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Articles

Time Banking and Social Capital Creation: a Transaction Data Analysis

Bancos de tempo e creación de capital social: unha análise de datos de transaccións

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Abstract

This article uses transaction data from three time banks located in Barcelona to analyze their potential to generate bonding and bridging social capital for their members. Regarding bonding social capital, the findings are in line with the related literature in terms of the average number of trading partners and the ego-network density. However, reciprocity is a more frequent form of behavior in our data than in other time banks from other countries. Concerning bridging social capital and considering different age groups, the results show slight evidence of homophilic behavior, although intergenerational transactions are also present, being more frequent between more similar age groups. Finally, we explore the influence of age on the time it takes for members to engage in transactions, which could somehow be related to their potential motivations behind joining a time bank.

Keywords: Bonding social capital; Bridging social capital; Community currency; Time banks; Informal economy.

Resumo

Este artigo utiliza datos de transaccións de tres bancos do tempo situados en Barcelona para analizar o seu potencial para xerar capital social entre os seus membros. En canto aos vínculos do capital social, os resultados están en consonancia coa literatura relacionada en canto ao número medio de socios de intercambio e a densidade da ego-network. Non obstante, a reciprocidade é máis frecuente nos nosos datos que noutros bancos doutros países. En canto á xeración do capital social entre diferentes grupos de individuos e considerando a idade, os resultados mostran lixeiras evidencias de comportamento homofílico, aínda que tamén están presentes transaccións interxeracionais, sendo máis frecuentes entre grupos de idade máis próximos. Finalmente, exploramos a influencia da idade no tempo que tardan os membros en realizar transaccións, o que podería estar relacionado coas súas posibles motivacións detrás de unirse a un banco de tempo.

Palabras chave: Capital social vinculante; Capital social ponte; Moeda local; Banco de tempo; Economía informal.

JEL: A13; Z13; C25; L39.

1. Introduction

A time bank could be seen as a mechanism for promoting social networks and contributing to well-being and social relationships in a given community (Clary, 2008). In this type of informal economy organization, participants exchange services with others using a time-based currency. Regardless of the types of services exchanged, all of them are equally valued; that is, everyone's time is worth the same. There is a diverse range of services that can be exchanged in time banks, such as personal services, housekeeping, administrative support, upcycling, and maintenance and repair, among others (Collom 2011; Carnero et al. 2015). Encouraging members to share resources, skills and knowledge helps foster a culture of sustainability. For instance, by repairing and maintaining items rather than disposing of them, time banks actively contribute to the circular economy by prolonging their lifespan. These collaborative efforts promote a more efficient use of resources while encouraging a shift towards more sustainable communities (Válek & Jašíková, 2013).

The objective of time banks is mainly social, their basic principles being reciprocity, collaboration, equality, and respect towards everybody involved (Cahn, 2000). They allow individuals to be able to afford to use certain services in the informal sector that might otherwise be unaffordable for them in the traditional market economy. In economic recessions with high unemployment rates, they especially allow the unemployed to counteract the negative effects of the crisis (Del Moral, 2013).

The aim of this article is to analyze the potential of time banking to create social capital and promote intergenerational links among members. Besides this, it explores the influence of age on the time it takes for members to engage in transactions, which could be related to their potential motivations behind joining a time bank. To tackle these objectives, this article has used transaction data from three time banks located in Barcelona. The dataset is composed of 452 active members who carried out 2,478 transactions, totaling 5,910 hours in provided and requested services. To our knowledge, this is the first attempt in the literature to analyze, using transaction records, the ability of time banks to promote social capital in Spain. We have explored two dimensions: (i) bonding social capital, i.e., the capacity of time banks to create relationships among members, and (ii) bridging social capital, i.e., the potential of time banks to connect members from different social groups with varying characteristics, namely, age, in our case.

Several indicators have been used within each dimension. Regarding bonding social capital, one of the most popular measures is ego-network density, which considers how dense the network of individuals is by looking at the actual connections among their trading partners. Another indicator deals with reciprocity, i.e. whether the ties between two members go in a two-way direction, in that they exchange services, sometimes as providers and other times as requesters, with the same partner. Concerning bridging social capital, the literature focuses on the potential of time banks to create social connections among groups that are dissimilar in certain characteristics, and who may find it challenging to establish relationships.

Our results for these indicators reveal, firstly, that the extent to which Spanish time banks succeed in creating bonding social capital with transactions among members is similar to other experiences in other countries, although the creation of trust-based trading relationships in the form of reciprocal transactions seems slightly more frequent in the Spanish case than in time banks analyzed in other countries. To our knowledge, the analysis of reciprocity in terms of transactions has not previously been addressed in the literature. Secondly, regarding bridging social capital and considering different age groups, we have found that elderly people have a

marked preference for transactions with members in their age group, thus not promoting intergenerational bridging social capital.

The rest of the paper is structured as follows: section 2 offers a review of the literature on time banks; in Section 3, devoted to materials and methods, we present and describe the data we have used; in section 4 we provide the results from our transactions data set, as well as the discussion of the results in terms of social capital creation; finally, section 5 draws the paper to a conclusion.

2. Literature review

The literature that has focused on exploring the ability of time banks to increase the social capital of communities and the individual motivations behind engaging in time banks can be framed as two different approaches: the first approach tackles these issues by using data from member surveys and/or coordinator surveys; meanwhile, the second approach uses transaction data recorded in the accounting system of online time banks.

For the first approach, among other articles related to social capital creation, North (2003) analyzed to what extent time banks are superior to other Local Exchange Trading Systems (LETS) as social mechanisms of community building. He found that time banks are more credible and have better organizational support than LETS. Seyfang (2003) noted that a time bank situated in London helps socially-excluded groups to become involved in community activities. Similar findings were shown in Seyfang (2004) for a Scottish time bank and Oliver Sanz (2016) for the case of Spain. Yuan et al. (2018) concluded, for several US time banks, that time banking engagement is a promising way of developing social capital, as it connects people and pools resources from the community.

Member and coordinator surveys are an important tool for addressing questions related to participation, organizational commitment, or satisfaction with time banks (Lasker et al. 2011). However, they also bring about certain methodological problems according to Collom (2012), namely that the response rates are often low, the questions are usually limited to a specific time period, and they are quite general, since participants cannot remember past transactions in detail. The second approach, which uses transaction data collected with time banking software, significantly aids the study of social capital creation in time banks, as it brings together information on all the exchanges carried out and on the participants involved in the transactions.

