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Conformism and Social Connections:

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Abstract

Recent years registered a renewed interest in social interactions. However, due to some well-known identification problems, empirical estimation of peer effects remains quite problematic. To overcome problems of this kind, a database providing detailed information on the sequential structure of choices is analyzed. Observations refer to the deposit of money in a personal account devoted to the purchase of food at campus refectories. A clear tendency to conform to directly observed deposits is registered in the data. Furthermore, higher conformism is observed among mutually acquainted individuals.

Keywords: Social interactions; Conformism; Social Proximity; Food Purchase

1 Introduction

According to standard economic analysis decision making is a goal-oriented process performed by individuals in isolation. Within this framework interactions among economic agents are exclusively mediated by the market. This approach has been subject to critiques because of its neglection of interactions happening outside the market insitution(Granovetter, 1985). To account for interactions of this kind, network analysis has been successfully applied to various domains having relevant economic contents. As an example, consider the the relevance of networks and connections that has

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been evidenced by a large number of job market studies (for a review see, Ioannides and Datcher Loury, 2004). In addition to this, recent theoretical contributions have advanced the understanding of dynamics associated to social interactions over networks (see among others, Bala and Goyal, 2000).

The study of interactions happening outside the market institution calls for an appraisal of such interactions. Among the various channels that may affect the actions of others, a relevant role is played by the *interactions at the preference level* (Manski, 2000). Interactions of this kind are observed when the relative desirability of alternatives depends on choices undertaken by other subjects. Casual empirical observations seem to confirm that people tend to conform to actions of subjects in their reference group (e.g., dress codes). It may well be that shared habits and tastes were the outcome of interactions at the preference level. Unfortunately, empirical estimation of such peer effects remains quite problematic. Manski (1993) illustrates various problems of identification encountered when trying to estimate whether the average characteristics of a group influence individual behavior. In particular, some complications due to the simultaneity of peer influences and to endogenous matching are investigated. The author shows that, even in the best-case scenario, employing a linear model only allows to estimate a composite social effect. In other terms, it will generally not be possible to separately identify the effects springing from genuine endogenous interaction and the effects related to the exogenous characteristics of the agents. Different strategies have been pursued to overcome these identification issues (for a review see, Soetevent, 2006). Nevertheless, clean estimation of endogenous social effects with happenstance field data remains an open task.

The present study aims at overcoming problems of identification by considering a dataset of discrete choices characterized by unidirectional local interactions. In addition, a measure of mutual acquaintance is introduced to control for potential effects related to endogenous matching. In more details, the observed discrete choice refers to the voluntary commitment of a certain amount of wealth to future food consumption. The observations are collected at the campus refectories of the University of Trento, Italy. Social connections are identified by computing the number of meetings at the campus refectory. The issue of social interactions is addressed by considering the impact of the commitment choice of a subject in the queue for lunch (i.e., the *leader*) on the same choice of the immediately following subject in the queue (i.e., the *follower*).

A renewed interest on the dynamics of the demand side of the economic system (Witt, 2001) has evidenced some crucial aspects connecting consumption and social structures. This connection is made explicit by Aversi *et al.* (1999), who stress the role of social interaction in building consumption habits and routines. The link between identity, social structures (e.g., friendship, group membership) and consumption has traditionally been neglected by economic theory. Stable and context-independent preferences are commonly assumed. In the present study the presence of social connections enters the analysis both as a control measure to identify endogenous social interactions in random matched couples but also as an observation variable adding a further dimension to the study of social spillovers.

Before reviewing some applied works on social spillovers, it is useful to point out some basic commonalities shared by formal models of social interaction (Glaeser and Scheinkman, 2003). First, the utility function of an individual accounts both for individual actions and actions of peers in a reference group. Second, a measure of social proximity provides links between different subjects and, finally, interactions can be either local or global.

Literature Review

Models of social interaction have been applied to various kinds of decisions having relevant economic consequences. With reference to social learning and the introduction of a new technology or technique, Conley and Udry (2000), show that farmers in Ghana tend to learn and adopt successful practices implemented by their neighbors. Miguel and Kremer (2003) considers the diffusion of a deworming drug in Kenya. The study points out the presence of endogenous social effects in the form of negative social learning. Indeed, individuals with more social connections were less likely to take the deworming drug because they were told by peers that the drug was ineffective.

Relevant contributions on social spillovers were developed with reference to preferences and attitudes towards other members of the reference community. Relying on aggregate data, Glaeser *et al.* (1996) show the relevance of social interaction in criminal behavior. In particular, social interactions seem to heavily affect the behavior of young individuals and to impact more on certain criminal activities. As the present study is focused on choices made by undergraduate students, the work of Sacerdote (2001) is of particular interest. The author measures peer effects among students who are randomly assigned to a college dormitory. What emerges from the empirical analysis, is that strong peer effects are identified in exam performances and in decisions involving social life. Instead, no similar effects are registered in choices having long-term consequences (e.g., the choice of the major).

