

Social and Economic Outcomes of Complementary Currency Systems within the Affordable Housing Sector

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ABSTRACT

The thesis of this paper is that residents of affordable housing buildings that participate in Calgary Dollars (C\$) report social and economic benefits which are correlated to their C\$ participation, especially for those that report physical or mental limitations.

This paper seeks to identify the role of complementary currency within the field of community economic development. The complementary currency studied is Calgary Dollars (C\$) which was created in 1996, has been funded as a program of the City of Calgary since 2003, and became a digital currency in 2018. In 2018, C\$ was integrated with numerous affordable housing agencies, including Norfolk Housing Association and Calgary Housing Company, those included in this research.

Beginning in 2018, C\$ created subnets, digital platforms for C\$ trading, accessible from desktop computers and mobile devices, for the Norfolk Housing Association and two for the Calgary Housing Company (CHC). C\$ are paid out in various forms of honorariums and incentives by the agencies to their residents and accepted by the agencies as part of rent payments. All six apartment buildings owned by the Norfolk Housing Association participate in C\$, a total of 140 units of which 50% accept subsidised rents and are located in the neighbourhood of Hillhurst-Sunnyside. Calgary Housing Company, Calgary's largest affordable housing agency, accepts C\$ for a portion of monthly rent payments in the neighbourhood of Manchester (where there are three buildings) and Louise Station (one building) totalling 433 units. These housing agencies have challenged C\$ to serve their mission, to benefit the social and financial outcomes for both the agency and its residents. C\$ seeks to deliver these outcomes while saving the agency money.

C\$ employs a digital complementary currency software platform titled Cyclos. Cyclos data, user information and transactions, are analysed in this research. C\$ conducts annual pre/post test user surveys which are submitted to the City of Calgary and this data will also be used for this research. C\$ user demographic data is also collected as part of the City of Calgary data collection.

The analysis of this data offers insights into C\$ participants who are residents of these affordable housing agencies. We compared participant demographics (quantitative), C\$ transaction data (quantitative), and pre/post test survey responses (qualitative). This mixed methods approach allows C\$ data to be compared for the first time, and with statistical significance.

The thesis of this paper is that residents of affordable housing buildings that participate in C\$ report social and economic benefits which are correlated to their C\$ participation, especially for those that report physical or mental limitations. We found a moderate positive correlation between both the number of C\$ transactions and the total C\$ value transacted when compared to participants' reported social well-being benefits as described by the statement: "Do you have someone to turn to for suggestions about how to deal with a personal problem?" We found a moderate correlation between both the number of C\$ transactions and the total C\$ value transacted as compared to participants' reported financial well-being as described by the statement "Compared to your financial situation a

year ago, are you and your family worse off, better off, or about the same?” It was also found that financial and social well-being reporting was positively correlated for participants with physical or mental health limitations.

ACKNOWLEDGEMENTS

Since its inception, C\$ has benefited from the advice of experts in the economics, community economic development, finance and social policy realms. This has included input from David Korten, Bernard Lietaer, Paul Glover, and others. We are grateful for their solidarity and support.

The C\$ Housing collaborations included in this paper have been lead by Jared Blustein, without which this paper would not be possible. This has required exceptional skills in front line program delivery, project and administrative management, and conceptual vision. His unique contributions to this paper include innovative program customizations, sector research, sociogram development, and program evolution management.

This paper is dependent on the exceptional investments into the management of the C\$ program and maintenance of the C\$ Program Logic Model made by Sierra Love. This has entailed management of annual survey campaigns, event execution, outcome measures and database design and management.

The monetary and economic management of digital C\$ has benefited from the wisdom of numerous experts. They include Mark Anielski, James Stodder, Ester Barinaga, Jim Stanford, Michael Shuman, Ubiquat Technologies, STRO, and Andreu Honzawa. Considerable expertise also resides within the Arusha Centre, home of C\$. Calculations regarding the velocity of C\$ currency could not have been completed without the input of Arusha centre staff and board of directors members Byra Danaa, Raghu Bhaskar, Santiago Recalde and Haider Fatir.

The research on which this paper is based originated from discussions between Mike Unrau and Gerald Wheatley who have collectively presented at a total of 3 past RAMICS conferences. Once the research had been established, this work could not have been completed without the analytical talents of Bret Klein and the data expertise of Natalie Calles.

The authors of this paper assign no responsibility to those listed here for the conclusions of this paper but are grateful for the contributions they've made and to the complementary currency movement more generally.

INTRODUCTION

The monetary system has been changing rapidly and this rate of change has accelerated dramatically in recent years due to new digital technologies and globalisation. Simultaneously, governments have seen their tax base erode due to global economic and monetary forces. Governments' ability to fund social programs has decreased despite the increased demands of ageing populations in the developed world.

Nations, regions, and municipalities have sought to stimulate the local economy to address social needs while boosting job quality, economic output, tax revenues, and environmental sustainability. In Asia, Europe, Australia, and the western hemisphere, complementary currencies are being employed to spur the economy or deliver social outcomes. Creating new monetary systems which are socially and environmentally sustainable continues to be rare however, as emergent digital currencies have been characterised by non-backed, speculatively-traded, globally-oriented, anonymous, or blockchain currencies rather than those designed for social equity or environmental sustainability (Klein, 2022).

The immense potential of complementary currencies has been largely unrealized but was well-described by Canadian Jane Jacobs. Jacobs' is the author of numerous books including *The Death and Life of Great American Cities* (1961), possibly the most influential book on urban planning and cities. Jacobs illustrated the current monetary design problem with an analogy of one heart having to serve two individuals. She described that if one heart was being shared between two people, and

one person was resting while the other person was running, both people would underperform and suffer. Jacobs offered this analogy to illustrate how depressed regions and economically dynamic regions were each poorly served by a single currency. As countries consolidate the design of national currencies into a single global design, complementary currencies will be invaluable to serve the diversity of local and regional social and economic needs, with customised designs that thoughtfully balance acceptance, issuance, and velocity to complement their national currency system.

