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**Working Paper**

## Effects of Rumours on IPO Success: A Qualitative Approach

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**Effects of Rumours on IPO Success: A Qualitative Approach**

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Mirko Dohnal**

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## Effects of Rumours on IPO Success: A Qualitative Approach

**JEL Classification:** *G11; G12; G14; G23*

**Keywords:** *initial public offering; IPO; rumours; qualitative models; rumour spreading approach*

### Abstract

**Research background:** In epidemiology, qualitative models have been developed and applied to study the propagation of infectious diseases since the 1920s. A version of these models is based on the rumour propagation. The main idea behind these models is that spreading an infectious disease or disseminating information are analogous phenomena. Recently, this idea has been used in several areas to analyse how a rumour affects the financial industry. The success of going public depends on many aspects including the predictability and visibility of the initial public offering candidate, enormous growth potential and no signals of a failure. However, the wide public of investors might be reached by rumours affecting significantly the success of initial public offerings.

**Purpose of the article:** This paper examines the impact of rumours on success or failure of initial public offerings. Rumours might significantly affect the decision-making of uninformed investors while considering investments in newly issued shares and thus are an important phenomenon within going public procedures.

**Methodology/methods:** The ISS (Ignorant-Spreader-Stifler) model is applied to study the impact of rumours on initial public offering success or failure. We assume that the information asymmetry is one of the most important reasons for spreading rumours. A case study experiment is conducted in order to validate the model.

**Findings:** Our analysis of spreading rumours suggests that if there is a qualitative model consisting of a set of scenarios and a transitional graph, the decision makers may predict the development of ignorants (I), spreaders (S) and stiflers (R) in time. In such a case, no variant is overlooked, i.e. the model covers all possible changes of the situation in time. Supposing that rumours are under control of the issuing

company, i.e. if detected in a timely manner and effective actions are introduced by decision makers, any reputational damages and thus initial public offering failure can be averted.

## Introduction

In epidemiology, qualitative models have been developed and applied to study the propagation of infectious diseases since the 1920s. The SIR (Susceptible-Infected-Removed) compartmental model by Kermack & McKendrick (1927, pp. 700-701) represents a milestone in the development of such models. It was used in public health while studying spreading infectious diseases and plague (Piqueira, 2010, pp. 1). Since the beginning of the 1960s, the transmission of ideas as an “epidemic” process has been studied to analyse how rumours affect marketing strategies, stock markets, etc. (Goffman & Newill 1964, pp. 225). The analogy between spreading an infectious disease and the dissemination of information was mathematically formalized by Daley & Kendall (1964, p. 1118).

Here, the Ignorant-Spreader-Stifler model (hereafter also ISS model), as a generalisation of the Daley & Kendall model, is applied to study the impact of rumours on the success of initial public offerings (IPOs). Palmon *et al.* (2009, pp. 210) reports that business magazines as well as high-tech information intermediaries such as websites, blogs and social networks are very often a source of confounding announcements that are likely to affect decision-making of uninformed investors; hence, in situations when rumours are spread targeted communication campaigns have to be introduced by going public companies and their investment banks in order to avoid an IPO failure.

As far as we know, there is a lack of knowledge in the academic literature how rumours might affect a target population of investors and thus their demand for newly issued shares while going public. These are supposed to have different risk and return characteristics compared to already traded shares because of informational asymmetry (see e.g. Pagano *et al.*, 1998, pp. 36).

The methods employed in this article include systematic and logical literature analysis, collecting of original data from experts, qualitative analysis, a case study approach, comparison, and expert interpretations.

The rest of this paper proceeds as follows. First, we review the literature on the adverse selection theory. Section 3 provides an overview of the methodological approach. Section 4 presents detailed findings and the last sections discuss and summarise the main conclusions.

## Theoretical background

Although the continental financial system is traditionally focused on banking, there has been an increasing interest in the stock markets and initial public offering implementation in recent years (e.g. Pagano *et al.*, 1998, pp. 27-28; Black & Gilson, 1998, pp. 244-245; Chemmanur & Fulghieri, 1999, pp. 249-250; Ritter & Welch, 2002, p. 1795; Lizińska & Czapiewski, 2016, pp. 175-194). This process has been accelerated by the globalisation phenomenon and changes leading to a growing role of interdependencies among economies and capital markets in both emerging and well-developed countries (Balcerzak, 2009, pp. 711–739; Balcerzak & Pietrzak, 2016, pp. 231-241; Pohulak-Żołędowska, 2016, pp. 451-466; Orylski, 2009, p. 47; Pietrzak *et al.*, 2016, 61-77; Zinecker *et al.*, 2016, pp. 416-421, Fałdziński *et al.*, 2016, pp. 189-194). Hence, going public is becoming more and more popular for young and small companies while raising external capital. This strategy, however, requires more transparency towards prospective investors considering buying newly issued shares. As reported by Blajer-Gołębiewska & Kos (2016, p. 11), there is an agreement in the academic literature that reputation affects investors' decisions. Therefore, the reputation of a company is "a strategic asset and is said to have an ability to create wealth".

