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KEY INDICATORS OF TIME BANK PARTICIPATION: USING TRANSACTION DATA FOR EVALUATION

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ABSTRACT

This paper presents some key and advanced statistical indicators of time bank participation. Unlike printed community currencies, time banks record their exchanges in databases. Such transaction data enables researchers to evaluate member participation in these networks across time. Nonetheless, there is very little published scholarship employing time bank transaction data. Examples from a U.S. time bank are provided. The suggested indicators are intended to encourage coordinators and scholars to study these networks. Coordinators who track their systems can intervene as necessary. Scholars researching individual time banks can use these metrics to facilitate comparisons of multiple cases in order to better assess the efficacy of time banking.

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1. INTRODUCTION

As evident in the pages of IJCCR, community currencies exist in a variety of forms. Printed local currencies, such as those using the Ithaca Hours model in the United States (see Jacob et al. 2004a, 2004b; Collom 2005), are at a disadvantage insofar as circulation and participant engagement are difficult to track. Coordinators and researchers are not easily able to determine when, where, or whether those bills are spent. Time banks, on the other hand, employ a "virtual" currency and members or coordinators record the exchanges that occur in databases. Nevertheless, few analyses of time bank transaction data exist. This paper develops some key and advanced indicators of time bank participation, seeking to give coordinators ideas for monitoring their networks and scholars a set of metrics to facilitate comparative analyses.

By tracking indicators of participation, time bank coordinators can better assess the health of their networks. Simple indicators such as active membership size and number of new members can inform coordinators about the extent to which they should focus on recruitment versus servicing existing members. Knowing the extent to which specific types of services are being exchanged and summary measures such as total hours traded could also be useful for grant writing purposes. Finally, by identifying who trades what with whom, coordinators can match particular members together in an effort to increase participation.

The paper begins with a brief overview of previous community currency research employing transaction data. A discussion of data preparation follows. Next, seven key indicators are defined and discussed, including system-wide and individual-level measures of participation. Four advanced indicators of individual participation are then presented. Examples from a U.S. time bank, the Portland West Time Dollar Exchange, are provided throughout. In the concluding section, the limitations of transaction data and the next steps for further research are discussed.

2. PREVIOUS RESEARCH

There is very little published research on participation in time banks or LETS (Local Exchange and Trading Systems) that analyzes official recorded transaction data. Most studies in this area involve membership or coordinator surveys in which the frequency and form of participation is estimated by respondents (see Williams 1996; Caldwell 2000; Aldridge et al. 2001 for example). Such surveys pose a number of methodological issues. Since members cannot be expected to recall all of the details of all of their past transactions, the questions must be rather general. Frequency of participation questions are usually limited to a time period (i.e., quarter or year) and often do not distinguish between providing versus receiving services. The quality of participation (i.e., types of services exchanged and types of trading partners) are also typically neglected. Moreover, response rates to such surveys are often low, raising issues of representativeness (Baruch and Holtom 2008). While surveys or interviews are necessary to study participation in printed community currencies where circulation is not able to be tracked, transaction records offer tremendous advantages for the study of time banks and LETS.

In the first published analyses involving transaction data, Seyfang (2001a, 2001b) analyzed the transaction records in a case study of a LETS network. She reported on two system-level indicators: total amount spent in the past year and the total number of transactions in the past year (2001a) as well as two individual-level indicators: total number of transactions and total number of trading partners (2001b).

There are four studies of time banks that employ transaction records. Collom (2011) and Lasker et al. (2011) use an individual-level indicator, average number of transactions per quarter, as a key variable in multivariate statistical analyses. An extensive use of transaction records is found in Collom's (2008) case study focusing on the participation of the elderly. The author uses average number of transactions per quarter, average number of trading partners per quarter, percentage of trading partners that are reciprocal (having both provided and received services from the same member), ego-network density, and the E-I (external-internal) index as dependent variables in multivariate analyses. The latter two measures are commonly used in social network analyses (see Scott 2000; Hanneman and Riddle 2005) and highlight the fact that transaction records are social network data, a point elaborated in the next section. All of the indicators presented below are engaged in comparative analyses of U.S. time banks in the forthcoming Equal Time, Equal Value (Collom, Lasker, and Kyriacou).

3. PREPARING TRANSACTION DATA FOR ANALYSIS

There are a number of different software packages that were programmed to track time bank exchanges. "Timekeeper" (Gordon 1995) was used by many in the 1990s. Today, the two largest national umbrella groups, TimeBanks USA and Timebanking UK, distribute their own software ("Community Weaver" in the former and "Time Online" in the latter). A group of time bank consultants in the U.S., hOurworld, designed another product, "Time and Talents." While each software package operates differently and has unique features, they all store the transaction information in a database table in a similar format. At a minimum, the transaction table from the database contains the following fields for each transaction: the date of the exchange, the provider's name or ID, the recipient's name or ID, the amount of time/number of credits earned (also known as time dollars or hours), and the type of service that was provided. These tables are usually set up so that each transaction is in a row of the table and the fields are in the columns. The software administrator should be able to easily export this information into a spreadsheet table for analysis. A data analysis software package will facilitate the production of these indicators.

