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Online disinformation: an economic analysis

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Abstract

Internet and social networks have hugely increased the quantity of information available to a decision-maker. Unfortunately, this huge quantity of information also includes fake news and false news. Therefore, a decision-maker needs to carefully select the reliable sources of information. This theoretical and empirical paper studies the effects of online disinformation from an economic perspective. Precisely, it introduces the role of disinformation in the choice of the optimal level of information. Disinformation can either increase the (auditing) cost or reduce the benefit of information. In the presence of disinformation, therefore, information is below its optimal level. Furthermore, if disinformation is regarded as true, a problem of poor quality of information exists in the economy. However, education helps to recognize disinformation. An empirical analysis substantiates the main insights of the theoretical model.

Keywords: Information and Knowledge; Internet; Disinformation
JEL Classification Codes: D83. L86

1. Introduction

The 'internet era' and the boom in social networks have hugely increased the quantity of information available to a decision-maker (Almeida and Mortari, 2021). Social networks, indeed, have become the main vehicle for accessing news (Lee McIntyre, 2018; Newman et al. 2019; Zimmer et al. 2019a, 2019b; Baptista and Gradim, 2020).

Unfortunately, this huge quantity of information available also includes fake news and false news.[1] Fake news has become a serious contemporary social problem (Almeida and Mortari,

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[1] According to several authors (Nielsen and Graves 2017; Gelfert 2018; Meneses 2018; Baptista and Gradim, 2020), the difference between "fake news" and "false news" is in the intention with which the lie is created and spread. Fake news falsifies what is genuine and true, imitating the real; also, fake news is spread to deceive (Kshetri and Voas, 2017; Gelfert 2018; Meneses 2018; Fallis and Mathiesen 2019; Baptista and Gradim, 2020); whereas false news may result from a journalistic error or the journalist's lack of professionalism in verifying its sources. Other authors, instead, do not consider "the intention to deceive" of creators of fake news to be essential (Pepp et al., 2019; Walters, 2019; Jaster and Lanius, 2018).

2021).[2] Consequently, the main task of a consumer/user of news is to select and recognise the reliable sources of information (Almeida and Mortari, 2021).

From an economic perspective, therefore, a trade-off between 'abundance' and 'reliability' of information emerges, namely, an economic agent must search for a trade-off between an inexpensive but risky activity (i.e., the use of all available information) and a time-consuming activity (i.e., the selection of reliable sources of information). As far as we are aware, in this wide and recent literature, an economic formalisation of this important issue is missing.

In filling this gap, the present work follows the European Commission's report (2018) and uses the term "disinformation" that covers a wide range of false or fraudulent information, with a deliberate intention to deceive, thus including fake news (Ireton and Posetti 2018). Since information distortion is mainly generated by internet and social networks, one should talk about "online disinformation"; but, for the sake of simplicity, the term "disinformation" is used in this paper.

The paper is both theoretical and empirical. Theoretically, it is a simple extension of standard model of information collection that includes the role of disinformation. Disinformation can either increase the cost or reduce the benefit of information. Precisely, if an economic agent selects the reliable sources of information, the degree of information in the economy is below its optimal level since the auditing is expensive. Instead, if disinformation is regarded as information (and, thus, the auditing is neglected), a problem of poor quality of information exists in the economy. Concisely, disinformation (regardless of intent to deceive) distorts people's choices.

However, the education level of consumers/users helps to recognise fake news. According to the literature, indeed, among the main factors that influence the belief in disinformation and online disinformation there is a lower education or digital literacy (Douglas et al., 2016; Craft et al., 2017; Kahne and Bowyer, 2017; Flynn et al., 2017; Tandoc et al., 2018; Leeder, 2019; Pop and Ene, 2019; Reuter et al., 2019). The role of education is, thus, included in the model. To substantiate the main insights of the theoretical model, a simple empirical analysis is developed.

The rest of this paper is organised as follows. The next section outlines the theoretical model, while Section 3 presents the empirical analysis. Finally, Section 3 concludes the work with some policy implications.

