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# Evolving trust in business relationships – A behavioural experiment

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**ABSTRACT**

Using situation-specific and dyadic data, we analyse how trust in inter-organisational relationships evolve over time. Based on a multidisciplinary approach, we define four trust-related concepts, which include both behavioural and perceptual aspects of this multifaceted phenomenon. We also develop the hypothesis that the behavioural consistency of the trustee affects the level of his/her trustworthiness as perceived by the trustor. To test this hypothesis, the paper specifies a finite Dynamic Trust Game that, in a unique way, models longer-term relationships characterised by interdependent actions between partners. In contrast to the simple Repeated Games modelling discrete exchange episodes, this game corresponds to the requirements of the interaction approach of the relationship management, since the iterations of the game are interrelated and embedded in previous ones.

Timely development of the behavioural variables in the game reflects an inverse U-shape with an increasing willingness to cooperate until round 8, with a maximum cooperation level of 80% on average. Behaviour seems to affect the perceived level of trustworthiness. However, we need additional experimental data on inconsistent behaviours to get a clear understanding of this effect.

**KEYWORDS**

finite dynamised trust game, time, behavioural consistency, business relationship

**JEL CLASSIFICATION INDICES**

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## 1. INTRODUCTION

The focal research question of this paper is how trust in inter-organisational relationships develops over time. Trust in our conceptualisation is a complex phenomenon that has behavioural and perceptual dimensions. After a descriptive analysis of how trust develops over time, we tested the hypothesis that the behavioural consistency of the trustee affects the level of his/her trustworthiness as perceived by the trustor and conceptualised as an asset of the relationship.

There is a long-standing and extremely rich body of literature on trust, which includes several approaches generating substantial knowledge, and leading to different understandings (Rose-Ackerman 2018). This paper builds on the conceptualisation of Experimental Game Theory (Berg et al. 1995). However, we discussed and integrated into our analysis other – partly overlapping – conceptualisations, developed by Strategic Management (e.g., Barney – Hansen 1994), Social Exchange Theory (e.g., Blau 1964), Relationship Marketing (e.g., Morgan – Hunt 1994), and Transaction Cost Economics (e.g., Williamson 1979).

Several researchers have emphasised that trust is one of the most important success factors of inter-organisational relationships (Blomqvist 2002; Ford et al. 2003). It can lead to the decrease of transaction costs (Bidault – Jarillo 1997), support the development of collaborative innovations (Miles et al. 2000), and contribute to the firm's overall competitiveness (Barney – Hansen 1994). However, trust in a relationship may change over time. Thus, getting a deeper understanding of these changes can contribute to more effective relationship management and the competitive advantage of a firm.

How trust in relationships develops over time has already been analysed using different methodologies. Case study (e.g., Huang – Wilkinson 2014), survey-based statistical analysis (e.g., Mayer et al. 1995), or modelling (e.g., Ebenhöh – Pahl-Wostl 2008) are widely used in papers on the timely development of trust. However, dyadic and situation-specific analysis of the phenomenon allows for a deeper understanding (Hardin 2009). This paper provides data on real trust-related behavioural patterns and perceptions using such an analytical solution. We have specified a finite Dynamised Trust Game with 10 interconnected iterations that models a coopetitive context of longer-term dyadic business relationships. Then, we applied this game in a behavioural experiment developing a dyadic and situation-specific database for further analysis.

The way we dynamised the game is unique, and it is related to the conceptualisation of longer-term inter-organisational relationships. The traditional conceptualisation follows a transactional approach, where specific transactions between agents are independent from each other (Williamson – Ouchi 1981). In such cases, there is no interconnectedness between exchanges, and each transaction can be analysed separately. In contrast, Ford et al. (2003) suggest an interaction approach emphasising the interconnected and interdependent character of subsequent transactions taking place in business relationships. Johanson – Wootz (1986) consider these interrelated exchange episodes as an investment process. Partners invest in each other through their business relationship. Theories of trust grounded in the social exchange theory (Blau 1964) correspond to this understanding. Instead of modelling simple, repeated transactions between partners, we aimed to model relationships with several interconnected transactions, where specific moves of a partner are embedded in the previous ones.

Dynamisation of games can be twofold. On one hand, a game can be repeated in the same experimental setting. This is widely used in trust-related research (e.g., Engle-Warnivk – Slonim 2004). Such a repeated Trust Game corresponds to the approach of discrete exchange episodes between partners which has been criticised by the researchers who emphasise the interaction approach (e.g., Gemünden et al. 1997). Another form of dynamisation occurs when moves of a game are interconnected and embedded in each other. This is the situation in the game that we proposed.

The configuration of the paper is as follows. The next Section provides a literature review and develops the understanding of our key, trust related concepts. In Section 3, we present the methodology applied, we specify the finite Dynamised Trust Game, the experiment and data development in detail. Section 4 presents and discusses research results. The last Section summarises the paper's key contributions, evaluates its theoretical and practical relevance and suggests future research directions.

## 2. LITERATURE REVIEW AND CONCEPTUALISATION OF KEY TERMS

Literature on trust is rich and includes several approaches and different understandings. These cluster around two key conceptualisations.