A growing field of inquiry about social interactions is that on intertemporal choices. Duflo and Saez (2002) show that, strong social effects are present when searching for information about a pension plan. In the study of Sorensen (200x) individual longitudinal data are collected. The empirical investigation starts from the observation that health plan decisions are highly correlated at the department level. By controlling for possible unobservable fixed effects at the department level, the author shows that decisions of the coworkers are important in the choice of health plan but not dominant when compared to other factors.

Interesting insights on the interdependence between different agents can be found in other fields than economics. In animal communities, communication of preferences and social learning seem to play a fundamental role in food gathering and other basic behaviors. Galef (1996) presents a review of social learning studies based on rats. An interesting finding of a laboratory experiment is that observing other rats eating a specific kind of food induces a preference for that food in the observer. The evolutionary explanation given by the author is that food which is eaten by some conspecific is less likely to be poisoned. Concerning the impact of social learning on humans, Henrich and McElreath (2003) consider the interaction between individual learning and social learning (imitation) and define some optimal patterns of imitation. According to the authors, individual learning is fundamental to bring innovation into a society but social learning can foster the diffusion of innovation. The relevance of social learning in the form of imitation has been confirmed also by recent research in neuroscience, both in humans (Iacoboni *et al.*, 1999) and in primates (Subiaul *et al.*, 2004).

What emerges from this brief literature review is that social interactions, although difficult to identify, are likely to influence individual behavior in various decisional tasks. The regression analysis reported in section 3.4 provides strong support to the hypothesis that endogenous social effects are the leading determinant of the decision to commit part of the personal budget to nutritional purposes. The quantitative analysis evidences also that stronger conformism is registered among subjects who are socially connected by mutual acquaintance. The remaining of the work is organized as follows. Section 2 illustrates how data employed in the analysis were collected and organized; Section 3 reviews some identification issues presents the results of the quantitative analysis; Section 4 discusses results and concludes.

2 Method

2.1 Data Source

Data employed in the analysis were collected by computerized systems located at different refectories of the University of Trento and were recorded by a central electronic database.[1] Each student of the University of Trento is provided with a personal ID card. The name of the owner and his/her own picture are printed on the card (see Figure 1). The card allows the owner to access various facilities at the campus. However, the present study considers only the purchase of meals at the campus refectories.

Figure 1 about here

The standard procedure to buy a meal at the campus refectories can be decomposed into different stages (see Figure 1). First, the customers enter the refectory and form a queue when approaching the counter where food is served by the refectory's employees. Second, the customers choose their meal

[1]Data were kindly provided to the author by the office which manages accommodation services (e.g., housing, meals, scholarships) to the students of the University of Trento, Italy.

at the counter and approach the cash desk preserving their relative position in the queue. Finally, the customers pay for their meal. The subject who is paying is not isolated from following subjects in the queue. Due to the electronic card various information are collected at the payment stage. In particular, the timing of the money transfer, the terminal ID number, the amount transferred, the type of operation and the ID of the customer are stored in the database.

Cash transfer can exceed the amount due for the meal. Cash in excess is either returned or stored on a private account which can be accessed with the personal ID card. Money deposited in the meal account can be spent only at the cash desk and only to buy meals at the refectory.

The deposit act, while being of small scale, presents some interesting features from an economic point of view. First, it is important to notice the qualitative content of the decision making. The act of depositing wealth in the account involves intertemporal allocation of consumption resources. Second, even if direct support cannot be provided here, it seems plausible to assume that Italian undergraduate student face budget constraints that render the choices considered here relevant to them, even if small in absolute terms.

Quantitative analysis presented in section 3 focuses on decisions to deposit cash in the personal meal account. Two important aspects of the observational unit must be highlighted. First of all, at the time when data were collected the routine described above was the only procedure available to deposit money in the personal meal account. Moreover, wealth deposited was not rewarded with any kind of interest rate. Thus, by depositing money on the card customers face an opportunity cost. However, three main concurrent motivational factors can, at least partially, explain deposits.

First, payment by card can reduce transactions costs associated with payment by cash. Indeed, payment by cash might entail a cost for subjects as it forces to pay attention on change returned by the cashier. People may prefer to pay their meals through an easy swipe of the electronic card. Moreover payment through the electronic card is faster than payment in cash.

Second, payment by card provides an implicit insurance. In fact, wealth deposited on the card is recorded in a database. If the card is lost or stolen, money can still be recovered through the payment of a cost due to the re-issue of a new card. This feature provides the card with an insurance advantage which is not present when transactions are made by cash.

Finally, the commitment of money to nutritional purposes provides an effective self-control device. Food consumption may be perceived as having positive impact on long-term health status but as being less desirable in the short term when compared with other kinds of activities having a negative impact on health status. In this perspective, the meal account can be thought of as a commitment technology for sophisticated subjects with self-control problems (O'Donoghue and Rabin, 2000).