C\$ was created by the Arusha Centre charitable society in 1996, initially as the time-based Bow Chinook Barter Community Hours. Their issuance framework, fees and management were determined by the policies of Ithaca Hours, set out by Paul Glover, et al., when Ithaca Hours were established in 1991 and as published in The Hometown Money Starter Kit. C\$ became a dollar-denominated currency and new notes were printed in 2000 and a digital currency in 2018. Currently, the City of Calgary funds C\$ and accepts C\$ for limited numbers of transit tickets and 50% of base business licence fees.

C\$ has obtained considerable political and policy support, beginning with a unanimous notice of motion by Alderman Jon Lord in 2000. Former Calgary Mayor Naheed Nenshi said “Local and complementary currencies can make a huge difference as we build communities together, and we're proud at the City of Calgary to accept C\$ for Transit tickets and business licence fees.” Calgary's current Mayor, Jyoti Gondek stated “I am committed to building a more resilient and inclusive Calgary. A crucial part of this vision is ensuring that all Calgarians have access to meaningful employment, income, housing, transportation, and quality of life. ... There are opportunities to improve access to credit for newcomers and other marginalised calgarians through local currency initiatives such as Calgary Dollars.” C\$ is profiled in the City Of Calgary Resilience Strategy and cited in the City of Calgary vision, (City of Calgary, 2022).

The C\$ funding received from the City of Calgary originates from the Family Community and Support Services department which is tasked with promoting and enhancing the well-being of Alberta families and communities. These funds are intended to help individuals adopt healthy lifestyles, improve their quality of life, and build capacity to prevent and deal with crisis situations should they arise.

At the provincial government level, the Alberta Finance Minister, Joe Ceci, stated in 2018 “Calgary Dollars' success with business and local economic resiliency makes it an important contribution to the City of Calgary. ... through Calgary Dollars our communities can strengthen their genuine wealth, which lies in the skills, talents and capabilities of its members.” In addition, Alberta Human Services Minister Irfan Sabir has officially endorsed C\$. Minister Sabir formalized that there will be no Canadian dollars deductions made from benefit payments as a result of C\$ revenue earned by Alberta residents on secured income that participate in C\$.

CONCEPTUAL FRAMEWORK

C\$ is a currency designed to be a unit of exchange, not a store of value. There is no interest paid on quantities accumulated and they are not designed to be exchanged for national currency, simply used at par with it. C\$ are exchanged by Calgarians, businesses and agencies that accept them for a minimum of 10% of the purchase price of their goods and services, at a value equivalent to Canadian dollars. They are taxable in the same ways that Canadian Dollars are, as applicable to business or individual Canadian tax law.

The value of C\$ currency involves both objective and subjective factors. C\$' perceived value can be affected by both the strength of what users can purchase, as well as the perception of their value and the loyalty of the users. C\$ are currently issued to those that create new advertisements accepting C\$ for the full or partial purchase price of goods and services, based on the C\$ monetary and issuance guidelines.

Canadian dollars, like other national currencies, are designed for the greatest ease of use for the largest variety of economic transactions and to be most effective in the competitive and growth-oriented global economy. They are traded speculatively and exchange rates are established to trade them for other national currencies. It is common knowledge that this currency design mobilises competition and speed for wealth creation. C\$, conversely, are designed to be non-speculative, not to be accumulated, focussed on interpersonal exchanges, and provide value within a limited geographic region for locally-produced goods and services. Although national and complementary currencies are both “money”, they could be considered as having two different overlapping purposes for different contexts.

There are numerous results from the C\$ monetary design that are different from those of the Canadian dollar. Firstly, because there is little incentive to hoard or speculate on C\$ they tend to be seen as additional unique income and spent quickly. This perception can encourage participants to see them as a new type of revenue and therefore that their income options have been diversified. This experience, combined with the interpersonal nature of C\$ transactions, have been shown to result in increased feelings of economic empowerment and community connection (Klein, 2022).

The C\$ monetary design results in increased transactional velocity. The velocity of money is the rate at which money in circulation is being exchanged for the purchase of goods and services. Reductions in the measured velocity of money can indicate conditions of stagnation and money “hoarding” by consumers who are pessimistic about the future. Monetary velocity is calculated as the ratio of quarterly nominal GDP to the quarterly average of money supply. The C\$ money supply refers to the C\$ issued and this is compared to the value of C\$ transactions. The measured velocity of C\$ in the fourth quarter of 2020 was 1.60. This is 45% larger than the velocity of conventional money in Canada. C\$ are perceived as additional income which does not generate interest growth and therefore it stands to reason that the rate of transactions increases (The Arusha Centre, 2022).

A beneficial outcome of C\$ results from the limits on where and how it can be spent. C\$ are accepted by those that participate in the ways that they choose, which can be the sale of goods and services or for purchase of basic needs. The majority of options are excluded from C\$ use, including many consumerist-oriented and unhealthy choices. As a result, local businesses, agencies, and individuals have a competitive advantage with C\$ over Canadian dollars. The housing agencies that pay out C\$ honorariums, for example, have a higher degree of confidence that C\$ will return to them as part of rental payments from residents as opposed to national currency. This is partially due to the practicality of rent acceptance for residence and also due to the absence of non-essentials available for purchase of C\$ (including consumerist or unhealthy purchases). Canadian dollars issued as honorariums to housing residents are at risk of these other uses. The limited expenditure options for C\$ appears to contribute to increases in residents paying their rent on time and completely as compared to a Canadian dollar incentive program (Calgary Dollars, 2022). This benefit is in addition to the measured positive affiliation that residents have with their housing agency from C\$. This positive affiliation has also been shown to reduce rental unit turnover, which is a substantial cost for housing agencies (Calgary Dollars, 2022).