The first one suggests that trust is the belief or the expectation of the trustor regarding the intentions of the other party, the trustee, in future situations. For example, Barney – Hansen (1994) interpret trust as the confidence of the trustor that the partner will not exploit his/her vulnerabilities. Aulakh et al. (1996) developed similar understanding, when they defined trust as the degree of confidence that the trustor has in the reliability of the partner.

The second conceptualisation understands trust as the willingness of the trustor to accept to be vulnerable to another party (Mayer et al. 1995). Lewicki – Brinsfield (2015) highlighted that trust conceptualised as a belief captures an important feature of the trustee, namely the level of his/her trustworthiness, as perceived by the trustor. This is closely linked to, but conceptually different from trust interpreted as the willingness of the trustor to accept vulnerability in a concrete situation, and to enter into this situation with the partner. Here, trust is a behavioural phenomenon that can only be manifested in concrete actions.

Not only trust, but also trustworthiness has a behavioural understanding. Barney – Hansen (1994: 176) indicate: "As the word itself implies, an exchange partner is trustworthy when it is worthy of the trust of others. An exchange partner worthy of trust is one that will not exploit another's exchange vulnerabilities." It is the trustee's actual behaviour in a situation of potential opportunism, through which he/she can prove this worthiness (Whitener et al. 1998).

Behavioural conceptualisation of both trust and trustworthiness dominates Experimental Game Theory. We can consider the classic Trust Game (Berg et al. 1995) with two players, *A* and *B*. Here, trust is captured by the behaviour of player *A;* and trustworthiness by the behaviour or action of player *B* (Ostrom – Walker 2003; Ashraf et al. 2006). Experimental Game Theory conceptualises both terms as behaviours, flow type of variables. Trust is embedded in the behaviour of player *A* and trustworthiness in the behaviour of player *B*. Lyon et al. (2015: 30) suggested: "… viewing trust as behaviour, one is inferring trust from the observed behaviour compared to the other alternative behaviours, which were not chosen. A trusting behaviour or choice cannot be absolutely specified unless we know what other choices or alternatives are available." This is true for the behavioural conceptualisation of trustworthiness as well. The classic Trust Game differentiates potential behaviours of both players according to the actual amount of Experimental Currency Unit (*ECU*) transferred by a player to his/her counterpart.

Player $B$ is considered – for example – as trustworthy only when his/her reinvested amount achieves or exceeds a certain amount, usually 80% of the funds available (e.g., Chang et al. 2010). Based on this, all other actions of $B$ would reflect a non-trustworthy behaviour.

An important feature of any trust-related situation is that the trustor is in a structurally vulnerable situation (Baier 1986). He/she cannot be certain of the trustee's action and has to rely on the counterpart's goodwill. This vulnerable position of player $A$, the trustor, is straightforward both in a one-shot Trust Game and in repeated Trust Games as well (Bohnet – Huck 2004; Boero et al. 2009). In these games, the positions of the two players are always the same: $A$ starts the game, he/she is in a vulnerable position, is the trustor. $B$ is the trustee on whom the trustor's vulnerability depends.

However, vulnerability is special in the dynamised version of the Trust Game discussed here. The proposed finite dynamised Trust Game contains 10 integrated rounds. These are not simple repetitions, because we made it possible to accumulate the money gained through the previous rounds. The accumulated amount was free for reinvestment in each of the iterations. This and the payout function[1] applied motivated cooperation between the players throughout the first 9 rounds. This cooperation was in the self-interest of both players – supposing they are rational decision makers. Consequently, in these rounds, the players' actual moves (to pass a certain amount of money back to his/her partner) represent ongoing turns of trusting and trustworthy behaviours, where the positions of the trustor and the trustee slide together. A clear structurally vulnerable position appears, however, in the last, the 10th round for player $A$. Because of the applied payout function, the last round reflects the classic, competitive scenario of the one-shot Trust Game.

As mentioned before, Experimental Game Theory conceptualises both trust and trustworthiness as behaviours belonging to the flow type of constructs. This understanding complements the faith-based approach of trust that understands it as the faith or confidence of the trustor that the counterpart will not exploit the trustor's vulnerabilities, even in situations, where such opportunistic behaviour would be possible (Barney – Hansen 1994; Morgan – Hunt 1994). As Coote et al. (2003: 597) put it: "… trust exists when one party has confidence in the honesty, reliability, and integrity of their partner". Accordingly, the trustor will be willing to take the risk and actually engage him(her)self into a trusting behaviour, only when he/she has confidence in the partner. These perceptions or expectations capture an important feature of the trustee, the perceived level of his/her trustworthiness (Lewicki – Brinsfield 2015), which can be measured. The actual level of perceived trustworthiness is confronted with the characteristics of the situation (e.g., risk), and it might work as an asset that guides behaviour: to trust or not to trust. The perceived level of the trustee's trustworthiness is a stock type of variable, a kind of inventory (Gillespie – Dietz 2009) that might govern behaviour. Transaction Cost Economics corresponds to this conceptualisation when it relates trust to governance mechanisms (Williamson 1979).