The motivational factors described above may affect decisions in the task considered. However, focus of the present work is on the impact that actions of relevant others have on actions of an agent. Particular attention will be paid to conformism. In simple terms, this can be defined as the tendency to act in a certain way because other individuals in a reference group are behaving that way. Various features of the decision process under examination suggest that peer effects are likely to play a relevant role in explaining observed behavior. Indeed, decisions are observed just after the introduction of the meal account. This implies that subjects do not maintain strong prior beliefs about the meal account and that the task is not a routinized activity. Both this conditions seem likely to favor the imitation of others' actions. A further element that can favor endogenous social effects is the fact that the decision makers all belong to a pool of university students. Various studies in the tradition of Social Identity Theory (Tajfel and Turner, 1986) highlighted the relevance of shared characteristics in the formation of beliefs about others' actions. It emerged, among other findings, that higher degrees of perceived similarity induce a better opinion about features and actions of the others (Turner, 1985). Thus, a psychological mechanism of this kind may also favor the transmission of behavior in the population under examination.

The quantitative analysis reported in Section 3.4, while controlling for additional explanatory factors, will explicitly address the issue of replication of the behavior of relevant others.

2.2 Mutual Acquaintance

A measure of mutual acquaintance is crucial to the analysis of the deposit act. This variable provides a clear identification of social connections in the dataset. Couples of subjects are characterized by mutual acquaintance if, during the time window considered here,[2] individuals in the couple are "close" in the queue at least a certain number of times.

In more details, the following strategy was pursued to identify mutual acquaintance. First, following the temporal order in the database, each subject is progressively kept as reference and individuals preceding her at the cash desk of k seconds and subjects following her of k seconds are recorded in an array.[3] The same operation is repeated each time the same ID shows up in the database. All the individuals met by the targeted subject are recorded in the array. The same procedure is applied to each subject in the database. Second, an *index of social connection* is created by counting the number of encounters between a subject and all the the other subjects in the dataset. The same operation is repeated for each subject. As an example, if subject i and subject j met four times, their index of social connection is equal to 4. Finally, when the index of social connection is higher than a given threshold h the two subjects are classified as being mutually acquainted.

Some numerical simulations were performed to define the threshold h of encounters that identifies mutual acquaintance (see Figure 2). In more details, an ordered array of artificial individual observations (Y) is built by randomly sampling (without re-introduction) elements from the array of empirical individual observations. Then, a series of random draws of length equal to the length of Y is recorded in an ordered array X. The draws are performed on a uniform distribution. An array of timing T of each observations in $y \in Y$ is defined by adding the corresponding $x \in X$ to the timing of the preceding observation. Concerning the lower boundary condition, the

[2]Data collected refer to the period going from February 9^{th}, 2004 to December 31^{st}, 2004.

[3]Two different maximum intervals between the operations were employed (i.e., $k = 60$ and $k = 120$). The regression analysis reported in Section 3.4 is based on data obtained from $k = 60$.

timing of the first observation in Y is set equal to the corresponding element in X.[4]

To gain in the understanding of the dynamics governing meetings in the queue for lunch, two different sets of simulations are computed by varying the support of the distribution from which each $x \in X$ is randomly drawn. In particular, two distinct uniform distributions are employed and two distinct arrays X obtained (i.e., $X_1 \backsim U(1,31)$ and $X_2 \backsim U(1,15)$). Given that the smaller k is equal to 60, both specifications imply that two consecutive meals produce an encounter between the two subjects. The average and the median time interval between consecutive choices in the emprical distribution are equal to 76.524 and 36, respectively. This implies that the likelihood of the encounters between couples of subjects is, overall, higher in the simulations than in the real sample. This penalizing assumption aims at enriching the comparison between real data and randomly generated sequences.

Figure 2 about here

Figure 2 portrays part of the cumulative distribution of the index of social connection in the simulations and in the real values. Only couples of subjects with at least one meeting are considered. To preserve the informativeness of Figure 2, the frequency of unitary meetings in real values has been omitted from the graph. The frequency amounts to 0.7752 for the distribution with k=60 and 0.7461 for the distribution with k=120.[5]

From Figure 2 it emerges a strong difference between real and simulated data and a very low differences among simulated values. Simulated distributions are almost completely characterized by single encounters and the mass of the distribution is accumulated on values lower than 3. On the other side, the index of social connection in real data extends over values greater than 1 and single encounters do not absorb the whole distribution of observations. From a comparison between simulated and real values, it seems plausible

[4]As an example, if $Y = \{10, 2, 5\}$ and $X = \{20, 120, 80\}$ the array of timing is $T = \{20, 140, 220\}$.

[5]The number of encounters in Figure 2 is much greater than the number of subjects. This is due to the fact that each subject can have multiple encounters during the life span of the database. Moreover, an encounter is not computed only with respect to the subject immediately close in the queue but with respect to all the subjects in the time range defined by k.

to argue that repeated encounters in real data are not the byproduct of a random matching process but, instead, are a reliable signal of the existence of social connections.

Relying on the evidence collected from the distribution of meetings obtained from simulated values, the threshold h is set equal to 4 when $k = 60$ and equal to 7 when $k = 120$. Some robustness checks on the plausibility of this threshold will be presented in the analysis below.

