MIS Quarterly

RESEARCH ARTICLE

REPEATED INTERACTIONS VERSUS SOCIAL TIES: QUANTIFYING THE ECONOMIC VALUE OF TRUST, FORGIVENESS, AND REPUTATION USING A FIELD EXPERIMENT

Ravi Bapna
Carlson School of Management, University of Minnesota,
Minneapolis, MN 55455 U.S.A. {rbapna@umn.edu}

Liangfei Qiu
Warrington College of Business, University of Florida,
Gainesville, FL 32611 U.S.A. {liangfeiqiu@ufl.edu}

Sarah Rice
Mays School of Business, Texas A&M University,
College Station, TX 77843 U.S.A. {srice@mays.tamu.edu}

Appendix A

Experimental Interface

General Guidelines

In this experiment, we use tokens, and 10 tokens = $1.

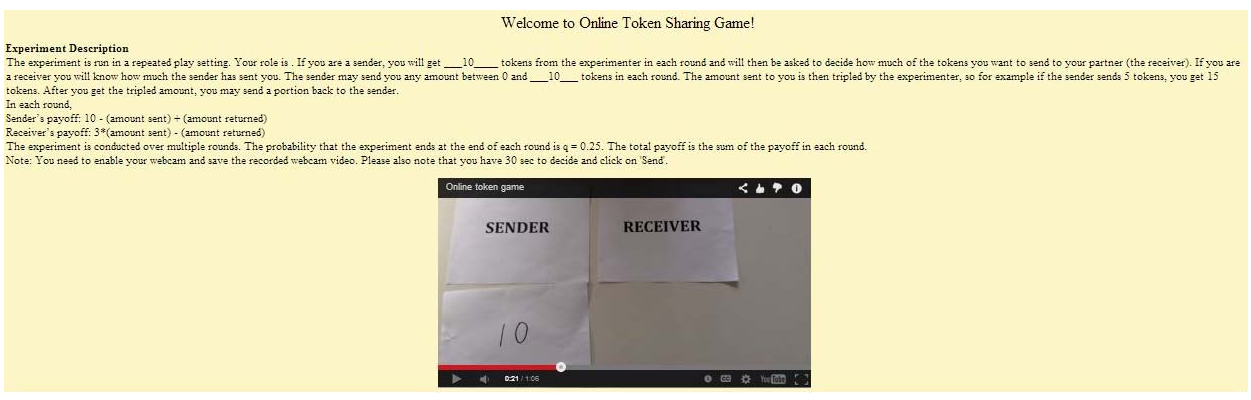

Figure A1. A YouTube Video on Experimental Instruction

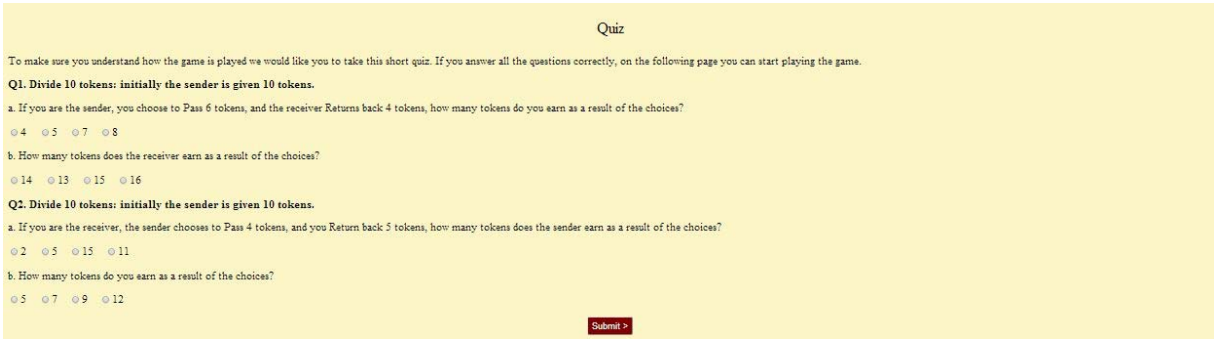

Figure A2. Screenshot of Quiz Testing Comprehension of Game Rules

Appendix B

Estimation Results on Receivers' Defections

Our empirical definition of a receiver's defection in AnonRP is each receiver's amount returned under AnonRP is less than that under AnonONE. The empirical definition of a receiver's defection in SocialRP is each receiver's amount returned under SocialRP is less than that under SocialONE.