Indeed, although the literature based on the second approach is more scarce, it has developed significantly in the last few years. Among other articles on this subject, Collom (2012) stated the benefits of using transaction data when analyzing members' participation and provided some key indicators of time bank participation that can be created from transaction records. Frankova et al. (2014) highlighted the utility and potential of the Transaction Network Analysis tool for studies of Local Exchange Trading Systems (LETS). Regarding the possibility of bridging social capital with time banking, Collom (2008) found that older participants tend to engage less with others in their own group but instead tend to interact more with dissimilar members, thus exhibiting heterophilic behavior. This allows them to establish and strengthen connections with those who are different from them. Concerning the possibility of bonding social capital, Panther (2012) pointed out that time bank members who engage in reciprocal transactions tend to be the most active and have more partners than other members do. In contrast, Lopaciuk-Gonczaryk (2019) analyzed a Polish LETS and rejected the hypothesis of the network influence on members' cooperative behavior. The individual motivations behind becoming time bank members have also been addressed via both

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of the approaches. Valor and Papaoikonomou (2016), using a survey of Spanish time banks, concluded that time banks are a social political project rather than a utilitarian economic one. Kakar (2020) explored this issue by using a survey of US time banks and found that their social value is strongly linked to service providers, whereas service receivers are predominantly influenced by the utilitarian value. Collom (2008) and Lasker et al. (2011) also supported the importance of the economic reasons for joining a time bank by way of transaction records.

Our article contributes to the second approach in the literature, which utilizes transaction records. This type of data allows for a richer analysis in terms of its network properties and the ability of time banks to promote social capital. We analyze how the ages of members affect transaction engagement time. To the best of our knowledge, this is the first article to tackle this issue using transaction data from Spanish time banks.

3. Time bank transaction-based data

Our data set comes from three time banks (TB1, TB2, and TB3, hereafter) located in Barcelona and registered with TimeOverflow, a free software program designed to handle transactions taking place in a bulk of time banks in Spain and Latin America. This online platform was created by CoopDevs, an open-source company developing software for the social and solidarity economy, and is offered by the Spanish Association for the Development of Time Banks to time banks interested in using it. Time bank activity in this data covered a time span that ranged between two and three years, ending in October 2016. The information available for each bank included the location, the registration date in the online system, the number of users, and the number of exchanges. For each exchange, there was information about the users involved, the exchange date, and the number of offered and requested hours. For all members, the available information included their ages, registration dates on the online system, trading partners and balance in terms of exchanged hours.[1] Unfortunately, we do not have information on the type of services exchanged (housekeeping, lessons, etc.). Thus, our analysis is not based on what services members exchanged, but on how many hours they exchanged (offers and/or demands) and with whom, i.e., their trading network characteristics.

A basic description of the three time banks is reported in Table 1. The number of members, excluding managers, ranged from 107 to 198 and the number of transactions from 693 to 984. Interestingly, although TB1 reported the earliest registration date, it had the lowest number of members and transactions. One of the most interesting indicators of bank activity was participation in terms of total hours exchanged. Members decided on the number of hours they would offer or request in each transaction. Data shows that the total number of hours exchanged ranged from 1,158 to 3,208. In each bank, there were members who always acted as requesters, others as providers, and some who showed both types of behavior. The percentages were around 20%, 20%, and 60% respectively, with slight variations across time banks. Hence, most of the users offered and requested services, showing both giving and receiving behavior. This is an indicator of the potential of time banks to enhance reciprocity among members, which is one of their core values (see Cahn (2000)) and will be explored in detail in Section 4.

[1] TimeOverFlow offered information on more Spanish time banks, but not all of them were comparable, since the bank registration date on the platform was quite varied, from October 2013 to April 2016. For the analysis, we selected time banks that fulfilled two conditions: (i) at least two years of activity as of October 2016, and (ii) at least 500 transactions reported. These selection criteria guaranteed more homogeneity and, thus, comparability, across time banks, and a sample size in terms of transactions that allowed us to perform a more credible statistical analysis. This process led to the selection of the three time banks that we analyzed.

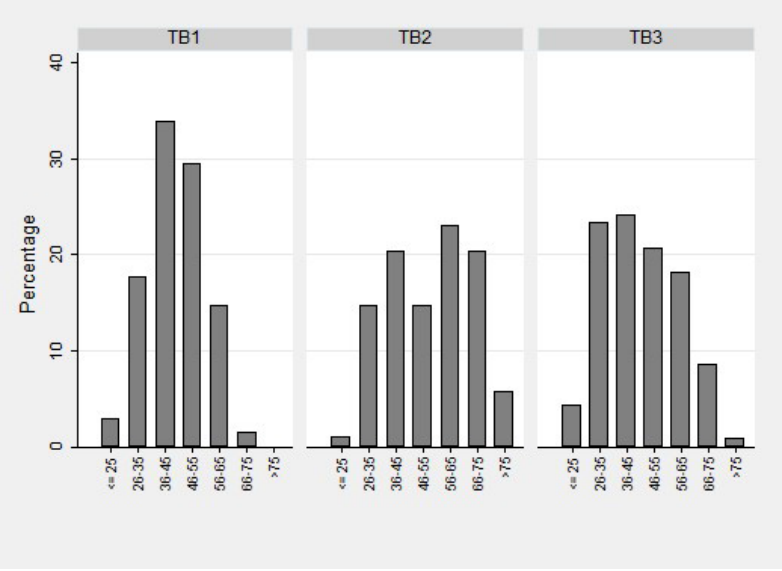
Table 1. Description of time banks (TB)

	TB1	TB2	TB3
Registration date	Oct. 2013	Oct. 2014	Nov. 2014 2014
Number of users	107	198	147
Number of transactions	693	984	801
Number of hours exchanged	1,158.5	3,208.0	1,543.5
% of members only requesting	17.8	21.7	18.3
% of members only supplying	20.5	19.2	17.7
% of members requesting and supplying	61.7	59.1	64.0
Average members' age	43.8	53.6	46.5

Source: Own calculations from the dataset on time banks.

