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Exploring the Role of Social Capital in Urban Resilience for Sustainable Development: The Case of Ho Chi Minh City in Vietnam

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ABSTRACT

The escalation of climate change has challenged urban sustainable development, especially in the top globally vulnerable countries. This paper investigates the role of social capital in shaping the resilience of residents in Ho Chi Minh City, Vietnam's first mega urban, based on survey data from 300 households, using a stratified sampling strategy to reflect the urban and suburban population structure of the city-dwellers with the application of PLS-SEM. The study highlights the significant role of bridging social capital, drawing on established research and theories, which emphasizes the importance of diverse social networks in enhancing problem-solving, optimism, material resources, and social resources. Additionally, the study uncovers the impact of bonding social capital, particularly in terms of enhancing material and social resources, underscoring the cultural inclination towards close-knit networks within Vietnamese society. Structural barriers associated with vertical networks are identified, implying the need to promote the role of linking social capital in enhancing resilience. The study confirms the cruciality of addressing socio-economic factors and promoting access to formal support systems for bolstering overall resilience among urban residents in Ho Chi Minh City and beyond. The results enrich the current literature when operationalizing and exploring the nexus of social capital and resilience multi-dimensionally in a mega urban setting of an emerging country for new pathways to achieve sustainability.

1. INTRODUCTION

As climate change continues to escalate, its impacts are predicted to be disproportionately felt, with some of the greatest challenges confronting mega urban regions located in the intra-tropical low elevation coastal zones of Southeast Asia [1]. Vietnam is among the countries most severely impacted by adverse climate change effects, ranking sixth globally in terms of vulnerability to extreme climate conditions over the past two decades. With a Climate Risk Index (CRI) of 13.5, the country has experienced an annual GDP loss of 0.6225% due to these conditions [2]. Among these regions, Ho Chi Minh City (HCMC) emerges as Vietnam's largest and rapidly developing megacity, contributing significantly to the national GDP [3]. However, the high population density and concentration of economic activities make HCMC especially vulnerable to rapid and unsustainable development, heightening its risk to climate change impacts. This results in flooding caused by both increased rainfall and rising sea levels, along with a significant temperature rise that affects human comfort, air quality, and energy consumption [4]

Resilience is crucial in disaster risk reduction efforts, considered an effective approach for enhancing community livelihoods and fostering sustainable development [5, 6]. Resilience entails the community's ability to return to equilibrium after disruption, drawing from the theory of equilibrium in physics and mathematics. Viewing resilience from a community perspective, it encompasses the community's capacity to cope, adapt, and effectively respond to crises, restoring normalcy [7]. Despite various definitions, the overarching concept of community resilience revolves around the community's ability to respond and adapt to negative changes (such as disasters, pandemics), focusing on internal resources such as self-organization, adaptation, and recovery [8, 9]. Urban resilience in the face of severe climate change has recently garnered significant attention from the research community. This emphasis is also reflected in the United Nations' 2015 Sustainable Development Goals (SDGs), particularly target 1.5, which seeks to strengthen the resilience of the poor and vulnerable to climate-related extreme events and other shocks by 2030 [10]. This underscores the crucial role of resilience in promoting sustainable development.

Social capital is regarded as a unique resource that does not depreciate over time like other capital sources, holding significant importance for economic, social, and environmental development, especially in disaster scenarios, aiding human survival before mobilizing other resources [11-14]. While the relationship between social capital and post-disaster resilience is a familiar research theme, studies on the

role of diversified social capital dimensions in post-disaster resilience remain relatively modest, indicating considerable potential for further exploration [11]. Social capital is increasingly recognized as a critical resource for resilience and sustainable development alongside traditional capital sources such as natural resources, physical assets, financial and human capital.

This study aims to simultaneously analyze the roles of various types of social capital, including bonding, bridging, and linking in both structural (networks) and cognitive (trust) aspects, in urban residents' resilience in HCMC, Vietnam. This research contributes theoretically and academically in several aspects. Firstly, social capital and resilience are operationalized multi-dimensionally in the context of Vietnamese urban settings. Secondly, the study provides empirical evidence on the role of different types of social capital in various aspects of resilience for sustainable development. Finally, resilience management is emphasized with the prioritization of mobilizing bridging social capital when confronting unforeseen changes, challenges, and crises.

The paper's organization is as follows: after the introduction, Section 2 offers a literature review that clarifies the concept, theories, model, and methodology applied in Section 3. Section 4 presents the empirical discoveries, demonstrating how bonding, bridging, and linking social capital impact four facets of urban residents' resilience in Vietnam, followed by the discussion of the research findings. Ultimately, the paper wraps up with Section 5, summarizing the remarkable conclusions.

2. BACKGROUND

2.1 Resilience

Resilience is described as a shield or shock absorber, post-disaster resilience aims to mitigate adverse impacts to the minimum extent possible, allowing communities to swiftly return to normalcy [15, 16]. Most definitions of resilience emphasize the capacity of individuals or systems to restore functionality by leveraging resources to adapt to disruptions or adversities [17]. Capacity in this definition includes strength and resources utilized to anticipate, cope with, resist and recover for a disaster. Thus, the key to resilience lies in adjustment to cope with adversities and their impacts. According to Carmen et al. [18], resilience can be categorized into three domains, ranging from low to high levels: 1) reaction, 2) response, and 3) proactive resilience. Reactive resilience entails immediate coping actions in response to shocks to achieve stability and return to the original state [19]. Conversely, responsive resilience involves adjustments based on learning from past shocks to reduce negative consequences from future shocks, seen as part of a continuous adaptation process [20, 21]. Pro-active resilience is a continuous process involving forward-thinking, experimentation, reflection, and learning, requiring a systemic vision and multidimensional approach related to standards, characteristics, values, and potential changes within the context [22]. In general, resilience needs to be discussed in a dynamic context rather than a static one. Secondly, the importance of context needs to be emphasized because the factors causing adversities can be natural, human-induced, or a combination of both. Thirdly, resilience measurement indicators need to be identified as previous studies often focused solely on the concept [23].