Mathematically, our definition of a receiver's defection is $b_{jt}^{A,R} < b_{j1}^{A,O}$ or $b_{jt}^{S,R} < b_{j1}^{S,O}$.

We collect a subsample that includes all receivers' defections (the amount returned), $b_{jt}^{m,R}$, $m = A$ or S, and the corresponding amount sent in the next period, $a_{i,t+1}^{m,R}$, from the observations under AnonRP and SocialRP. Then, we estimate the following regression model:

$$a_{i,t+1}^{m,R} - a_{i1}^{A,O} = (\beta_0 - d_0) - d_1 b_{j1}^{A,O} + \beta_1 SocialRP + \beta_2 Embeddedness_{ij} + \beta_3 PhotosTagged_{ij} + \beta_4 SharedWallposts_{ij} + \beta_5 b_{jt}^{m,R} + \left(\varepsilon_{jt}^{m,R} - \varepsilon_{j1}^{A,O}\right)$$

Like the case of senders' defections and receivers' forgiving behavior in regression model (8), $a_{i,t+1}^{m,R} - a_{i1}^{A,O}$ measures the forgiveness of sender i. The estimation results are robust and are presented in the following table. We find that the coefficients on the tie strength measures and *SocialRP* in the case of receivers' defections and senders' forgiving behavior are very similar to those in the case of senders' defections and receivers' forgiving behavior. Therefore, forgiveness is symmetric for the pair.

Table B1. Forgiveness as a Function of Social Ties: Receivers' Defections and Senders' Forgiving			
	(1)	(2)	(3)
Variables	**Default OLS**	**Cluster Bootstrapping**	**Cluster-Robust Inference**
Embeddedness	0.00702**	0.00702**	0.00702**
	[2.354]	[2.216]	[2.056]
PhotosTagged	0.0825**	0.0825**	0.0825**
	[2.624]	[2.433]	[2.416]
SharedWallposts	0.0613***	0.0613***	0.0613***
	[3.152]	[3.024]	[3.084]
SocialRP	0.178***	0.178***	0.178***
	[3.652]	[3.334]	[3.415]
$b_{jt}^{m,R}$	1.574**	1.574**	1.574**
	[2.148]	[2.085]	[2.116]
$b_{j1}^{A,O}$	-1.536***	-1.536***	-1.536***
	[-3.358]	[-3.172]	[-3.295]
Constant	2.132***	2.132***	2.132***
	[3.427]	[3.368]	[3.255]
R-squared	0.176	0.176	0.176
Observations	255	255	255

z or t-statistics in brackets; ***p < 0.01, **p < 0.05, *p < 0.1

Appendix C

Pair as a Unit of Analysis

In our main analysis, the unit of analysis is an individual. Because our randomization is conducted at the pair level, we change the unit of analysis to pair level as a robustness check and examine the effect of repeated interactions and social ties on the level of cooperation. Our regression model in pair level analysis is as follows:

$$\begin{aligned} \bar{a}_k^{m,n} + \bar{b}_k^{m,n} = {} & \varphi_0 + \varphi_1 Repeat_n + \varphi_2 Social_m + \varphi_3 Embeddedness_k \\ & + \varphi_4 PhotosTagged_k + \varphi_5 SharedWallposts_k + \varepsilon_k^{m,n} \end{aligned} \tag{C1}$$