The scarcity of information for young and small firms may put forward financial analysts' and columnists' recommendations. Therefore, both columnists and financial analysts represent very often a source of the "intellectual epidemic" (Palmon *et al.*, 2009, p. 210), which is highly influential in decision-making of uninformed investors. Goffmann & Newill (1964, p. 225) characterized the "epidemic" process as "transition from one state (susceptible) to another (infective) where the transition is caused by exposure to some phenomenon (infectious material)". The transmission of ideas is analogous to the transmission of viruses; "once an individual is infected with an idea he may in turn, after some period of time, transmit it to others".

## Research Methodology

In this paper, the ISS (Ignorant-Spreader-Stifler) model is applied to study effects of rumours on the success of going public depending on many exogenous and endogenous aspects including e.g. the predictability and visibility of the initial public offering candidate, his growth potential, the business cycle etc. (Supriya, 2016, pp. 40-43). Based on the study of Nekovee *et al.* (2007, pp. 457–470), the total population (T) of investors is

divided into three groups. The first group is represented by the ignorants (I) who have not heard the rumour but they are susceptible to become informed. The second group of investors, the spreaders (S), are active individuals that are spreading the rumour. The stiflers (R) representing the third group have heard the rumour but they are no longer spreading it (Piqueira, 2010, pp. 1).

Our approach that models spreading of rumours in the context of IPOs is of a qualitative nature. This means that shallow knowledge on spreading of rumours is available only as a verbal description based on trends: decreasing, constant, or increasing. It means that there are no quantifiers, numbers, and fuzzy/rough sets (Dohnal, 1992, pp. 539-543).

Trend based models (TB) use different types of Equationless Heuristics (EHE). They differ according the derivative orders. The algorithms given below are based just on second order derivatives. It makes no sense to incorporate the third and higher orders derivative. An example of the first order EHE is as follows (for details see Lindgren & Bandhold, 2002, pp. 47-101):

*If HCQ is increasing then MCD is increasing.*  
*If HCQ is decreasing then MCD is decreasing.* (1)

Where: MCD - *marginal cost of debt* and HCQ - *home country institutional quality*.

An example of the second order EHE is as follows:

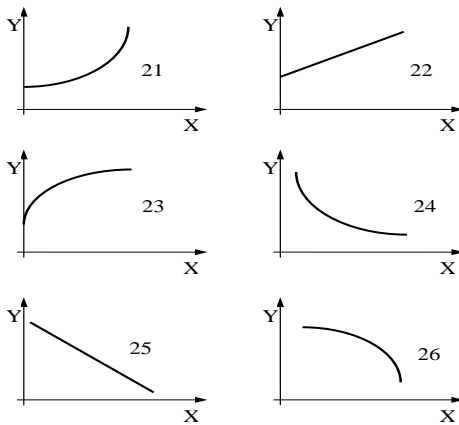
*If HCQ is increasing, then MCD is increasing more and more rapidly.*  
*If HCQ is decreasing, then MCD is decreasing more and more rapidly.* (2)

Information intensity of traditional statistical analysis generates pressure on artificial intelligence experts to develop new formal tools, see e.g. Russel (2009, pp. 180-240), which are not as precise as statistics but can take into consideration such information items as EHEs (Vicha & Dohnal, 2008, pp. 70-78). The TB methods presented in this paper are based on four TB values:

Positive	Zero	Negative	Any Value	
+	0	-	*	(3)

Many shallow knowledge items are available just as verbal descriptions based on trends, *decreasing, constant, increasing*, only (Yan *et al.*, 2013, pp. 1-12). For example, *if the management of the issuing company improves reporting towards investors then the information asymmetry tends to decrease and the probability of a successful IPO is increasing*. Typical examples of such pair wise trend relations are given in Figure 1.