C\$ are digital credits in a closed economic environment, facilitating outcome measurement as compared to Canadian dollars. Agencies that issue and accept C\$ can quantitatively observe the flow of transactions, and subsequently, their social and economic outcomes. Because Canadian dollars are universally used, they are more difficult to confidently measure and attribute as an outcome of community economic development initiatives.

National currencies are tradable as commodities, accepted universally, and interest is paid to those that save them. This design stands in contrast to that of C\$ which incentivizes social interaction, basic needs payments, and the increased velocity of transactions.

C\$ and Affordable Housing:

Public investments in affordable housing are outstripped by demand in Canada (CMHC, 2022). The financial sustainability of Alberta's affordable housing agencies has never been more challenged in providing resident engagement, facility upkeep, and community building programming. C\$ strives to be a cost-saving initiative for these agencies while delivering positive mission outcomes. The application of complementary currency in the affordable housing sector can be modified for the outcomes of the agency and residence, for example, emphasising reduced isolation, cost savings, or community engagement and profile.

When C\$ was initiated in affordable housing agencies the option of printed currency or digital currency were both offered. Management of the housing agencies universally preferred digital currency for accounting simplicity and to foster their residents' increased digital literacy. The use of C\$ reduces the digital divide for low-income participants because it is accessible both from desktop computers or smartphones and allows for residents to share a device to access different accounts. C\$ staff also facilitate virtual sessions and workshops for direct digital literacy support. C\$ also provides a "gamification" motivation in building digital and financial literacy.

The C\$ program includes resident-to-resident engagement, community interaction, and facilitates positive resident associations with the housing agency. The result of these varied benefits can result in increased resident positive association with their landlord, their community, and their neighbours (Calgary Dollars Program Logic Model, 2022). Resident participants in C\$ report the high value they place on using C\$ toward rental payments, and agencies report improved timeliness and completeness of rental payments as a result of the C\$ program (Calgary Dollars Program Logic Model, 2022). These outcomes help reduce agency staff time required to collect rent, while improving the relationship between tenants and the agency. C\$ has been shown to reduce tenant turnover and its associated costs, estimated at \$2,700 per turnover in Calgary (Boardwalk, 2017).

Calgary Housing Company

Angela Coulter, Partnership Coordinator at Calgary Housing Company, reported that

"Calgary Dollars has provided Calgary Housing Company with an important tool to incentivize and track resident engagements within our buildings, and to promote resident involvement in the community. Our residents have begun to discover methods for earning supplemental income, develop skills and relationships, and thus improve the image and safety of our buildings. CHC is committed to providing affordable and dignified housing to Calgarians in need. Our collaboration with Calgary Dollars has assisted us with this mission by creating conditions for residents to become more independent while simultaneously creating greater community in our participating units" (Coulter, 2020).

Her statement reaffirms that C\$ do not impact resident's other sources of funding, as they are able to earn as much as they want without adversely impacting those alternative income sources.

During the most recent reporting period, \$10,000 worth of C\$ were paid as honorariums across four participating Calgary Housing Company buildings. Honorariums are paid for participation in resident and community events, cleaning and support services, and a household tool/goods lending library. Overall, 286 transactions in C\$ took place among 95 participant residents. Pre/post test survey data analysis revealed the following (Calgary Dollars Program Logic Model, 2022):

- 80% of C\$-participating residents in CHC units reported that they felt they were more involved in their community than before joining C\$
- 74% of respondents said that they had built relationships of trust as a result of C\$
- 62% stated that joining C\$ has allowed them to better live within their means

- 82% said they had someone to turn to for suggestions about how to deal with a personal problem as a result of the program

C\$ participants living in CHC buildings had a turnover rate of 1%, as compared to the affordable housing sector average of 23% per year (City of Calgary, 2016). Turnover costs in the affordable housing sector are estimated at \$2,700 per unit (Boardwalk, 2017). Preliminary calculations suggest 21 turnovers may have been averted for an estimated \$59,000 cash saving for CHC due to the C\$ users having only 1% turnover compared to the 23% average turnover in this housing sector. C\$ were employed to provide honorariums for additional building cleaning, safety and programming services which further contributed to agency cash savings.

Norfolk Housing

Norfolk housing had 162 transactions in the last reporting year for a total value of \$7,368 by 40 users (Calgary Dollars, 2022). Programming has included online social and skill-building gatherings throughout the pandemic, building ambassador activities, sustainability ambassador events, walking tours, and social/fitness/educational programming. Environmental impacts include promoting sustainability through waste stream ambassador education, distributing climate action checklists, hosting eco workshops.

Norfolk housing confirmed that C\$ has incentivized their residents “to get to know each other, learn about the role of our organisation in the community, and to reduce the demands on our resources by accessing the capacity of residents to help one another. it is our mission to create inclusive and affordable communities for all ... Calgary Dollars can further connect our housing residence to wellness and financial resources.” (Mazereeuw, 2019)

METHODOLOGY

A total of 18 research questions were explored in the research for this paper as compared to user survey and demographic data. The research reporting for this paper took the form of two statistical reports as results were tabulated (Klein, 2022). The subject of this paper is questions 5 and 6 from report number 1 and questions 7 and 8 from report number 2 (Klein, 2022).

The four research questions in this study are:

Question #5: Is there a relationship between Social Wellbeing Change and Program Participation for the Affordable Housing Subnet? (Klein, 2022)

Question #6: Is there a relationship between Financial Wellbeing Change and Program Participation for the Affordable Housing Subnet? (Klein, 2022)

Question #7: Do C\$ affordable housing participants with physical or mental limitations benefit socially? Represented here as “Has Limitation” (Klein, 2022)

Question #8: Do C\$ affordable housing participants with physical or mental limitations benefit financially? (Klein, 2022)

This research paper presents for the first time, the relationships between two C\$ data sources. Quantitative transaction data and user demographics are being compared to qualitative survey data obtained from pre-post participation user surveys.