According to the information on members' age, the average value is about 44 years old in TB1, 54 in TB2, and 46 years old in TB3. Figure 1 shows the age distribution in each bank. The information on members' age was available for 63.6% of the observations in TB1, 96.5% in TB2, and 78.9% in TB3. As can be seen, less than 5% of members were in the first age interval (25 years old or under). In TB1, almost 80% of members were between 36 and 65 years old, while in TB2 and TB3 this percentage was around 60%. It must be highlighted that in TB2, the percentage of members on the right tail of the distribution (aged more than 65 years) was quite large, around 26%, while this percentage was around 10% in TB3 and almost negligible in TB1. Among the related articles that have used transaction data, Collom (2008) analyzed a US time bank and found that around 8% of members were 65 years old or over; Panther (2012), using data from a time bank located in England, showed that more than half of members, around 57%, were in the 35-54 age interval and 18% were 55 years old or over. Profiles of these users show the average member as being younger than in the data used in this article, with the exception of TB1 members. Age is an important sociodemographic characteristic that may influence participation and social capital creation, as discussed in Section 4.

Figure 1. Distribution of members by age group



Source: Own calculations from the dataset on time banks.

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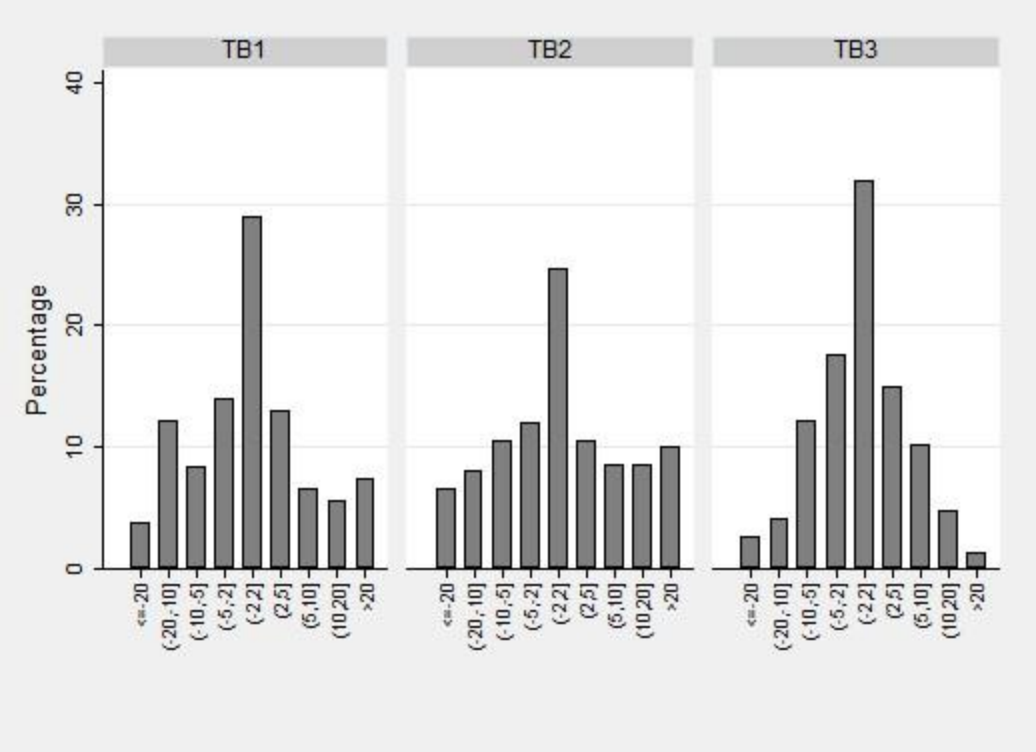
The distribution of members by account balance can also be obtained from the data. Account balance is defined as the difference between the number of hours provided and requested. Positive values reflect excess supply while negative values represent excess demand. Overall, the 95% central distribution of the account balance ranged from -33.7 to 40.5 hours, with some differences across banks. The account balance was discretized into nine intervals. The results are shown in Figure 2. The distribution of account balances in TB1 and TB2 showed heavier tails than in TB3. Members with a balance in the middle interval, (-2,2] hours, were considered to have a balanced account. The percentage of such members ranged from 25% in TB2 to 32% in TB3. This definition of a balanced account was also used in Collom (2012), who reported 41% of members in that interval, considerably above the figures in this article, which point to a higher percentage of users exhibiting excess supply or excess demand. If a member has a highly positive account balance (strong excess supply), this could be interpreted, according to Panther (2012), in two ways, either that there is a lack of services that satisfy their needs or that a member's participation is more motivated by voluntary work. In Section 4 the motivations behind joining a time bank are explored in more detail.

Figure 2. Distribution of members by account balance



Source: Own calculations from the dataset on time banks.

The data also allows us to obtain some individual indicators to analyze members' activity in terms of exchanges and participation hours. Table 2 displays the number of exchanges and participation hours by member in each bank as well as the number of hours per exchange. It is worth making two comments: firstly, the bank registration date ranged from October 2013 to November 2014, as shown in Table 1, the available period of data being three years for TB1 and two years for TB2 and TB3; secondly, users may have registered at any period since the time bank's creation, which means that there is heterogeneity in the period they have been active. To obtain comparable figures across members in the three banks, Table 2 includes the number of transactions per member and year for members who were active for at least one year. This represents around 79% of users in TB1 and 87% in TB2 and TB3. The average number of

exchanges per member and year was 8 in TB1, 5.4 in TB2, and 6.6 in TB3; the median values were much lower, 4.3, 2.1, and 2.6, respectively, thus reflecting a heavy right tail that corresponded to a very small number of active members, with more than 45 exchanges per year (the maximum was almost 80 exchanges in TB3). Regarding the average number of participation hours per member and year, the data shows that they were quite similar in TB1 and TB3, around 13 hours, while in TB2 the figure was higher, at 18 hours. The differences were less marked in the median values (around 8, 7 and 6 hours in the three banks, respectively), reflecting the asymmetry of the distribution, especially in TB2. It is worth mentioning that more exchanges do not necessarily imply more participation hours. The bottom panel of Table 2 reports the number of hours exchanged per transaction. The duration of the exchanges were decided by the members involved meaning that they did not necessarily all last for one hour. Indeed, the average duration of a transaction ranged from 2 hours in TB1 and TB3 to 3.4 in TB2, meaning that it was almost 70% higher in TB2 than in the other two banks. Although the difference was not so marked in the median, standing at around 1.7 hours in TB1 and TB3 and 2.5 hours in TB2, it was still 50% higher in the latter.