**Figure 1.** Examples of qualitative pair wise relations



Source: own processing

All pair wise relations  $X, Y$  in Figure 1 are trend relations. It means that nothing is quantified. For example the relation No. 23 indicates that:

- ☐ The relation is increasing, i.e. the first derivative is positive.
- ☐ There is a “saturated” relationship between  $Y$  and  $X$ , i.e. the second derivative is therefore negative.
- ☐ If  $X = 0$ , then  $Y =$  positive value.

The scenario based analysis are relatively well known, see e.g. (Bohensky *et al.*, 2011, pp. 876–893). The scenario concept has different interpretations, see e.g. (Derbyshire & Wright, 2017, pp. 254-266). Scenario methods are often qualitative in their approach rather than quantitative (Derbyshire & Wright, 2017, pp. 254-266). Such mixtures of qualitative and quantitative features can be used to distinguish scenarios, forecasts and visions (Lindgren & Bandhold, 2002, pp. 47-101):

<i>Scenarios</i>	<i>Forecasts</i>	<i>Visions</i>
Possible, plausible futures	Probable futures	Desired future
Qualitative or Quantitative	Usually qualitative	Quantitative

An intuitive definition of qualitative transition scenarios has been carried out by McDowall (2014, pp. 1-14). Different very specific definitions have been carried out by e.g. in Kröger and Schäfer (2016, pp. 64-81).

Predictive scenario approaches are likely to result in policies that perform poorly under severe information shortages (IS). It is inevitable to combine an adaptive policy-making framework and a computer based approach to generate and explore many scenarios.

The set of variables is as follows:

$$X_1, X_2, \dots, X_n \quad (4)$$

A set of  $m$  TB  $n$ -dimensional scenarios is described by a sequence of  $TB$  triplets, for details see (Vicha & Dohnal, 2008, pp. 70-78):

$$[(X_1, DX_1, DDX_1), (X_2, DX_2, DDX_2), \dots, (X_n, DX_n, DDX_n)]_j, \quad (5)$$

Where  $j = 1, 2, \dots, m$ .  $DX_i$  is the first and  $DDX_i$  is the second time  $TB$  derivatives. The scenarios used in this paper are defined by the set of triplets (5) and the triplets are quantified by the values (3).

A  $TB$  shallow model, studied in this paper, is a set of  $w$  pair wise relations, see Figure 1:

$$P_v(X_i, X_j), \quad v = 1, 2, \dots, w. \quad (6)$$

This set of relations can be solved to evaluate all scenarios satisfying the model (3). For example the following set of relations can be studied:

	Shape	$X$	$Y$	
1	22 (see Figure 1)	$X_1$	$X_2$	(7)
2	26 (see Figure 1)	$X_3$	$X_2$	

A solution of qualitative models is a combinatorial task and is not studied in this paper, for details see (Vicha & Dohnal, 2008, pp. 70-78). The solution of the model (7) provides us with 13 scenarios:

	$X_1$	$X_2$	$X_3$	
1	+++	+++	+--	
2	++0	++0	+--	
3	++-	++-	+ - +	
4	++-	++-	+ - 0	
5	++-	++-	+ --	
6	+0+	+0+	+0-	
7	+00	+00	+00	(8)
8	+0-	+0-	+0+	
9	+ - +	+ - +	++-	
10	+ - 0	+ - 0	++-	
11	+ --	+ --	+++	
12	+ --	+ --	++0	
13	+ --	+ --	++-	

The interpretation of the results (8) is as follows: e.g., the triplet (+ + +) which describes the time behaviour of the variable  $X_1$  of the first scenario indicates that  $X_1$  is positive;  $DX_1$  is positive;  $DDX_1$  is positive, see (5). It means that the variable  $X_1$  is increasing more and more rapidly.

Any additional relation or equation is restrictive. Therefore, the number of scenarios  $m$  (2) will decrease or be constant if a model extension is performed. The following qualitative equation is added to the model (7):

$$X_1 + X_2 = X_3 \quad (9)$$



The following set of scenarios provides us with a solution:

	$X_1$	$X_2$	$X_3$	
1	+++	+++	---	1
2	++-	++-	+-+	3
3	++-	++-	+0-	4
4	++-	++-	---	5
5	+0+	+0+	+0-	6
6	+00	+00	+00	7
7	+0-	+0-	+0+	8
8	+ - +	+ - +	++-	9
9	+ - -	+ - -	+++	11
10	+ - -	+ - -	++0	12
11	+ - -	+ - -	++-	13

(10)

The right column shows the identification of the corresponding scenario of the model (7). The scenarios Nos. 2 and 10 of the set (8) are not in the set (10). A complete set of all possible one-dimensional transitions is given in Table 1.