Table 1: Summary of Key Indicators of Time Bank Participation

LEVEL	NAME	DESCRIPTION
System	Number of active members per quarter	The number of members who are providing and/or receiving services within each quarter
System	Quarter of first transaction	The number of new members per quarter
System	Total number of hours per quarter	Turnover (number of time dollars or hours earned) per quarter
System	Service categories	Thirteen broad categories to classify services
Individual	Total hours of participation	Sum of the total number of hours providing and receiving services
Individual	Average hours per quarter	Total hours divided by quarters participated
Individual	Account balance	Difference between hours earned and spent

By definition, these transaction records are social network data, a list of exchange ties between members. Such data is relatively rare in social network analysis and has three characteristics. It is longitudinal, directed, and valued (see Scott 2000). Transactions occur across time, a long period of time (many years) for some time banks. The data is considered directed since the ties are not symmetrical, one time bank member is providing something in exchange for the time dollars from the recipient. The amount of time (number of time dollars) of the transaction is the value of the tie. Social network analysis software is required to construct the advanced indicators presented below.

Before computing any measures, it is particularly important to inspect the raw data and assure that all of the transactions listed in the database are actually exchanges, information that one wants to quantify. Each time bank has its own policies and each software package has its own features. Data entry errors occur regularly and are handled differently. Some are able to just erase them while others have to cancel them out with an additional transaction for negative time or one that swaps the provider and receiver. Many time banks also have "social capital" or donation accounts that they use for the transfer of the credits or debits of the closed accounts of those members who leave the network. It is up to the researcher to determine if such administrative transactions are meaningful and should be studied or simply deleted from the dataset.

4. KEY INDICATORS OF TIME BANK PARTICIPATION

Table 1 summarizes the seven key indicators to be described in this section. These indicators are intended to be suggestive. Coordinators or researchers may find little use for some of these and other possibilities certainly exist.

The first four indicators comprise a longitudinal, system analysis. That is, looking at characteristics of the network as a whole across time. The first indicator is number of active members per quarter. While a time bank coordinator can easily look up the total membership size at any given time, this number is misleading. Participation in most voluntary organizations tends to vary tremendously among organizational members. This is what social movement scholars refer to as differential participation. Some people join groups and never actually participate, others are only occasionally active, and then there are those who are highly engaged (see Knoke 1988; Wiltfang and McAdam 1991; Passy and Giugni 2001; Collom 2011). Thus, basic membership numbers cannot capture variation in participation and therefore are likely to overstate participation

The number of active members identifies those members who are providing and/or receiving services within a particular time period. Quarters (three month intervals) appear to be the best time metric for these analyses. Months provide too many data points and years not enough. To compute the number of active members per quarter, the dataset must be sorted by date of transaction and then separated into quarters. The count of the number of unique providers and receivers indicates the number of active members in each particular quarter.

When plotted as a line graph, the number of active members across time provides key information on the life cycle of a particular time bank. For coordinators, an observed decline in active members could spur an investigation and intervention as needed.

Figure 1 provides a sample line graph of the number of active members per quarter of a time bank that existed in Portland, Maine for over four years, the Portland West Time Dollar Exchange (PWTDE)[1].

As seen in the line graph, this time bank had only 10-15 active members in its first year of operation and then slowly grew over the next seven quarters. It experienced a

1 PWTDE launched in early 2002 (Quarter 1 in the line graph) and closed in June 2006 (Quarter 18 in the line graph). PWTDE was embedded in Portland West, a community-based social service agency (now known as LearningWorks) and made membership available to all residents of Portland, Maine's West End (see Collom, Lasker, and Kyriacou forthcoming for the different models of time banking). Portland West ran out of grant money to support its community outreach programs and was forced to close the time bank (Doherty 2006). All PWTDE members were invited to join Portland's larger and better-known time bank, the Hour Exchange Portland.

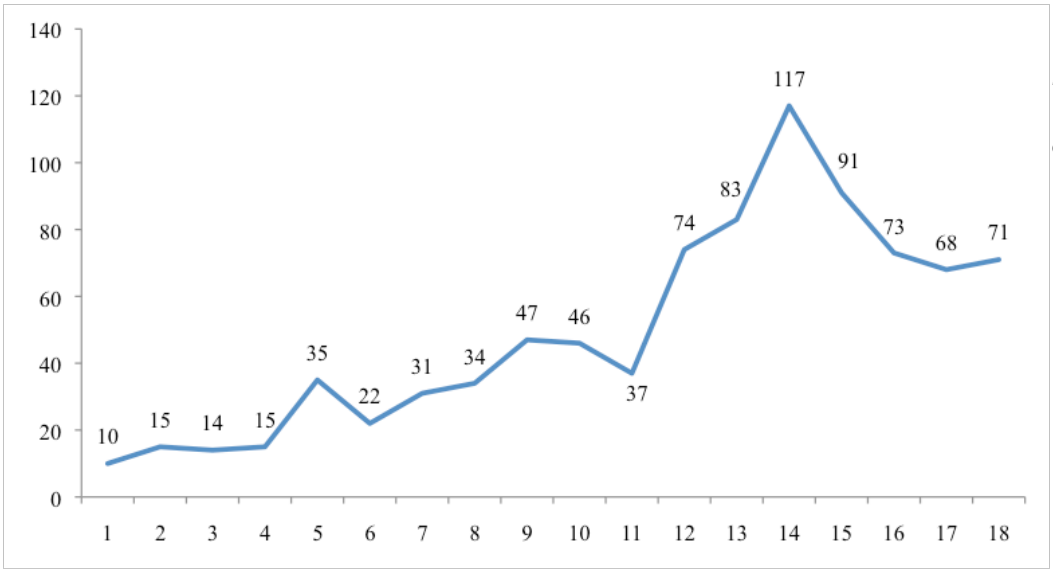


Figure 1. Number of Active Members per Quarter, Portland West Time Dollar Exchange

large gain in active members in Q12 (74) and peaked out with 117 active members in Q14. This trend of growth and then decline has also been found at other U.S. time banks (see Collom, Lasker, and Kyriacou forthcoming). By tracking such trends, coordinators can intervene as needed, encouraging their current members to exchange services as well as seeking new members.