Program Participation is defined as the number of C\$ transactions and total amount of C\$ transferred to date. This data was obtained from the Cyclos database for participants selected from the C\$ survey campaign.

Physical or mental limitation data is self-reported user data obtained as part of the annual C\$ survey (Calgary Dollars Program Logic Model, 2022).

The user survey questions are those of the City of Calgary and use a pre-post test survey data collection methodology, statistically analysed by City of Calgary staff. These are compared across the FCSS-funded programs then presented to the City of Calgary Council. The analysis was conducted to

create an understanding of potential changes in social and financial well-being as a result of participation in the C\$ program.

Subjective reporting is vulnerable to the recollections and the disposition of the user who is reporting them and therefore this research helps to ensure that the C\$ program is clearly correlated to the outcomes reported.

Survey responses were collected in the annual survey campaign managed by C\$ staff and social work practicums. An intake survey is administered when a new C\$ user creates their account with C\$. The followup survey is administered to C\$ users who have been participants for up to 5 years. Promotions to complete the followup survey are sent digitally and C\$ honorariums incentives are offered.

For this research, social well-being was characterised by the survey question, “do you have someone to turn to for suggestions about how to deal with a personal problem?” Financial well-being was characterised by the survey question, “compared to your financial situation a year ago, are you and your family worse off, better off, just about the same?” Subjects of the survey answered the above questions on 5-point and 3-point Likert scales respectively.

All participants were filtered by those who had at least 1 response on both intake and follow up surveys. All of these participants were given a unique 3-digit identification code. Some participants filled out multiple intake or follow up surveys. It was assumed that both surveys were equally valid. The median result for each well-being question on either the intake or follow up surveys for each participant was taken. Once each participant had a single associated intake and follow up score for well-being, the well-being change was calculated. Each participant had a single associated score for well-being change for each question answered. A positive result would then suggest that the participant had an increase in well-being. A negative result would then suggest that the participant had a decrease in well-being.

A non-parametric paired samples test (Wilcoxon Ranked Sign Test) was performed to determine if the difference in wellbeing scores between the intake and follow up surveys were statistically significant. A non-parametric independent samples test (Mann-Whitney U-Test) was also performed to determine if the differences in wellbeing change between demographics were statistically significant. Although the data appeared to be normal (passing a Shapiro-Wilk normality test), an argument could not be made for the data to be characterised as of an interval scale. The relationship between well-being change and Program Participation was analysed within the affordable housing subnet. The well-being change was compared to both the Number of Transactions and Amount Transferred.. A Spearman correlation coefficient and significance was extracted from the relationship to characterise its strength.

RESULTS

Period of study for this paper:

The pre-post test C\$ user survey data that is analysed in comparison with transaction and transfer data as well as physical and mental limitations demographic data is compiled from 2014 to 2022. This allows for a robust data set to be analysed. The transaction and transfer data for this study is the data set from the implementation of the digital C\$ platform which began in 2018 to summer of 2022.

This research paper builds upon the annual City of Calgary Family and Community Support Services reporting which is completed by C\$ staff as a survey of C\$ users across the city. These surveys are conducted with invitations to all C\$ users in the city and are prioritised to those who are identified as “vulnerable” by the City of Calgary definitions. From this city-wide C\$ user sample there is a preponderance of users who reside in affordable housing units where C\$ programming exists.

In this paper, the C\$ user survey data and demographic information is compared to C\$ participation, the Number of Transactions and Amount Transferred,

City of Calgary - FCSS Program Logic Model pre/post test user survey for all city-wide C\$ users:

Total C\$ user accounts at Oct 21, 2022: 2,839

Total respondents in C\$ user survey: Social Inclusion: 32. Perceptions of Poverty: 47

Analysis of the pre/post test data for the C\$ user survey in 2022 reported statistically-significant positive correlations for the following:

“Social Inclusion - Participation in Neighbourhood”

NCSC1: How many people do you know in your community?

NCSC2: I get involved in community events or activities.

NCSC3: I help out in my community by volunteering.

Survey Number and Name		007 - Social Inclusion - Participation in Neighbourhood										
Average Time from Pre-Test to Post-Test		657 days										
#	Question Code	Valid Responses #	Valid Responses %	Categories Reported	Pre-Test % (#)	Post-Test % (#)	Difference % (#)	Pre-Test Average Score	Post-Test Average Score	Z-Score	P-Value	Significant Change (Yes / No)
1	ncsc1	32	100%	Many/Most	6% (2)	47% (15)	41% (13)	1.9	2.5	3.73	≤0.01	YES(+)
3	ncsc3	32	100%	Some of the time/Most of the time/Always	28% (9)	78% (25)	50% (16)	2.2	3.0	3.62	≤0.01	YES(+)
4	ncsc4	32	100%	Some of the time/Most of the time/Always	28% (9)	66% (21)	38% (12)	2.0	2.8	3.42	≤0.01	YES(+)
Overall Averages					21% (7)	64% (20)	43% (13)	2.0	2.8	3.59	≤0.01	YES(+)

Individual/Family Poverty - Perceptions

POV1: I worry whether the money I have will be enough to support myself and (if applicable) my family. (Never, A little of the time, Most of the time, Always)