2. The theoretical model

Information collection is an economic activity. By assuming, as usual, that the marginal benefit (of information) is decreasing in information, whereas the marginal cost (of information) is increasing in information, the optimal level of information maximises the difference between overall benefits and costs of information, namely, at the margin, benefits and costs of information must be equal (see Figure 1).

In mathematical terms, the following maximisation problem is solved by an economic agent searching for the optimal level of information (I):

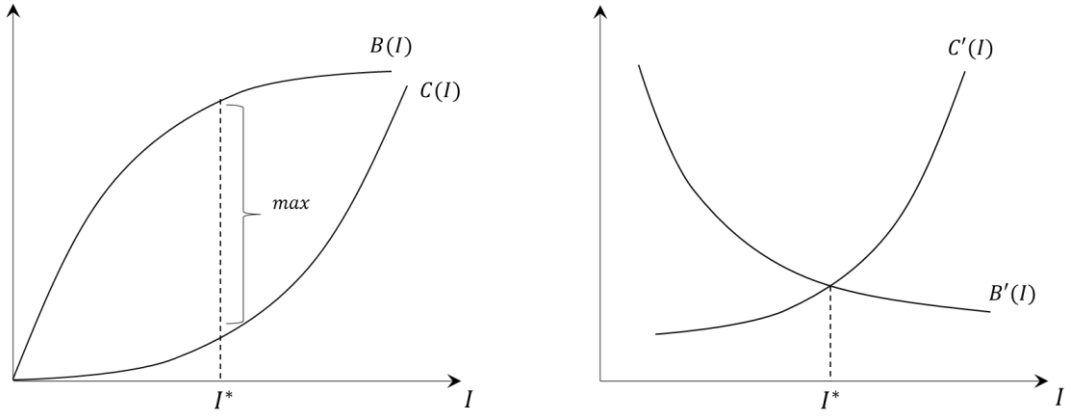
[2] The reasons why social networks make fake news a serious contemporary social problem are several: (i) information consumed through social networks can be separated from sources (Celliers and Hattingh, 2020); (ii) in social networks, only a part of the whole information is shown (Hanson, 2007); (iii) users of social networks tend to consume news by reading only headlines (Flintham et al., 2018); (iv) users of social networks tend to consume news in *"a relaxed mode […] instead of a critical-thinking mode"* (Kanoh, 2018); (v) users of social networks establish relations with those who have similar opinions and ideas (Almeida and Mortari, 2021), thus consuming news offered by people who are like-minded (Celliers and Hattingh, 2020); (vi) users of social networks tend to share news that matches their opinions without fact checking (McIntyre, 2018). Conditions (v) and (vi) identify the so-called "bubble effect" (Flintham et al., 2018; Celliers and Hattingh, 2020; Almeida and Mortari, 2021).

$$\underbrace{max}_{\{I\}}[B(I) - C(I)]$$

$$B'(I) - C'(I) = 0 \xrightarrow{yields} I = I^*$$

where $B(I)$ is the benefit of information, $C(I)$ is the cost of information; whereas, $B'(I) \equiv \frac{d[B(I)]}{d(I)}$ and $C'(I) \equiv \frac{d[C(I)]}{d(I)}$ are, respectively, the marginal benefit and the marginal cost of information.

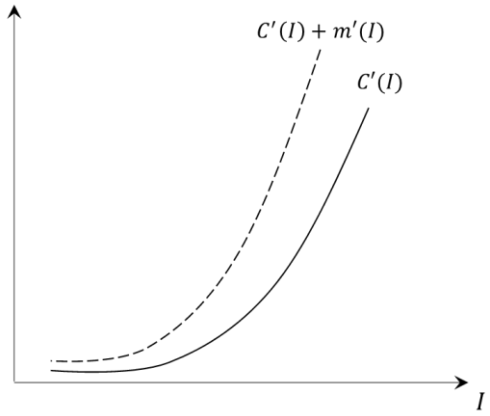
Figure 1. Standard cost-benefit analysis



The model with disinformation introduces into the standard model of information collection two simple and realistic assumptions[3].