The second indicator is also a system-level one, quarter of first transaction. This follows the same logic as active members and is a proxy for the number of new members per quarter. While the date of a member's application or orientation may be available, the date of their first transaction provides a more substantive starting point. To produce this indicator, the transaction dates in the data file must be recoded into quarters. Each member will have usually participated in multiple transactions, so there will be a quarter value (such as 1 through 18 in Figure 1) for every transaction (providing or receiving a service) by each member. The minimum value of these quarter scores must be found for each member. The lowest value of the transaction quarters for each member is the quarter of their first transaction. The sum of the number of members in this first quarter variable provides the number of new members in each quarter.

Figure 2 illustrates the line graph for the PWTDE case. Notice that the trend looks somewhat similar to that in Figure 1. The new member peak came in Q14 (as in the case of the active member peak) when 48 PWTDE members had their first transaction. By adding up all of the values in Figure 2, we see that PWTDE had a total of 319 members across its history.

New membership rates are important to study since they are a major component of the size of the overall membership. As in the case of all voluntary organizations, community currency networks lose members over time. Every quarter, some members cease participating. This is due to a variety of reasons such as lack of time, lack of need, dissatisfaction with the system or services, moving out of the area, or death. Time Banks need to simultaneously maximize engagement of their existing members and recruit new ones. These "servicing" versus "organizing" functions are major dilemmas for some organizations (labor unions are a classic example). With limited resources, balancing these two competing demands can be challenging.

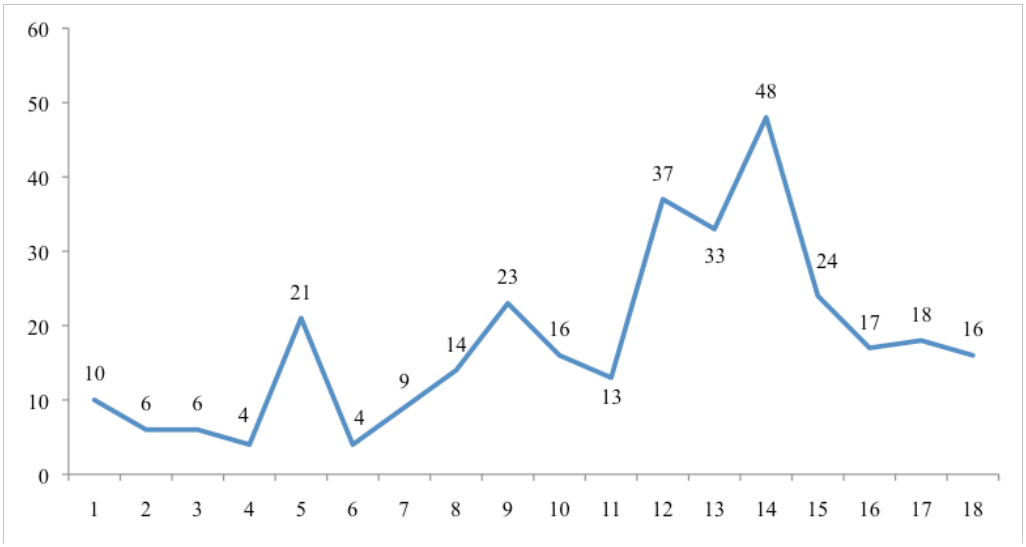


Figure 2. Number of New Members per Quarter, Portland West Time Dollar Exchange

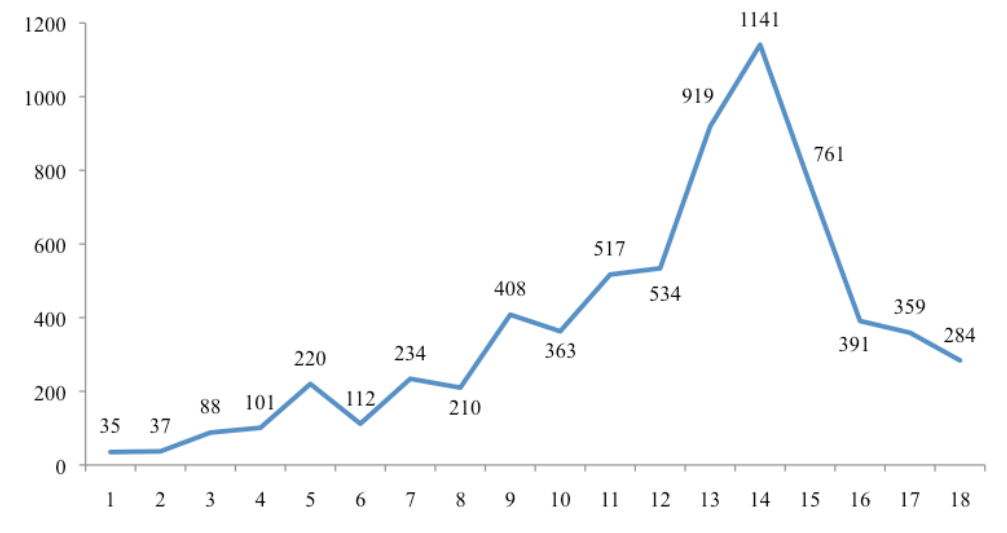


Figure 3. Total Number of Hours per Quarter, Portland West Time Dollar Exchange

Once these first two indicators are computed across a time bank's history, two other useful measures can be easily derived. The average number of active members per quarter is simply the mean of the number of active members of each quarter (which is 49.1 in the PWTDE case). Likewise, the average number of new members per quarter is a useful summary statistic (which is 17.7 for PWTDE). These measures make it possible to identify the periods in which activity is above or below average.