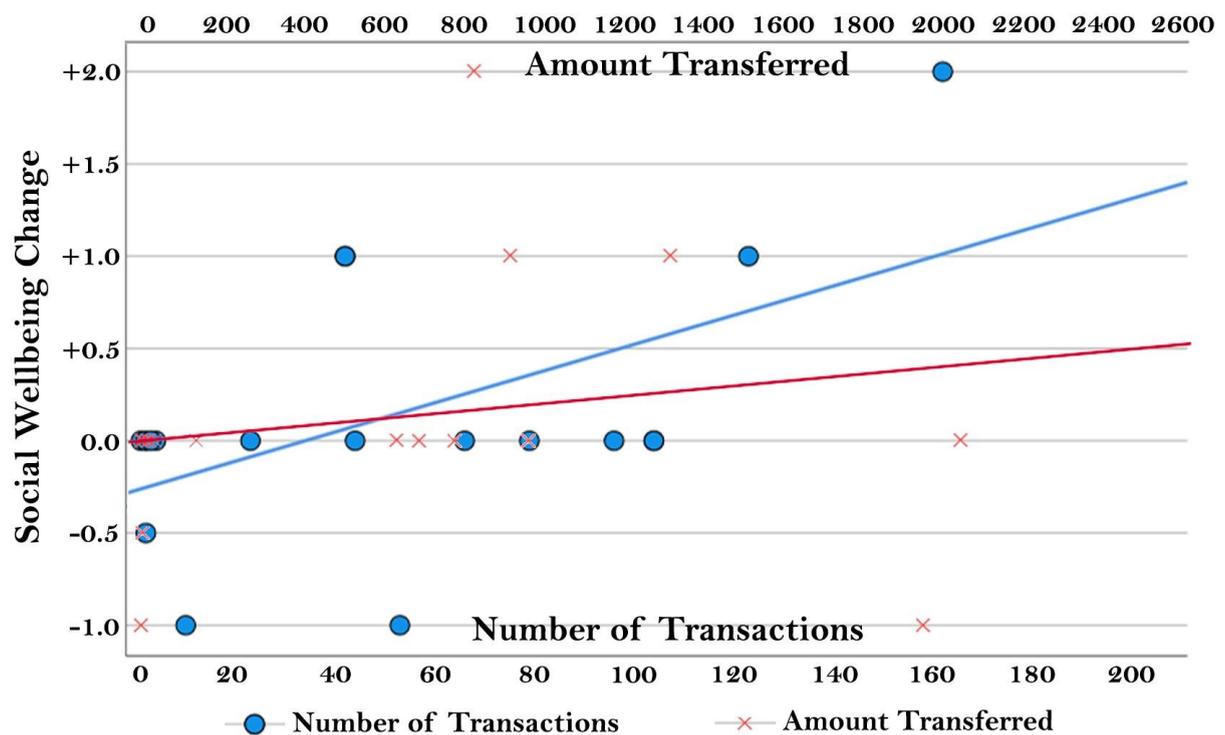
Survey Number and Name		014 - Individual/Family Poverty - Perceptions										
Average Time from Pre-Test to Post-Test		678 days										
#	Question Code	Valid Responses #	Valid Responses %	Categories Reported	Pre-Test % (#)	Post-Test % (#)	Difference % (#)	Pre-Test Average Score	Post-Test Average Score	Z-Score	P-Value	Significant Change (Yes / No)
1	pov1	47	100%	A little of the time/Never	45% (21)	62% (29)	17% (8)	2.2	2.5	2.06	≤0.05	YES(+)

Question #5: Is there a relationship between Social Wellbeing Change and Program Participation for the Affordable Housing Subnet? (Klein, 2022)

Sample size: N=19

A positive linear relationship was found between the social well-being change and both the Number of Transactions and Amount Transferred for those in the affordable housing subnet. Overall we are 89% confident that there is a moderate correlation between the social well-being change and the Program Participation (Klein, 2022). The social well-being change has a stronger relationship to the Number of Transactions than the Amount Transferred.

Social Wellbeing Change vs. Program Participation



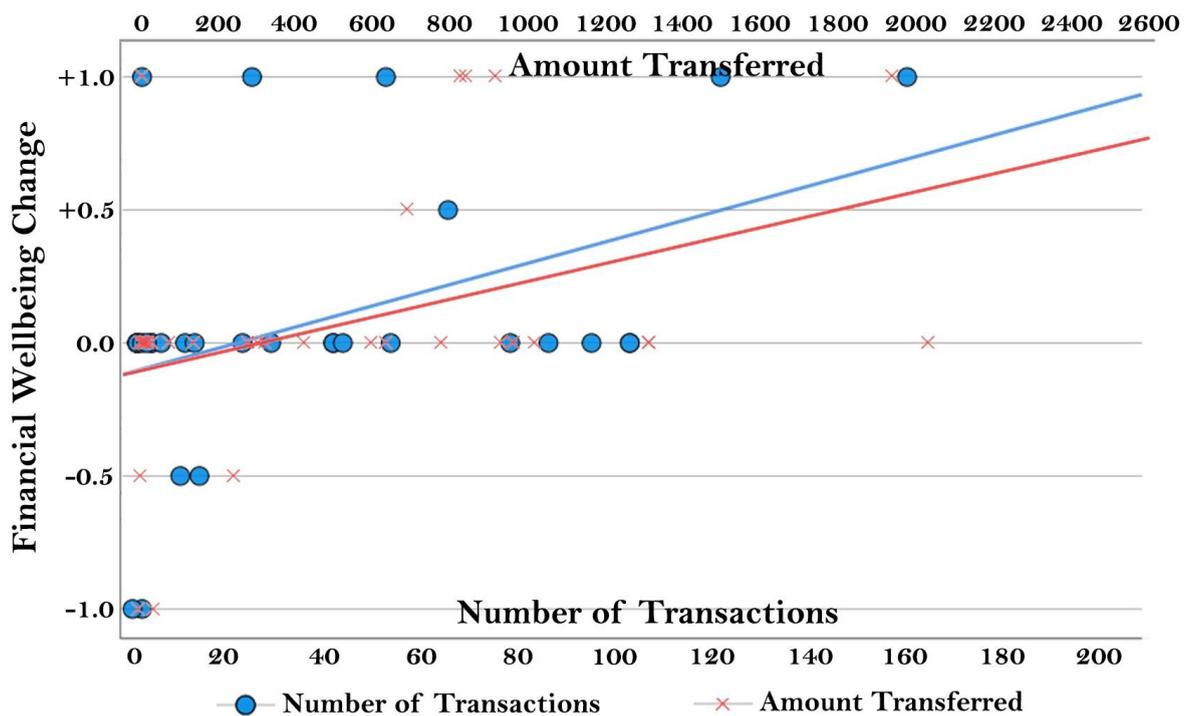
Plot Description: A Scatter Plot is displayed for the Social Wellbeing Change vs. Number of Transactions and the Social Wellbeing Change vs. Amount Transferred for those within the Affordable Housing Subnet. A line of best fit was constructed for each data set and displayed on the graph to show how the Social Wellbeing Change has a positive increase as Program Participation increases. The Number of Transactions is demonstrated by the blue circles whose trend is represented by the blue line. The scale for the Number of Transactions can be seen on the bottom horizontal axis. The Amount Transferred is demonstrated by the red crosses whose trend is represented by the red line. The scale for the Amount Transferred can be seen on the top horizontal axis. One can see visually that both metrics of the Program Participation are positively correlated to the Social Wellbeing Change. One can also see that the Number of Transactions has a stronger relationship with Social Wellbeing Change when compared to Amount Transferred. That is to say that if one increases their Number of Transactions one would expect a Social Wellbeing Change that is larger than if they proportionally increased their Amount Transferred.