Precisely, **(1)** disinformation is usually easy to find and inexpensive, since they are created and spread through social network and social media (Baptista and Gradim, 2020). Hence, disinformation does not increase the collecting cost of information. In the presence of disinformation, however, economic agents should perform checks and audits on information sources (Almeida and Mortari, 2021). Indeed, social networks can contribute to the proliferation of disinformation through advanced algorithms and artificial intelligence systems that are able to generate "believable" false information automatically (Kshetri and Voas, 2017; Baptista and Gradim, 2020).

Figure 2. The overall marginal cost of information



[3] This model does not distinguish between spreaders and creators of "disinformation", since the motivations are similar, namely, affecting the behaviour of consumers/users (Lewis and Marwick 2017; Marwick 2018; Baptista and Gradim, 2020). Indeed, most people who share fake news consider it to be true (Baptista and Gradim, 2020).

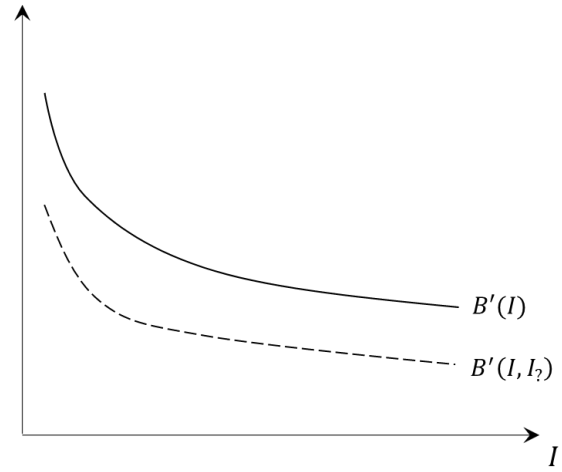
Hence, we introduce the auditing cost of information $m(I)$, namely, the time used for verifying the authenticity of information. The auditing cost of information has the same properties of the collecting cost of information, viz.:

$$\frac{d[m(I)]}{d(I)} \equiv m'(I) > 0 \quad \text{and} \quad \frac{d^2[m(I)]}{d(I)^2} \equiv m''(I) > 0,$$

since it increases (at increasing rates) as the amount of information increases. It follows that the marginal auditing cost increases the overall marginal cost of information (see the dotted line in Figure 2).

(2) The benefit that also includes disinformation ($I_?$) lies below the benefit that only includes "true" (reliable) information (see the dotted line in Figure 3), since false news and fake news distort the optimal choices of economic agents.

Figure 3. The marginal benefits of information and disinformation



Concisely, disinformation can either increase the cost or reduce the benefit of information. Precisely, (a) the auditing cost enables to discover the truthfulness (reliability) of the sources of information, and, thus, the benefit of information does not decrease; however, the overall cost of information increases, since the auditing of information is expensive.

(b) Instead, if disinformation is regarded as true (and, thus, it is used by economic agents), the auditing cost is zero, but the benefit of information becomes lower, since disinformation makes the choices of economic agents no longer optimal.

To identify and discard disinformation, it is necessary to carry out checks and audits on information sources, thus incurring a cost. Formally, we assume that if $m(I) > 0$, then disinformation $I_? = 0$. In this case, the maximization problem is given by:

$$\underbrace{max}_{\{I\}} [B(I) - C(I) - m(I)] \xrightarrow{yields} B'(I) = C'(I) + m'(I)$$

It follows that the optimal level of information moves from point A to point B (see Figure 4). Eventually, the quality of information remains high, but the auditing cost reduces the quantity of information used in the economy. Indeed, disinformation forces economic agents to use an invaluable and scarce economic resource (the time) for checking the reliability of information.

An economic agent could ignore the auditing cost for two main reasons: it is too high, or disinformation is considered to be true. Of course, these two reasons could be connected, namely, an economic agent assumes that the auditing cost is too high because s/he believes that disinformation is reliable.

In this case, the maximization problem becomes the following:

$$\underbrace{max}_{\{(I,I_?)\}} [B(I,I_?) - C(I)] \xrightarrow{yields} B'(I,I_?) = C'(I) \xrightarrow{yields} (I,I_?)^*$$

$C(I) = C(I,I_?)$, since $C(I_?) = 0$. Accordingly, the equilibrium level of information also includes false/fake news that reduce the benefit of information (see Figure 5).