Based on the previous discussion, we differentiated between trust and trustworthiness as behaviours (flow) of the trustor and the trustee; but we also can conceptualise trustworthiness as an asset or stock that reflects the perceptions of the trustor regarding a characteristic of the trustee. To use key trust-related concepts in an unambiguous way, we defined them for subsequent analyses as follows:

[1]See details on the payout function in the methodological Section.

- Trust interpreted as a behaviour ($T_{Flow}$): We interpretd $T_{Flow}$ as the trusting behaviour of the trustor; his/her willingness to accept vulnerability in a situation with a partner, and enter into this situation. This is a flow type of concept, a behavioural phenomenon that can only be manifested in concrete actions of the trustor.
- Trustworthiness interpreted as a behaviour ($TW_{Flow}$): The paper conceptualises $TW_{Flow}$ as a flow type of concept. It is the behaviour of the trustee in a concrete situation, which does not exploit the vulnerability of the trustor.
- Perceived level of trustworthiness as an asset ($TW_{Stock}$): It is an asset, a stock conceptualised as a perception regarding the confidence of the trustor that the trustee will not exploit his/her vulnerability embedded in a future, upcoming situation.

Based on the definitions above, we hypothesised a specific relationship between trust-related behaviours and expectations. Several authors have already hypothesised relationships among them. Mayer et al. (1995) explicitly built into their model a feedback loop indicating an upgrading process of behaviours based on perceptions. Similarly, Noteboom (2015) noted that there is a relationship between perceptions and behaviours in the trust-related situations. This paper explicitly formulates the hypothesis that a player's perceived level of $TW_{Stock}$ is determined by his/her behavioural consistency, interpreted as the difference between the trustor's expectations regarding the trustee's behaviour and his/her actual behaviour (Whitener et al. 1998).

Only a few previous studies have built into the game and related experiment design the measurement of expectations. Chaudhuri – Gangadharan (2007) have linked a one-shot Trust and Dictator Game, in which they asked the players to indicate the amount of *ECU* expected back. Their results show that expectations regarding reciprocity, measured by the difference between the amount of *ECU* a trusting player gives to and expects back from his/her partner do influence the actual behaviour of player *A*, the trustor. Complementary to behavioural reciprocity, we focused on behavioural consistency of the trustee. We hypothesised that the behavioural consistency of the trustee affects the level of his/her $TW_{Stock}$ as perceived by the trustor.

## 3. METHODS

### 3.1. Specifications of the finite dynamised Trust Game

We specified the game along the (i) decision variables, and (ii) the applied payout structure. Then, we discussed strategies and stability of the game, and lastly, extended the model with the concept of trustworthiness interpreted as an asset.

**3.1.1. Decision variables.** First, we presented key variables and parameters used in the modified version of the game and defined the incentive structure for the players in more detail.

We introduced the following variables:

- $I_t^A$ *ECU* available for player *A* at the end of iteration *t*,
- $I_t^B$ *ECU* available for player *B* at the end of iteration *t*,
- $x_t$ *ECU* given by player *A* to player *B* during iteration *t*,
- $y_t$ *ECU* given by player *B* to player *A* during iteration *t*.

The letter $T$ denotes the iteration count, which, in our case, is $T = 10$.

With the help of these variables, we can construct the following equations, given that player $A$ starts the game with 10 *ECU* and player $B$ does not have anything at the beginning, but can triplicate the *ECU* amount passed by $A$:

$$I_t^A = I_{t-1}^A - x_t + y_t, \quad I_0^A = 10\ ECU$$
$$I_t^B = I_{t-1}^B + 3 \cdot x_t - y_t, \quad I_0^B = 0\ ECU$$
$$(t = 1, 2, \ldots, T).$$

We set non-negative investments, the *ECU* given in each round, as a condition; thus, $x_t \geq 0$, $y_t \geq 0$

Assuming that the goal of the players is to maximise the combined *ECU* collected (adding the earnings of players $A$ and $B$), we can formulate the goal function in the following way:

$$I_T^A + I_T^B \rightarrow \max.$$

The solutions to the above dynamic optimisation problem are the Pareto optima. The maximum obtainable final *ECU* is $I_0 \cdot M^T$, where $M$ is the investment multiplicator, the coefficient, with which we multiplied the amount player $A$ gives to player $B$. With the parameters we defined, this is $10 \cdot 3^{10}$ when both players fully commit all *ECU* available to them up until the last iteration, where the transferred *ECU* multiplies by rule. This criterion is true for all iterations, except for the last decision player $B$ makes (the 10th iteration). Because of this, if the players cooperate to obtain the collective maximum state of the game, player $B$ will have the choice to divide the winnings among the players. Player $B$ decides how much *ECU* player $A$ can get $y_T^o = 10 \cdot 3^T - \tilde{x}$

**3.1.2. Additional variables.** In the classic Trust Game, the concept of $TW_{Stock}$ is not included. As discussed in *Section 2*, we interpreted this as an asset-type variable that reflects an important feature of the trustee as perceived by the trustor. We measured the actual level of this asset for both players and in all iterations. We asked the players to give the perceived level of trustworthiness ($TW_{Stock}$) of their counterpart at the beginning of each iteration using a –2 → + 2 scale (– 2 meaning: I think he/she is not trustworthy at all; + 2 meaning: I think he/she is trustworthy to a great extent).