Table 2. Activity indicators by member

Number of exchanges per year	TB1	TB2	TB3
Mean	8.0	5.4	6.6
Median	4.3	2.1	2.6
Std dev	10.6	8.3	10.5
[min, max]	[0.4, 60.0]	[0.5, 46.1]	[0.5, 76.8]
Number of participation hours per year			
Mean	13.2	17.9	12.5
Median	7.9	6.7	5.8
Std dev	16.4	28.6	18.8
[min, max]	[0.2, 92.4]	[0.2, 175.4]	[0.3, 121.2]
Number of hours per exchange			
Mean	1.9	3.4	2.1
Median	1.6	2.5	1.7
Std dev	1.0	2.9	1.5
[min, max]	[0.3, 6.0]	[0.5, 20.0]	[0.4, 10.0]

Source: Own calculations from the dataset on time banks.

After describing the members' activity, the social network structure of transaction records was analyzed to explore the potential of time banks to create social capital.

4. Time banking and social capital creation: results and discussion

Time banking goes beyond exchanging hours in provided or received services. It also offers an opportunity for community interactions, as stated in the extensive literature that has focused on time banks from different perspectives (see Section 2). Social network creation and reciprocity behavior which may arise from community interactions are two of the core values of time banking (Cahn, 2000; Seyfang, 2006). Indeed, one of the main goals of time banks is to build social capital. As we have mentioned, this article contributes to the literature that explores

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the capacity of time banks to promote social capital. To the authors' knowledge, this is the first article that has explored this issue for the Spanish case using transaction data. It focuses on two different aspects of social capital that have been named in the theoretical literature as bonding and bridging social capital (Gittell & Vidal, 1998). In the context of time banking, this article follows Collom (2012), who identified bonding social capital indicators as the density of the network and the existence of reciprocal contacts, both of which are related to trust-based relationships among members. Bridging social capital refers to interactions that members establish with others who are dissimilar to them in some characteristics. These two perspectives have allowed us to test whether social capital is created around time bank activity and to what extent this phenomenon promotes relationships among members that would otherwise probably not take place. With these links, users do not only exchange services, but they also have the potential to create personal relationships, thus increasing social well-being[2]. Table 3 reports some bonding social capital indicators related to the network properties for the three time banks analyzed. Panel A shows measures related to the network density, while Panel B offers some reciprocity measures.

Table 3. Bonding social capital indicators

A. Density measures	TB1	TB2	TB3
Number of trading partners each member has			
Mean	5.9	4.2	4.8
Std dev	6.4	5.0	5.3
[min, max]	[1, 30]	[1, 34]	[1, 38]
Ego-network density(a)			
Mean	0.24	0.17	0.16
Std dev	0.25	0.27	0.24
[min, max]	[0, 1]	[0, 1]	[0,1]
B. Reciprocity measures	TB1	TB2	TB3
% of members with reciprocal partners			
Mean	45.8	32.8	39.5
Std dev	50.1	47.1	49.0
[min, max]	[0, 100]	[0, 100]	[0, 100]
Number of reciprocal partners each member has(b)			
Mean	2.7	2	1.8
Std dev	2.2	1.8	1.3
[min, max]	[1, 9]	[1, 9]	[1, 5]
% reciprocal partners each member has(b)			
Mean	36.5	37.6	32.4
Std dev	24.2	28.8	22.4
[min, max]	[6.7, 100]	[5.9,100]	[4.8, 100]
% of exchanges with reciprocal partners(b)			
Mean	37.3	40.6	40.7

[2] Bonding and bridging social capital can be created out of various means such as meetings and events, which could take place in time banks. However, we only have data on transactions between reciprocal partners as opposed to group activities.

A. Density measures	TB1	TB2	TB3
Std dev	22.7	25.1	22.2
[min, max]	[8.7, 100]	[4.2, 100]	[7.7, 100]

[(a)] Proportion of all ties actually observed among each member's trading partners.
[(b)] Only for members with at least one reciprocal partner.

Source: Own calculations from the dataset on time banks.

Regarding network density, the first indicator considered is node degree, which is defined as the number of trading partners each member has and reflects the density of the network at a local level. The three time banks showed similar figures in this indicator, with average values between 4.2 and 5.9 and maximum values between 30 and 38. Although not reported in the table, the whole distribution of the number of partners each member has, allowed us to explore this issue more deeply. In TB1 the percentage of members with more than five partners was 37%. The figures for TB2 and TB3 were, 23% and 27%, respectively. In the left tail of the distribution, the percentage of members with only one partner was 28%, 31%, and 26% for TB1, TB2, and TB3, respectively. In addition, there were two types of behavior that appeared in the data with similar frequencies: members with only one trading partner and members with a quite large number of them. One may believe that the more engaged members were (i.e., the more partners they had), the more active they would be in terms of exchanges. To see to what extent this was the case in the data, the correlation between the number of trading partners and the number of transactions each member reported was computed. The figures were 0.93, 0.92, and 0.73 for TB1, TB2 and TB3, respectively, supporting evidence of this conjecture. The average degree found in the data is comparable with other findings in the literature. To cite two examples, Collom (2012), using a US time bank, reported an average of 4.8 trading partners per member, while it was 4.3 in Romanello (2017) for a Brazilian time bank.

The second density indicator used was the ego-network density, which measured the extent to which the partners of each member were connected in exchanges. It is a measure of the social cohesion in the network. This indicator lies in the unit interval.[3] The higher the value, the higher the density of the network. The denser the network, the better the communication channels among the members are, thus enhancing the information diffusion about the activities provided and received. Hence, ego-network density could be seen as an indicator of bonding social capital. The figures were 0.17 and 0.16 for TB2 and TB3, respectively. In TB1, the figure was slightly higher, at 0.24, i.e., considering all the potential ties among each member's partners, 24% of them were actually present. Some other articles have analyzed ego-network density, such as Collom (2008), Collom (2012) and Collom et al. (2016) for US time banks. The figures ranged from 0.14 to 0.29. Although the existing literature in this area with transaction records is quite scarce, the results in Table 3 regarding ego-network density seem to point to a homogeneous pattern between the data from the three Spanish time banks and Collom's from the US time banks.