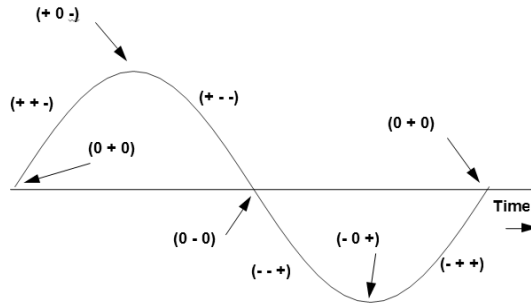
**Table 1.** A list of all one-dimensional transition

	From	To	Or	Or	Or	Or	Or	Or
1	+++	++0						
2	++0	+++	++-					
3	++-	++0	+0-	+00				
4	+0+	+++						
5	+00	+++	---					
6	+0-	---						
7	++-	+0-	+0+	+00	0-+	00+	000	0-0
8	+0-	+0+	---	0-0				
9	+0-	+0-	0-0	0-0				
10	0++	++0	++-	+++				
11	0+0	++0	++-	+++				
12	0+-	++-						
13	00+	+++						
14	000	+++	---					
15	00-	---						
16	0-+	---						
17	0-0	--0	--+	---				
18	0--	--0	--+	---				
19	-++	-+0	0++	0+0				
20	-+0	-+-	-++	0+0				
21	-+-	-+0	-0-	-00	0+-	00-	000	0+0
22	-0+	-++						
23	-00	-++	---					
24	-0-	---						
25	--+	--0	-0+	-00				
26	--0	---	--+					
27	---	--0						

Source: own elaboration

As an example, the third line of Table 2 indicates that it is possible to transfer the triplet  $(+ + -)$  into the triplet  $(+ 0 -)$ . This transition is not the only possible one. There are two more possible transitions. Figure 2 provides a TB description of an oscillation using the one-dimensional triplets  $n = 1$  (5). The time sequence of the one-dimensional transitions shown in Figure 2 corresponds to Table 1.

**Figure 2.** TB one-dimensional time record



Source: own elaboration

Table 1 is not a dogma. It could be modified on an ad hoc basis. The only requirement is that the transitions must satisfy a common sense reasoning of the user. A transitional graph  $G$  is an oriented graph. Its nodes are the set of scenarios  $S$  and oriented arcs are the transitions  $T$ :

$$G(S, T). \quad (10)$$

The set of  $n$ -dimensional transitions  $T$  can be generated by the corresponding set of scenarios  $S$  using the one-dimensional transitions (see Table 1). All  $n$  one-dimensional transitions must satisfy requirements set in Table 1 if  $n$ -dimensional scenarios are studied. A path  $P$  is an oriented sequence of scenarios. The graph  $G$  (11) can have loops and therefore a path  $P$  can pass through the loop infinitely many times.

## Empirical Results: A Case Study Analysis

We applied the methodology described in the previous chapter within a case study in order to investigate the impact of rumours on the success of going public. An IPO can be considered successful if a sufficient demand for shares has been drum up, which results in the sale of issued shares at the highest price while also providing investors with opportunities to cash earnings in the long-term.

We assume that the wide public of uninformed investors might be reached by rumours affecting significantly the success of initial public offerings. There are two confounding announcements (A1 and A2) involved into our case study:

A1: *Top managers are leaving the company after being listed; thus, the earnings of the going public company might decrease.*

A2: *Trading activities of top management prior going public are investigated. The managers are suspected of bribing policy makers and the scandal might be far more widespread than earlier believed.*

Both announcements are published by a columnist in a leading business magazine and reveal information which is new for the public and is likely to affect negatively the sale of newly issued shares within the IPO procedure. Findings carried out by Palmon *et al.* (2009, pp. 230) suggest that an announcement is potentially confounding and “triggers a larger market reaction” if a columnist’s recommendation “makes references to management officials, or contains merger and acquisition news”.