Figure 4. The effect of auditing cost

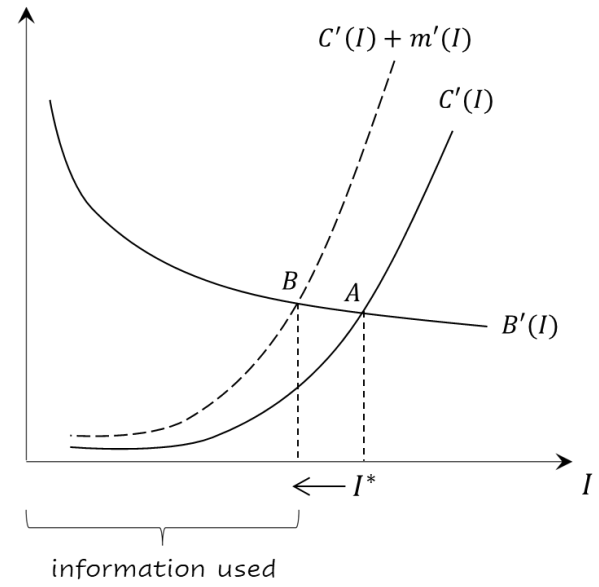
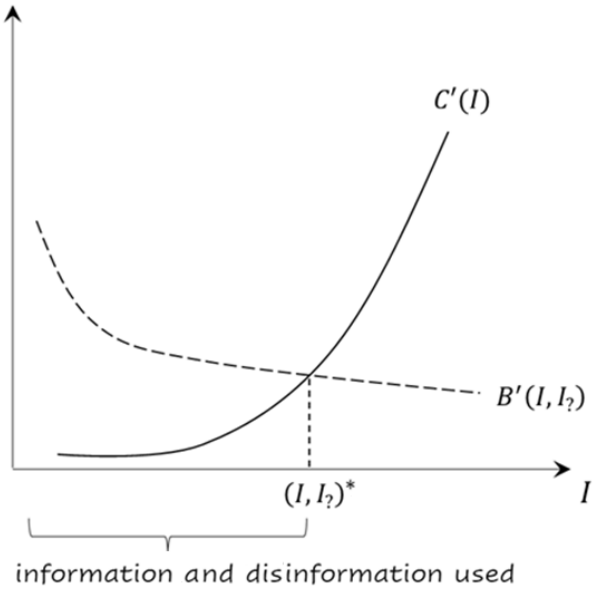


Figure 5. The effect of disinformation



In general, the equilibrium level of information that also includes disinformation can be higher, lower or equal to the optimal level of information that excludes disinformation. Anyway, the main problem related to the use of disinformation is the poor quality of information used in the economy that leads to wrong decisions.

Fake news and false news can manipulate users of social networks, thus shattering their critical-thinking capacity (Almeida and Mortari, 2021). This problem concerns many people, since, nowadays, social networks are one of the main instruments for getting (dis)information (Lee McIntyre, 2018; Newman et al. 2019; Zimmer et al. 2019a, 2019b; Baptista and Gradim, 2020).

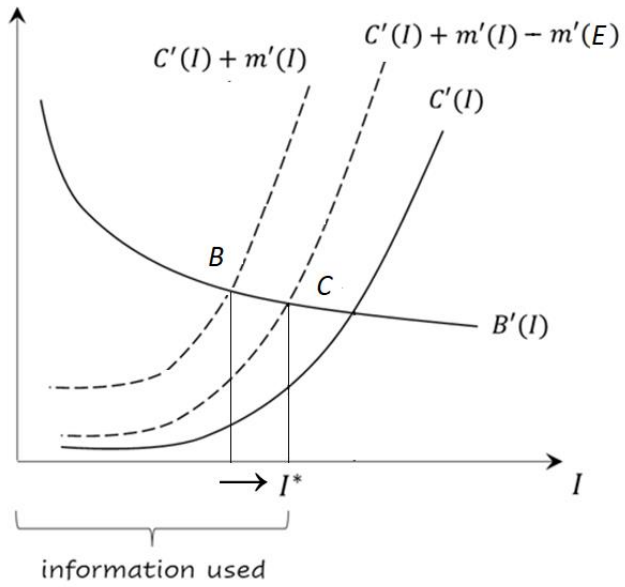
Concisely, the auditing cost preserves the quality of information, although at the cost of a lower amount of information, whereas the use of disinformation generates a problem of poor quality of information in the economy. In turn, the poor quality of information gives rise to wrong economic decisions.