To measure resilience, scales for self-assessment of community resilience have been developed. To focus on individual characteristics when facing adversities, the Connor-Davidson Resilience Scale [24] became popular and used in studies measuring community resilience after disasters [25, 26]. The scale includes questions measuring 5 factors: 1) acceptance of change, 2) control, 3) individual competence, 4) psychological impact, and 5) trust in instincts. However, this scale does not address the approach to external resources, one of the critical factors for achieving post-disaster adaptation [27]. First et al. [17] addressed this limitation by proposing the Disaster Adaptation and Resilience Scale (DARS) to measure 5 domains including: 1) material resources, 2) social resources, 3) problem-solving, 4) depression management, and 5) optimism. This is considered the most comprehensive scale for measuring post-disaster resilience. Therefore, this study will rely on the DARS scale to measure urban resilience in the context of escalated climate change. However, the dimension of depression management is omitted with the focus on 4 dimensions: 1) material resources, 2) social resources, 3) problem solving, and 4) optimism. The dimension of depression management is skipped in the application of the DARS to measure urban resilience in Ho Chi Minh City for several reasons. Firstly, while depression management is undoubtedly crucial for overall mental health and well-being, it may not directly align with the specific focus of measuring resilience in the context of urban environments. Urban resilience, as defined in this study, primarily pertains to the capacity of communities to effectively respond to and recover from disasters or adverse events, encompassing resources such as human, social and material capital [17, 28]. Therefore, depression management dimension of DARS scale does not fit well with community-level resilience in terms of the connotations of urban resilience. Secondly, depression management, although vital, can be influenced by a wide range of individual and contextual factors that may not necessarily reflect the community's overall resilience in the face of disasters or adversities. While mental health considerations are undoubtedly significant in post-disaster recovery efforts, the DARS scale focuses on domains more directly related to community-level resilience capacities, which may include collective problem-solving abilities, access to resources, and social cohesion. Moreover, the inclusion of depression management as a dimension in the DARS scale could potentially introduce complexity and overlap with optimism, leading to difficulties in interpretation and analysis of resilience levels. By omitting this dimension, the scale can maintain clarity and focus on factors more directly relevant to understanding and assessing urban resilience in the context of climate change adaptation and recovery.

2.2 Social capital

Social capital is a multidimensional concept approached in various dimensions and contexts depending on the research goals. Initially defined by Hanifan [29] as goodwill, friendship, empathy, and social relationships within groups and families, forming the societal units, social capital was further conceptualized by Coleman [30] as resources derived from trust, norms, and network connections. Fukuyama [31] added the dimension of trust as an aspect of social capital, while Putnam [32] measured this through citizens' community activities. Other scholars like Burt [33] and Lin [34] approached social capital at the individual level. Despite

ongoing debates, this concept can be addressed at both individual and community levels in studies on the role of social capital after disasters [11].

According to Carmen et al. [18], social capital in most previous studies was defined and measured in terms of social network aspects. Broader approaches such as: social network and resources; social network, trust, and norm of reciprocity; and social network with accompanying cultural-social dimensions (norms, values, identity) have also been used by researchers but are less common. Delving into social networks, the concept of strong/weak ties [35] or bonding, bridging, and linking networks [32, 36] has been operationalized and analyzed [37]. This classification is based on theories of structural holes [33]. Some researchers have used this classification for the trust aspect of social capital, with bridging and bonding trust conceptualized as generalized trust and specific trust, respectively [38]. Linking social capital, in addition to its multidimensional nature and various conceptualizations, encompasses connections derived from the relationships of individuals or communities with formal organizations such as state authorities [11, 39]. Sometimes, linking social capital is regarded as a subset of bridging social capital [36]. In this study, social capital dimensions are operationalized following Chen et al. [37] and Van Beuningen and Schmeets [39] under three dimensions: bonding, bridging and linking.

2.3 Social capital and resilience

Analyzing the relationship between social capital and urban resilience draws upon several theoretical frameworks, notably the weak tie theory, the structural holes theory, and the social resources theory. Granovetter [35] applied the weak tie theory to elucidate the strength of social connections in individual job searches, highlighting four elements—time spent on relationships, emotional intensity, intimacy, and reciprocal services. Strong ties within networks, such as family, friends, and colleagues, facilitate rapid information sharing. However, strong tie networks tend to be closed, often circulating outdated information. Conversely, weak tie networks provide fresh, valuable information and diverse experiences. The structural holes theory, as expounded by Burt [33], focuses on patterns of relationships within networks. Structural holes occur when intermediaries exist within networks, fostering timely access to unique information, bargaining power, and career opportunities. Social resources theory posits that social capital resides within networks, with individuals benefiting from networks possessing or controlling resources pertinent to their goals [34].