The third key indicator is total number of hours per quarter. This identifies turnover in the system, the number of credits or time dollars provided or earned each quarter. Once the dataset is sorted by date of transaction and separated into quarters (as was done for the computation of number of active members), one can easily sum the total hours earned in each quarter and plot them in a graph as in Figure 3.

The trend we see here, once again, is similar to that in Figure 1 with a peak in Q14. By adding up all of the values in Figure 3, we learn that a total of 6,712 hours of services were provided at PWTDE (in 2,316 transactions). Once the total number of hours is computed, other derivatives are possible. The average number of hours per quarter is one (and is 373.0 here). By incorporating the number of active members, it also easy to compute the average number of hours per active member per quarter (which is 7.0 at PWTDE).

The fourth key indicator, and last at the system-level, surrounds the services exchanged in time banks. Most time bank software packages have built-in service categories and those where members enter their transactions in online usually allow users to type in the exact service if it does not fit into the existing categories. There are literally thousands of different types of time bank exchanges. The intention of the service category indicator is to provide a reasonable number of broad service categories to make comparisons practical. After consulting the service categories of several software packages, the user-recorded services in several U.S. time bank databases, and occupational classification coding schemes, thirteen service categories were constructed. This typology is not definitive, not all of the categories are relevant for every time bank and there may be services exchanged that do not fit neatly into one of the categories.

Table 2 provides these broad categories. In some cases, similar types of tasks were separated depending on the nature of the actual transaction. For example, Events and Program Support primarily involves organizing time bank events or helping run the time bank, whereas Office and Administrative Support is clerical help provided to individual or organizational members, not the time bank. If one member teaches another how to use a computer, that was coded under Tutoring, Consultation, and Personal Services. If a member fixes a computer hardware problem or rids another member's computer of a virus, that is coded under Computers and Technology. This latter category encompasses more technical services that are potentially performed independently while the former service category is defined as teaching or directly helping another member.

Coding time bank transactions into these thirteen service categories can be relatively easy or very laborious, depending on how one's time bank records their transaction data and how much of it there is. If each transaction is already assigned to an existing service category, a simple recode command in data analysis software will suffice once one determines what goes where in the new scheme. However, if members or coordinators have access to and use an "other" category code and describe some services themselves, every one of those user-described transactions will have to be inspected and recoded into one of the final set of categories.

Once the coding is complete, several statistics can be produced: the total number of hours provided in each category, the total number of transactions in each category, and total percentages for both of the former. Using percentages al-

Table 2. Thirteen Suggested Time Bank Service Categories

SERVICE CATEGORY	EXAMPLES
Arts and Crafts Production	Arts and crafts, artwork
Beauty and Spa	Haircut, massage, facial
Cleaning, Light Tasks and Errands	Cleaning, mending and alterations, errands
Computers and Technology	Computer repair, website design, audio/video production
Construction, Installation, Maintenance and Repair	Carpentry, painting, yard/garden maintenance
Entertainment and Social Contact	Companionship, performances, telephone assurance
Events and Program Support	Assistance with project/event, committee meetings
Food Preparation and Service	Cooking, catering
Health and Wellness	Yoga, acupuncture, meditation
Office and Administrative Support	Clerical help, bulk mailing
Sales and Rentals of Items	Purchase of used goods, space rental
Transportation and Moving	Transportation, moving assistance, hauling
Tutoring, Consultation and Personal Services	Lessons, tutoring, basic computer assistance, childcare

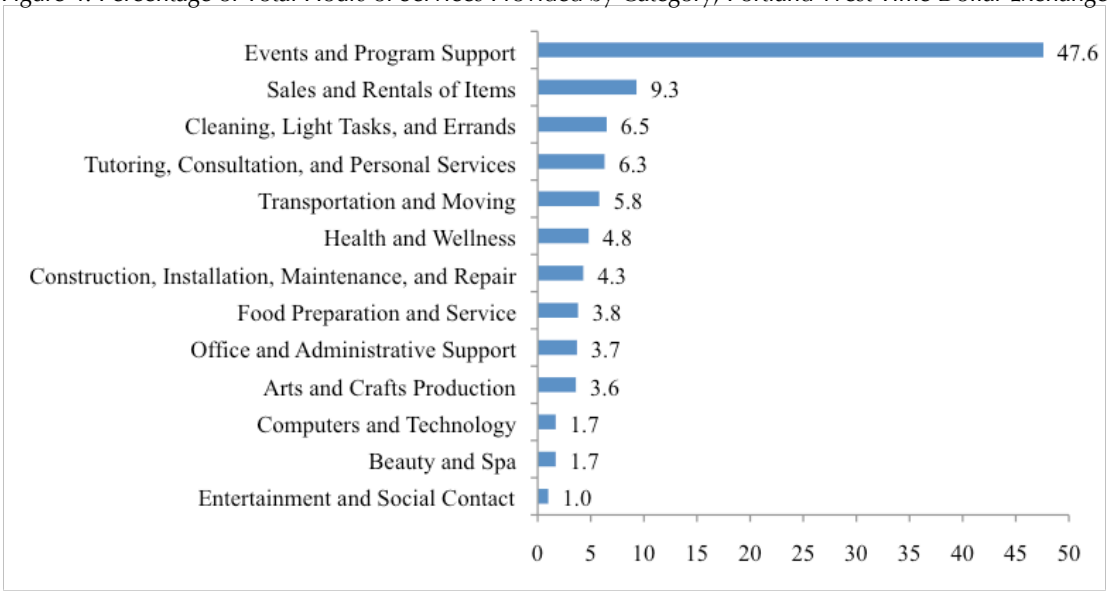
lows one to make substantive statements as we will see below.