3 Data Analysis

3.1 Identification Issues

The seminal work of Schelling (1973) brought economists' attention to interactions between individual discrete choices. In a recent contribution on this issue, Brock and Durlauf (2001) consider the properties of generalized logistic models in the presence of social interactions. In models of this kind, the introduction of a utility component related to the actions of others in the individual utility function solves the problem of social interactions. The assumptions underlying the Brock and Durlauf's formal model are quite strong and likely to limit the applications to real-world interactions. Evans *et al.* (1992) present an empirical estimation of peer group effects among teenagers regarding teenage pregnancy and school dropout. To control for problems of self selection, a simultaneous equation model, instead of a single equation model, is employed in the analysis. The estimation strategy followed shows that, when the observed behavior is not independent of the choice of joining a reference group, a single equation model is likely to overestimate the impact of group's characteristics on observed decisions. As already mentioned, Manski (1993) focuses on a fundamental problem of empirical estimation of endogenous social effects. Indeed, when the behavior of a subject is linked to the average characteristics of a reference group, a problem in the identification of the causality of social spillovers emerges (i.e., *reflection* problem). The characteristics of the subjects are defined by the average characteristics of the group which, in turn, influence group's characteristics. It follows that, even under conditions of independence in the matching of the population, only a composite social effect is identifiable.

Endogenous effects (i.e., originating from the behavior of the group) cannot be disentangled from *exogenous* effects (i.e., originating from exogenous characteristics of the group) or *correlated* effects (i.e., originating from the similarities among group members).

The database employed here offers a unique opportunity to overcome problems of simultaneity and endogenous matching. In fact, endogenous effects are not estimated with reference to a summary measure of the characteristics of the reference group but, with reference to a predetermined and directly observed choice of another subject (i.e., the leader). This represents a valid solution for the reflection problem. Indeed, the subject whose choice is considered can only observe the action of the other subject and not influence it. The causality of social interaction is thus embedded in the physical structure of the decision making process which only allows for spillovers from the action of the leader to the action of the follower.

As already noticed, when matching is not random, endogenous effects cannot be distinguished from effects due to exogenous characteristics of the subjects or from unobservable common characteristics (e.g., tastes and motivations). To control for the consequences of deliberative matching, an interaction term between the action of the leader and the social connection between the leader and the follower is introduced in the analysis. The presence of the interaction term allows to assess conformism only with reference to the choices observed under a condition of pseudo-experimental matching. Finally, it is important to remark that the possibility of effectively identify endogenous social effects relies on the fundamental assumption that choices are not publicly revealed before the associated action becomes observable. The robustness check reported in Section 3.4.1 seems to support this assumption.

3.2 Description of the Variables

The dependent variable of the analysis (Follower Deposit, FD) refers to the act of deposit performed by a follower. It is a dichotomous variable, equal to 1 when more or equal than 10 EURO are deposited in the meal account in correspondence to the first transfer after the introduction of the account technology. Otherwise, it is equal to 0. As the maximum price for a meal is

3.10 EURO, a deposit allows to purchase at least 3 meals at the refectory.

Concerning the explanatory variables, the following measures are employed in the analysis.

Deposit Leader (DL) is equal to 1 when the leader deposits more than 10 EURO in the meal account in correspondence to the first transfer after the introduction of the account technology. Otherwise, it is equal to 0. The estimated coefficient associated to this variable reflects the endogenous social spillovers originating from the action of the leader and directed towards the action of the follower.

Acquaintance (A): assumes value 1 when the follower and the leader are mutually acquainted. When no significant social connection is present the value assumes value 0. The relationship between each subject of the couple of decision makers is built following the procedure described in section 2.2 for the definition of a_{ij}. In the main regression, the parameter h is set equal to 4. Thus, when subjects meet more than 4 times during the time window covered by the database the variable acquaintance assumes value 1, while it is equal to 0 in the remaining cases.

The interaction term *Deposit Leader* $\times$ *Acquaintance (DL*A)* is equal to 1 when an amount equal or greater than 10 EURO is deposited by the leader and the leader is acquainted with the follower. Given that this variable is an interaction between the two covariates previously described, it is equal to 0 when the leader is not acquainted with the follower and/or the leader does not deposit an amount equal or greater than 10 EURO in the meal account. The variable provides a control on the interactions between subjects that are not randomly matched. As stated before, this variable makes it possible to disentangle genuine endogenous effects from exogenous and correlated effects. However, the coefficient of the interaction term provides only a compound estimation of effects that are to be ascribed to exogenous characteristics of the leader and to the unobservable characteristics shared by the leader and the follower.

International student (IS) is equal to 1 when the individual is an international student and equal to 0 when the student is Italian.

Male (M) accounts for the gender of the subject (i.e., 1=male, 0=female)

Total Transactions (TT) registers the total number of transactions performed by the subject over the time span of the dataset. It is used as a proxy for the number of meal purchases that the decision maker expects to make at the time of the introduction of the meal account. This variable is likely to play a fundamental role in the definition of motivational factors detailed in Section 2. Indeed, transaction costs, self-control problems and insurance effects associated to the use of the card are all positively affected by the frequency of meals purchased at the refectory.

Week beginning (WB) is equal to 1 when the day of the registered transaction is the beginning of the working week and 0 otherwise. The variable controls for a potential increase in the deposits at the beginning of the working week.

3.3 Descriptive Statistics

Descriptive statistics about the amount of money associated to a deposit act are reported in Table 1.