Question #6: Is there a relationship between Financial Well-being Change and Program Participation for the Affordable Housing Subnet? (Klein, 2022)

Sample size: N=32

A positive linear relationship was found between the Financial Well-being Change and both the Number of Transactions and Amount Transferred for those in the affordable housing subnet. Overall we are 97% confident that there is a moderate correlation between the Financial Well-being Change and the Program Participation.

Financial Wellbeing Change vs. Program Participation



Plot Description: A Scatter Plot is displayed for the Financial Wellbeing Change vs. Number of Transactions and the Financial Wellbeing Change vs. Amount Transferred for those within the Affordable Housing Subnet. A line of best fit was constructed for each data set and displayed on the graph to show how the Financial Wellbeing Change has a positive increase as Program Participation increases. The Number of Transactions is demonstrated by the blue circles whose trend is represented by the blue line. The scale for the Number of Transactions can be seen on the bottom horizontal axis. The Amount Transferred is demonstrated by the red crosses whose trend is represented by the red line. The scale for the Amount Transferred can be seen on the top horizontal axis. One can see visually that both metrics of the Program Participation are positively correlated to the Financial Wellbeing Change. One can also see that the Number of Transactions has a stronger relationship with Financial Wellbeing Change when compared to Amount Transferred. That is to say that if one increases their Number of Transactions one would expect a Financial Wellbeing Change that is larger than if they proportionally increased their Amount Transferred.

Summary of questions #5 and #6:

From this result we can say that increases in program participation does relate to a positive increase in Social and financial well-being. We can also say that the Number of Transactions has a greater effect on the well-being change than the Amount Transferred.

Question #7: Do C\$ affordable housing participants with physical or mental limitations benefit socially? Represented here as "Has Limitation" (Klein, 2022)

Sample size: N=19

Out of a sample size of 19 Affordable Housing C\$ participants: 5% had No Limitation, 95% reported "Has Limitation". The Social Wellbeing Change was normal for both categories. Looking at the central tendency for Social Wellbeing Change, Has Limitations had a net positive result and No Limitations had a net negative result.

To investigate if the Social Wellbeing Change was greater for Has Limitation compared to No Limitation, an Independent Samples Mann-Whitney U-Test was performed. The significance extracted from the test was 4%, supporting the hypothesis, "For C\$ Affordable Housing participants, Has Limitation has a greater Social Wellbeing Change than No Limitation". With the standard threshold being 5%, we can suggest that Has Limitation had a significantly greater Social Wellbeing Change when compared to No Limitation. The effect size reported a value of 18%, which means that 18% of the variance in Social Wellbeing Change is due to variation in Health Limitation. This is considered a small effect size and indicates we need a larger sample size to effectively characterise the population. We can say that we are at most 96% confident that Has Limitation will have a stronger social benefit than No Limitation for C\$ Affordable Housing participants (Klein, 2022).

Question #8: Do C\$ affordable housing participants with physical or mental limitations benefit financially? (Klein, 2022)