Figure 4 is a bar graph illustrating the distribution of service types at PWTDE. Nearly one-half (47.6%) of all of the hours that have been provided at PWTDE fall in the Events and Program Support category. Many members had regularly provided a variety of assistance for events and projects to the time bank itself as well as other organizational members. It should be noted that this proportion is much higher than what has been found in other research using these service categories (see Collom, Lasker, and Kyriacou forthcoming).

The next most popular service category is Sales and Rentals of Items for time dollars, comprising 9.3% of all of the hours at PWTDE. There is considerable variance in how the remaining hours are distributed across the service categories. At the low end, we see that Computers and Technology, Beauty and Spa, and Entertainment and Social Contact represent types of services that were not frequently exchanged at PWTDE.

The next indicators measure individual member participation in time banks, rather than system characteristics. Total hours of participation is the first key indicator at the individual level. This is the sum of the total number of hours providing services (time dollars earned) and the total number of hours receiving services (time dollars spent) for each member. In data analysis software, one would take the lists of all of the transactions provided by each member

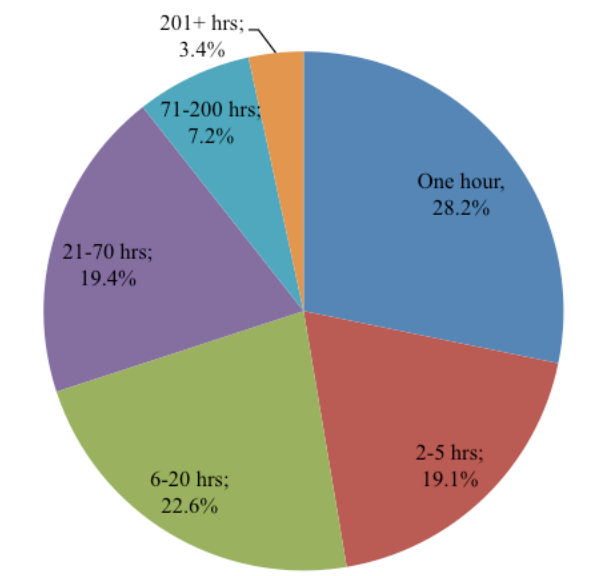
Figure 4. Percentage of Total Hours of Services Provided by Category, Portland West Time Dollar Exchange



and all of the transactions received by each member and then sum the hours for each member (a "split file" command to organize the output by member makes this task more manageable). Alternatively, using social network analysis software, total hours would result from the addition of each member's "outdegree" and "indegree" (see Scott 2000).

At PWTDE, total hours of participation among the 319 members ranges from 0.5 to 2,994. The latter is the account for the different programs of the host agency, Portland West. The PWTDE account has the next highest amount of total hours of participation at 995.5. Every time bank has its own account to credit those who assist in running the time bank. One individual member has a total of 658.5 hours of participation. The average total hours of participation among the 319 members is 42.1, but that value is inflated given the presence of the high, outlying values. Thus, it is often more appropriate to create a categorical version of this variable rather than using the raw numerical version. For example, the pie chart in Figure 5 may provide a better understanding of the distribution of total hours of participation at PWTDE.

Figure 5. Members' Total Hours of Participation in Categories, Portland West Time Dollar Exchange



The next indicator is average hours per quarter. The previous indicator, total hours of participation, does not control for membership length. Some members will have recently joined their time bank whereas others may have been members since theirs launched. Thus, the total hours of participation variable suffers from a time bias. Those who have joined more recently are likely to have fewer hours of exchanges than those who joined longer ago. Therefore, the average hours of exchanges per quarter of participation controls for membership length. It is computed by dividing total hours of participation by number of quarters participated. The latter can be found by getting a count of the days between one's first transaction and their last.

At PWTDE, average hours per quarter ranges from 0.5 to 176.3. The average member has 8.5 hours of participation per quarter on average. This value is also inflated due to the high outliers who are particularly active. The median of the distribution is 4.0: 52.7% of the membership exchanged an average of four hours or less per quarter. Thus, we see that the majority of the members in this time bank were not very active. A categorical version of this variable, as we saw above in Figure 5, could also be constructed to help describe the distribution of this variable.

Account balance is the next key indicator and time bank software packages already provide this one. It is simply the difference between hours or time dollars earned (credits) and spent (debits). This indicator taps into one of the central questions surrounding time banking. How many members spend more than they earn? When some people first hear about time banking they think it is too good to be true. Some are skeptical that people will "rip-off" the system. One of the advantages of time banking over other forms of local currencies is that participants can usually receive services without having any time dollars or even if they have a negative balance. Debt is usually tolerated, and in some cases encouraged, framed as an incentive for providing services and seen as a future obligation to the system.

The account balance indicator allows one to determine the extent to which members hold debits, balanced accounts, or credits in their time banks. A categorical version of the account balance variable is presented in Figure 6. In this version, accounts are considered "balanced" if the member had somewhere between 2 debits and 2 credits.

As seen in Figure 6, the modal category is the balanced one, with 41.7% of members. Thirty percent are in the 3 to 20 credits category. Only 13.2% of members held any debt in this time bank when it closed. Eleven percent fall between 3 and 20 hours in debt. Higher levels of debt are not common and these debt-holders tend to be organizations who receive more services from members than they are able to provide.