where $\bar{a}_k^{m,n}$ is the average amount sent in each period of pair k when the game is one of the following treatments: $m = S$ (social treatment) or A (anonymous treatment), and $n = O$ (one-shot game) or R (repeated game), and $\bar{b}_k$ is the average amount returned in each period of pair k. For instance, in a 10-period repeated game, if the total amount sent by a sender and the total amount returned by a receiver is 60 and 80 tokens, respectively, then $\bar{a}_k^{m,R} + \bar{b}_k^{m,R} = 6 + 8 = 14$; in a one-shot game, if the total amount sent by a sender and the total amount returned by a receiver is 4 and 5 tokens, respectively, then $\bar{a}_k^{m,O} + \bar{b}_k^{m,O} = 4 + 5 = 9$. In general, $\bar{a}_k^{m,n} + \bar{b}_k^{m,n}$ measures the total level of cooperation of pair k. In equation (9), $Social_m$ and $Repeat_n$ are dummy variables that take the value 1 if $m = S$ (social treatment) and $n = R$ (repeated game), respectively. The variables $Embeddedness_k$, $PhotosTagged_k$, and $SharedWallposts_k$ are our three measures of social tie strength of pair k mentioned earlier. If a game is played by anonymous strangers, the values of these three variables are 0. If both φ_1 and φ_2 are greater than zero, it implies that repeated play and social ties can sustain a higher level of cooperation. If φ_3, φ_4, and φ_5 are greater than zero, the level of cooperation of pair k is an increasing function of the strength of social ties.

As an additional check, we also change the dependent variable from $\bar{a}_k^{m,n} + \bar{b}_k^{m,n}$ to $\bar{\pi}_k^{m,n}$, where $\bar{\pi}_k^{m,n}$ is the sum of the average period payoff of a sender and a receiver in pair *k*. For instance, in a 10-period repeated game, if the final total payoff of a sender and a receiver is 70 and 80 tokens, respectively, then $\bar{\pi}_k^{m,R}$ = 7 + 8 = 15; in a one-shot game, if the final total payoff of a sender and a receiver is 4 and 8 tokens, respectively, then $\bar{\pi}_k^{m,O}$ = 4 + 8 = 12. In general, $\bar{\pi}_k^{m,n}$ measures the social welfare of pair *k*. If both φ_1 and φ_2 are greater than zero, it implies that repeated play and social ties can achieve a higher level of social welfare. If φ_3, φ_4, and φ_5 are greater than zero, the level of social welfare of pair *k* is an increasing function of the strength of social ties.

Table C1. Pair Level Analysis: Estimating Regression Model (C.1)

	(1)	(2)	(3)	(4)
Variables	**Default OLS**	**Bootstrapping**	**DV as Social Welfare**	**Default OLS**
Repeat	2.142***	2.142**	3.287**	1.854***
	[2.741]	[2.205]	[2.158]	[2.522]
Social	4.358***	4.358***	5.164***	3.116***
	[2.846]	[2.742]	[3.012]	[2.584]
Embeddedness	0.0823*	0.0823*	0.0942*	0.0726*
	[1.792]	[1.773]	[1.788]	[1.724]
PhotosTagged	0.114***	0.114***	0.131***	0.102***
	[3.128]	[3.321]	[2.872]	[2.615]
SharedWallposts	0.148***	0.148**	0.172***	0.127***
	[3.306]	[2.195]	[3.248]	[2.754]
Repeat∗Social				2.023***
				[3.258]
Constant	10.62**	10.62**	12.74**	10.84**
	[2.155]	[2.148]	[2.204]	[2.187]
R-squared	0.684	0.684	0.692	0.695
Observations	400	400	400	400