The total population ( $T$ ) of investors is divided into three groups: the ignorants ( $I$ ), spreaders ( $S$ ) and stiflers ( $R$ ). Moreover, we introduced the variable seroprevalence ( $P$ ), which is calculated as:

$$P = \frac{S}{S + R} \quad (11)$$

Goffman and Newill (1964, pp. 227) assume homogenous mixing among the members of the total population and describe deterministically the whole process while using a system of differential equations. Hence, we obtain our qualitative model as follows:

$$\begin{aligned} DI &= -I \\ DS &= I \cdot S - S \cdot (S + R) \\ DR &= S \cdot (S + R) \\ DII &= -II \\ DSS &= II \cdot SS - SS \cdot (SS + RR) \\ DRR &= SS \cdot (SS + RR) \\ (S + R) \cdot P &= S \\ (SS + RR) \cdot PP &= SS \end{aligned} \quad (13)$$

We consider the following restrictions:

Shape	$X$	$Y$	
1	23 (see Figure 1)	$I$	$II$
2	23 (see Figure 1)	$R$	$RR$

(14)

Due to a lack of numerical data a qualitative and trend-based approach has been applied to solve our model. A solution to the system of differential equations (13) requires application of the qualitative summation and multi-

ples. In this case, we are looking for all possible variants of ordered triplets corresponding to the defined equations (see Table 2). Each row represents a scenario how the number of the ignorants (*I*), spreaders (*S*) and stiflers (*R*) might develop in time. The rows are divided into three parts linked to the variables *I*, *R*, *S*, *P* (concerning the rumour A1) and *II*, *RR*, *SS* and *PP* (concerning the rumour A2). Each variable is described while using a triplet, e.g. the variable *I* in the first row is given by the triplet (+ − \*). The ordered triplets are just a different way how to define trends of the individual variables describing either the rumour A1 or the rumour A2. For example, the triplet of the variable *I* (+ − \*) represents a decreasing trend (see Figure 1). The interpretation of the individual components of the triplet is as follows:

I	DI	DDI
+	-	*
Positive value	Decreasing trend	Acceleration (2nd derivation) unknown

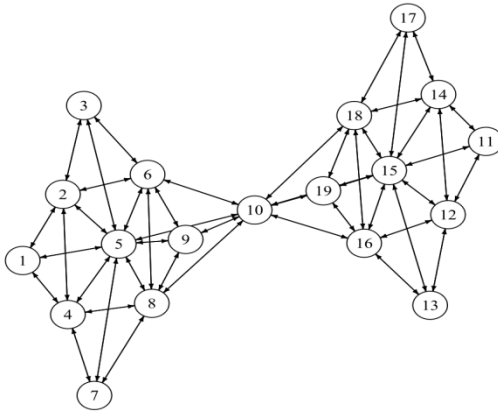
**Table 2.** Scenarios

Scenario	I	R	S	II	RR	SS	P	PP
1	+−*	++*	++*	+−*	++*	++*	++*	++*
2	+−*	++*	++*	+−*	++*	++*	++*	+0*
3	+−*	++*	++*	+−*	++*	++*	++*	+−*
4	+−*	++*	++*	+−*	++*	++*	+0*	++*
5	+−*	++*	++*	+−*	++*	++*	+0*	+0*
6	+−*	++*	++*	+−*	++*	++*	+0*	+−*
7	+−*	++*	++*	+−*	++*	++*	+−*	++*
8	+−*	++*	++*	+−*	++*	++*	+−*	+0*
9	+−*	++*	++*	+−*	++*	++*	+−*	+−*
10	+−*	++*	+0*	+−*	++*	+0*	+−*	+−*
11	+−*	++*	+−*	+−*	++*	+−*	++*	++*
12	+−*	++*	+−*	+−*	++*	+−*	++*	+0*
13	+−*	++*	+−*	+−*	++*	+−*	++*	+−*
14	+−*	++*	+−*	+−*	++*	+−*	+0*	++*
15	+−*	++*	+−*	+−*	++*	+−*	+0*	+0*
16	+−*	++*	+−*	+−*	++*	+−*	+0*	+−*
17	+−*	++*	+−*	+−*	++*	+−*	+−*	++*
18	+−*	++*	+−*	+−*	++*	+−*	+−*	+0*
19	+−*	++*	+−*	+−*	++*	+−*	+−*	+−*

Source: own elaboration

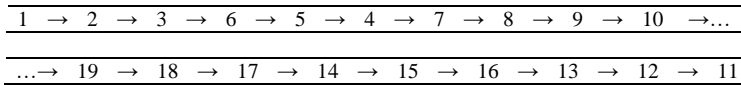
We intend to use our set of scenarios (see individual rows in Table 2) to describe the dynamic behaviour of our model. For this purpose, a sequence of scenarios has to be carried out. A transitional graph is a suitable tool (see Figure 3). Its (numbered) nodes represent the set of scenarios and oriented arcs represent the transitions. The scenarios in combination with their transitions enable us observing the dynamic behaviour of the qualitative model, which describes how the rumours A1 and A2 might be spread.

