to pander. Once again, the resulting effect is ambiguous, since the magnitude of either effect depends largely on contextual factors.

Finally, the condition for pandering shows that m influences the con-artist's expected utility in two ways, by both increasing it through the possibility of reinvesting $m\alpha$ and decreasing it by affecting the probability of getting caught. It is interesting to note that, overall, m has a positive effect on the decision to pander. This means that, as m increases, so does the probability of pandering. This points towards the fact that an increase in likelihood of getting caught does not play a determining role in the decision-making process. Rather, it is the initial reaction term of the population that is central in determining the con-artist's choices.

In fact, the reaction term bares a lot more weight when it comes to justifying the con-artist's choices at earlier stages of the game. Indeed, the results of proposition 3 are not strictly sufficient to justify pandering. Working back further, the conditions for setting up the con can be determined.

For the con-artist to set up the con, his expected utility of setting up the con must be greater than the expected utility of the alternative. In this case, it is assumed that the alternative yields a utility of 0, such that the con will be set up when it yields a positive utility.

Since this stage of the game includes the decision on whether to pander, the expected utility of the con-artist is assumed to be the highest of the two, but essentially, the only condition that needs to be satisfied is that one of the two expected utilities (of pandering and not pandering) needs to be greater than 0. As stated earlier, when discussing proposition 3, the expected utility of pandering is:

$$EU_P = p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c$$

This expected utility is the one taken into consideration when the client invests and the best alternative for the con-artist is to pander. Therefore the expected utility of setting up the con when the best option for the con-artist is to pander once the client has invested is:

$$EU_{SP} = p_1(p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c) + (1 - p_1)(-c)$$

where p_1 is the probability that the client trusts the agent, and thus, invests, in the first stage of the game. At this stage, if the client does not invest, the utility of the con-artist is $-c$, since he is not able to subtract anything from the client, and loses to set-up costs of the con.

Similarly, the second alternative to consider is the one in which the best course of action is not to pander after the client invested. In that case, the expected utility of the con-artist will be:

$$EU_{SnP} = p_1(\alpha - c - \delta(\alpha)\beta) + (1 - p_1)(-c)$$

Hence, in order for the con-artist to set up the con, one of the following conditions needs to be satisfied: $EU_{SP} > 0$ or $EU_{SnP} > 0$. Proposition 4 follows:

Proposition 4: *The decision on whether to set up the con depends primarily on the cost of set-up and on the amount invested. External factors, such as the population's reaction term, the probability that the client invests and the size of the punishment, determine the required magnitude of these two variables.*

External factors are defined by the aspects of the game that the con-artist has no influence over, while costs of setting up the con are accepted to differ across individuals depending on their inherent characteristics. It is assumed that the con-artist will set up the con if the costs he faces are low enough for him to set the amount α such that it is undistinguishable from the offer of the trustworthy agent.

Solving the first condition, when pandering is the optimal course of action, yields:

$$EU_{SP} > 0 \Leftrightarrow p_1(p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c) + (1 - p_1)(-c) > 0$$

$$\Leftrightarrow p_1 p_2[m\alpha - \delta(m\alpha)\beta] - p_1 \alpha r > c$$

$$\Leftrightarrow \alpha > \frac{c}{p_1(p_2 m - p_2 R m \beta - r)}$$

Similarly, the condition when the con-artist is better off not pandering is:

$$EU_{SnP} > 0 \Leftrightarrow p_1(\alpha - c - \delta(\alpha)\beta) + (1 - p_1)(-c) > 0$$

$$\Leftrightarrow \alpha > \frac{c}{p_1(1 - R\beta)}$$

Hence, the con-artist will set up the con when $\alpha > \frac{c}{p_1(p_2 m - p_2 R m \beta - r)}$ or when $\alpha > \frac{c}{p_1(1-R\beta)}$. When both of these conditions are satisfied, the con-artist is faced with the decision of whether or not to pander, which refers to the condition that was used to answer the previous proposition.

The first thing to note, when looking at the present conclusions, is that, when the con-artist is better off not pandering, α has to be greater than c, as $p_1 < 1$, and $(1 - R\beta) < 1$. This is not necessarily the case when pandering is the best alternative. This gives an indication regarding the range of α that is available to the con-artist depending on what the most profitable approach is, while also confirming the conclusion reached when discussing the initial equilibrium. Indeed, it confirms the idea that no mixed equilibrium exists when $\alpha < c$.