Another important indicator of bonding social capital is reciprocity. For given members, reciprocal partners are those with whom services are both offered and requested, i.e., they are two-way exchange partners.[4] Reciprocity enhances trust-based trading relationships and reinforces their symmetry, since both participants are providers and receivers. Not every member is involved in reciprocal transactions. As has been mentioned, around 60% of users

[3] For example, a value of 50% would mean that, given the network of a member's trading partners, the actual ties among these partners would be 50% of all the potential ties that would happen among them.

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are involved in both offered and requested services, with slight variations across time banks. The members engaged in exchanges with reciprocal partners are a subset of this group of members. Panel B in Table 3 shows some reciprocity measures. Firstly, we considered the percentage of members who had at least one reciprocal tie. This percentage was 46% in TB1, 33% in TB2, and around 40% in TB3. Thus, the absence of reciprocity was quite a frequent phenomenon, with an incidence that varied between 54% and 67%. Nevertheless, it was less frequent than in other time banks analyzed in other countries. For example, Collom (2012) reported 75% for the case of a US time bank while for a Brazilian one, Romanello (2017) quoted 96%. Secondly, to analyze the strength of the ties between reciprocal contacts, the analysis focused on the behavior of members who had at least one reciprocal partner. Within this group, the average number of reciprocal contacts was 2.7 in TB1, 2 in TB2, and 1.8 in TB3. The minimum value was 1 in the three banks (we considered members with at least one reciprocal tie) and the maximum value was 9 reciprocal contacts in TB1 and TB2 and 5 in TB3. Although not reported in the table, the distribution of the number of reciprocal contacts was highly skewed, where a high percentage of members had only one reciprocal contact (40% in TB1 and 60% in TB2 and TB3) while few members had more than four reciprocal contacts (20% in TB1, 10% in TB2 and 7% in TB3). For each member with reciprocal contacts, the percentage of total contacts that were reciprocal was around one third, with only slight differences across time banks (ranging between 32.4% and 37.6%). One of the most interesting features regarding reciprocity was the intensity of the reciprocal ties in terms of exchanges. As far as the authors are aware, this issue has not been analyzed in the literature on time banks with transaction data. The analysis has addressed this question by calculating, for each member with reciprocal partners, the percentage of transfers made with these partners. The figure lay at about 40%, although it was slightly lower for TB1. Thus, it should be pointed out that for members with reciprocal ties, nearly half of the total services were provided or received within the network of reciprocal partners. Trust and reciprocity are related concepts, and this relationship was reflected in repeated transfers with the same group of partners. The potential to generate trusted relationships is one of the assets of time banks as social capital builders. This has been stated in the literature in many cases with survey data. As for the Spanish case, Oliver Sanz (2016) is one such paper. The analysis offered in this article has allowed us to provide empirical evidence based on transaction records.

An interesting feature of time banks is their potential to generate not only bonding but also bridging social capital. Time bank members are heterogeneous and being part of the network allows them to exchange with others who may be similar or dissimilar to them in some characteristics, such as age, educational attainment or income. Bridging social capital is created when members are linked to others who are different from themselves, thus exhibiting heterophilic behavior. In contrast, when members are more inclined to exchange with their peers, they show homophilic behavior. One of the most widely used measures of bridging social capital is the External-Internal Index (E-I index, hereafter), proposed by Krackhardt and Stern (1988). It is defined, for each individual i, as the number of external ties E_i (those with dissimilar members) minus the number of internal ties I_i (those with members with similar characteristics)[5], divided by the total number of ties, i.e.,

[4] For example, if two members, let's say A and B, had one reciprocal tie, this would mean that they had at least two exchanges between them, such that their roles of provider and requester of services would change in both transactions.

[5] For example, regarding income groups, external ties are those between low- and high-income people, whereas internal ties are those among people belonging to the same income group. In the same way, regarding age, external (internal) ties are those between young and old (young) people.

$$E - I\ index_i = \frac{E_i - I_i}{E_i + I_i} \quad (1)$$

This indicator lies in the [-1,1] interval. The value -1 means that users only exchange with members who are alike ($E_i = 0$), reflecting absolute homophily. In contrast, the index takes the value 1 if users only exchange with alters who are different from them ($I_i = 0$), thus indicating absolute heterophily. The value 0 is associated with neither homophily nor heterophily, showing neutral behavior ($E_i = I_i$). To analyze to what extent bridging social capital is present in the data, different group members are considered in terms of age. The information available in the dataset did not provide enough details to consider different groups based on characteristics such as gender or working status. However, it was possible to test for the existence of intergenerational links, which is one of the most intriguing aspects of bridging social capital. The analysis was restricted to TB2, where information on age was available for almost all its members (191 out of 198). Considering ties where information on age was available for both users, the final sample was composed of 188 members involved in 740 ties. The sample was split into four age groups: G1 (up to 40 years old; 25% of members), G2 (between 41 and 55 years old; 26.6% of members), G3 (between 56 and 65 years old; 23.4% of members) and G4 (elderly members, over 65 years old; 25% of members). Obviously, the number of groups and the relative group size affect the value of the E-I index, since it determines the potential number of internal and external ties and this could partly explain the observed ties. The average E-I index in our data was 0.49, thus reflecting a higher incidence of external ties. But, as stated by Everett & Borgatti (2012), if one is interested in the underlying individual preferences rather than in the actual individual choices, one should take into account the relative group size. This is why a weighted E-I index has been created, where individual *I* is defined as follows:

$$Weighted\ E - I\ index_i = \frac{\frac{E_i}{N - N_i} - \frac{I_i}{N_i - 1}}{\frac{E_i}{N - N_i} + \frac{I_i}{N_i - 1}} \quad (2)$$

where N is the network size and N_i is the size of the group the individual *i* belongs to. Thus, the values of E_i and I_i are normalized by the group size by dividing the number of external and internal ties by the total number of potential ties the individual *i* can have outside and within his/her group, respectively. The average weighted E-I index was 0.28, reflecting slight heterophilic behavior. In our data, the non-weighted index overestimated the preferences for external ties, thus calling for the weighting correction. Collom (2008), using transaction data from a US time bank, and considering five groups in terms of organizational status, elder status, and sex, found an average E-I index score of 0.22, thus also showing slight evidence of heterophily.