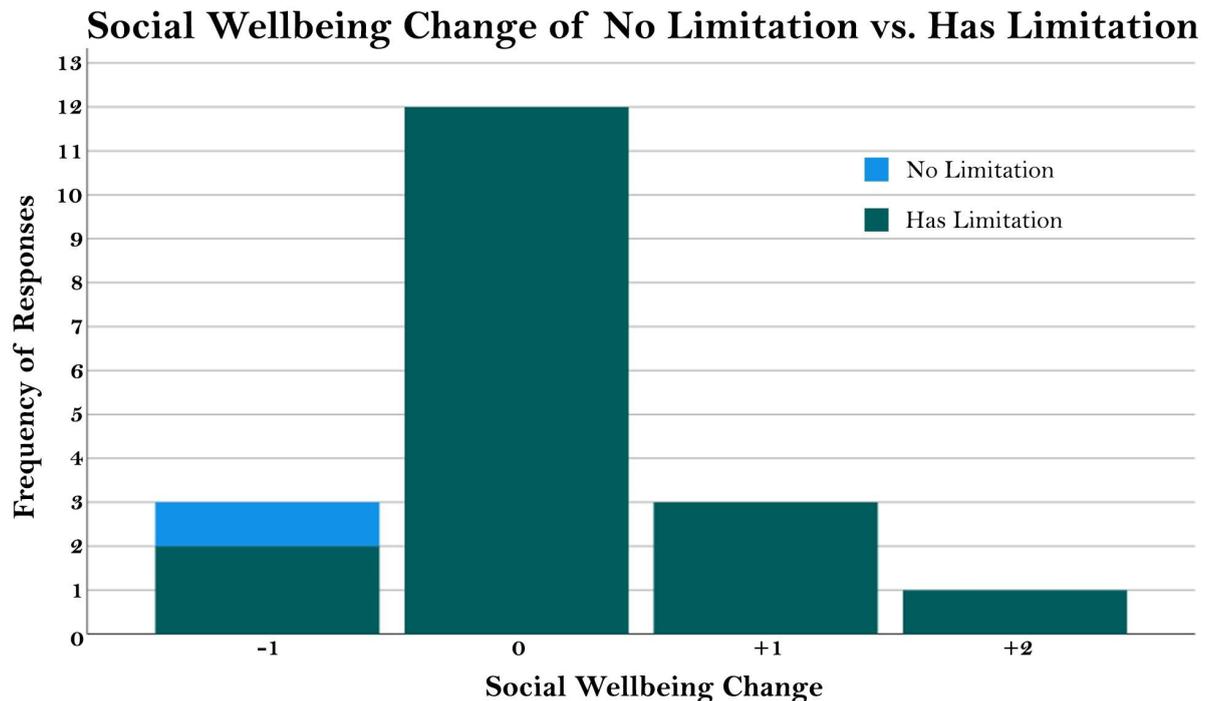
Sample size: N=32

Out of a sample size of 32 Affordable Housing C\$ participants: 55% had No Limitation, 75% had Has Limitation. The Financial Wellbeing Change was normal for both categories. Looking at the central tendency for Financial Wellbeing Change, Has Limitation had a net positive result and No Limitation had a net negative result.

To investigate if the Financial Wellbeing Change was greater for Has Limitation compared to No Limitation, an Independent Samples Mann-Whitney U-Test was performed. The significance extracted from the test was 4%, supporting the hypothesis, "For C\$ Affordable Housing participants, Has Limitation has a greater Financial Wellbeing Change than No Limitation". With the standard threshold being 5%, we can suggest that Has Limitation had a significantly greater Financial Wellbeing Change when compared to No Limitation. The effect size reported a value of 9%, which means that 9% of the variance in Financial Wellbeing Change is due to variation in Health Limitations. This is considered a small effect size and indicates we need a larger sample size to effectively characterise the population. We can say that we are at most 95% confident that Has Limitation will have a stronger financial benefit than No Limitation for C\$ Affordable Housing participants (Klein, 2022).

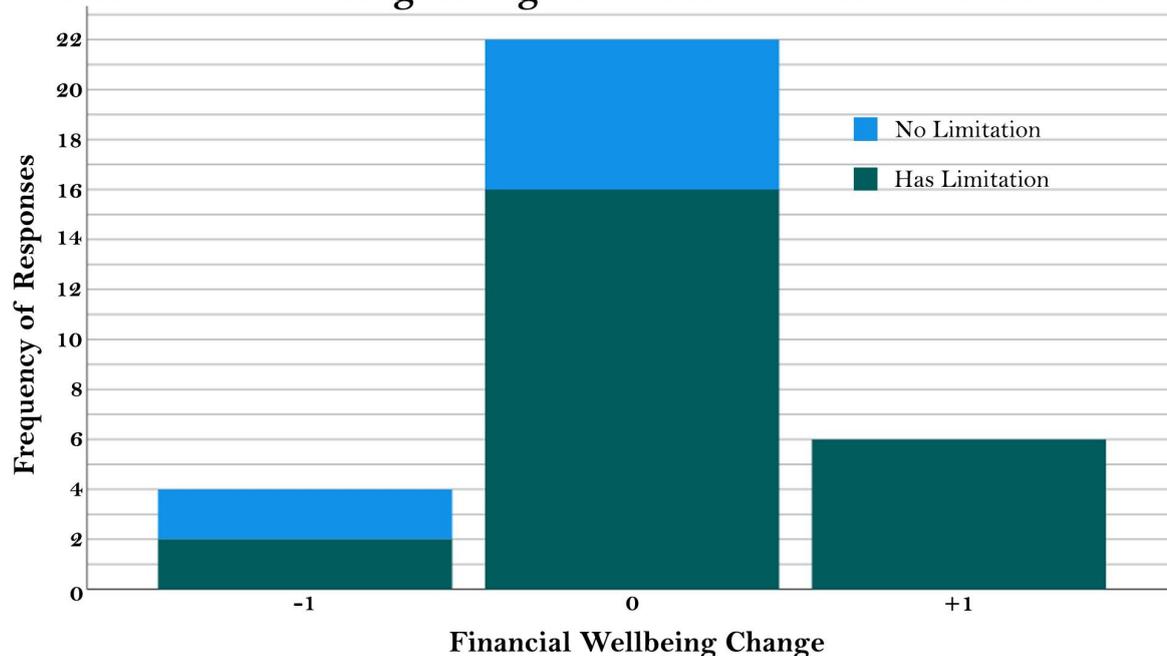
Summary of questions #7 and #8:

It was found that both the Social and Financial Wellbeing Changes are significantly greater for participants with a physical or mental health limitation when compared to participants with no limitation (with confidence levels of 96% and 95% respectively).



Plot Description: A stacked histogram plot of the distribution of Social Wellbeing Change score by Health Limitation. For No Limitation, one participant scored -1 for Social Wellbeing Change. For Has Limitation, two participants scored -1, twelve participants scored 0, three participants scored +1 and one participant scored +2 for Social Wellbeing Change. Overall one can see that No Limitation had a net negative result and Has Limitation had a net positive result for Social Wellbeing Change.