Thus, we can extend the set of variables to include the following:

- $TW_t^A$ the level of trustworthiness of player $A$, as perceived in iteration $t$ by player $B$.
- $TW_t^B$ the level of trustworthiness of player $B$, as perceived in iteration $t$ by player $A$.

In addition to the above variables, we introduced an expectation function for the players to track expectations regarding the future behaviours of the players. We asked participants to indicate the amount they expect to get back from their partner in the next iteration (both in *ECU* and expressed as the per cent of the available fund that is free for investment in a given iteration). These expectations are related to trust and trustworthiness interpreted as behaviours, flow-type of concepts ($T_{Flow}$ and $TW_{Flow}$). We continuously recorded the amount of *ECU*s actually passed by the players to each other throughout the 10 iterations of a game. In order to measure behavioural consistency, we also asked them to indicate related expectations, what amount do the players in a given iteration expect back from their counterpart. These expectation functions are as follows:

- $x_t^e$ the expectation of player *B* concerning the amount player *A* will transfer at iteration *t*, and
- $y_t^e(x_t)$ the expectation of player *A* concerning the amount player *B* will transfer at iteration *t*.

Using the actual *ECU* (or %) values we could calculate the behavioural consistency (*BC*) of both players *A* and *B* for all iterations by calculating the difference between actual investment decisions and related expectations.

The actual expectation values regarding future behaviours as well as the $TW_{Stock}$ values were known only to the experimenter and were not presented to the actual game partners. With the help of the expectation functions, we can model the hypothesised relationships between changes in the level of perceived $TW_{stock}$ and behavioural consistency of the players in all the iterations of the game. Based on the above description, we defined $TW_{Stock}$ with the following functions:

- $f^A(y_t^e(x_t), y_t)$ denotes the differential function of the perceived $TW_{Stock}$ of *A* (showing how player *B* perceives player *A*, during the iteration *t*), which depends on the amount that player *B* expects back from player *A*, and also on the amount actually received from *A*.
- $f^B(x_t^e(y_t), x_t)$ denotes the differential function of the perceived $TW_{Stock}$ of *B* (showing how player *A* perceives player *B* during the iteration *t*), which depends on the amount player *A* expects back, and also he/she actually gets back from player *B*.

With the above terminology, we formulated a discrete differential equation system of the changes in perceived levels of trustworthiness as follows:

$$TW_{t+1}^A = TW_t^A + f^A\left(y_t^e(x_t),\ y_t\right),\ TW_0^A = 0,$$

$$TW_{t+1}^B = TW + f^B\left(x_t^e(y_t),\ x_t\right),\ TW_0^B = 0.$$

We had experimented this game with students studying economics or business. Thus, to judge a partner's initial trustworthiness ($TW_{Stock}$), players could only rely on this piece of information, namely their partner were similarly trained students.

**3.1.3. Payout structure.** The function that defines the payouts for the players in the experiment was not linearly associated with the final *ECU* amount, as usual, but instead formulated in the following way

$$F_A\left(I_T^A\right) = G\cdot\delta\left(I_T^A - I_T^B\right) + \frac{I_T^A + I_T^B}{10\cdot M^T}\cdot K,$$

and

$$F_B\left(I_T^B\right) = G\cdot\delta\left(I_T^B - I_T^A\right) + \frac{I_T^A + I_T^B}{10\cdot M^T}\cdot K,$$

where

*G* premium for the 'winner' with more *ECU* at the end,
*K* premium coefficient based on the collectively accumulated *ECU* amount,
*M* investment multiplicator, and
*T* iteration count.

In our experiment, we used the values of $G = 500$ real currency (Hungarian Forint, *HUF*), $K = 1000$ *HUF*, $M = 3$ and $T = 10$.

A $\delta(.)$ function - for the winner premium allocation - is defined in the following way:

$$\delta(z) = \begin{cases} 0 & z<0, \\ \frac{1}{2} & z = 0, \\ 1 & z>0. \end{cases}$$

## 3.2. Experiment and database development

The game design was programmed using MS Excel and installed on the computers of the university's computer lab. Participants were students studying economics or business. Previous research indicated that such students have statistically similar behaviour compared to the practising managers (Bolton et al. 2012a; Bolton et al. 2012b).[2]

We conducted the experiment in a controlled environment, where communication between pairs was only possible through the computer. An application in an MS Excel environment by communicating through VBA macros and an interim data file was developed. The programme was deployed on the internal network of the university to ensure stable connectivity. The subjects were familiar with this kind of user interface, which allowed them to log all actual investment decisions (*ECU* transfers: $T_{Flow}$ and $TW_{Flow}$), the expected transfer values of their partner, and the levels of perceived trustworthiness ($TW_{Stock}$).