**Figure 3.** Transition graph

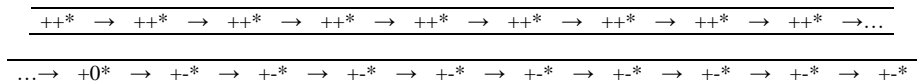


Source: own elaboration

The dynamic behaviour of the variable  $S$  can be used as an example. The node No. 1 is defined as the initial one; if the orientation of arrows between individual nodes remains unchanged, we can outline the following path (from a set that is possible):

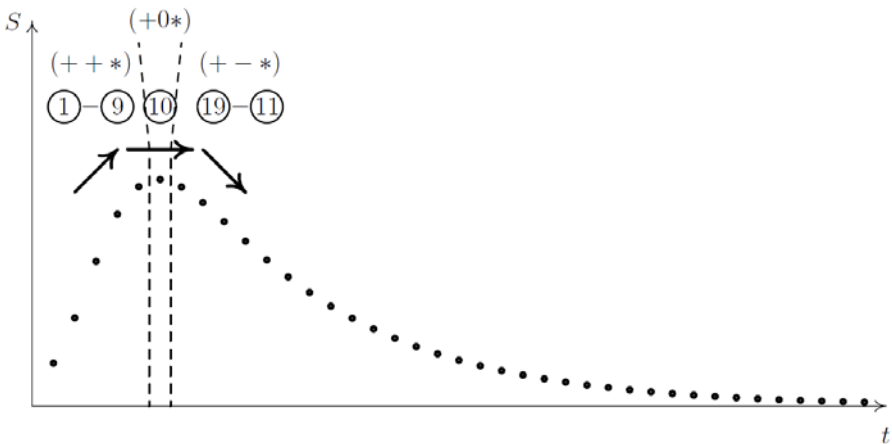


When we use the ordered triplets (see Table 2), the path can be also described in the following form:



When the above trends of the variable  $S$  are ordered consecutively, we can obtain a figure describing its development; this figure corresponds to a numerical solution (see Figure 4). Table 3 shows the development of other observed variables incorporated into our model.

**Figure 4.** Development of spreaders (*S*)



Source: own elaboration

**Table 3.** Development of observed variables

No Var	1	2	3	6	5	4	7	8	9	10	19	18	17	14	15	16	13	12	11
<i>I</i>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
<i>R</i>	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
<i>S</i>	↑	↑	↑	↑	↑	↑	↑	↑	↑	→	↓	↓	↓	↓	↓	↓	↓	↓	↓
<i>II</i>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
<i>RR</i>	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
<i>SS</i>	↑	↑	↑	↑	↑	↑	↑	↑	↑	→	↓	↓	↓	↓	↓	↓	↓	↓	↓
<i>P</i>	↑	↑	↑	→	→	→	↓	↓	↓	↓	↓	↓	↓	→	→	→	↑	↑	↑
<i>PP</i>	↑	→	↓	↓	→	↑	↑	→	↓	↓	↓	→	↑	↑	→	↓	↓	→	↑

## Conclusions

Supposing that both rumours included into our case study might be under control of issuing companies; if detected in a timely manner and effective actions are introduced by decision makers, any reputational damages can be averted. Our set of scenarios and the transitional graph represent a tool which makes sure that no variant is overlooked, i.e. covers all possible changes of the situation in time. Thus, the managers of companies going public are not just passive observers. If there is a qualitative model, the decision makers may predict the development of ignorants (*I*), spreaders (*S*) and stiflers (*R*) in time. If investors' choice relies largely on rumours published in columns, blogs or social networks, it is essential for companies going public to know the number of investors within the individual groups. Next, targeted communication campaigns can be introduced to reduce investors' concerns in relation to a failure of the IPO. For example, supportive resources of information might be published, as well as press releases refuting rumours or claims convincingly.

The main advantage of the TB analysis is that no numerical values of constants and parameters are needed and the set of TB scenarios / solutions is provably complete. It means that a decision maker and/or forecaster has a simpler task to solve, namely to choose from a given set of variants. No reasonable variant can be overlooked if the analysis is based on a feasible TB model.

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