5. ADVANCED INDICATORS OF TIME BANK PARTICIPATION

In this section, some advanced indicators are presented. These are all individual-level indicators concerning each member's network of transaction partners. These measures rely upon social network analysis software and can be tedious to produce. Again, these are intended to be suggestive, there are many other possibilities and coordinators may find these to have limited utility. Table 3 summarizes the four advanced indicators to be described below.

UCINET 6 (Borgatti, Everett, and Freeman 2002) is one of the leading social network analysis software packages and some its commands will be briefly described here. Users must first import their transaction data into the software.

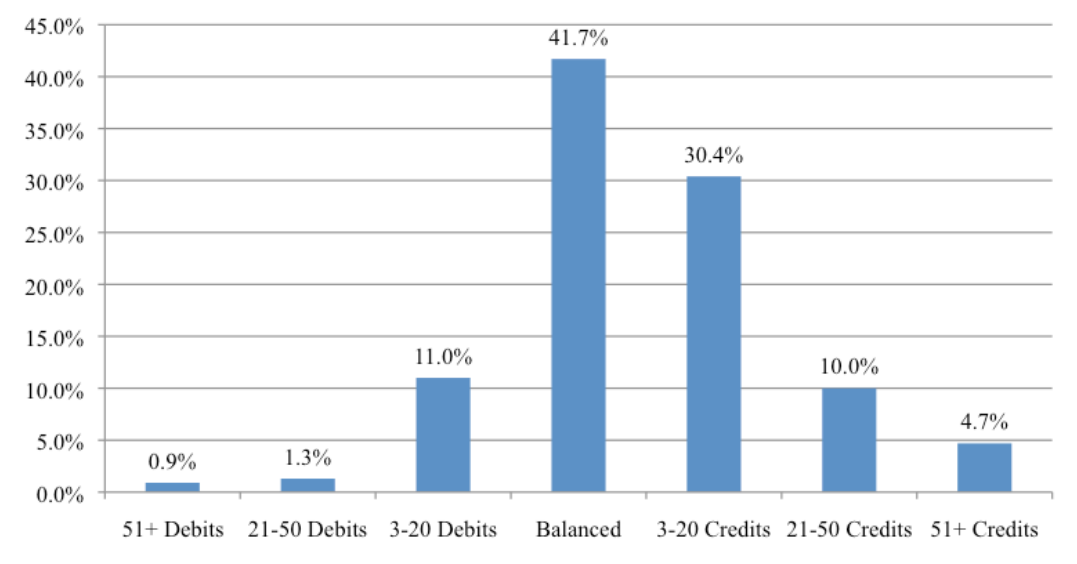


Figure 6. Percentage of Members in Account Balance Categories, Portland West Time Dollar Exchange

The "edgelist1" format is most conducive given the nature of these transaction spreadsheets. During importation, each transaction is simply listed as three fields: ID of the provider, ID of the receiver, and number of hours (credits) provided.

Number of trading partners is the first advanced indicator. This measures the size of members' exchange networks (or the number of unique contacts) within their time bank. Some people exchange with a lot of different members whereas others do only with a few. In UCINET 6, the "Egonet basic measures" output contains a "Size" variable which provides each member's number of trading partners. The value of this indicator for each member would be between one (for those who have only traded with one other member) and the total number of active members across the history of the time bank (for those who have traded with every member in the network). At PWTDE, the number of trading partners ranges from 1 to 176 with 4.8 being the average. Nearly half (48.3%) of all the members traded with only one other member. The median value is 2 as 14.4% traded with two other members. At the high end, 10.3% of members had exchanged services with 10 or more different members.

Knowing how many trading partners each member has could be useful information for coordinators. Some time bank members trade repeatedly with the same people and develop deep bonds with a few members. If there are other members who provide similar services who are new to the network or not very active, a coordinator could suggest to a member with few trading partners that it might be a "win-win" situation if they requested the service from a different member. This would present a new social opportunity and would help integrate the new or inactive member into the time bank.

The next advanced measure is number of reciprocated contacts, the number of two-way exchange partners. Reciprocation is one indicator of "bonding" social capital. Bonding ties tend to be strong and exclusive, creating social solidarity (Putnam 2000; Halpern 2005). These tend to be deeper connections among people who are rather similar to one another. When a member provides a service to one from whom they have previously received a service, they make the relationship reciprocal. Reciprocation further develops a social relationship, represents "success" as these two participants have chosen to transact again, and makes the relationship more egalitarian as both parties will have provided and received. Nonetheless, direct reciprocity is not necessarily a goal within time banks. Indeed, the advantage of time banking over bartering is that a member is not restricted to a relationship in which both people have some-

Table 3. Summary of the Advanced Indicators of Time Bank Participation

LEVEL	NAME	DESCRIPTION
Individual	Number of trading partners	The size of a member's exchange network
Individual	Number of reciprocated contacts	The number of two-way exchange partners
Individual	Ego-network density	The percentage of transaction ties among one's trading partners that exist
Individual	Number of services exchanged	The number of different service categories that one has exchanged within

thing that the other one wants. This indicator is among the more complicated to produce[2].

At PWTDE, three-quarters (74.6%) of the members did not have any reciprocated contacts, 13.2% had one, 6.3% had two, and 5.9% of members had three or more. Thus, reciprocation was relatively rare at PWTDE.

The next key indicator of individual participation in time banking is a measure of network density. In contrast to number of trading partners (above), the density of one's exchange network measures the extent to which the members with whom one trades are engaging in transactions with one another. Ego-network density is a variable that is used in many studies. The most well-known examples in Sociology employ General Social Survey data (see Marsden 1987; Moore 1990; McPherson, Smith-Lovin, and Brashears 2006).