Table 1 about here

Table 1 shows that the vast majority (88.60%) of money transfers are not associated with a deposit act. The average amount deposited amounts is about 14 EURO and the median of the distribution of deposits is equal to the threshold value of 10 EURO. This is likely to signal the presence of extreme values in the deposits. For transfers not associated with a deposit act, the median and the average values of the distribution are very similar. In particular, the former is equal to the price of the cheapest meal available at the campus refectory.

The regression analysis reported in Section 3.4 focuses on the interaction between the deposit act of the leader and the same act of the follower. A further dimension, namely mutual acquaintance, is considered to check whether social connections are likely to influence patterns of conformism. The following tables present some descriptive measures referred to the sample employed in the regression analysis. The sample is built by considering only the first decision of each subject after the introduction of the technology. Moreover, only transactions performed by a follower within 60 seconds from the action of the leader are considered. Encounters are defined by setting $k = 60$.[6] Finally, mutual acquaintance is defined by setting $h = 4$.

Table 2 reports the distribution of the deposit acts of the followers (i.e., FD) conditional on the status of mutual acquaintance between followers and matched leaders (0 = stranger, 1 = mutual acquaintance).

Table 2 about here

From Table 2 it emerges that about 25% of transactions in our sample are performed by followers being acquainted with the matched leader. Deposit is relatively more frequent among these subjects (18.17%) than among subjects matched with a stranger (9.15%). However, given the higher frequency of matching with a stranger, the majority of deposits (60.30%) are performed by followers matched with a stranger .

The main concern of the present work is the identification of endogenous interactions between actions of the leaders and actions of the followers. At this aim, before approaching the regression analysis, it is useful to present some indicators of the correlation between decisions of interacting couples in the regression sample. A positive and statistically significant correlation between decisions of the leader and decisions of the follower is registered (Spearman's rho = 0.2810, p-value = 0.000). In particular, a stronger correlation is registered between subjects linked by mutual acquaintance (Spearman's rho = 0.4589, p-value = 0.000) than between strangers (Spearman's rho = 0.1658, p-value = 0.000). Table 3 presents the cross correlation indexes of the explanatory variables employed in the regression analysis of Section 3.4.

Table 3 about here

In general, the level of correlation between explanatory variables is low. In particular, total transactions are positively correlated with some of the explanatory variables, but, except for the variable acquaintance, the magnitude of these correlations is quite modest. Thus, on the basis of Table 3,

[6] Results do not significantly change when considering the time interval $k = 120$.

it can be argued that the fulfillment of the exogeneity condition is generally met for what concerns explanatory variables employed in the regression analysis reported below.

3.4 Regression Analysis

The regression analysis provides an estimation of the impact of different explanatory variables on the probability of observing a deposit in the meal account. The logit estimation presented in Table 4 is based on cross-section data about the first transaction after the introduction of the meal account technology. Estimations reported in Table 4 are expressed in the odds ratio format. This provides us with information about the change in the odds of observing a positive realization of the dependent variable when alternative realizations of an explanatory variable are observed. Given two possible realizations for an explanatory variable X, $X_1 = 1$ and $X_0 = 0$, an odds ratio bigger than 1 implies that odds associated to X_1 are bigger than odds associated to X_0. Thus, the probability of observing a positive realization in the dependent variable is higher among those facing an $X = 1$ than among those facing an $X = 0$.

<u>Table 4 about here</u>

From the estimation reported in Table 4, it clearly emerges that a deposit of the leader significantly increases the odds of observing a deposit of the follower. The odds of observing a deposit of the follower associated to a deposit of the leader are almost three times bigger (2.968) than the odds associated to the alternative choice of the leader. From this it can be argued that followers tend to conform to observed actions of the leaders.

The odds ratio associated to the interaction between mutual acquaintance and the leader's deposit shows that in the presence of the interaction the odds of observing a deposit of the follower are more than three times bigger (3.561) than the estimated odds in the alternative condition. Also in this case the statistical significance of the estimated coefficient is very high. Thus, the presence of a symmetric social connection between the leader and the follower strengthens the tendency to replicate observed actions.

In contrast, the effects of mutual acquaintance are low in magnitude and not statistically significant. This means that the social connection with the leader does not affect the action of the follower, *per sé*.

Concerning control variables, the following effects are registered. First, the fact that the transaction happens at the beginning of the week increases the chances of observing a deposit. Second, males tend to deposit more often. Third, performing an high number of transactions in the future increases the likelihood of a deposit today. Finally, being an international student decreases the chances of depositing on the meal account.

3.4.1 Robustness Check

A robustness check has been performed to provide support to the identification strategy employed. Four different combinations of proximity of decisions (diff) and social connection (h) are considered. A reliable identification structure should capture stronger endogenous social effects when a more strict definition of reciprocal knowledge (i.e., higher h) or a lower time interval between decisions (i.e., lower $diff$) are considered. Table 5 reports the specification of the parameters adopted and the expected consequences on endogenous social effects under the hypothesis of an effective identification strategy.