These theories collectively underscore the critical role of social capital in individual and community well-being. Aldrich and Meyer [11] illustrate that cohesive networks, particularly familial and friendship networks, serve as robust support systems during adversities, advocating for policy interventions aimed at enhancing community social capital. Social capital accumulation facilitates timely access to material and emotional support, aiding effective crisis coping strategies and contributing directly to recovery efforts [40]. However, the significance of social capital extends beyond crisis response; it plays a crucial role in long-term resilience. Jacobs and Cramer [41] emphasize the multidimensional aspects of social capital, including cultural and social dimensions, in shaping proactive resilience. The diversity and connectivity of social capital networks enhance disaster management and optimize community resilience, underscoring the necessity of leveraging and deploying social capital resources amidst resource scarcity and unforeseen challenges. This analytical approach enables the identification of appropriate social capital resources amidst scarce resources when confronting unforeseen challenges and disruptions. Beneficial role of social capital in mitigating community issues is also found in analyzing the nexus of social capital and resilience of urban communities in Brisbane, Australia after the flood in 2011 [42]. Valuable insights into how bonding and bridging social capital contribute to community resilience in disaster contexts is clarified by Lee [43]. Both social trust and personal networks demonstrates strong positive effects on community's ability to withstand and recover from natural hazards in East Asian. However, mixed impact of voluntary association membership on community resilience is found across different societies. Japan and South Korea experience positive effect while contrary result is in Taiwan. This implies potential mediator variables, such as the cultural and societal context, on the role of social capital in resilience. Fraser [44] proposes to develop linking social capital besides bonding and bridging in Japan's municipalities to model their resilience impact for better disasters preparation. On the contrary, Shahid et al. [45] approaches social capital at integrated index (SCI) based on three dimensions: civic and political participation, network ties and trust, consolidated and knowledge resources and confirms the contribution of SCI to resilience in Islamabad and Rawalpindi, Pakistan.

Overall, the integration of theories and empirical evidence confirms the significant role of social capital, either as an integrated index or individual dimensions, in fostering urban resilience. Given the need for comprehensive strategies that harness diverse social capital resources for resilient communities, exploring the impact of diversified types of social capital on urban resilience is motivated. Therefore, three dimensions of social capital including bonding, bridging and linking are investigated in the resilience model of HCMC residents.

3. RESEARCH METHOD

3.1 Data source

The data utilized for the PLS-SEM model originates from primary sources gathered via a survey conducted among households residing in HCMC, Vietnam. The primary objective of the survey is to evaluate the existing level of social capital and resilience, as well as to explore the pathways through which social capital influences urban resilience. To ensure robust statistical analysis, a stratified sampling technique was employed to select a sample of 300 households, surpassing the minimum requirement for PLS-SEM analysis as per the "rule of ten." This rule dictates that the sample size should be ten times the number of observed variables of the formative measurement construct or ten times the number of independent variables in the structural model [46].

The stratification of the sampling frame into urban and suburban areas was based on the respective population proportions of each area. Ho Chi Minh City has a total population of 9,367,066, comprising 2,087,944 urban households and 539,909 suburban households. Within the urban stratum, which includes 16 urban districts and 1 urban town (Thu Duc), households were allocated proportionately to

each area with 39 households in Thu Duc City (12.96% of population) and 190 households in urban districts (63.30% of population). Similarly, within the suburban stratum, consisting of 5 suburban districts, 5 towns under suburban districts, and 58 suburban communes, households were allocated based on population distribution with 71 households (23.74% of population) (refer to Table 1). Subsequently, simple random selection procedures were employed based on the households list administered by the Peoples' Committee to select surveyed households referred in column (4) of Table 1.

Face to face interview has been applied to conduct the survey. To maintain the integrity of the sample size of 300 households throughout the survey process, alternative households were selected from nearby neighborhoods if any initially chosen household representatives were inaccessible. This approach ensures the efficient execution of the survey while also preserving the representativeness of the data collected from the community. Selecting volunteers from neighboring areas contributes to the reliability of the survey methodology and facilitates comprehensive data collection.

Table 1. Allocation of surveyed households

(1)	Average Population (Persons) (2)	Percentage (3)	Surveyed Households (4)
Total	9,367,066	100%	300
Thu Duc City	1,213,664	12.96	39
Urban districts	5,929,418	63.30	190
Dist. 1	141,622	1.51	5
Dist. 3	189,837	2.03	6
Dist. 4	176,461	1.88	6
Dist. 5	145,562	1.55	5
Dist. 6	237,986	2.54	8
Dist. 7	355,264	3.79	11
Dist. 8	453,448	4.84	15
Dist. 10	228,366	2.44	7
Dist. 11	210,672	2.25	7
Dist. 12	704,194	7.52	23
Go Vap	667,520	7.13	21
Tan Binh	501,697	5.36	16
Tan Phu	472,658	5.05	15
Binh Thanh	480,325	5.13	15
Phu Nhuan	165,980	1.77	5
Binh Tan	797,826	8.52	26
Sub-urban districts	2,223,984	23.74	71
Cu Chi	527,320	5.63	17
Hoc Mon	584,943	6.24	19
Binh Chanh	809,803	8.65	26
Nha Be	224,761	2.40	7
Can Gio	77,157	0.82	2

Source: Authors' work.

Before conducting the official survey, a pilot survey was carried out to assess the appropriateness and clarity of the questionnaire to ensure the reliability of the collected information. During the survey, the investigators introduced themselves and research purpose to obtain the consent of the respondents, then conducted interviews based on a structured questionnaire designed to collect information on social capital, resilience, and personal information of the respondents. Monitoring and supervision activities were carried out throughout the survey process, with a particular focus on reviewing survey results daily to promptly address missing data or any systematic errors to get the targeted sample of 300 surveyed households.