This statistic is readily available in social network analysis software packages including UCINET 6. Density is expressed as a percentage. If a member's trading partners (known as "alters") have never exchanged with one another, that member's ego-network density is zero. If all of one's alters have transacted with each other, density is 100%. In this calculation, the direction of the tie between members (providing versus receiving) is being ignored, only seeking to see if a tie exists. Some participants are located in highly connected regions of the overall network while others are in sparse areas (where one's alters are not exchanging with one another). Dense networks are generally good for producing bonding social capital. Information is likely to flow faster through denser networks as well. In time banking, referrals are an important way of learning about services. Time bank members often talk about the network and their exchanges within it during their transactions. Thus, those who are in well-connected regions of the network are likely to have greater resources (in the form of information about other members and services) and therefore, may be more likely to be more active. If one's trading partners are well-connected and talk about some great services that they have received or some members who are really in need of particular things, that information may spur greater activity.

Coordinators and members may find it useful to know who is trading with whom. If none of a member's alters are connected, it would suggest that referrals are not the method that member uses to find services. A coordinator could peruse the networks of members who are not very active and do some matching and suggest particular providers that are in well-connected regions of the network. If members were able to see their own trading networks, they could do some matching as well and connect trading partners of theirs who do not currently trade with one another. Nevertheless, some coordinators and members may not find this information particularly useful.

Social network diagrams (or "sociograms") are often used to help clarify the concept of ego-network density and are the easiest way to see who is trading with whom. Figure 7 provides examples for two PWTDE members. In each diagram, the members or "nodes" are shown as blue squares. Ego (the member we are focusing on) is in the middle of the diagram. The lines (technically referred to as "ties" or "arcs" or "edges") indicate that at least one transaction has occurred between the connected members. The arrowheads on the lines point to the recipient of the service. Lines with double arrowheads illustrate reciprocal relationships in which both members have provided and received services. Sociograms can be made more detailed by adding values to the ties (the number of hours of services exchanged) as well as characteristics of the nodes (gender, age, etc.). For the purposes here, they will be kept relatively simple.

Panel a) provides the ego-network for a member that is close to the PWTDE averages: a moderately sized network (6 alters) with low density (13.33%). That is, only 2 of the possible 15 ties among alters are present (see the top of the diagram). The ties between ego and their alters are present by definition and are not counted in the computation of ego-network density. Notice that the alter positioned at about "2 o'clock" in the diagram has provided to and received from ego.

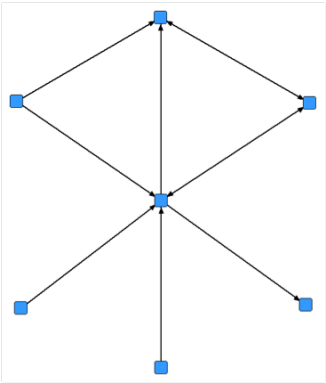
Panel b) illustrates the ego-network for the PWTDE account. This is a large ego-network as 176 members have provided or received services from the time bank itself. However, the density of this network is very low, only 0.99%. There are very few ties among alters here (only 153 of 15,400 possible ties exist). As evident, there can be challenges to visualizing large networks. One option is to exclude ego (and therefore their ties to alters) so that the sociogram only portrays the ties among alters (this is also a better depiction of the density measurement).

Panel b) also provides a good opportunity to discuss the association between network size (number of trading partners) and density. These two variables tend not to be independent of one another. That is, larger networks usually have lower density than smaller networks. In general, it is more difficult for people to maintain ties with the same proportion of alters as a network grows. There are con-

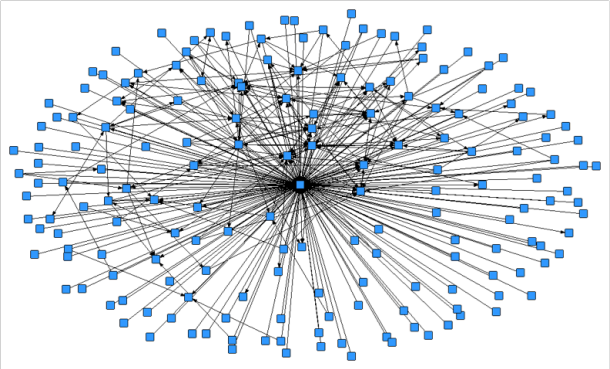
[2] Many social network analysis software packages (including UCINET 6) store data in square matrix format (in which the row and the column labels are identical, the members, and the values represent the presence or absence of a tie, the number of hours exchanged between two members). These matrices are easily manipulated and transformed with the appropriate software. To produce the number of reciprocated contacts, the original matrix that is produced from a time bank transaction table is transformed from a valued matrix (containing the number of hours per transaction) into a binary matrix (0 vs. 1 indicating whether any transaction tie exists between two actors). The lower and upper halves of the new binary matrix are then added (using the "Symmetrize" command and the "Sum" function). Values in this resulting matrix of 2 identify reciprocal relationships. This matrix is then transformed into a final binary matrix (distinguishing values of 2 from those of 0 and 1) to allow a count of the total number of reciprocated contacts (obtained from the "Degree" function).

Figure 7. Sample Time Bank Sociograms Illustrating Network Size and Density

a) Moderate Size (6); Low Density (13.3%)



b) High Size (176); Low Density (1%)



straints to the number of social relations that people can feasibly maintain (see Friedkin 1981; Scott 2000).

The ego-network density indicator at PWTDE ranges from 0% to 100% with an average of 14.2%. Nearly two-thirds (64.9%) of the members have 0% density, no transaction connections among their alters.