More generally, it is evident from these conditions that the α and c are indeed the main drivers of the con-artist's decision, alongside p_1, R, and β. Intuitively, the relationship is positive for α and p_1, while it is negative for the other three variables. As α increases, it becomes more attractive – and easier – to set up a con. However, the relationship between α and p_1 is similar to the one between r and p_2 as discussed ahead of proposition 4. Indeed, if a higher α means that it is easier to set up the con, as the conditions are satisfied for higher values of c, it also means that the share of con-artists amongst the agents will increase, which will in turn decrease p_1. While it is impossible to say with certainty which effect will dominate, these findings confirm the intuition behind the findings of proposition 1: an equilibrium share of con-artists that is greater than 0 exists.

As mentioned before the introduction of proposition 4, the reaction term was expected to play a more important role in decisions such as that of whether to set up the con. Indeed, it is evident that R bares more weight in the con-artist's initial decision. Intuitively, one of the main concerns of the con-artist before he sets up his scheme will be the probability he has of getting caught. This concern obviously dampens once the con is already set up, since the probability of getting caught is greater than 0 regardless of his decision at that point[11].

Another interesting finding can be derived from the condition for setting up the con when the con-artist does not pander. This condition is essentially equivalent to the one that needs to be satisfied in order for the con-artist to set up the game as discussed in proposition 2. In this setting, the game simply consists of a client investing, and getting his return if the agent is trustworthy, while losing it otherwise. Hence, pandering is not considered yet. One of the main conclusions that were drawn from the condition for the client to invest was that his decision was not dependent on α. Instead, the decision depended only on the rate of return r and on the client's perceived share of trustworthy agents. From the con-artist's perspective, the second sufficient condition for setting up the con actually shows that the con-artist's utility is dependent on the exact opposite: the con-artist needs α to be above a certain threshold, while r does not influence his utility at all if he does not pander.

This relationship between the client's utility and that of the con-artist further supports the ability of the con-artist to mimic the investment offer of a trustworthy agent, as long as α is high enough to justify the set up[12]. Indeed, since the non-pandering con-artist does not care about r, he can set it such that it satisfies the investment condition of the client. Of course, this does not hold for the pandering con-artist, since his expected utility decreases in r.

This seems to indicate that pandering and non-pandering con-artists thrive under different circumstances. When the conditions to satisfy the client are difficult to meet, con-artist are more likely to be non-pandering, since a higher r will dissuade a greater share of con-artist from pandering. Conversely, it seems that when the client's requirements are easily satisfied, pandering will become more attractive.

Simultaneously, it appears that pandering is correlated with a higher share of con-artist amongst the pool of agents. There could be two reasons for this: firstly, as mentioned previously, pandering is more likely when the conditions to satisfy the client are easily met, while it also seems to generate more opportunities for higher profits. Secondly, when there is a higher share of con-artists in the pool of agents, clients are more likely to be distrusting, which might create more incentives for the con-artists to gain their trust by pandering, hence subtracting more money from them. This second reason does not appear in the previously studied model, as it implies that the con-artist plays the same game a multitude of times, such

[11] This touches upon the paradox regarding the independence axiom in rational choice theory: people are more likely to take a riskier gamble over a safer one, while they change their preferences when choosing between a gamble and certainty. In the case of the con-artist, it seems intuitive to assume that the perceived difference between a 0% chance of getting caught and a 10% chance of getting caught is more important than the difference between a 10% and a 20% chance of getting caught (Reiss, 2013).

[12] Note that, since this is largely dependent on the costs of setting up the con, which vary across individuals, the previously made assumption that there will always be a certain share of the population that satisfies this condition and thus become con-artists is still realistic. In other words, α is "always" high enough.

that he has many clients. In this situation, when new clients are less trusting, it is harder to get new investors, which makes pandering preferable.

When it comes to reality, it is difficult to assess when clients have difficult versus easy conditions to satisfy, but it is safe to assume that both types exist, which makes the discussed propositions and implications all the more relevant when it comes to accurately predicting under what circumstances con-artists arise, and how they behave depending on the context.