The data recorded by the application were:

- the identification number of the pair and the type of subject (*A* starting the game or *B* his/her partner),
- iteration number within a specific game,
- amount invested into the other player and the *ECU* amount received back ($T_{Flow}$ and $TW_{Flow}$),
- accumulated amount available for investment at the beginning of the iteration,
- perceived level of trustworthiness ($TW_{Stock}$), and
- the amount expected to receive from the counterpart in the next iteration.

All behavioural trust variables were indicated in both per cent of the available fund and in the *ECU* value. The players could also see the current *ECU* accumulation for both players, updated data, and each time after the 'amount to be given' option had been modified. After a player was committed to pass over a given amount of *ECU* in an iteration, he/she had to hit a 'save' button to convey the information to their partner. The tool included message boxes to help the subjects progress the game. A display at the end of the game prompted the player to ask the tutor to approve the score. Upon completion, the tutor directed the subjects to the payout desk in a different but nearby room.

[2]Managers make different types of decisions, including group decisions. Relational decisions are inherently dyadic, but can be more complex, including several stakeholders. To avoid the problem of mis-specifying the level of analysis, we emphasised that the experiment that was designed and executed is not capable to handle the complexity inherent in such multi-stakeholder decisions.

Students were contacted via e-mail using the central mailing system through the university's Newsletter, where we advertised the game, including actual monetary rewards. Participation was volunteer. Interested students could use an online sign-up sheet to take empty slots at an upcoming event (signup.com).

Players were anonymous to each other, and randomly paired. It was important to ensure that pairs remained anonymous to each other during the whole game. The number of participants per experiment varied between 6 and 24. We kept it low to ensure secrecy. This approach guaranteed that the actual changes detected in the stock level of perceived trustworthiness were the products of the previous iteration of the game and were not influenced by other factors (e.g., Boero et al. 2009). Altogether, there were 7 occasions organised and 98 participants. A label on the instruction sheets defined the assignment of the pairs (who starts the game). The experimenter handed these sheets to the players using a simple heuristic to maximise the physical distance between the paired subjects.

Each experiment started by distributing the information sheet describing the game and providing technical assistance. We asked the participants to identify themselves with their names and university identification numbers. The instruction sheet prompted the players to sign a statement that they had not played this game before, and they accepted the use of the information gained on their behaviour for research purposes. They also had to indicate acceptance of their cash reward in *HUF* based on the payout function and their actual performance in the experiment. The instruction sheet had a section designated to confirm the end result that was approved by the experimenter in the computer room, and, based on this, the other experimenter at the payout desk calculated the actual reward which was paid immediately.

Our database consists of 49 pairs and relationships. Since each game had 10 iterations, we had information on 490 specific dyadic behaviours, which made up our database for further analysis.

## 4. RESULTS

### 4.1. Descriptive statistics of key behavioural variables

We had data on behaviours, the invested and reinvested amounts ($T_{Flow}$ and $TW_{Flow}$), in both monetary terms (*ECU*) and percentages. We carried out calculations using both datasets. The results did not differ significantly. Thus, we only presented and discussed the results using the data in percentages (Table 1, Figs 1 and 2).

Player *A* started the game and invested in his/her partner on an average of almost 70% of the available *ECU* amounts. Their expectations of what they would get back were somewhat lower, on average, 66.7%. The data on player *B*s reflect a reverse picture; they expected to get more than 70% of *A*s' available *ECU* amount. However, players in the position of *B* paid only somewhat more than 68% of their actual investment funds. Differences between the two players concerning both expectations and actual investment values showed slight differences.

Fig. 1 reflects the timely development of actual investments (flow types of variables) and related expectations over 10 iterations. We found an inverse U-shaped curve in case of both players. Players in the position of *A*, who started the game, invested approximately 52.9% of their available funds in the first round, on average. This investment increased quite sharply during the following few iterations and stabilised from rounds 3 to 8. Values regarding both

**Table 1.** Means and variances of key variables ($N = 490$)

| | Mean | Variance |
|---|---|---|
| $x_t$ = Amount of *ECU* in a given iteration passed to *B* by *A* (%) | 69.969 | 36.338 |
| $y_t$ = Amount of *ECU* in a given iteration passed to *A* by *B* (%) | 68.390 | 33.213 |
| $x_t^e$ = Amount of *ECU* expected to get back from the partner as indicated by *B* (%) | 71.302 | 30.623 |
| $y_t^e$ = Amount of *ECU* expected to get back from the partner as indicated by *A* (%) | 66.706 | 32.458 |
| $\delta TW_t^A$ = Change in the perceived level of *A*'s trustworthiness in a given iteration as indicated by *B* (– 2 → +2 Scale) | -0.016 | 0.673 |
| $\delta TW_t^B$ = Change in the perceived level of *B*'s trustworthiness in a given iteration as indicated by *A* (– 2 → +2 Scale) | -0.008 | 0.803 |