Besides the analysis of users' partners, users' exchanges were also considered for all individuals, i.e., exchanges made within their groups (internal exchanges) and those made with users of other groups (external exchanges). The two indexes, partner-based and exchange-based, could be very different. For example, if one considers an individual whose partners are mainly internal, but where the number of exchanges occurring is very low (supposing that there is only one exchange with each of them) but who also has one external partner where a high number of exchanges happen. For this individual, the partner-based E-I index will be close to -1 while the exchange-based E-I index will be close to 1. Nevertheless, this type of behavior was

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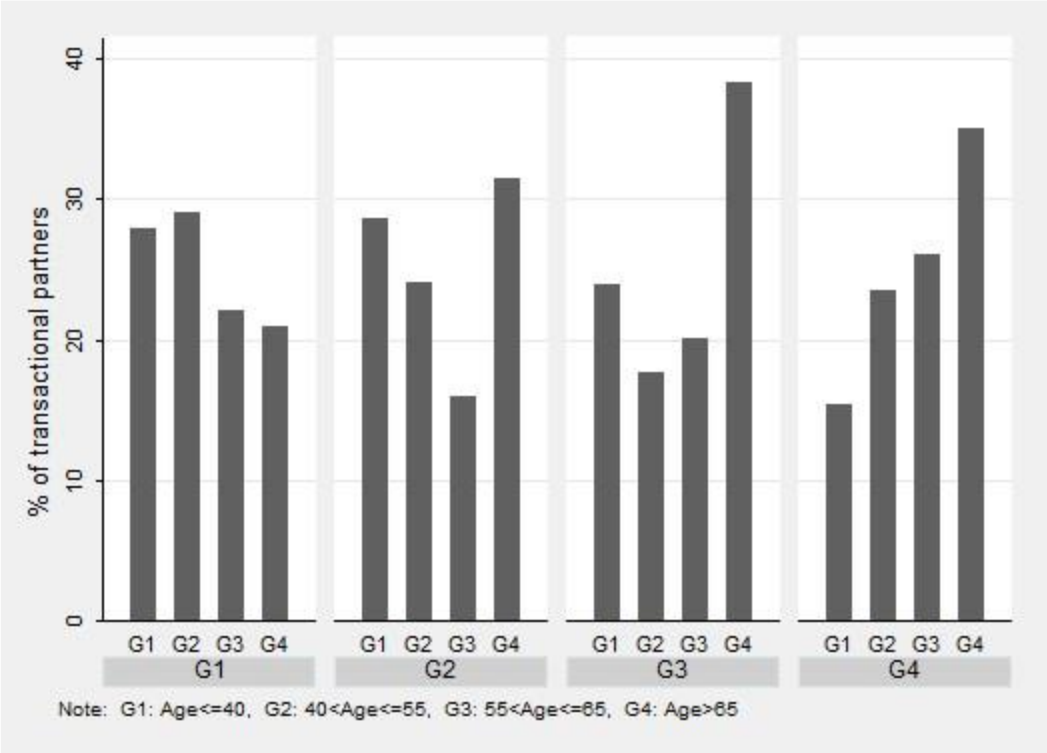
not present in the data. The average non-weighted and weighted E-I exchange-based indexes were 0.51 and 0.30, respectively, quite similar to the E-I tie-based indexes (0.49 and 0.28). Indeed, the correlation between external (internal) partners and external (internal) exchanges was 0.857 (0.861).

Figure 3 provides some additional descriptive evidence of the existence of bridging social capital, showing with whom each group transacted. The most notable patterns were found for G4, where there was a higher preference for ties within the same age group (homophilic behavior) than could be observed for the other groups. Moreover, the more dissimilar the age groups, the lower the frequency of ties.

Figure 3. Percentage of transactional partners among and between age groups



Source: Own calculations from the dataset on time banks.

Table 4 displays the results of a test that compared the observed ties with the expected ties under the assumption of neutral preferences. The unit of observation was the tie (i,j), composed of a reference member i and his/her partner j. We considered the age group for all the reference members and that of all their partners in the observed ties. The first column reports the relative size of each age group. If preferences were neutral, the expected percentage of ties with each group resembled the relative group size. The figures in the second to fourth columns are the observed preferences, i.e., the percentage of ties with each group (corresponding to the bar heights in Figure 3). In the cases marked with an asterisk, the null hypothesis of neutral preferences was rejected. This happened in all groups, except in G1 (first row). Members in G2 (second row) interacted with those in G3 with a significantly lower frequency than expected under neutral preferences (16% being the observed frequency vs. 23.4% if preferences were neutral); the opposite was found in their interactions with G4 members (31.43% vs. 25%). Regarding G3, the frequency of ties with G2 was lower than expected under neutral preferences (17.61% vs. 26.6%) but was higher than expected with G4 (38.36% vs. 25%). Finally, in G4, the frequency of internal ties was significantly higher than expected under neutral preferences

(35.04% vs. 25%); the opposite was true for the frequency of external ties with the youngest members, those in G1 (15.38% vs. 25%).

Table 4. Bridging social capital (Dissimilarity matrix)

	% of ties each group has with other groups				
Age group (%) of members	G1	G2	G3	G4	Total
G1 (25.0%)	27.91	29.07	22.09	20.93	100
G2 (26.6%)	28.57	24.00	16.00***	31.43*	100
G3 (23.4%)	23.90	17.61***	20.13	38.36***	100
G4 (25.0%)	15.38***	23.50	26.07	35.04***	100

Note G1: Age≤40; G2: 40<Age≤55; G3: 55<Age≤65; G4: Age>65. Within each group, a test of random choice of ties with all groups was performed.
Within each group, a test of random choice of ties with all groups was performed: *, ** and *** represent the null hypothesis of random choice being rejected at 10%, 5% and 1%, respectively.

Source: Own calculations from the dataset on time banks.