Financial Wellbeing Change of No Limitation vs. Has Limitation



Plot Description: A stacked histogram plot of the distribution of Financial Wellbeing Change score by Health Limitation. For No Limitation, two participants scored -1 and six participants scored 0 for Financial Wellbeing Change. For Has Limitation, two participants scored -1, sixteen participants scored 0, and six participants scored +1 for Financial Wellbeing Change. Overall one can see that No Limitation had a net negative result and Has Limitation had a net positive result for Financial Wellbeing Change.

DISCUSSION AND CONCLUSION

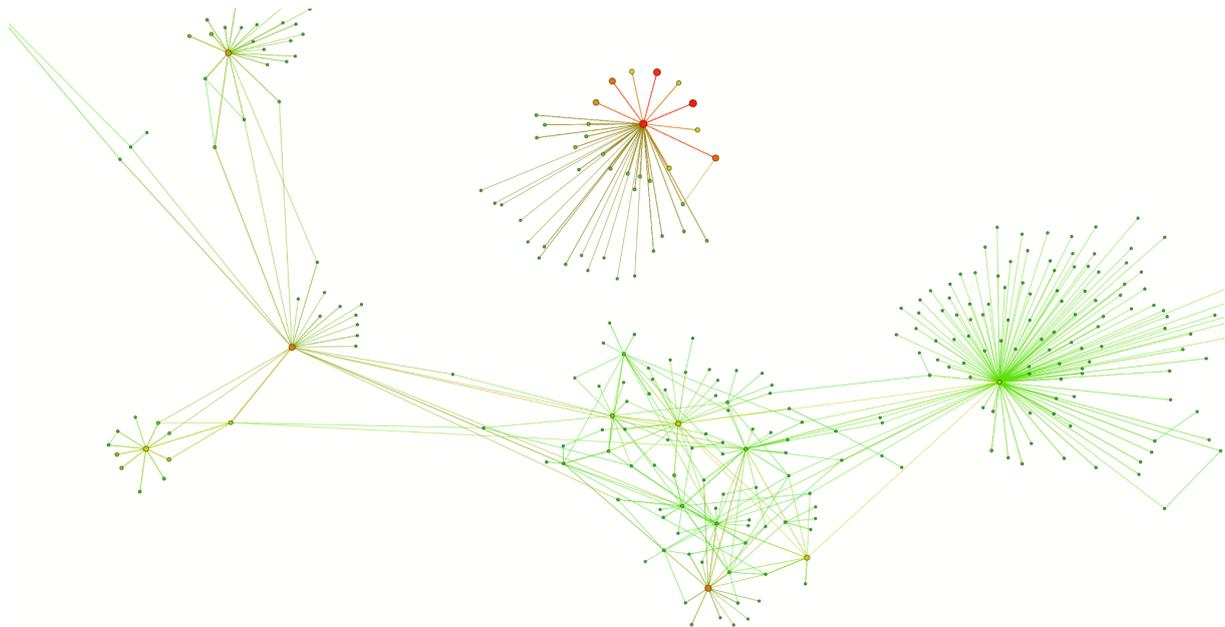
The thesis of this paper is that residents of affordable housing buildings that participate in C\$ report social and economic benefits which are correlated to their C\$ participation, especially for those that report physical or mental limitations.

This research connects the quantitative use of C\$ with participant survey responses and demographic data. C\$ has a history of demonstrating economic capital and social capital benefits as reported subjectively by participants. Subjective reporting is vulnerable to the recollections and the disposition of the user who is reporting them and therefore this research helps to ensure that the C\$ program is clearly correlated to the reports of participants.

This paper hopes to provide valuable contributions to the complementary currency movement. It seeks to describe the nuances of social network benefits, economic benefits, agency benefits, both for service delivery and cost-effectiveness. Our hope is that this research strengthens the argument of complementary currencies to deliver a range of benefits.

The focus of this research on affordable housing agency participation in complementary currencies can contribute to other affordable housing agencies' consideration of complementary currencies. Similar outcomes could also be realised in market housing contexts and other community settings.

There are a number of counterintuitive aspects to the research of complementary currency. Calgary Dollars, as the name suggests, is a monetary system and therefore initially would suggest potential economic benefit for participants. Historically however, outcome measurements have shown that C\$' social capital benefits for participants are greater than their economic capital benefits (Calgary Dollars Program Logic Model, 2022).



Sample anonymized sociogram of C\$ transactions indicating the strength and direction of economic transactions and social networks (Calgary Dollars, 2022)

Another counter-intuitive outcome that has been observed is that participants consistently report increased economic empowerment, which appears disproportionately large in comparison to the dollar value of their C\$ transactions. This may be attributable to the low income demographic which is predominant among C\$, where a dollar value seen as small by others is perceived as highly valuable for a lower income individual. There appears to be disproportionate psychological benefits that come from participants feeling that C\$ gives them an increased diversity in revenue streams. Participants can be economically empowered when they have multiple skills and goods of value as sources of revenue and relationships. This liberates them from the perception that they have only one source of revenue in the traditional economy and therefore only one source of value in society. As a result, the appearance of a low value of C\$ transactions seems to translate into a disproportionately large perceived economic benefit for some participants (Wheatley, 2006).

This research supports the conclusion that digital currencies can be beneficial in affordable housing contexts with potential application in other housing or low-income contexts. At the beginning of this work it was unknown whether lower-income users would have access to devices and the digital literacy necessary to participate. The C\$ program is accessible on desktop computers and smartphones which can be acquired or even shared among affordable housing residents with the further benefit of “gamifying” the benefits of the complementary currency. Vulnerable populations should not be further isolated due to their lack of digital literacy and access at a time when social interactions, government requirements, banking transactions, and general communications are increasingly taking place in an exclusively digital environment.

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