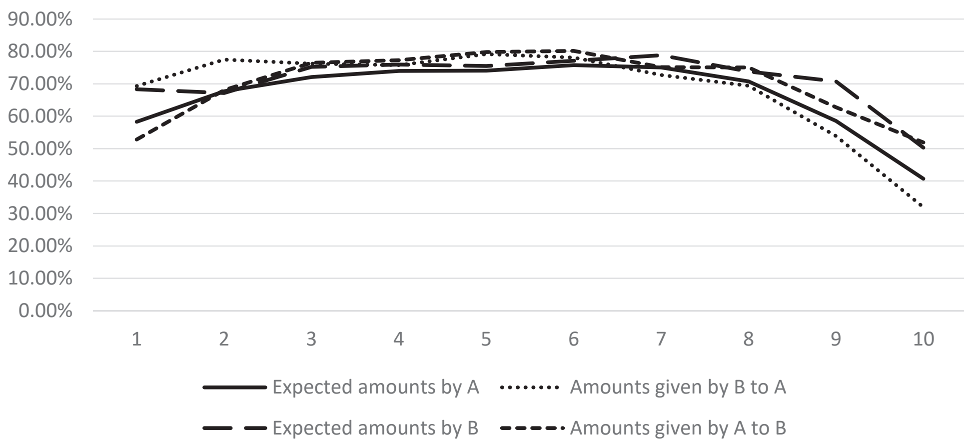


**Fig. 1.** Invested and expected *ECU* amounts of both player positions during the 10 iterations (%, mean)[3]

actual investments and expectations of player *A*s decreased significantly during the last 2 two rounds. The pattern was the same in the case of *B*s, with only a few small differences. They returned more to player *A*s in the first round, and the values of both the actual investments and expectations showed a smaller increase compared to that of the players starting the game.

[3]We are aware that the curves in Figs 1 and 2 are not continuous, but this representation makes it easier to detect small changes between corresponding values.

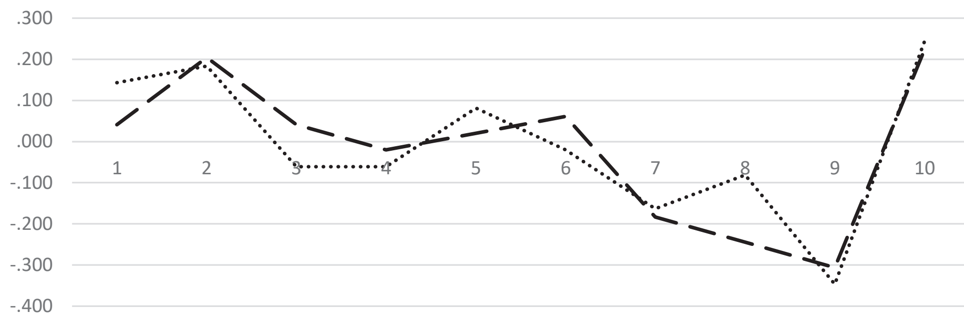


**Fig. 2.** **Changes in the perceived levels of trustworthiness as indicated by the players**
***Notes*****: Dotted line for player A and dashed line for B (– 2 → + 2 scale).**

Maximum percentages invested into the partner were around 80% for both player positions. This is an interesting result since previous research using traditional one-shot or repeated games regarded a player as trustworthy, when the reinvested amount achieved or exceeded 80% of the funds available (e.g., Chang et al. 2010). This 80% seems to be critical in this game too. This value is a mean; thus, individual behaviour might differ significantly. Still, it is worth mentioning that this 80% might indicate the existence of a threshold, which most of the players cannot overcome easily even during iterations, where self-interest requires total cooperation and sharing 100% of the *ECU* amounts available. This significantly violated the overall performance of both players in the relationship. The median of the payout value for a player was 600 *HUF* compared to the theoretical maximum of 2000 *HUF*.

The payout function generated co-opetition between players. As mentioned, in the case of rational decision makers, this should have resulted in maximum investments values (100%) on both sides, during the first nine iterations, and to a decrease of these investments in the last, competitive one. We could detect a significant decrease in investments on both sides during the last two rounds. Untrusting behaviour of players appeared one iteration earlier than expected, and the average *ECU* amounts sent back in the last round dropped below 40% of the available funds of the players acting as *B*. Player *A*s also decreased the invested amounts in the final rounds to 50% of their available funds. Earlier decrease in invested and reinvested amounts than rational contributed to a significant loss for most of the players. The sharper decrease in returned *ECU*s in the case of player *B*s were probably due to the overall objective of these players to get the winner's premium (*G*); however, on average, they were not maximising their own earnings either.

Both actors of the game seem to recognise their own overall position. For player *A*, it is the position of the trustor being in a vulnerable situation at the end of the game, while for *B* this is the position of the trustee with the opportunity to behave opportunistically. These positions might explain both the behaviours in the last two rounds, but also those in the first few rounds. Players recognised their positions at the beginning of the experiment, and this led to moderated level of trusting behaviours throughout the game. They showed a cautious behaviour, waited out at the beginning, experienced the counterpart's actual behaviour and adjusted their decisions accordingly. The slight differences in behaviours (and also expectations) between the two players are very small and reflect reciprocity. This backs previous research results (Chaudhuri – Gangadharan 2007).

### 4.2. Testing the hypothesis on the relationship between perceived level of trustworthiness and behavioural consistency

Table 1 indicates the mean values of perceived trustworthiness interpreted as an asset ($TW_{Stock}$) as well. These show only very small changes over time. On average, there was a slight decrease in the value of $TW_{Stock}$, since the average values are negative.