The previous analysis on the existence of bridging social capital did not control for the characteristics of both members involved in each tie. Let us suppose that a tie *(i,j)* has *i* as the reference member and *j* as his/her neighbor in that tie. After considering all the observed ties, the probit models were estimated to calculate the probability that member *i* would choose an external tie:

$$\Pr(y_i = 1|X_i) = F\left(\beta_0 + \sum_{g=2}^{4} \beta_g D_{ig} + \lambda' x_i\right) \qquad (3)$$

where $F(.)$ was the normal cumulative distribution function, y_i was a binary indicator that took the value 1 for external ties, i.e., if members in the tie (i,j) belonged to different age groups, and 0 otherwise, D_{ig} was the group indicator for individual i (G1 being the reference group) and x_i was a vector of controls that included member characteristics related to participation: the number of partners and the number of exchanges. Two models were estimated, a basic one that only included the group dummies and a model that added the controls. Since each reference member . could be involved in ties with different partners, we considered standard errors clustered at the individual level. Results are shown in Table 5. It is worth mentioning that, since the data did not allow potential sources of endogeneity to be controlled for, the interpretation was descriptive rather than causal.

Table 5. Bridging social capital (Probit estimation results)

	Basic model		Model with participation controls	
	Coefficient	Avg. partial effect	Coefficient	Avg. partial effect
Constant	0.586 (0.082)***		0.574 (0.120)***	
G2 (41-55)	0.121 (0.151)	0.039 (0.048)	0.157 (0.159)	0.050 (0.050)
G3 (56-65)	0.252 (0.107)**	0.078 (0.034)**	0.231 (0.109)**	0.072 (0.034)**
G4 (>65)	-0.201 (0.124)	-0.071 (0.044)	-0.198 (0.117)*	-0.070 (0.042)*
No. of partners			-0.016 (0.010)	-0.005 (0.003)
No. of exchanges			0.007 (0.003)*	0.002 (0.001)*

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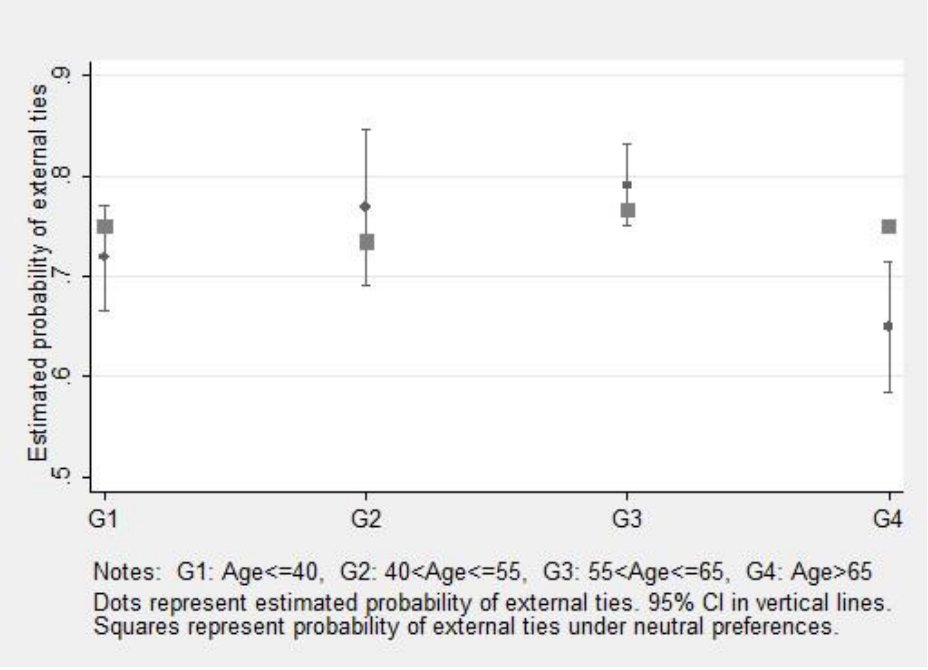
	Basic model		Model with participation controls	
	Coefficient	Avg. partial effect	Coefficient	Avg. partial effect
No. of observations	740		740	
p-value joint sign. test	0.001		0.001	

Note The unit of observation is the tie (i,j), composed of a reference member i and the partner j.
Dependent variable: a binary indicator of an external tie: the value is 1 if i and j belong to different age groups, and 0 otherwise.
Reference age group: G1 (≤40 years old).
The number of partners and the number of exchanges refer to the reference member i in the tie.
Standard errors are clustered at the reference member level in parentheses.
*, ** and ***: significant at 10%, 5% and 1%, respectively.

Source: Own calculations from the dataset on time banks.

The results regarding the age group dummies were quite similar in both models. With respect to the model with controls and average partial effects, we found no differences in the probability of external ties between G2 and G1. However, *ceteris paribus*, the members in G3 were 7.2 percentage points more likely to be involved in external ties than those in G1. The opposite was true in G4, since the probability of external ties for elderly members was 7 percentage points lower than for the reference group. Figure 4 illustrates our exploration of the observed behavior and the expected behavior under the hypothesis of neutral preferences for external/internal ties. It shows the estimated value and the 95% confidence interval for the probability of external ties for each group, based on the estimated model with controls. Taking into account the relative size of each group, λ_g% for g=1,2,3,4, the hypothesis of neutral external/internal preferences would lead to a percentage of external ties of (1-λ_g)%. For the age groups G1, G2, G3 and G4, these percentages were 75%, 73.4%, 76.6% and 75%, respectively. As can be observed, for the elderly (G4), the hypothesis of neutral preferences of internal/external ties was rejected at the 5% significance level. This group exhibited homophily, preferring ties within the same age group.

Figure 4. Estimated probability of external ties for the age groups



Source: Own calculations from the dataset on time banks.