The survey questionnaire has been meticulously crafted to gather quantitative data for the research, employing a 7-point Likert scale for participant responses. This scale ranges from 1, indicating 'completely disagree,' to 7, indicating 'completely agree.' The decision to utilize a 7-point Likert scale instead of the conventional 5-point Likert scale is founded on its ability to capture nuanced quantitative data effectively. By offering a broader spectrum of response options, the 7-point scale enables participants to articulate subtle nuances in their opinions or attitudes with greater precision [47]. This heightened sensitivity helps mitigate the risk of central tendency bias, where respondents might be inclined towards neutral options. Furthermore, the scale's granularity enhances the capacity to discern varying degrees of agreement or disagreement, enabling a more nuanced understanding of participant viewpoints. From a statistical perspective, the extended scale provides increased variability, potentially yielding a more robust dataset and facilitating a more comprehensive analysis. This choice aligns with established academic practices, as the 7-point Likert scale is widely employed for its ability to elicit richer and more detailed data without burdening respondents with an overly lengthy scale.

3.2 PLS-SEM

For this study, Structural Equation Modeling (SEM) serves as the analytical approach to examine the impact of various forms of social capital on the urban resilience. SEM encompasses two distinct types, as delineated by Henseler [48]: Covariance-Based SEM (CB-SEM) and Variance-Based SEM (VB-SEM). CB-SEM estimates model parameters by minimizing disparities between the sample covariance matrix and the estimates, making it suitable for models involving common factors. On the other hand, VB-SEM estimates model parameters based on proxies, formed through the linear combination of observed variables. Within VB-SEM methodologies, Partial Least Squares-SEM (PLS-SEM) stands out as a powerful tool when appropriately applied in research [46]. PLS-SEM, introduced by Wold in 1966 and further developed in subsequent years, has witnessed a remarkable surge in application in recent times [46].

PLS-SEM is particularly well-suited for analyzing the interrelationships among variable groups, including latent variables, maximizing explained variance by estimating partial relationships through an iterative sequence of Ordinary Least Squares (OLS) regressions. A notable characteristic of PLS-SEM is its accurate estimation of unobservable variable scores via linear relationships with observed variables, making them effective substitutes for observed variables and highly valuable for explaining dependent variables. Furthermore, PLS-SEM does not necessitate the assumption of normality in data distribution, unlike CB-SEM [46].

The evaluation of the PLS-SEM model comprises two primary steps [46]. The first step involves the measurement model assessment, employing reflective measurement models to gauge social capital and resilience in this study. Evaluation criteria entail the scrutiny of construct reliability and validity metrics such as Cronbach's alpha, composite reliability, and average variance extracted, alongside discriminant validity through HTMT and Fornell-Larcker criteria. This evaluation encompasses dimensions of social capital, including bonding, bridging, and linking, as well as facets of urban resilience, such as material resources, social resources, problem-solving,

and optimism. The second step encompasses the structural model assessment, which entails assessing the statistical significance and magnitude of regression coefficients, and gauging the explanatory power of influencing variables on the dependent variable through R-squared and f-squared coefficients. Although PLS-SEM was initially designed for prediction, model fit indices are used when researchers have aimed to extend its application to theory testing to allow for evaluating how well a hypothesized model structure aligns with empirical data, thereby aiding in the identification of model misspecifications [46].

4. RESULTS AND DISCUSSION

A survey encompassing 300 households in Ho Chi Minh City offers a multifaceted insight into its residents. Gender parity is evident, with a near-equal split of 49% males and 51% females, reflective of the city's population. The data underscores the city's youthful essence, with 43% of respondents under 30, while 37% fall within the 30 to 50 age range, and 20% are over 50. Educational backgrounds vary, with 30.8% completing high school, 34% holding vocational training or college diplomas, and an impressive 35.2% boasting undergraduate or postgraduate degrees, highlighting a robust intellectual landscape of the city population. Marital status exhibits diversity, with 55% married and 37% single. Income distribution paints a nuanced picture, as 42% earn between 5 million and under 10 million VND, followed by 20.3% earning under 5 million VND. The higher income brackets are less populated, with only 1.3% earning between 50 and under 80 million VND, and a mere 0.7% earning over 80 million VND. This dataset provides valuable insights into the socio-economic fabric and demographic makeup of Ho Chi Minh City's households (see Table 2).

Table 2. Sample's information

Description	Percentage (%)
Gender	
Male	49.0
Female	51.0
Age group (years)	
Under 30	43.0
From 30-<40	23.0
From 40 -<50	14.0
Over 50	20.0
Education	
Up to high school	30.8
Vocational training	17.0
College	17.0
Undergraduate	25.2
Postgraduate	10.0
Marital status	
Single	37.0
Married	55.0
Widow	4.3
Divorced/Separated	3.7
Monthly Income (VND)	
Under 5 Million	20.3
From 5 Million –<10 Million	42.0
From 10 Million <20 Million	19.0
From 20 Million –< 30 Million	12.0
From 30 Million – < 50 Million	3.7
From 50 Million – < 80 Million	1.3
Over 80 Million	0.7
No income	1.0

Source: Authors' work.

The measurement model for social capital and resilience among HCMC residents, as outlined in Table 3, demonstrates robust reliability and validity across all dimensions. For social capital, the bonding dimension (SC_bond) exhibits a satisfactory Cronbach's alpha of 0.797, with composite reliability (rho_a) and (rho_c) values exceeding 0.87, indicating high internal consistency. Similarly, the bridging (SC_bridge) and linking (SC_link) dimensions also display strong reliability and convergent validity, with composite reliability scores above 0.88 and average variance extracted (AVE) values ranging from 0.567 to 0.704. Regarding resilience, all dimensions, including material resources (RS_Ma), social resources (RS_So), problem-solving abilities (RS_Pr), and optimism (RS_op), showcase excellent reliability, with Cronbach's alpha ranging from 0.895 to 0.918. Moreover, composite reliability values surpass 0.90, indicating high internal consistency, while AVE values range from 0.642 to 0.803, suggesting good convergent validity. This robust measurement model underscores the reliability and validity of the constructs capturing social capital and resilience among HCMC residents, providing a solid foundation for further analysis and interpretation.