<u>Table 5 about here</u>

The last column of Table 5 shows the expected direction of the change in the coefficient of the explanatory variable capturing social effects (i.e., *Deposit Leader*). Specification (1) is characterized by a stronger definition of mutual acquaintance than in the main regression. In (2) a shorter time interval between decisions is considered. In (3) a longer time interval between choices in a couple is imposed (i.e., potential absence of visual interaction is imposed on the estimation). Finally, in (4) a very long distance between decisions of the leader and decisions of the follower and a very loose definition of mutual acquaintance is introduced in the estimation.

<u>Table 6 about here</u>

The following patterns emerge from the comparison between robustness checks reported in Table 6 and the estimation presented in Table 4. In line with the prediction of robustness, a stronger positive impact of the deposit of the leader is registered in parameterization (1) and (2). In addition, the impact of the same variable decreases in condition (3) and almost vanishes in estimation (4). Concerning the interaction term, its impact on deposit odds is positive and highly significant in specification (1) and (2) and becomes statistically not significant in conditions (3) and (4). The control variables do not exhibit relevant changes in terms of the direction of the effect across different parameterization. However, some changes are registered in terms of statistical significance of the coefficients.

Overall, the results of the robustness check seem to support the validity of the identification strategy employed. Interestingly, the statistical significance of the coefficient associated with the interaction term vanishes when a longer time interval between decisions is imposed (i.e., specification (3)). This suggests that interaction effects between actions of non-strangers depend on visual interaction between the subjects. It follows that the coefficient of the interaction term is likely to capture social effects associated to exogenous characteristics of the leader and not to shared unobservable factors. Indeed, the correlation in choices due to shared unobservable factors (e.g., tastes and motivations) does not require the observation of a fellow's choice as it originates from the preference structure of each decision maker. Thus, the increase in conformist behavior associated to mutual acquaintance is likely to have its origin in the leader's exogenous characteristic of being acquainted with the decision maker. This implies that a stronger motivation originates from imitation of a socially connected subject than from imitation of a stranger.

4 Conclusions

In recent years the issue of social interactions has attracted the interest of economists. However, a reliable identification of social spillovers in empirical field data is still a difficult task. In this study, a dataset providing a detailed sequential description of the decision process was employed in order to overcome well-known problems of identification. Choices analyzed refer to the deposit of money on a personal account devoted to the of food at a campus refectory. These choices involve relatively small amounts of wealth. Nevertheless, they represent an interesting observational unit as they involve both intertemporal allocation of wealth and nutritional needs. These two dimensions characterize a large part of the decisions observed in an economic system. The detailed timing structure associated to individual observations permits also to identify clusters of individuals who frequently meet in the queue for lunch at the refectory. The frequency of this kind of meetings was employed to build a matrix of social proximity. The procedure followed was supported also by computer simulations.

The identification of endogenous social interactions relied on two features of the dataset: the possibility to control for endogenous matching and the unidirectional nature of social spillovers. From the identification strategy pursued it emerged that subjects tended to conform to directly observed deposit acts in the queue for lunch. Moreover, stronger conformism was observed in couples of non-strangers. The robustness check helped interpret this fostering in imitation among mutually acquainted subjects. When the distance between decisions was instrumentally increased, the impact of mutual acquaintance on conformist behavior vanished. If the effect under examination had been due to correlated unobservable factors, this pattern should not have been observed. Thus, it seems likely that conformism was increased by the fact that the decision maker perceived the leader as a non-stranger and, in addition, directly observed her actions.

Similar findings are present in the behavioral literature (e.g., Smoski and Bachorowski, 2003). However, due to its relevance in the field of economic decision making, the impact of social proximity on imitative behavior deserves further attention.

Finally, from a methodological point of view, the present work highlights the opportunity of exploiting fine-grain data sources to estimate endogenous social interactions which are otherwise difficult to identify. The increasing diffusion of electronic cash may help extend this methodological approach to other decisions having relevant economic consequences.

A Tables

Table 1: Deposits: descriptive statistics ($k = 60$)

	N	mean	sd	med
	6940	4.278	5.126	2.6
Deposit	791	14.523	10.275	10
No Deposit	6149	2.960	.921	2.6

Table 2: Mutual Acquaintance and Deposits ($k = 60$)

		Acquaintance		
		0	1	Tot
Deposit	0	4735 (77.00%) (90.85%)	1414 (23.00%) (81.83%)	6149 (100.00%) (88.60%)
	1	477 (60.30%) (9.15%)	314 (39.70%) (18.17%)	791 (100.00%) (11.40%)
	Tot	5212 (75.10%) (100.00%)	1728 (24.90%) (100.00%)	6940 (100.00%) (100.00%)

Table 3: Correlations among the explanatory variables ($k = 60$)

	Acquaintance	Week Beginning	Male	Int. Stud.
Week beginning	-0.0016			
Male	0.0531*	-0.0360		
Int. Student	-0.0151	-0.0199	0.0365	
Total Transactions	0.357*	0.0326	0.1954*	0.0605*