z or t-statistics in brackets; ***p < 0.01, **p < 0.05, *p < 0.1

The estimation results of equation (C1) are shown in Table C1. In columns 1 and 2 of Table C1, the dependent variable is $\bar{a}_k^{m,n} + \bar{b}_k^{m,n}$, the sum of average amount sent and average amount returned in each period of pair. We find that the cooperation level is significantly higher when the game is played repeatedly or played between Facebook friends. Tie strength measures, such as the number of photos tagged together and the number of shared wall posts, have a significant impact on the cooperation level. We also use the regression model that interacts Social and Repeat. The results are robust and are presented in the column 4. In column 3 of Table C1, the dependent variable is $\bar{\pi}_k^{m,n}$, the sum of the average period payoff of a sender and a receiver in pair *k*, and the results on social welfare of a pair are similar.

Appendix D

Interactions between Social Ties and Prior Round Amount Sent

As a robustness check, we conduct an additional regression analysis on the interaction terms between social tie measures and prior round amount sent. We estimate the regression model as follows:

$$\begin{aligned} a_{it}^{m,R} = {} & c_i + \beta_0 + \beta_1 Social_m + \beta_2\left(Social_m \cdot Embeddedness_{ij}\right) + \beta_3\left(Social_m \cdot PhotosTagged_{ij}\right) \\ & + \beta_4\left(Social_m \cdot SharedWallposts_{ij}\right) + \beta_5 a_{it-1}^{m,n} + \beta_6\left(Social_m \cdot a_{it-1}^{m,n}\right) + \beta_7\left(Social_m \cdot Embeddedness_{ij} \cdot a_{it-1}^{m,n}\right) \\ & + \beta_8\left(Social_m \cdot PhotosTagged_{ij} \cdot a_{it-1}^{m,n}\right) + \beta_9\left(Social_m \cdot SharedWallposts_{ij} \cdot a_{it-1}^{m,n}\right) + \varepsilon_{it}^{m,R} \end{aligned} \quad \text{(D1)}$$

The estimation results are presented in the following table. We find that the coefficients on the interaction terms between social tie measures and prior round amount sent are negative, which suggests that social ties substitute for repeated play, rather than simply add to the effect of repeated play.

Table D1. The Interaction between Social Tie Strength and Prior Round Amount Sent

	(1)	(2)	(3)
Variables	**Default OLS**	**Cluster Bootstrapping**	**Cluster-Robust Inference**
Social	0.805***	0.805***	0.805***
	[2.874]	[2.923]	[2.811]
Social∗Embeddedness	0.273*	0.273*	0.273*
	[1.882]	[1.815]	[1.811]
Social∗PhotosTagged	0.136***	0.136***	0.136***
	[3.325]	[3.274]	[3.167]
Social∗SharedWallposts	0.0842***	0.0842***	0.0842***
	[3.854]	[3.921]	[3.887]
$a_{it-1}^{m,n}$	0.558***	0.558***	0.558***
	[4.145]	[4.023]	[4.108]
Social∗ $a_{it-1}^{m,n}$	-0.0874***	-0.0874***	-0.0874***
	[3.232]	[3.425]	[3.338]
Social∗Embeddedness∗ $a_{it-1}^{m,n}$	-0.101*	-0.101*	-0.101*
	[-1.806]	[-1.796]	[-1.784]
Social∗PhotosTagged∗ $a_{it-1}^{m,n}$	-0.0214***	-0.0214***	-0.0214***
	[-2.954]	[-3.108]	[-3.045]
Social∗PhotosTagged∗ $a_{it-1}^{m,n}$	-0.0134***	-0.0134***	-0.0134***
	[-3.854]	[-3.925]	[-3.755]

z or t-statistics in brackets; ***p < 0.01, **p < 0.05, *p < 0.1

Appendix E

Practical Significance of Tie Strength in Generating Forgiveness

Based on the estimates in Table 7, Figure E1 shows how much the predicted level of forgiveness measured by the amount returned would rise as a result of an increase in PhotosTagged or SharedWallposts when we hold other factors fixed. Suppose that two pairs of participants are identical except the first pair has 20 more photos tagged together and 40 more shared wall posts. When both senders of the two pairs defect, the receiver of the first pair will return approximately 4.5 tokens more than the receiver of the second pair according to Figure E1. That is a significant amount given the average amount returned under AnonONE is 4.03 tokens. Our results suggest that while repeat interactions alone are able to solve the lack of information problem between transacting partners, forgiveness is not as easy to obtain unless the repeated partners are endowed with social relations.