Table 3. Reliability and validity of measurement model

Description	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
SC_Bond	0.797	0.878	0.876	0.704
SC_Bridge	0.876	0.880	0.910	0.669
SC_Link	0.871	0.899	0.900	0.567
RS_Ma	0.908	0.923	0.926	0.642
RS_So	0.895	0.898	0.920	0.658
RS_Pr	0.906	0.915	0.927	0.680
RS_Op	0.918	0.920	0.942	0.803

Source: Authors' work.

The discriminant validity of the reflective measurement model for social capital and resilience dimensions among HCMC residents is assessed through both the heterotrait-monotrait ratio (HTMT) and the Fornell-Larcker criterion. In Table 4, the HTMT ratios for all constructs are below the threshold of 0.85, indicating adequate discriminant validity. Notably, the values range from 0.245 to 0.766, suggesting that the constructs are more strongly related to their own measures than to measures of other constructs, thus supporting their discriminant validity. Furthermore, Table 5 reinforces these findings using the Fornell-Larcker criterion, where the square root of the average variance extracted (AVE) for each construct exceeds its correlations with other constructs, affirming discriminant validity. Overall, both analyses corroborate the distinctiveness of the social capital and resilience dimensions, providing confidence in their ability to measure unique aspects of HCMC residents' characteristics.

In this study, the standardized root mean square residual (SRMR) was found to be 0.086, indicating the average difference between the observed correlation matrix and the model-implied correlation matrix [49]. Typically, a good model fit is suggested by an SRMR value of 0.08 or lower [50], although some researchers consider a cut-off of less than 0.10 to be acceptable [49]. Additionally, the normed fit index (NFI) was evaluated at 0.610, suggesting that this model improves fit by 61% compared to the null or independence model. A

model is considered to have a good fit when the difference between the model's correlation matrix and the empirical correlation matrix is not significant [51]. In this study, both d_ULS and d_G values were below the 95% threshold in the bootstrapped quantile.

The structural model (PLS-SEM) results provide insights into the relationship between social capital and resilience among HCMC residents (Table 6 and Figure 1).

Table 4. Heterotrait-nonotrait ratio (HTMT)

Description	RS_Op	RS_ Ma	RS_So	SC_Link	RS_Pr	SC_Bond	SC_Bridge
RS_Op							
RS_Ma	0.387						
RS_So	0.475	0.486					
SC_Link	0.590	0.245	0.317				
RS_Pr	0.776	0.559	0.692	0.523			
SC_bond	0.443	0.483	0.519	0.650	0.522		
SC_bridge	0.682	0.504	0.534	0.683	0.727	0.766	

Source: Authors' work.

Table 5. Fornell-Larcker criterion

Description	RS_op	RS_Ma	RS_So	SC_Link	RS_Pr	SC_Bond	SC_Bridge
RS_Op	0.896						
RS_Ma	0.366	0.801					
RS_So	0.432	0.453	0.811				
SC_Link	0.543	0.204	0.292	0.753			
RS_Pr	0.717	0.517	0.625	0.485	0.825		
SC_bond	0.393	0.446	0.490	0.531	0.475	0.839	
SC_bridge	0.616	0.473	0.478	0.611	0.664	0.656	0.818

Source: Authors' work.