Applications

Now that the main propositions and implications around the model have been discussed, a brief overview of some real life application will be given. Indeed, in order to justify the relevance of the model, it needs to be compared and applied to known cases of con-artistry. To do this, two examples of different magnitudes will be given.

1. The Ponzi Scheme (Madoff's case).

The example of the Ponzi Scheme was used to introduce the topic of this paper. One of the main reasons for this is that it is one of the most well-known and successfully applied cons in the past century, and because it is the one that inspired the idea of including pandering in this model. As explained before, the Ponzi Scheme consists of offering many people an investment with good returns and near to no variance on these returns, and then to use the pool of investments to pay investors their return when they decide to opt out (Zuckoff, 2005). In this con, the con-artist uses the game tree as it is presented in figure 2 (see Model), except that, instead of applying it to one potential client, he applies it to as many clients as possible, hence drastically increasing his reserves. The reason why this is made possible is that the clients, on average, trust the con-artist, and therefore do not decide to opt out (in the case of the model, this means that a majority of them decides to reinvest). Looking at the present model, it is easy to see that the probability of the client reinvesting is far closer to 1 than it is to 0, or even 0.5. Knowing this, when the same game is played with a lot of investors, the investment pool is always deep enough for the con-artist to pay the few people that decide not to reinvest, and he can therefore extend his business.

This scheme, however, does have limitations. For instance, in the model, it is possible for the con-artist to stop pandering at any point in time, with a probability of getting away with it. However, in examples such as Ponzi's or Madoff's, this possibility obviously disappeared. It should be noted that in both of these cases, the con-artist simply kept on pandering up to the point where he was so renowned that there was no other option than to keep on pandering. The issue, in both cases, is that they then became vulnerable to external factors, that are completely independent on the con itself, but that influence the client's behaviour. Madoff's con, for instance, fell apart in times of economic uncertainty, in which clients suddenly became much more likely to opt out of the investment.

Overall, although this paper cannot account for external shocks affecting the client's behaviour, the model remains highly applicable to similar schemes, especially when the con-artist operates on a somewhat smaller scale (for example, investments in thousands instead of billions of dollars), such that he always has the opportunity to stop pandering and "disappear".

2. Small-scale scams (Internet scams).

Besides cons that are based on pandering and on making clients reinvest, another popular type of con is one that is based purely on making the client invest only once. These cons have greatly increased in popularity amongst con-artists mainly due to the ease with which they are set up on the internet. Studies, in psychology, namely, have tried to uncover the ways these internet scams are designed to make the "client" or in this case, the victim, trust them (Muscanell et al, 2014). The aim of these scams can be multiple, from gaining access to personal information to subtracting donations or other types of money transfers from the client. When the aim is to directly make the client "give away" a certain amount of money, the game is once again very similar to that represented in con-artist's perspective of the game tree. Essentially, the con-artist simply relies on the willingness of the client to make the investment, and then disappears with it.

This con is so easy to set up that the majority of internet users are aware of its existence, however, the internet allows these con-artists to reach such important amounts of clients that they only need a very small fraction of them to work in order to compensate for the cost of setting up the con. Here, people's trusting nature once again comes into play, as only those who are consciously aware of the existence of these cons know to avoid them.

All in all, the applications of the model are multiple, and capture most of the cons involving money or any type of investment. The only things that significantly differ from the perspective of the model is the fact that the game that is presented here is played not once, but as many times as possible, which means that the costs of setting up the con can be spread out over the total number of games that are played. This, however, is not a problem, as the cost of setting up the con, in the context of the game, can simply be seen as the average cost per game played.

Discussion

Now that the model has been presented, and the propositions as well as the applications have been discussed by testing under which conditions decisions are made by both parties (con-artists and clients), the different assumptions of the model will be examined in order to determine how much their relaxation would impact the conclusions that were drawn. Initially, these assumptions are used primarily for simplicity, in order to provide a clear and concise, yet explanatory model on the behaviour of con-artists. Therefore, none of these assumptions are expected to play a determining role in obtaining any of the conclusions. This section will justify the applicability of the main conclusions to reality despite the model's stylised assumptions.