The last advanced indicator is number of services exchanged. Earlier, the service category indicator was introduced. Now it is time to consider the individual level to determine the diversity of the types of services that members exchange. Do members tend to exchange a variety of different services or just a few? In the formal economy most people tend to consume a variety of goods and services. It should be interesting to determine the extent to which time bankers exchange a range of services as well.

The number of services exchanged is simply the count of the number of different service categories that each member has provided or received services within. The values will range from 1 to 13. Once the service category variable described above is created, one can sum the number of unique categories for each member. This can be computed in UCINET 6 or other social network analysis software by using the service category as the attribute of the tie (instead of the number of hours provided). Alternatively, a "split file" command in standard data analysis software (to divided the output by members) and a frequency distribution of the service category variable could be used[3].

Figure 8 provides the distribution for PWTDE members. Just over half of members (53.0%) have exchanged services within only one of the thirteen service type categories. Fifteen percent have traded within two different categories and 8.8% within three different categories. Fewer than ten percent of PWTDE members have exchanged services within eight or more different service categories. Most do not have high diversity in the types of services they trade in this time bank.

6. LIMITATIONS AND NEXT STEPS

As others have noted (Seyfang 2001a; Lasker et al. 2011), transactions records are far from perfect. Some members do not report all of their transactions. There are a variety of reasons for this. One of the ironies is that unreported hours are sometimes the result of the successes of time banking itself. As members get to know each other better and establish relationships with those with whom they are exchanging, recording transactions with friends may begin to seem unnecessary or even inappropriate. In other cases, members have high balances and simply do not bother. Technology may also play a role in underreporting. While exchanges were most often arranged through and recorded by the staff or coordinator in the early days of time banking, today most of this activity is done by members themselves. For some, even entering information online takes time and effort that may not seem worth it. Others simply forget.

While a time bank's transaction records reflect its "official" balances, they are an undercount of the exchanges that occur among members. It is not possible to know how underreporting might bias the results of the indicators of participation that have been described here.

If one is willing to accept that transaction data provide valuable information about time banks, they can take the next step and collect additional data. Characteristics of individual members can be linked to the seven individual-level indicators presented above for powerful statistical analyses. Most time banks have an application process in which applicants provide some demographic information. New time banks should be systematic and view the application form as a data collection opportunity. Membership forms can include variables such as gender, age, race, education, income, marital status, etc. With this information, researchers could test for demographic differences in member participation. With social network analysis software, one could also investigate who trades with whom.

3 A more powerful indicator tapping into the diversity of services exchanged could be created by taking the Index of Qualitative Variation (IQV) for each member's distribution of service types exchanged (see Collom, Lasker, and Kyriacou forthcoming).

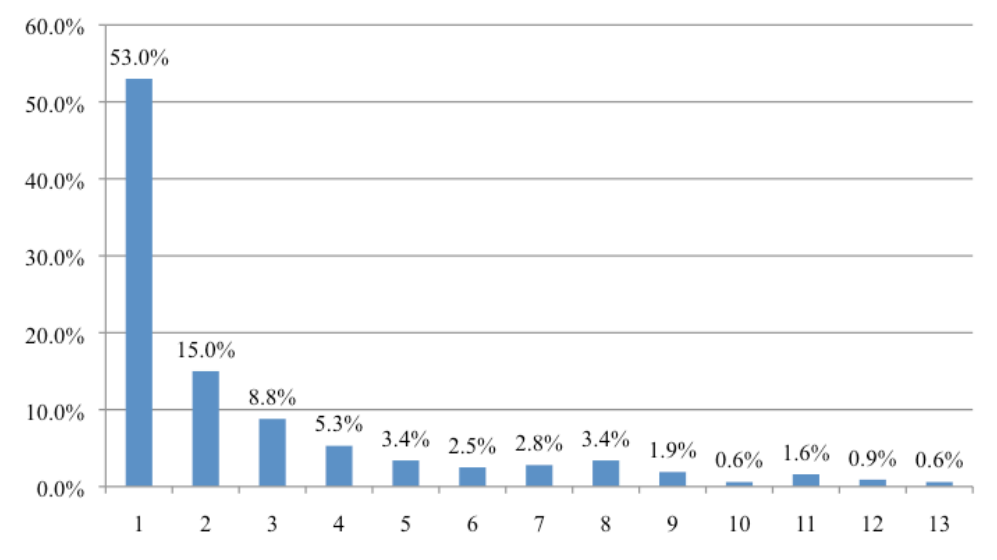


Figure 8. Distribution of Number of Service Types Exchanged, Portland West Time Dollar Exchange

Membership surveys can also be used to collect additional information. Coordinators and researchers should be aware that such surveys cannot be anonymous if they are to be linked to member's transaction records. Also, careful attention should be paid to response rates and the representativeness of the sample. Surveys would be a very good tool to measure the outcomes of time bank participation as well as organizational commitment or satisfaction with the time bank (see Collom 2007; Lasker et al. 2011 for examples).

Finally, existing secondary data on characteristics of the area (city or county) where one's time bank is located could be collected and compared to some of the longitudinal system indicators described above. For example, unemployment rates by area and month are often publicly available. Thus, it is possible to test for correlations between local unemployment rates across time and the number of active members per quarter, the number of new members per quarter, and the total number of hours exchanged per quarter.

This paper has provided details on some key and advanced indicators of time bank participation that can be created from transaction records. The study of time bank participation produces several potential benefits. Coordinators who track their systems closely are more likely to be able to develop effective policies and practices. If new membership rates or turnover declines, they can intervene as needed. Scholars are encouraged to construct these key indicators for comparative purposes. While individual case studies are most common, comparisons of multiple systems over time will enable us to learn more about the dynamics of time banking and its potential to empower the economically marginalized and build social capital.

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