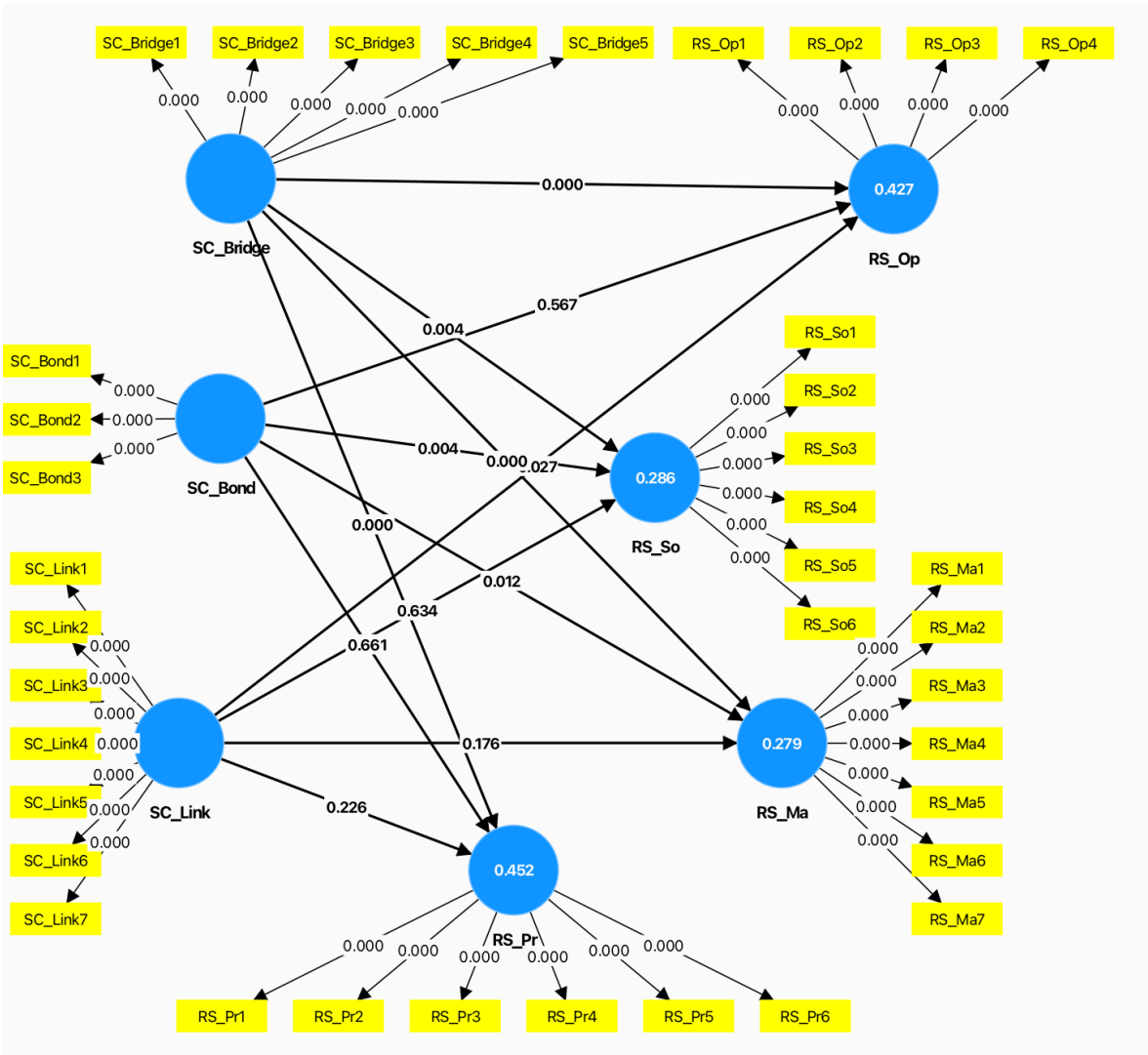

Figure 1. PLS-SEM output (bootstrapping)

Table 6. Structural model

	Path Coefficients	Standard Deviation	P-Values	95% CI
SC-link -> RS_Op	0.284	0.129	0.027	[0.076-0.574]
SC-link -> RS_Ma	-0.195	0.144	0.176	[-0.476-0.092]
SC-link -> RS_So	-0.069	0.144	0.634	[-0.307-0.269]
SC-link-> RS_Pr	0.116	0.096	0.226	[-0.043-0.326]
SC_bond -> RS_Op	-0.084	0.146	0.567	[-0.377-0.193]
SC_bond -> RS_Ma	0.283	0.113	0.012	[0.062-0.509]
SC_bond -> RS_So	0.325	0.114	0.004	[0.090-0.540]
SC_bond -> RS_Pr	0.043	0.098	0.661	[-0.148-0.232]
SC_bridge -> RS_Op	0.497	0.136	0.000	[0.206-0.734]
SC_bridge -> RS_Ma	0.407	0.113	0.000	[0.181-0.628]
SC_bridge -> RS_So	0.307	0.107	0.004	[0.085-0.510]
SC_bridge -> RS_Pr	0.565	0.100	0.000	[0.355-0.750]
R^2RS_Op =0.427; $R^2_{adjusted}$ RS_Op =0.409; R^2 RS_Ma =0.279; $R^2_{adjusted}$ RS_Ma =0.256; R^2 RS_So =0.286; $R^2_{adjusted}$ RS_So =0.263; R^2 RS_Pr =0.452; $R^2_{adjusted}$ RS_Pr =0.435				
f^2SC-link-> RS_Op =0.084; f^2 SC-link -> RS_Ma =0.031; f^2 SC-link -> RS_So =0.004; f^2 SC-link -> RS_Pr =0.015;				
f^2SC-bond-> RS_Op =0.007; f^2SC-bond-> RS_Ma =0.060; f^2 SC-bond -> RS_So =0.080; f^2 SC-bond -> RS_Pr =0.002;				
f^2SC-bridge-> RS_Op =0.204; f^2 SC- bridge -> RS_Ma =0.108; f^2 SC- bridge -> RS_So =0.062; f^2 SC- bridge -> RS_Pr =0.275				

Source: Authors' work.

Firstly, examining Table 6, it is evident that social capital, particularly in the form of bonding (SC_bond) and bridging (SC_bridge), significantly impacts various dimensions of resilience. Specifically, SC_bridge is measured in a reflective model with 5 observed variables implying open networks quantity (members) and quality (meetings; reciprocality, active participation and open network trust). It exhibits strong positive path coefficients to all resilience dimensions (RS_Op, RS_Ma, RS_So, RS_Pr), indicating a substantial influence, consitent with its leveraging roles. Conversely, SC_bond refers to the closed networks attributes, shows positive path coefficients to RS_Ma and RS_So, suggesting a positive association, while its impact on RS_Op and RS_Pr is not statistically significant. This finding confirms the survival resources for first-aid of bonding social capital. Moreover, it reveals that bridging social capital is more relevant for urban context. SC_link captures political participation and institutonal trust, demonstrates a statistically significant positive impact only on RS_Op, indicating a limited influence on resilience in comparison to SC_bridge. Additionally, the R-squared values for resilience dimensions suggest that the structural model explains a considerable proportion of variance, with RS_Pr showing the highest explanatory power at 45.2%. In conclusion, the structural model reveals the significant impact of social capital, particularly bridging social capital, on the resilience of Ho Chi Minh City residents, underscoring the importance of social networks and community connections in fostering resilience.

The findings of this study significantly enhance our understanding of resilience dynamics among urban residents in HCMC, Vietnam in the context of escalated climate change.