An important community currency system issue is related to the motivations behind members participating. Collom (2007, 2011), using data on a US time bank, found that the most motivating factors were economic (such as members joining to satisfy their needs) or ideological ones (e.g., members joining to create a better society, to support movements for social change, and so on), while social factors (like meeting new people, or feeling better with yourself, among others) were less important. Although these results on motivations were survey-based, Collom (2008) and Lasker et al. (2011) also demonstrated how significant the economic reasons behind joining a time bank were by using transaction records. The fact that there is a negative income effect on transactions (with these articles finding that low-income participants are engaged in more transactions) seems to support the idea that economic reasons significantly drive willingness to participate. These authors did not find different behavior in terms of transactions exchanged by age. The data used in this article allowed us to explore the potential influence of age on the time it takes for members to engage in transactions. Although this was not enough evidence to reach conclusions about potential motivations behind joining a time bank, we were able to explore whether the findings in Collom (2008) were also present in our data as well as shed some light on the issue. The left panel in Table 6 presents the estimation results of a probit model where the dependent variable was an indicator of whether it had taken more than one year to transact for the first time since the member's engagement in the time bank. We included the age group dummies and, to control for participation, the number of partners and the number of exchanges. We restricted the sample to members who had been active for at least one year.

Table 6. Member participation

	More than one year to exchange(a)		Participation measures(b)	
	Coefficient	Avg. part. effect	Number of partners	Number of exchanges
Constant	0.231 (0.294)		0.752 (0.124)***	1.071 (0.145)***
G2 (41-55)	-0.520 (0.340)	-0.165 (0.108)	0.091 (0.157)	0.153 (0.185)
G3 (56-65)	-0.350 (0.334)	-0.115 (0.110)	-0.107 (0.161)	0.061 (0.183)
G4 (>65)	-1.075 (0.367)***	-0.288 (0.100)***	0.283 (0.151)*	0.471 (0.176)***
No. of partners	-0.195 (0.089)**	-0.052 (0.022)**		
No. of exchanges	0.026 (0.207)	0.007 (0.005)		
Recipr. partner indicator			1.226 (0.111)***	1.843 (0.133)***
No. of observations	152		191	191
p-value joint sign. test	0.000		0.000	0.000
p-value Poisson test(c) (H_0: Poisson model)			0.000	0.000

(a) Results based on a probit model. Dependent variable: an indicator of whether it has taken more than one year to transact for the first time (only for members who have been active for at least one year).
(b) Negative binomial models for the number of partners and the number of exchanges.
(c) The null hypothesis is neither overdispersion nor underdispersion (Poisson distribution). Reference age group: G1 (≤40 years old). Standard errors in parentheses.
*, ** and ***: significant at 10%, 5% and 1%, respectively.

Source: Own calculations from the dataset on time banks.

We found that controlling for participation, the probability of taking more than one year to make the first transaction, was 29 percentage points lower for the elderly members than for

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the youngest. Younger users may be more likely to join the time bank with the intention of supporting this social organization than to actively participate in giving and receiving activities. This behaviour supports the ideological motivations mentioned in Collom (2011) as opposed to a desire for direct benefits to be reaped from the exchange. However, the older individuals are, the more interested in taking advantage of the potential benefits of exchange they appear to be, which supports the evidence of economic motivations in Collom (2011). To further investigate this issue, in the right panel of Table 6, we considered the following model:

$$E[y_i|X_i] = \exp\left(\beta_0 + \sum_{g=2}^{4} \beta_g D_{ig} + \lambda' x_i\right) \qquad (4)$$

where y_i was a measure of participation. We took two measures into account, the number of partners and the number of exchanges; D_{ig} was the age group indicator for individual i (G1 is the reference group) and x_i was an indicator of whether the user had reciprocal partners. According to Panther (2012), those with reciprocal transactions tend to be more active in exchanges and have more partners. We employed negative binomial models, which controlled for the potential overdispersion found in many applications with microdata. The results show that the elderly members had, on average, 28% more partners and were involved in 47% more exchanges than the youngest ones. As we have already mentioned for the previous models, the interpretation of the estimation results is descriptive rather than causal.

Thus, the elderly members exchanged sooner once they joined a time bank, while also showing more active behavior, which could have been for economic reasons, i.e., to satisfy their needs, which happened to a greater extent than what was observed for the youngest members. The results for young people were in line with Valor and Papaoikonomou (2016) who, using survey data from Spanish time banks, stated that the main motivation to join them is not economic, but is driven by ideological reasons. The findings with this data based on transaction records seems to confirm this pattern. An exhaustive review of the literature on motivations for joining time banks can be seen in Collom et al. (2016).

5. Conclusions

This article contributes to the literature on the potential of time banks to create social capital by analyzing transaction data from three time banks located in Barcelona. The dataset was composed of 452 active members who had been involved in 2,478 transactions. To the authors' knowledge, this is the first article that has explored the capacity of time banks to promote social capital using transaction data from Spanish time banks. Both bonding and bridging social capital were considered.

Regarding bonding social capital, the findings on the average number of trading partners and the ego-network density indicators were in line with the results found in the literature for US time banks. The overall percentage of members with at least one reciprocal partner was considerably higher than the figure found in other articles using transaction data from US time banks. For the first time, in this article, reciprocity has been analyzed, in terms of transactions, exploring trust-based relationships among members, reflected in repeated transfers with the same group of partners. Our results show that this type of transfer constituted 40% of the total. Concerning bridging social capital, four age groups were considered. We found an average weighted E-I index of 0.27, representing the incidence of external ties. A deeper analysis into each age group shows that the elderly members' preferences for internal ties were higher than

what was observed for the youngest members. Finally, our results point towards the elderly members transacting sooner and more actively than the youngest members.

In spite of the above, our study does have some limitations. Firstly, it refers to time banks with specific characteristics. Secondly, transaction data alone cannot clearly determine reasons for joining a time bank. Thus, our results on this issue must be taken with caution. Combining our analysis with survey data could provide further insights. Nevertheless, our findings may be of interest from different perspectives. On the one hand, the results could be relevant for academics interested in social currencies, an issue of growing interest in the literature. On the other hand, local governments might wish to design their social policy by taking into account the needs of their citizens and promote the spread of these types of informal economy channels to enhance social capital creation.

Author contributions

Conceptualization, A.C., B.M. and R.S.M.; Methodology, A.C., B.M. and R.S.M.; Software, A.C., B.M. and R.S.M.; Validation, A.C., B.M. and R.S.M.; Formal Analysis, A.C., B.M. and R.S.M.; Data Curation, A.C., B.M. and R.S.M.; Writing – Original Draft Preparation, A.C., B.M. and R.S.M.; Writing – Review & Editing, A.C., B.M. and R.S.M. All authors have read and agreed to the published version of the manuscript.

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