A. Attitude Towards Risk

Throughout the Model section, one of the key assumptions is that clients react the same towards gains and losses, which essentially comes down to assuming risk neutrality. One obvious point of criticism regarding this assumption would be that people are commonly thought of as being risk averse. Empirical research supports this, even showing that people grow more risk averse as the amount in consideration increases (Binswanger, 1981). Similarly, people seem to “value” losses more than gains, in the sense that the “value function” is expected to be steeper for losses than for gains (Kahneman & Tversky, 1979). This implies, of course, that people are more reluctant to invest when they have the possibility of losing their investment, which is the case in the model presented in this paper. This does not appear to have any direct implications on the con-artist’s utility function, however, it does impact the client’s expected utility. When nothing is said about the amount α, this does not play a role, however, realistically, an increase in the amount is likely to make the client more reluctant to invest, thus decreasing p. This might come into play when the con-artist considers whether or not to pander. Indeed, an increase in m would result in a decrease in the client’s willingness to invest, which might make the con-artist less likely to pander. It is worth noting, however, that while this change in attitude towards losses adds another constraint to the con-artist’s conditions, it does not fundamentally change the game, or the way the con-artist will behave. Instead, it simply adds another factor that the con-artist needs to account for when making his decision on whether or not to pander[13].

Coming back to risk aversion, this does not affect the conclusions in any other way than that it decreases people’s overall willingness to invest, meaning that it makes the conditions for setting up the con slightly harder to satisfy. In this sense, the risk neutrality that was chosen in the model is easier to justify than any arbitrary measure of risk aversion. Given that the model produces results that are largely unaffected by this kind of attitude towards risk, the use of risk neutrality is not only convenient, but also generally preferable.

B. Fixed and Variable Amounts

Throughout the model, not much is said about the value or the magnitude of the amount α that the client invests. This is done because considering actual or relative amounts is not a necessary assumption for the model to make accurate predictions. In fact, when considering the probability of getting caught, the reaction term is modelled as a relative amount. Considering different attitudes towards risk, as mentioned previously, and considering more specific values of α, it is evident that the amount to invest has to be taken into account by the client when deciding whether or not to trust the agent. Nonetheless, it seems logical that the rate of return and the inclination to trust the agent (depending on the perceived share of trustworthy agents) are the variables that bare the most weight in the consideration of whether to invest. Including risk aversion would simply mean that a higher rate of return is required to satisfy the client’s initial condition to invest.

[13] In addition, note that the con-artist is already limited in the amount he can subtract by the probability $\delta(\alpha)$ of getting caught, meaning that another independent constraint on α is not likely to change the conclusions much.

When considering the game from the con-artist's perspective, the amount α plays a more important role, as the game considers an increase in the invested amount between different stages, and the amount is tied to a reaction term that determines the probability of getting caught. Here, it is important to mention that the amount is naturally limited by the amount that is available to the client (since this holds for the reaction term already, it is simply considered to hold *by construction* across the entire model).

C. Reaction Term

The use of a reaction term might not seem like the most obvious solution to capture the probability of getting caught. One can think of this probability of getting caught as being a function of what the amount represents to the client. This way, the reaction term might compare the invested amount to the total amount that the client possesses. This justifies how the probability of getting caught cannot exceed 1 from a mathematical perspective on top of it being a logical constraint. Furthermore, it makes the average reaction term of the population easy to assess for the con-artist, as he can simply base it on the average income of the population.

D. Size and Form of Punishment

One of the variables in the con-artist's game is the punishment β that the con-artist faces if he gets caught. This variable simply captures the "severity" of the punishment, without specifying exactly what the punishment entails or what it depends on. It seems intuitive to assume that the punishment should increase in the amount that is subtracted, for example. Furthermore, it could depend on the number of victims of the con, on the number of laws that were violated in setting up the con. Within the framework of this model, the main issue with this variable lies in its contextuality. Indeed, the nature of the punishment seems to depend more on factors that are linked to the area in which the con is set up than on factors that are inherent to cons in general.

As seen from the results of the model, this punishment is always linked with the probability of getting caught, and, more specifically, with the reaction term of the population. Given that the reaction term already directly relates to the amount α that is invested, this makes the impact of β on the main conclusions dependent on the amount, *by extension*. Therefore, it would seem that the stylised nature of this variable is justified within the framework of this game. The contextual factors that affect it cannot be captured accurately by a model that does not target a specific industry or institution. In light of this, although they should not be disregarded, these factors are accounted for to the greatest possible extent in the way β is defined.