The four dimensions of resilience—encompassing resources (both material and social) and coping strategies (including problem-solving and optimism)—underscore that resilience is not merely about avoiding vulnerability. Rather, it equips individuals and communities to better respond to disasters. Resilience emphasizes the effective coordination of community resources, creating opportunities for sustainable and robust development rather than simply returning to a pre-disaster state. Moreover, by harnessing internal resources through resilience, communities become less dependent on a single source of support. Instead, they achieve the goal of diversifying their support systems. Furthermore, communities will utilize support resources more efficiently and sustainably by highlighting the crucial role of bridging social capital across multiple domains. This justification was evidenced with established research and theories highlighting the importance of diverse social networks [32, 33, 35, 51]. For instance, the "structural hole theory" and "strength of weak ties" proposed by Burt [33] and Granovetter [35] respectively underline the importance of diverse connections and interactions as well as general trust in leveraging network advantages. The access to information, resources, and opportunities is often facilitated through connections with acquaintances or individuals outside one's immediate social circle. Comparisons with prior studies consistently demonstrate that strong connections between individuals from different social backgrounds correlate with heightened levels of resilience, as evidenced by positive associations found in problem-solving (0.565), optimism (0.497), material resources (0.407), and social resources domains (0.307). These results underscore the enduring relevance of social capital theories in urban contexts and emphasize the necessity of fostering inclusive social networks to enhance resilience among urban populations. In the context of HCMC, where rapid urbanization and economic growth are prevalent, the importance of bridging social capital in navigating social, economic, and political landscapes cannot be overstated. Thus, targeted interventions aimed at strengthening bridging social capital within urban communities are crucial, aligning with the broader theoretical framework emphasizing the pivotal role of social connections in resilience-building efforts. Policymakers can leverage these empirical findings and theoretical insights to formulate more effective strategies to support the resilience of urban residents in HCMC and beyond.

Moreover, the study reveals the significant impact of bonding social capital, characterized by connections within close-knit groups, on resilience, particularly in terms of enhancing both material resources (0.283) and social resources (0.325). This finding underscores the cultural inclination within Vietnamese society to rely on tight-knit networks of family, friends, and neighbors for support and resources during adversities. While bonding social capital provides a strong sense of trust, reciprocity, and emotional support, its efficacy may be limited to the resources available within the confines of the closed network of strong ties. The study also uncovers limitations associated with closed networks, where strong ties and limited diversity may hinder access to external resources and perspectives, thus impeding the full leverage of available opportunities.

The limited role of linking social capital—connections to vertical social networks and institutions—in bolstering resilience among urban residents in Ho Chi Minh City has

been highlighted. Theoretically, linking social capital encompasses ties with formal institutions, public officials, and political groups, which facilitate access to societal-level resources, information, and opportunities [39]. However, in practice, several factors can hinder the effectiveness of linking social capital, particularly in contexts like Vietnam, where governance challenges such as bureaucratic inefficiencies, corruption, and limited avenues for civic engagement have been noted in the World Governance Indicators [53]. These issues can erode trust in formal organizations, reducing residents' motivation to engage with these networks.

This finding is significant within the Vietnamese socio-economic landscape, where barriers to accessing formal networks and institutions are prevalent. The relatively minor impact of linking social capital on resilience—evidenced by its primary association with optimism (0.284) and not with other domains—emphasizes the difficulties individuals encounter when attempting to utilize formal support systems. This suggests that in addition to the strengths of bridging and bonding social capital within Vietnamese communities, efforts to address structural barriers and enhance access to formal networks and resources are crucial. Improving trust in formal organizations and fostering greater civic participation could complement existing social capital, thereby strengthening overall resilience in the face of adversity.

From a policy perspective, the findings of this study highlight the critical need for targeted interventions that align disaster governance with the principles of sustainable development. In the context of HCMC, where escalated climate change pose significant challenges to resilience, it is essential for policymakers to adopt strategies that not only address immediate disaster risks but also contribute to long-term community sustainability. This dual approach requires a focus on strengthening social capital, particularly bridging social capital, which plays a vital role in fostering community resilience.

To begin with, policymakers should prioritize initiatives that foster inclusive social networks. Bridging social capital, which connects individuals and groups across diverse socio-economic, cultural, and geographic divides, is crucial for creating a more resilient urban population. Unlike bonding social capital, which tends to reinforce existing, often homogenous, networks, bridging social capital encourages connections between different groups, facilitating the exchange of resources, knowledge, and support across the community. This can be particularly important in urban settings where diversity is a hallmark, and where the challenges of inequality and social fragmentation can undermine collective resilience. By fostering inclusivity, bridging social capital can help to mitigate these challenges, enabling a more cohesive and supportive community that is better equipped to respond to and recover from disasters.

Community-building programs are a key mechanism for cultivating such inclusive networks. These programs can be designed to bring together residents from different backgrounds through shared activities, workshops, and events that promote mutual understanding and cooperation. For example, neighborhood associations, cultural festivals, and collaborative public space projects can serve as platforms for building trust and establishing connections among diverse groups. These initiatives not only strengthen social bonds but also create a sense of shared responsibility and collective identity, which are essential components of a resilient community.

Capacity-building initiatives are another crucial element of this strategy. By enhancing the skills and knowledge of residents, particularly in areas related to disaster preparedness and response, these initiatives can empower communities to take proactive steps in managing risks. Capacity-building efforts should focus on equipping residents with practical tools and resources, such as first aid training, disaster drills, and knowledge of local emergency protocols. Additionally, these programs can foster leadership within the community, encouraging individuals to take on active roles in organizing and leading resilience-building efforts. This, in turn, can help to cultivate a culture of preparedness and self-reliance, reducing dependency on external aid and increasing the community's overall capacity to withstand and recover from disasters.