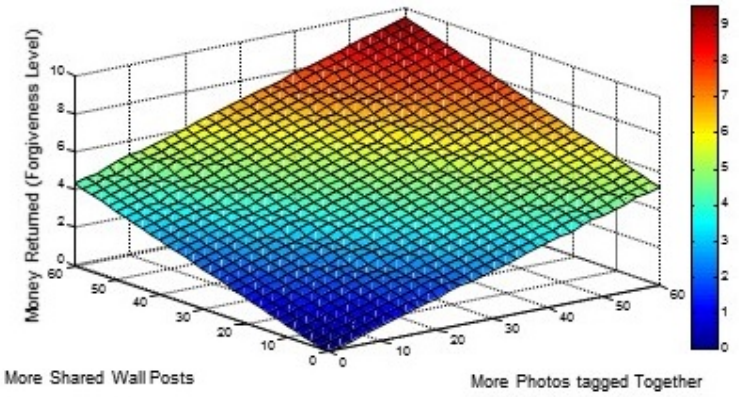

Figure E1. The *Ceteris Paribus* Effect of Social Tie Measures on Forgiveness

Appendix F

Robustness Checks on Separating Confounding Factors in Forgiveness

A potential concern in measuring forgiveness is that a friend is likely to return more than a stranger, even if the friend and the stranger forgive the defection to the same extent. We address this concern by conducting two robustness checks. First, we modify our measure of forgiveness and defections as follows: if $a_{it}^{A,R} < a_{i1}^{A,O}$ in anonymous games or $a_{it}^{S,R} < a_{i1}^{S,O}$ in social games, then we call it a defection. Then, we measure the level of forgiveness in SocialRP:

$$b_{jt}^{S,R} - b_{j1}^{S,O}$$

where $b_{jt}^{S,R}$ is the amount returned in a stage game in SocialRP treatment after a defection, and $b_{j1}^{S,O}$ is the amount retuned in SocialONE treatment. Using the difference, $b_{jt}^{S,R} - b_{jt}^{S,O}$, we try to rule out the confounding factor (the effect that a friend is likely to return more will be cancelled out) and uncover the extra amount that is attributed to forgiveness. Similarly, we measure the level of forgiveness in AnonRP as follows:

$$b_{jt}^{A,R} - b_{j1}^{A,O}$$

where $b_{jt}^{A,R}$ is the amount returned in a stage game in AnonRP treatment after a defection, and $b_{jt}^{A,O}$ is the amount retuned in AnonONE treatment. We present the statistics of the forgiveness measure: $b_{jt}^{m,R} - b_{j1}^{m,O}$ after a defection in Table F1.

Table F1. Statistics of the Forgiveness Measure

	(1)	(2)
Variables	**Forgiveness AnonRP**	**Forgiveness SocialRP**
Mean	1.94	2.86
Std	0.31	0.34

Note: The unit is a token.

We run the following regression equation to examine the effect of social ties on the level of forgiveness.

$$\begin{aligned} b_{jt}^{m,R} - b_{j1}^{m,O} = (\beta_0 - d_o) - d_1 a_{i1}^{m,O} + \beta_1 SocialRP + \beta_2 Embeddedness_{ij} \\ + \beta_3 PhotosTagged_{ij} + \beta_4 SharedWallposts_{ij} + \beta_5 a_{it}^{m,R} + \left(\varepsilon_{jt}^{m,R} - \varepsilon_{j1}^{m,O}\right) \end{aligned} \quad \text{(F1)}$$

where $m = S,A$.