E. Rate of Return

Throughout the model, the rate of return variable is assumed to remain largely constant – at least, the possible impact of variations in r are not discussed extensively. One can perhaps question this choice by arguing that, due to costs of setting up the con, the con-artist might be constrained in the rate of returns that he can set. In such a situation, it might become possible to distinguish between offers from the con-artists and offers from trustworthy agents, thus introducing signalling. The issue with this situation is that, following standard economic reasoning, all trustworthy agents would offer a rate of return that proves their trustworthiness, thus driving con-artists out of the market. The very idea that con-artists are indistinguishable from trustworthy agents thus goes against the idea that signalling is possible.

In fact, even if the possibility of signalling exists, this would only affect the case in which the con-artist wants to pander, since the non-pandering con-artist can offer any rate of return he wishes, and is thus perfectly capable of mimicking the trustworthy agent for any rate of return. Essentially, the situation in which the rate of return allows to distinguish between both types of agents simply makes the pandering stage of the game disappear but does not further affect the results of the game itself. Given the role of pandering in the con-artist's game, getting rid of this stage of the game seems less realistic than keeping it, even if it means placing less emphasis on the effects of a changing r.

Furthermore, a fluctuating rate of return only affects the willingness to invest on the side of the client and the incentives to pander on the side of the con-artist, and this does not affect the conclusions of the model as long as it satisfies the condition that the offers from all agents are indistinguishable.

F. Equilibrium Share of Con-Artists

One of the main aspects of the game that was discussed in the model itself is whether an equilibrium share of con-artists exists in the pool of agents. This is, intuitively, a crucial point of concern when it comes to the type of activity that is looked at in this paper. However, although it was possible to conclude that there was always room for con-artists in the framework of this particular game, the values π can take remain unclear. Throughout the paper, it is assumed that the share of con-artists remain relatively small, as this seems to be the case in a realistic setting. However, in the game itself, depending on the values taken by the other variables, π can greatly vary.

On the one hand, this is one of the limitations of the paper, as it fails to capture the fact that the share of trustworthy agents typically greatly exceeds the share of con-artists. On the other hand, the second example used in the applications for the model shows a situation in which the share of con-artists can greatly exceed the share of trustworthy agents. In this sense, the limitation is dependent on the context in which the model is used, but remains a limitation nonetheless.

Conclusion:

All in all, the aim of this paper was to find an equilibrium share of con-artists in a model that is applicable to the largest possible range of cons that involve any type of payment or investment. This equilibrium was found, and its most important conclusion stated that the share of trustworthy agents can always fall below 1, meaning that there is always room for con-artists to arise. Following this first finding, the two sub-games were considered, one from the client's perspective and one from the con-artist's. These games shed light on the conditions to invest, for the client, by showing that the client's main concern was the rate of returns and the relative share of con-artists in the population of agents. Subsequently, they looked at the conditions to set up the con, which seemed to be driven predominantly by the cost of set-up, and at the decision on whether or not to pander.

Analysing these different aspects of the model allowed this paper to draw conclusions with regards to why con-artists behave a certain way, and how their existence is made possible by the way society and investment opportunities are set up. From the findings, it is evident that people's predisposition to trust one another is a crucial part of what allows con-artist to arise and thrive in the context of this game, but it also transpired that the conditions for con-artists to enter the market depend more on their own characteristics than on those of the client, or of the market in general.

Overall, the view offered in this paper was a very broad one, which was destined to lay down a basis for further analysis as much as to offer insight in the mechanisms behind classic cons.

While the primary goals of the paper were achieved, a number of limitations have to be highlighted. Firstly, given the lack of pre-existing economic literature on the subject, the presented model was created without being able to incorporate the perspective offered by such pre-existing literature. Because of this, it is possible that this paper overlooked, or failed to present, additional explanatory factors that could have been added to the model. Secondly, the nature of the issue that is looked at does not allow for much empirical testing. Indeed, collecting data on con-artists and cons is very difficult, as most successful con-artist are never caught or discovered. This makes it hard to measure reliably whether this model is an accurate predictor of the con-artist's behaviour.