The good news is that education helps to recognise disinformation (see, e.g., Flynn et al. 2017; Pop and Ene, 2019; Baptista and Gradim, 2020). Hence, we assume that the auditing cost depends negatively on the education level (E) in the economy, viz.:

$$\frac{\partial[m(I,E)]}{\partial(E)} \equiv m'(E) < 0$$

Consequently, with respect to the case shown in Figure 4, education increases the optimal level of information used in the economy, that moves from point B to point C (see Figure 6).

Figure 6. The effect of education



Furthermore, the case shown in Figure 5 could refer to a very low level of education that makes the auditing cost too high.

As a result, education can be a key tool in combating the spread of disinformation (Flynn et al. (2017). More educated people are less likely to share fake news (Pop and Ene 2019). Furthermore, more educated people are more likely to use advanced technological programs that can detect misinformation[4].

3. Empirical analysis

The main insight emerging from the theoretical model is that "online" disinformation (regardless of intent to deceive) distorts people's choices and the distortion become stronger in the absence of both controls and education.

Therefore, the empirical analysis uses a survey study for testing that result. Precisely, in the academic year 2021-2022, I administered a questionnaire, anonymously and without any obligation or constraint of compiling, to my first-year students in economic development (bachelor's degree). The questionnaire consisted of 50 closed-ended questions (with 1 right answer

[4] The development of technological programs and recommendation algorithms to combat online disinformation has been one of the major objectives of recent research (Hardalov et al. 2016; Burkhardt 2017; Mohseni and Ragan 2018; Lex et al. 2018; Hou et al. 2018).

and 4 wrong answers) on basic economic issues.[5] The total score is merely the result of correct answers, without penalty for incorrect answers. The completed questionnaires were 534 in number and the total scores represent the dependent variable of the empirical model.

The anonymous questionnaire also asked for some general information. To incentivise answers, binary variables were used (see Table 1). The seven questions in Table 1 represent the explanatory variables of the regression model.

Table 1. General information (anonymous questionnaire)

Question	**Symbol**	**Answer (please, tick the appropriate box)**	
(1) Tool mainly used for studying	x_1	Traditional *(books, magazines, newspapers)*	Internet
(2) Internet search duration	x_2	About a day	More than a day
(3) Gender	x_3	Male	Female
(4) Age class	x_4	18 – 30	> 30
(5) Working student	x_5	Yes	No
(6) Household members	x_6	≤ 3	> 3
(7) Final grade ("scuola secondaria di secondo grado")	x_7	≤ 80	> 80

The regression model to be estimated is, thus, the following:

$$y = \alpha + \sum_{i=1}^{7} \beta_i \cdot x_i + \varepsilon \quad (1)$$

where y is the test score, x_i are the seven control variables, β_i are the regression coefficients, α is the constant term and ε is the stochastic error term.

The main descriptive statistics on the variables used in the analysis are reported in Table 2.

Table 2. Descriptive statistics

Variables	**Mean**	**Min**	**Max**
y	26.25	13	46
x_1 (1 = Traditional)	0.41	0	1
x_2 (1 = More than a day)	0.29	0	1
x_3 (1 = Female)	0.55	0	1
x_4 (1 = 18 – 30)	0.86	0	1
x_5 (1 = Yes)	0.23	0	1
x_6 (1 = ≤ 3)	3.8	2	5
x_7 (1 = > 80)	81	60	100

From Table 2 emerges that the internet use has become prevalent. Unfortunately, however, the "Internet search duration" is often too fast, since only a small share of students take more than a day to search for. According to the theoretical model, this result could be due to the auditing cost, namely, search and audits are very expensive activities.