The perceived levels of trustworthiness of the two players developed in an almost parallel fashion (Fig. 2). This is not a surprise, considering that during the first 9 rounds the positions of the two players (to be the trustor or the trustee) were continuously changing.

The initial level of $TW_{Stock}$ was 0.71, on average (using the – 2 and +2 scale), indicating a slight positive, trusting attitude. This might have been because the players were aware that students studying economics and business were the subjects of the experiment, and they might have supposed a rational, thus mainly cooperative behaviour during most of the rounds of the game. The changes in this initial level of $TW_{Stock}$ were between $\pm$ 0.2, and the maximum change in the last two rounds was only moderately higher than this value (Fig. 2).

Interestingly, the mean level of $TW_{Stock}$ of players in the position of $B$ did not decrease at the end of the game. On the contrary, we detected a quite substantial increase. This is probably because we had some pairs in which player $B$ did not strive for the winner's premium ($G$) but decided to share it with player $A$. This must have been an unexpected and positive move of player $B$ as perceived by $A$. During previous iterations, the players behaved as expected, in a consistent way. Behavioural consistency, the match between expected and actual behaviours, did not result in a significant change in the levels of perceived trustworthiness. Only unexpected moves seem to alter the perceived level of a player's trustworthiness. Unfortunately, the number of pairs, where player $B$ did not behave as expected in the final round – and was not opportunistic – is very small. Thus, we could not carry out further statistical analysis on this issue.

Our hypothesis suggests that the level of a trustee's trustworthiness ($TW_{\text{Stock}}$) as perceived by the trustor is determined by his/her behavioural consistency, which we measured as the difference between expected and actual behaviours.

As discussed in *Section 3*, we formulated a discrete differential equation system and used it to test this hypothesis:

$$TW_{t+1}^{A} = TW_{t}^{A} + f^{A}\left(y_{t}^{e}(x_{t}),\ y_{t}\right),\ TW_{0}^{A} = 0,$$

$$TW_{t+1}^{B} = TW_{t}^{B} + f^{B}\left(x_{t}^{e}(y_{t}),\ x_{t}\right),\ TW_{0}^{B} = 0,$$

The differential equation system presented can also be expressed as follows:

$$TW_{t+1}^{A} - TW_{t}^{A} = f^{A}\left(y_{t}^{e}(x_{t}),\ y_{t}\right),$$

$$TW_{t+1}^{B} - TW_{t}^{B} = f^{B}\left(x_{t}^{e}(y_{t}),\ x_{t}\right),$$

This system highlights that solving our differential equation system results in a regression model. We applied the linear regression model of the SPSS22 programme to test our hypothesis. We summarised the results for players in the position of $A$ and $B$ in Tables 2 and 3, respectively.

The coefficients of our regression models are significant, but the values of $R^2$ are low. Thus, the hypothesis has not been proved. However, based on our results we couldnot refute it either.

The low $R^2$ values might be due to the mathematical-statistical features of our database and the characteristics of the variables used in the regression models. Differences in the values of $TW_{Stock}$ are almost constant; the coefficients of the predictor are close to constant as well. Variances of $TW_{Stock}$ are close to zero; because of this, the correlation coefficients cannot be interpreted well. This means that, in case the partners behave as expected, regression models, even non-linear ones, do not seem to be appropriate for obtaining better $R^2$ values.

A player's perceived level of $TW_{Stock}$ does not seem to change significantly if a trustee behaves in a consistent way. Behavioural inconsistency seems to alter the value of this $TW_{Stock}$. Thus, further research and more extensive data collection is necessary to develop a database that include more data pairs on inconsistent behaviours and the associated levels of $TW_{Stock}$.

**Table 2.** The perceived level of trustworthiness ($TW_{stock}$) of players in the position of A perceived by B (%)

| **Regression model** | | | |
|---|---|---|---|
| ***R*** | ***R* Square** | **Adjusted *R* Square** | **Std. Error of the Estimate** |
| 0.333 | 0.111 | 0.108 | 0.636 |
| Predictors: (Constant), $x_t^e$, $x_t$. | | | |

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| **Model** | **Sum of Squares** | **df** | **Mean Square** | ***F*** | **Sig.** |
| Regression | 24.661 | 2 | 12.331 | 30.450 | 0.000 |
| Residual | 197.208 | 487 | 0.405 | | |
| Total | 221.869 | 489 | | | |
| Dependent variable: $\delta TW_t^A$.<br>Predictors: (Constant), $x_t^e$, $x_t$. | | | | | |

| **Coefficients** | | | | |
|---|---|---|---|---|
| **Model** | **Unstandardised Coefficients** | | ***T*** | **Sig.** |
| | ***B*** | **Std. Error** | | |
| Constant | 0.003 | 0.077 | 0.036 | 0.971 |
| $x_t$ | 0.007 | 0.001 | 7.199 | 0.000 |
| $x_t^e$, | −0.007 | 0.001 | −6.200 | 0.000 |
| Dependent variable: $\delta TW_t^A$ | | | | |