Suggestions for further research would include trying to test the validity of this model on historical data for instance. While many successful cons go unnoticed and unpunished, they are sometimes revealed when analysing past events or patterns. In addition, looking at unsuccessful cons from an economic perspective could be equally valuable. Otherwise, experimental methods could be used, creating a situation in which the characteristics of this model would become observable to the researcher. This may allow further research to uncover shortcomings of this model and improve it accordingly. Finally, more theoretical research should focus on extending the model to different types of economic or financial cons, borrowing from additional psychological literature to determine and explain the con-artist's behaviour. For instance, the model could be adapted to look at one particular type of con, such as the Ponzi scheme. Alternatively, the model could be extended to an n-period game, in order to determine when the con-artist should stop pandering.

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Appendix:

I. Bayesian Equilibrium and Proof for proposition 1 and 2:

The probability that the agent is trustworthy, given that the client has the option to reinvest is:

$$\mathrm{P} = \frac{\pi}{\pi + (1-\pi)x}$$

The client will reinvest if the expected return of reinvesting is greater than that of not reinvesting, which results in:

$$\frac{\pi}{\pi + (1-\pi)x}\alpha r(m+1) - \frac{(1-\pi)x}{\pi + (1-\pi)x}\alpha(m-r) > \alpha r$$

$$\Leftrightarrow \frac{\pi}{\pi + (1-\pi)x}r - \frac{(1-\pi)x}{\pi + (1-\pi)x} > 0$$

$$\Leftrightarrow \pi r > (1-\pi)x$$

$$\Leftrightarrow x < \frac{\pi r}{(1-\pi)}$$

Simultaneously, the con-artist will pander if:

$$p_2(m-r)\alpha - (1-p_2)r\alpha - c > \alpha - c$$

$$\Leftrightarrow p_2 m > 1 + r$$

$$\Leftrightarrow p_2 > \frac{1+r}{m}$$

Hence, the resulting mixed equilibrium is reached when:

$$x = \frac{\pi r}{(1-\pi)};\ p_2 = \frac{1+r}{m}$$

Proposition 1: *In equilibrium, the share of trustworthy agents is strictly lower than 1.*

Proposition 2: *When the investment offers are indistinguishable, the condition for the client to trust the agent and invest amount α depends only on his perception of the share of trustworthy agents.*

Using backwards induction, the next step is to find out when the client will invest for the initial investment opportunity. The client will invest if his expected utility is larger than 0, which is the expected utility of not investing:

$$EU_{CL} > 0 \Leftrightarrow (1-\pi)(x(\alpha r - p_2 m\alpha) + (1-x)(-\alpha)) + \pi(\alpha r + p_2 m\alpha r) > 0$$

$$\Leftrightarrow (1-\pi)(x(r - p_2 m) - 1 + x) + \pi(r + p_2 m r) > 0$$

Substituting the values from the mixed equilibrium:

$$\Leftrightarrow (1-\pi)(\frac{\pi r}{(1-\pi)}\left(r-\frac{1+r}{m}m\right)-1+\frac{\pi r}{(1-\pi)})+\pi(r+\frac{1+r}{m}mr)>0$$

$$\Leftrightarrow \pi r\left(r-\frac{1+r}{m}m\right)-1+\pi+\pi r+\pi(r+\frac{1+r}{m}mr)>0$$

$$\Leftrightarrow \pi+\pi r-\pi r+\pi(2+r)r>1$$

$$\Leftrightarrow \pi(1+(2+r)r)>1$$

$$\Leftrightarrow \pi>\frac{1}{1+2r+r^2}$$

Given the mixed equilibrium values, the final step is to determine whether the con-artist will set up the con in this situation:

$$EU_{CA}>0 \Leftrightarrow xp_1(p_2m\alpha-\alpha r)+(1-x)p_1\alpha-c>0$$

$$\Leftrightarrow\ xp_1p_2m\alpha-xp_1\alpha r+p_1\alpha-xp_1\alpha-c>0$$

Substituting the previously found mixed equilibrium values:

$$\Leftrightarrow\ \frac{\pi r}{(1-\pi)}p_1(1+r)\alpha-\frac{\pi r}{(1-\pi)}p_1\alpha r+p_1\alpha-\frac{\pi r}{(1-\pi)}p_1\alpha-c>0$$