Indeed, x_2 should capture the effect of disinformation. It is not advisable to ask people directly whether "the internet source was verified", especially if one is interested in the true behavior of

[5] For example, human capital can be: (1) generic or specific (true); (2) public or private; (3) public or corporate; (4) university or corporate.

respondents regarding the type of information used. In that case, in fact, there is a strong tendency to obtain socially desirable answers. Instead, the question "Internet search duration" is not trivial since many people can deem reliable and effective a quick search. Concisely, we expect that the longer "Internet search duration", the higher the test score, since *ceteris paribus*, the higher the search duration, the higher the chance that the internet sources are verified or at least compared. In turn, this should increase the test score.

Of course, x_7 captures the role of education.Table 3 presents the full results of this empirical analysis[6].

Table 3. Results of the regression analysis

Dependent variable: Test score (y)	**Coefficient**	**t-statistic**
x_1 (1 = Traditional)	4.49	1.89
x_2 (1 = More than a day)	7.81	2.55
x_3 (1 = Female)	1.23	2.11
x_4 (1 = 18 – 30)	1.65	3.42
x_5 (1 = Yes)	1.59	2.08
x_6 (1 = ≤ 3)	1.27	2.77
x_7 (1 = > 80)	11.94	3.18
Adj R-squared	0.6781	

Note: Statistical significance at the 5% level (p-value < 0.05): t-statistic.

The empirical results would seem to confirm the main insights of the theoretical model, since both a higher internet search duration (x_2) and the final grade (x_7) increase, *ceteris paribus*, the test score. On average, indeed, x_2 increases the test score (y) by about 8 points, while x_7 increases the test score by about 12 points.

Note that the tool used for studying (x_1) is not statistically significant in explaining the test score; whereas, gender (x_3), age (x_4), family size (x_6), and work activity (x_5) does not appear to strongly affect the test score (the relative regression coefficients are lower than 2 points).

4. Conclusions

Nowadays, internet and social networks have become the main instrument used for getting information; but, at the same time, they are responsible for the huge spread of disinformation (fake news and false news). In the era of internet and social networks, therefore, people have to carefully check the reliable sources of information.

The auditing cost, however, is an expensive activity since advanced algorithms are able to generate "believable" disinformation. Moreover, people often follow the behaviour of the so-called "influencers", i.e., individuals capable of influencing the other people's choices.[7]

Economically, therefore, an important trade-off between 'abundance' (the use of all available information) and 'reliability' (the selection of reliable sources of information) needs to be solved. As far as we are aware, in this wide and recent literature, an economic formalisation of this important trade-off is missing.

Primarily, the paper presents a theoretical model where the role of disinformation is introduced into the standard theory of information collection; subsequently, an empirical analysis is performed.

[6] Model (1) overcomes the main statistical tests, namely correct specification of the model and normal data.
[7] Social networks "*also created the influencer, a contemporary conspicuous leisure model*" (Almeida and Mortari, p. 347, 2021). This is a further important problem, since the believability of disinformation has more strength and spread when it comes from influencers (Almeida and Mortari, 2021; Celliers and Hattingh, 2020).

In general, the auditing leads to a degree of information in the economy that is below its optimal level, since it is a time-consuming activity. Furthermore, in the absence of auditing or when disinformation is considered to be true, a major problem of poor quality of information exists in the economy. However, education can reduce the spread of disinformation in the society.

A simple empirical analysis seems to corroborate the main insights of the theoretical model. Precisely we find that: 1) auditing is an expensive economic activity; but, at the same time, it allows to recognise disinformation; 2) education is always very important in economic performance.

Unfortunately, auditing can eliminate false news and superficial fake news, but it is not the solution for all fake news. In several case, indeed, there are strong social institutions that support fake news as truth. Also, some fake news can be so deeply placed in decision making process that an auditing activity could even suggest they are true. Concisely, fake news as social phenomenon is much more complex than an auditing issue. Therefore, a broader and deeper socio-economic analysis is required to deal with all fake news.

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