The estimation results are presented in the following table. We find that the coefficient on SocialRP, β_1, is still positive and statistically significant, which implies social connections can increase the level of forgiveness. A concern in regression equation (8) is that β_1 being positive may be simply because friends are likely to return more, not because they have a higher level of forgiveness. Our regression equation (F1) is different from equation (8). Specifically, the level of forgiveness in SocialRP is measured by $b_{jt}^{S,R} - b_{j1}^{S,O}$ in equation (F1) instead of $b_{jt}^{S,R} - b_{j1}^{A,O}$ in equation (8). In equation (8), if $b_{jt}^{S,R} - b_{j1}^{A,O}$ is larger, we would say that receiver *j* has a higher level of forgiveness in SocialRP. In this case, a positive β_1 in equation (8) may be driven by the fact that friends are likely to return more (not because they have a

higher level of forgiveness). To put it simply, if the mean of $b_{jt}^{S,R} - b_{j1}^{A,O}$ is greater than the mean of $b_{jt}^{A,R} - b_{j1}^{A,O}$, β_1 in equation (8) is very likely to be positive, but it may suggest that friends are likely to return more instead of a higher level of forgiveness.

Table F2. Forgiveness as a Function of Social Ties: Regression Models (F1)

	(1)	(2)	(3)
Variables	**Default OLS**	**Cluster Bootstrapping**	**Cluster-Robust Inference**
Embeddedness	0.00553**	0.00553**	0.00553**
	[2.143]	[2.087]	[2.034]
PhotosTagged	0.0924**	0.0924**	0.0924**
	[2.226]	[2.147]	[2.152]
SharedWallposts	0.0715***	0.0715***	0.0715***
	[3.325]	[3.142]	[3.107]
SocialRP	0.187***	0.187***	0.187***
	[3.542]	[3.321]	[3.204]
$a_{it}^{m,R}$	1.701**	1.701**	1.701**
	[2.228]	[2.164]	[2.107]
$a_{i1}^{m,O}$	-1.633***	-1.633**	-1.633**
	[-2.856]	[-2.183]	[-2.274]
Constant	2.421***	2.421***	2.421***
	[3.206]	[3.144]	[3.086]
R-squared	0.188	0.188	0.188

z or t-statistics in brackets; ***p < 0.01, **p < 0.05, *p < 0.1

In equation (F1), we change the dependent variable. If $b_{jt}^{S,R} - b_{j1}^{S,O}$ is larger, we would say that receiver *j* has a higher level of forgiveness in SocialRP. In this case, the effect of social ties is likely to cancel out in $b_{jt}^{S,R} - b_{j1}^{S,O}$. In other words, if the mean of $b_{jt}^{S,R} - b_{j1}^{S,O}$ is greater than the mean of $b_{jt}^{A,R} - b_{j1}^{A,O}$, β_1 in equation (F1) is very likely to be positive. The confounding factor that friends are likely to return more becomes less of a concern because it will be canceled out in $b_{jt}^{S,R} - b_{j1}^{S,O}$ to a large degree. Although the confounding factor may not be perfectly canceled out in equation (F1), the results in Table F2 capture the effect of social ties on forgiveness more precisely.