Social inclusion policies are also critical in this context. These policies should aim to reduce barriers to participation for marginalized or underrepresented groups, ensuring that all residents have the opportunity to contribute to and benefit from resilience-building efforts. For instance, policies that support affordable housing, accessible public services, and equitable access to education and employment can help to address the underlying social and economic disparities that often exacerbate vulnerability to disasters. By promoting social inclusion, policymakers can create a more equitable and resilient urban environment where all residents, regardless of their background, have the means to participate in and benefit from the community’s collective resilience.

Investment in infrastructure that facilitates social interaction and community engagement is another essential component of this policy approach. Public spaces such as parks, community centers, and marketplaces play a vital role in fostering social connections and encouraging civic participation. By creating environments that encourage residents to come together, interact, and collaborate, such infrastructure investments can strengthen social capital and, by extension, community resilience. Moreover, well-designed public spaces can also serve as critical assets during disasters, providing safe gathering points and hubs for emergency response activities.

Education and awareness campaigns are also necessary to emphasize the importance of social capital in building resilient communities. These campaigns can help to shift public perceptions and behaviors, encouraging residents to actively engage in community-building activities and to recognize the value of social networks in disaster preparedness and recovery. Educational efforts should be tailored to different segments of the population, using accessible language and culturally relevant messaging to ensure broad reach and impact. By raising awareness about the role of social capital, these campaigns can foster a more engaged and proactive citizenry, contributing to the overall resilience of the urban community.

In summary, the integration of disaster governance and sustainable development requires a multifaceted policy approach that prioritizes the strengthening of bridging social capital. By fostering inclusive social networks, implementing community-building and capacity-building programs, promoting social inclusion, investing in supportive infrastructure, and conducting education and awareness campaigns, policymakers in HCMC can build resilient urban communities that are better prepared to cope with and recover from the challenges posed by disasters. These efforts not only enhance immediate disaster response capabilities but also contribute to the long-term sustainability and well-being of the city’s residents.

5. CONCLUSIONS

In conclusion, this study makes a significant contribution to our understanding of the pivotal role of social capital, particularly bridging social capital, in fostering resilience among urban residents in Ho Chi Minh City, Vietnam. By examining the importance of diverse social networks, our findings not only contribute to the existing body of research on resilience dynamics but also offer innovative theoretical insights. Notably, the cross-situational validation of the relationship between social capital and resilience enriches classical theories, such as the weak ties and structural hole theories, and extends the application of social capital theory into the field of disaster governance. This study also highlights the cultural inclination within Vietnamese society to rely on close-knit networks during times of adversity, which, while valuable, reveals limitations that underscore the need for interventions to promote more inclusive social networks for enhancing resilience. Furthermore, formal networks remain a potential resource of linking social capital for more pro-active strategies from the municipal authority.

In terms of research limitations, several important factors should be carefully considered when interpreting the findings of this study. First and foremost, the reliance on cross-sectional data presents a significant constraint, as it captures the relationship between social capital and resilience at a single point in time. This limitation inherently restricts our ability to draw causal inferences, making it difficult to determine whether social capital directly influences resilience, or if resilient communities are simply more likely to develop strong social networks. The temporal nature of these constructs is crucial; social capital and resilience are dynamic and likely evolve in response to various external factors, such as socio-economic changes, policy interventions, or recurrent exposure to adversity. Future research should thus prioritize longitudinal designs, which would allow for the tracking of these variables over time, offering deeper insights into their causal relationship and the ways in which they mutually reinforce each other.

Another limitation lies in the subjectivity involved in measuring social capital. Social capital is a multi-faceted construct that encompasses a wide range of social interactions, trust levels, and network structures, all of which are difficult to quantify with precision. The subjective nature of survey responses, which often rely on self-reported data, introduces potential biases such as social desirability bias, where respondents may overstate their levels of social capital or resilience. Additionally, cultural factors can influence how individuals perceive and report their social networks and community involvement, leading to variations in how social capital is measured across different contexts. This subjectivity warrants caution in interpreting the results, as it may not fully capture the complexity of social capital or its true impact on resilience.

To address these limitations, future research could benefit from a multi-method approach that combines quantitative measures with qualitative data, such as in-depth interviews or ethnographic studies. Such an approach would provide a richer, more comprehensive understanding of how social capital operates within communities and contributes to resilience. Moreover, the application of contextual theories that consider the specific socio-political and cultural environments in which social capital functions could offer more tailored insights. For example, investigating how social capital interacts with local governance structures, economic conditions, or cultural norms could reveal important contextual factors that influence the effectiveness of social capital in promoting resilience.

Furthermore, cross-cultural comparisons could significantly enhance our understanding of the role of social capital in resilience. By comparing findings across different cultural settings, universal aspects of social capital that contribute to resilience, as well as context-specific factors that may enhance or hinder its effectiveness could be identified. Such comparisons would also allow for the testing of social capital theories in diverse environments, potentially leading to the refinement of these theories or the development of new, more inclusive frameworks.

Lastly, multilevel analysis is another promising avenue for future research. Social capital operates at multiple levels—individual, community, and institutional—and its impact on resilience may vary across these levels. A multilevel approach would enable researchers to disentangle the effects of social capital at different levels of analysis, providing a more nuanced understanding of how individual-level networks, community cohesion, and institutional trust contribute to overall resilience. This approach could also help identify potential interactions between levels, such as how community-level social capital might moderate the relationship between individual social networks and personal resilience.

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