Spearman's rho correlations; * = statistically significant at the 1% level

Table 4: Logistic Regression Estimation

Deposit Follower	Odds Ratio (s.e.)
Deposit Leader	2.968 (0.430)***
Acquaintance	0.987 (0.126)
*DL*A.*	3.561 (0.813)***
Week beginning	1.306 (0.135)**
Male	1.611 (0.166)***
Int. student	0.263 (0.097)***
Tot. transactions	1.016 (0.002)***
Obs	4871
Prob > chi2	0.000
Pseudo R2	0.1541

***(0.1%); **(1%); *(5%) significance level

Table 5: Robustness check - parameters specification

Specification	h	diff	$\triangle$ endog. social effects
(1)	10	< 60	$+$
(2)	4	< 30	$+$
(3)	4	> 60	$-$
(4)	1	> 160	$--$

Table 6: Logistic Regression Estimation: Robustness Check

	Odds Ratio (s.e.)			
Deposit Follower	(1)	(2)	(3)	(4)
Deposit Leader	3.901(0.494)***	4.457(1.026)***	1.951(0.316)***	1.705(0.465)*
Acquaintance	1.110(0.168)	1.072(0.282)	1.129(0.321)	1.317(0.765)
*DL*A*	2.560(0.651)***	3.625(1.233)***	1.559(0.741)	0.555(0.881)
Week beginning	1.306(0.134)***	1.376(0.217)*	1.222(0.171)	1.294(0.311)
Male	1.588(0.162)***	1.560(0.241)**	2.167(0.302)***	2.532(0.605)***
Int. stud.	0.262(0.098)***	0.109(0.089)**	0.682(0.200)	0.462(0.268)
Tot. transactions	1.016(0.002)***	1.022(0.003)***	1.011(0.001)***	1.008(0.002)**
Obs	4871	2465	2097	696
P > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.1488	0.2204	0.0818	0.0672

***(0.1%); **(1%); *(5%) significance level

B Figures

Figure 1: Observational sequence

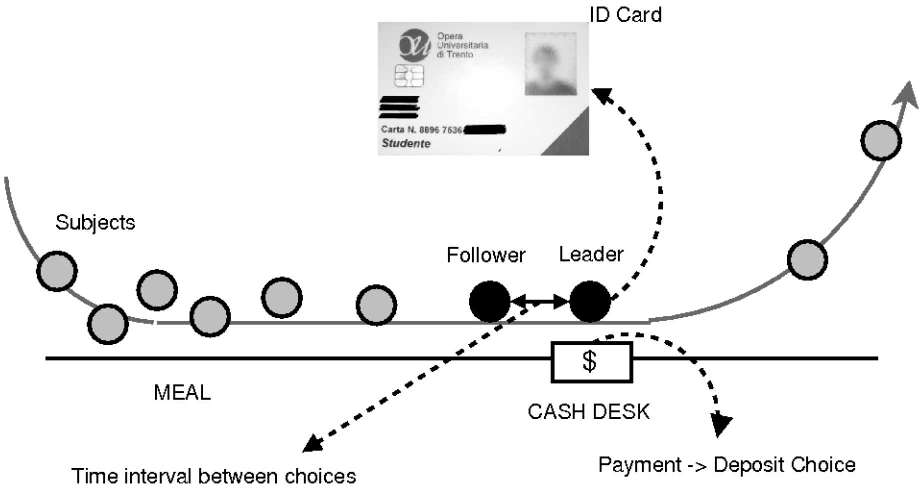
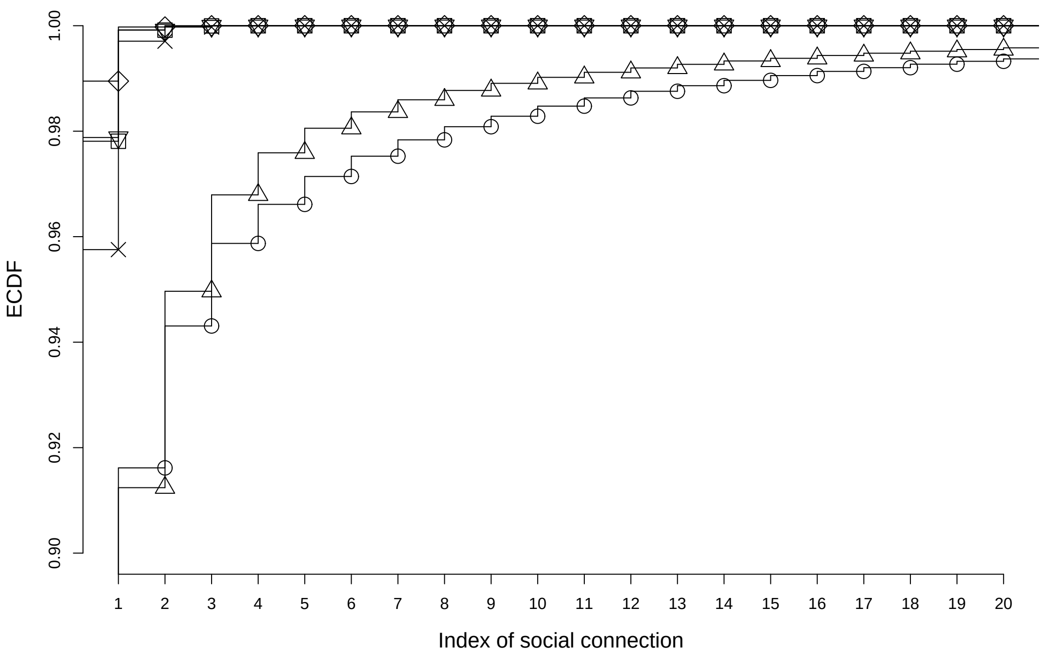