$$\Leftrightarrow\ \frac{\pi r}{(1-\pi)}p_1(1+r)\alpha-\frac{\pi r}{(1-\pi)}p_1\alpha(1+r)+p_1\alpha-c>0$$

$$\Leftrightarrow p_1\alpha>c$$

$$\Leftrightarrow p_1>\frac{c}{\alpha}$$

Hence, in the first stages of the game, the mixed equilibrium yields:

$$\pi=\frac{1}{1+2r+r^2};\ p_1=\frac{c}{\alpha}$$

This leads to the conclusion that the game has a mixed Bayesian Nash Equilibrium which is:

$$x=\frac{\pi r}{(1-\pi)};\ p_2=\frac{1+r}{m};\ \pi=\frac{1}{1+2r+r^2};\ p_1=\frac{c}{\alpha}$$

II. Proof for proposition 3:

Proposition: *Given that the con-artist sets up the con, the decision on whether to pander depends positively on p_2 and m, and negatively on r, β, and the reaction term of the client (R).*

The condition for pandering is:

$$EU_P > EU_{nP} \Leftrightarrow p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c > \alpha - c - \delta(\alpha)\beta$$

$$\Leftrightarrow p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r > \alpha - \delta(\alpha)\beta$$

$$\Leftrightarrow p_2 m\alpha - p_2\delta(m\alpha)\beta > (1+r)\alpha - \delta(\alpha)\beta$$

$$\Leftrightarrow (p_2 m - 1 - r)\alpha > p_2\delta(m\alpha)\beta - \delta(\alpha)\beta$$

$$\Leftrightarrow \alpha > \frac{p_2\delta(m\alpha)\beta - \delta(\alpha)\beta}{(p_2 m - 1 - r)}$$

As defined in section II. of the **Model**, $\delta(\alpha) = R\alpha$. Substituting this into the previous inequality results in:

$$\Leftrightarrow \alpha > \frac{p_2 Rm\alpha\beta - R\alpha\beta}{(p_2 m - 1 - r)}$$

$$\Leftrightarrow R\beta < \frac{p_2 m - 1 - r}{p_2 m - 1}$$

$$\Leftrightarrow R < \frac{p_2 m - 1 - r}{(p_2 m - 1)\beta}$$

III. Proof for proposition 4:

Proposition: *The decision of whether to set up the con depends primarily on the cost of set-up and on the amount invested. External factors, such as the population's reaction term, the probability that the client invests and the size of the punishment, determine the required magnitude of these two variables.*

The first sufficient condition for setting up the con, when the con-artist decides to pander after the client has invested, is:

$$EU_{SP} > 0 \Leftrightarrow p_1(p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r - c) + (1-p_1)(-c) > 0$$

$$\Leftrightarrow p_1(p_2[m\alpha - \delta(m\alpha)\beta] - \alpha r) - c > 0$$

$$\Leftrightarrow p_1 p_2[m\alpha - \delta(m\alpha)\beta] - p_1\alpha r > c$$

Once again, $\delta(\alpha) = R\alpha$ is substituted into the inequality:

$$\Leftrightarrow p_1 p_2[m\alpha - Rm\alpha\beta] - p_1\alpha r > c$$

$$\Leftrightarrow p_1(p_2 m - p_2 Rm\beta - r)\alpha > c$$

$$\Leftrightarrow \alpha > \frac{c}{p_1(p_2 m - p_2 Rm\beta - r)}$$

The second sufficient condition for setting up the con, when the con-artist decides not to pander after the client has invested, is:

$$EU_{SnP} > 0 \Leftrightarrow p_1(\alpha - c - \delta(\alpha)\beta) + (1 - p_1)(-c) > 0$$

$$\Leftrightarrow p_1(\alpha - \delta(\alpha)\beta) > c$$

Substituting $\delta(\alpha) = R\alpha$:

$$\Leftrightarrow p_1(\alpha - R\alpha\beta) > c$$

$$\Leftrightarrow p_1(1 - R\beta)\alpha > c$$

$$\Leftrightarrow \alpha > \frac{c}{p_1(1 - R\beta)}$$