Second, we provide an additional check to separate these two effects: friends are more generous to each other, versus friends are more forgiving. In the former case, a friend receiver will return back a larger portion of tokens, compared to a stranger receiver, but the amount returned is more correlated to the amount sent (in other words, there is punishment if the sender defects). In the latter case, a friend receiver's amount returned is less correlated with the amount sent (in other words, a friend returns a larger share than a stranger when the sender deviates). Therefore, we look at the correlation between the amount sent and the amount returned in both SocialRP and SocialONE. In our study and also in the prior literature, forgiveness is usually defined in the context of repeated interactions (Fudenberg et al. 2012; McCullough 2001). Therefore, we conjecture that in SocialONE, the main mechanism is that friends are more generous. In contrast, in ScoialRP, the main mechanism is that friends are more forgiving. From our data, the correlation between the amount sent and the amount returned in SocialONE is 0.762, which is greater than the correlation between the amount sent and the amount returned in SocialRP, 0.405. This result suggests that generosity between friends is more common in SocialONE, but forgiveness is more common in SocialRP. There still might be generosity in SocialRP, but forgiveness makes the correlation coefficient in SocialRP smaller. On the other hand, the result also confirms that $b_{jt}^{S,R} - b_{j1}^{S,O}$ after a defection (in our first robustness check) is a good measure of the level of forgiveness in SocialRP.

In Crawford and Haller (1990), players in an anonymous repeated game can learn from the history of the game and revise their strategies. We further control for the past actions of the sender ($a_{it}^{m,R}$ and $a_{i,t-1}^{m,R}$), which reflects the history of the game, in regression (F2). The results are robust and are presented in Table F3. In other words, we take into account that the receiver may learn from the senders' past behaviors in regression (F2). However, due to the restriction of linear regressions, this learning process is also linear. This is a limitation as well as a future research direction of our study.

$$b_{jt}^{m,R} - b_{j1}^{m,O} = (\beta_0 - d_0) - d_1 a_{i1}^{m,O} + \beta_1 SocialRP + \beta_2 Embeddedness_{ij} + \beta_3 PhotosTagged_{ij} + \beta_4 SharedWallposts_{ij} + \beta_5 a_{it}^{m,R} + \beta_6 a_{i,t-1}^{m,R} + \left(\varepsilon_{jt}^{m,R} - \varepsilon_{j1}^{m,O}\right) \quad \text{(F2)}$$

where $m = S,A$, and $t \geq 2$.

Table F3. Forgiveness as a Function of Social Ties: Regression Models (F2)

	(1)	(2)	(3)
Variables	**Default OLS**	**Cluster Bootstrapping**	**Cluster-Robust Inference**
Embeddedness	0.00482**	0.00482**	0.00482**
	[2.083]	[2.128]	[2.114]
PhotosTagged	0.0872**	0.0872**	0.0872**
	[2.205]	[2.187]	[2.145]
SharedWallposts	0.0688***	0.0688***	0.0688***
	[3.256]	[3.084]	[2.943]
SocialRP	0.184***	0.184***	0.184***
	[3.337]	[3.114]	[3.108]
$a_{it}^{m,R}$	1.105**	1.105**	1.105**
	[2.024]	[2.087]	[2.093]
$a_{i1}^{m,O}$	-1.452***	-1.452**	-1.452**
	[-2.664]	[-2.235]	[-2.218]
$a_{i,t-1}^{m,R}$	0.436**	0.436**	0.436**
	[2.144]	[2.152]	[2.157]
R-squared	0.197	0.197	0.197

z or t-statistics in brackets; ***p < 0.01, **p < 0.05, *p < 0.1

Appendix G

Distribution of the Strength of Social Ties

Table G1. Distribution of the Strength of Social Ties

Variables	25 Percentile	Median	75 Percentile	90 Percentile
PhotosTagged	0	1	12	29
SharedWallposts	0	2	6	9.5
Embeddedness	0.05	0.18	0.43	0.56

References

Crawford, V. P., and Haller, H. 1990. "Learning How to Cooperate: Optimal Play in Repeated Coordination Games," *Econometrica* (58:3), pp. 571-595.

Fudenberg, D., Rand, D. G., and Dreber, A. 2012. "Slow to Anger and Fast to Forgive: Cooperation in an Uncertain World," *American Economic Review* (102:2), pp. 720-749.

McCullough, M. E. 2001. "Forgiveness: Who Does It and How Do They Do It?," *Current Directions in Psychological Science* (10:6), pp. 194-197.