Figure 2: Empirical cumulative distribution function of the sum of encounters of real and simulated distributions of encounters



Symbol	*Distribution*	k	Num	*Average*
○	real	60	595,208	1.75
△	real	120	1,320,124	1.66
□	X_2	60	922,500	1.02
×	X_2	120	1,838,391	1.05
◇	X_1	60	444,317	1.01
▽	X_1	120	917,489	1.02

References

Aversi, R., Dosi, G., Fagiolo, G., Meacci, M., and Olivetti, C. (1999). Demand dynamics with socially evolving preferences. *Industrial and Corporate Change*, **8**(2), 353–408.

Bala, V. and Goyal, S. (2000). A noncooperative model of network formation. *Econometrica*, **5**, 1181–1229.

Brock, W. A. and Durlauf, S. N. (2001). Discrete choice with social interactions. *Review of Economic Studies*, **68**, 235–260.

Conley, T. G. and Udry, C. R. (2000). Learning about a new technology: Pineapple in ghana. Yale University, Economic Growth Center, Discussion Paper.

Duflo, E. and Saez, E. (2002). The role of information and social interactions in retirment plan decisions. NBER Working Paper No. 8885.

Evans, W. N., Oates, W. E., and Schwab, R. M. (1992). Measuring peer group effects: A study of teenage behavior. *The Journal of Political Economy*, **100**(5), 966–991.

Galef, B. G. J. (1996). Social enhancement of food preferences in norway rats: a brief review. In H. C. M. and B. G. J. Galef, editors, *Social Learning and Imitation in Animals*, pages 49–64. New York: Academic Press.

Glaeser, E. and Scheinkman, J. A. (2003). *Advances in Economics and Econometrics: Theory and Applications, Eight World Congress*, chapter Nonmarket interactions, pages 339–369. Massachusets: Cambridge University Press.

Glaeser, E. L., Sacerdote, B., and Scheinkman, J. A. (1996). Crime and social interaction. *The Quarterly Journal of Economics*, **111**(2), 507–548.

Granovetter, M. (1985). Economic action and social action: The problem of embeddedness. *The American Journal of Sociology*, **91**, 481–510.

Henrich, J. and McElreath, R. (2003). The evolution of cultural evolution. *Evolutionary Anthropology*, **12**, 123–135.

Iacoboni, M., Woods, R. P., Brass, M., Bekkering, H., Mazziotta, J. C., and Rizzolati, G. (1999). Cortical mechanisms of human imitation. *Science*, **286**, 2526–2528.

Ioannides, Y. M. and Datcher Loury, L. (2004). Job Information Networks, Neighborhood Effects, and Inequality. *Journal of Economic Literature*, **XLII**, 1056–1093.

Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. *The Review of Economic Studies*, **60**(3), 531–542.

Manski, C. F. (2000). Economic analysis of social interaction. *The Journal of Economic Perspectives*, pages 115–136.

Miguel, E. and Kremer, M. (2003). Networks, social learning, and technology adoption: The case of deworming drugs in kenya. Working Paper.

O'Donoghue and Rabin, M. (2000). The economics of immediate gratification. *Journal of Behavioral Decision Making*, **13**(2), 233–250.

Sacerdote, B. (2001). Peer effects with random assignment: Results for Dartmouth Roommates. *The Quarterly Journal of Economics*, **116**(2), 681–704.

Schelling, T. S. (1973). Hockey helmets, concealed weapons, and daylight saving. *The Journal of Conflict Resolution*, **17**(3), 381–428.

Smoski, M. J. and Bachorowski, J.-A. (2003). Antiphonal laughter between friends and stranger. *Cognition and Emotion*, **17**(2), 327–340.

Soetevent, A. R. (2006). Empirics of the Identification of Social Interactions: An Evaluation of the Approaches and Their Results. *Journal of Economic Surveys*, **20**(2), 193–228.

Sorensen, A. T. (200x). Social learning and health plan choice. *RAND Journal of Economics*. forthcoming.

Subiaul, F., Cantlon, J. F., Holloway, R., and Terrace, R. S. (2004). Cognitive imitation in rhesus macaques. *Science*, **305**, 407–410.

Tajfel, H. and Turner, J. C. (1986). The social identity theory of intergroup behavior. In S. Worchel and W. G. Austin, editors, *Psychology of Intergroup Relations*, chapter 1. Nelson-Hall, $2^n d$ edition.

Turner, J. C. (1985). Social categorisation and the self-concept: a social cogitive theory of group behavior. In C. J. P. Greenwich, editor, *Advances in Group Processes: Theory and Research*, volume 2.

Witt, U. (2001). Economic growth - what happens on the demand side? introduction. *Journal of Evolutionary Economics*, **11**, 1–5.