**Table 3.** The perceived level of trustworthiness ($TW_{stock}$) of players in the position of B as perceived by A (%)

| **Regression model** | | | |
|---|---|---|---|
| ***R*** | ***R* Square** | **Adjusted *R* Square** | **Std. Error of the Estimate** |
| ,292 | 0.085 | 0.081 | 0.770 |
| Predictors: (Constant), $y_t$, $y_t^e$. | | | |

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| **Model** | **Sum of Squares** | **df** | **Mean Square** | ***F*** | **Sig.** |
| Regression | 2.890 | 2 | 13.445 | 22.651 | 0.000 |
| Residual | 289.077 | 487 | 0.594 | | |
| Total | 315.967 | 489 | | | |
| Dependent variable: $\delta TW_t^B$.<br>Predictors: (Constant), $y_t$, $y_t^e$. | | | | | |

| **Coefficients** | | | | |
|---|---|---|---|---|
| **Model** | **Unstandardised Coefficients** | | ***t*** | **Sig.** |
| | ***B*** | **Std. Error** | | |
| Constant | 0.044 | 0.089 | 0.490 | 0.625 |
| $y_t$ | 0.007 | 0.001 | 5.518 | 0.000 |
| $y_t^e$ | −0.008 | 0.001 | −6.150 | 0.000 |
| Dependent variable: $\delta TW_t^B$. | | | | |

## 5. CLOSING REMARKS

Trust has an important role in managing business relationships, since it can significantly contribute to its success and the performance of its members. The focal research question of our paper was how trust in inter-organisational relationships develops over time. The timely development of trust has already been researched extensively; however, a dyadic, situational analysis is rare. Especially, when we consider longer-term relationships, where specific interactions are not simple repetitions of a previous transaction, but they are embedded in previous events. Thus, we proposed a special dynamisation of the classic Trust Game that meets the requirements of this interaction approach (Ford et al. 2003). We developed and specified a finite Dynamised Trust Game that models co-opetition between partners. In such a relationship, structural vulnerability is tricky. During interconnected iterations of cooperation, the positions of the trustor (being vulnerable) and the trustee (with an opportunity to behave opportunistic) are sliding together. The usual vulnerable position of player *A* appears, however, in the proposed game. Theoretically, the last iteration simulates the situation of competition between partners. We could not find any previous research that would have described this unique and ambiguous situation, though the importance of trust in co-opetition is growing (Ritala 2012).

Trust, the focal concept of our analysis, is complex and multifaceted. We mainly built on the conceptualisation of Experimental Game Theory but complemented it with a multidisciplinary literature review. We aimed to align different conceptualisations, and defined four trust-related variables, namely: trust and trustworthiness conceptualised as behaviours of the trustor and the trustee ($T_{Flow}$ and $TW_{Flow}$, respectively); the level of trustworthiness of the trustee as perceived by the trustor conceptualised as an asset ($TW_{Stock}$); and behavioural consistency defined as the difference between the trustor's expectations regarding the trustee's behaviour and his/her actual behaviour. We used the finite Dynamised Trust Game proposed in an experiment. Design of this experiment provided the measurement of all these variables. We developed a database useful for a descriptive analysis of all the trust-related concepts introduced. Specificity of this description is that it contains situation-specific data pairs developed in concrete dyadic relationships. We could carry out the experiment with 49 pairs. Given the number of iterations in the game, this represents 490 specific trust-related behaviours for analysis. According to our best knowledge, such a database is unique, since it represents value. However, it poses some limitations as well. We need further behavioural database development to enrich and refine our knowledge on questions discussed.

Behavioural variables of the game reflect an inverse U-shape with an increasing willingness to cooperate during iterations from 1 to 8, with a maximum cooperation level of 80% on average. This reflects a lower level of cooperation than expected, given the motivation of the players specified in the payout function (100% cooperation), and supposing rational decision makers. This 80% might represent a threshold level that could, and actually did, generate significant losses for both players. Similarly, the untrusting behaviour that appeared earlier than expected (in iteration 9 instead of 10) contributed to a significant decrease in the overall performance of the relationship, and its members. This is not only theoretically challenging, but has direct significance for practice. Further research can elaborate on main reasons of these performance losses.

Previous research (Chaudhuri – Gangadharan 2007) has already proved that reciprocity does influence actual behaviour of the trustor. Complementary, we focused on behavioural consistency. We tested the hypothesis that the level of a partner's trustworthiness ($TW_{\mathrm{Stock}}$) as perceived by the trustor is determined by his/her behavioural consistency that we measured as the difference between expected and actual behaviours. As discussed, we could not prove or refute this hypothesis. Further research is needed to develop a database with a significant portion of inconsistent behaviours that would make hypothesis testing more effective.

In the behavioural experiment, we had students studying economics or business. Previous research supports this decision (Bolton et al. 2012a, 2012b). Developing a database with the participation of actual managers is another potential avenue for further research with an objective to develop situation-specific, dyadic data on trust and its development over time. Other game designs can also be specified and experimented. These could model relationship situations different from the co-opetitive one, we had; or they could model other types of decision-making processes, for example multi-stakeholder ones involving more than two actors.

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