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Interactive Effects of Institutional, Economic, Social and Environmental Barriers on Sustainable Housing in a Developing Country

Michael Atafo Adabre[1] ; Albert P.C. Chan[2]; Amos Darko[3]

Abstract

This study investigates the causal relationships among 'institutional', 'economic', 'social' and 'environmental' sustainability barriers in addition to assessing their effects on sustainable housing. A questionnaire survey was conducted with professionals in the regulated sector of the Ghanaian housing market. Data collected were analyzed using the partial least squares structural equation modeling (PLS-SEM). Results revealed the following significant paths among the barriers: 'institutional barriers' to 'economic barriers' path is supported at a significance level of $p < .05$ at a t-value of 2.125; 'institutional barriers' to 'social barriers' path is also supported at a significance level of $p < .05$ at a t-value of 2.132 and likewise 'institutional barriers' to 'environmental barriers' path of $p < .01$ at a t-value of 3.740. Between the barriers and sustainable housing, both 'institutional barriers' and 'environmental barriers' have significant impacts on sustainable housing at t-values of 3.673 and 1.790 supported at $p < .01$ and $p < .10$, respectively. Three underlying barriers, viz: 'bureaucratic delays', 'policy instability' and 'weak enforcement of development control on land' accounted for all the significant paths of the 'institutional barriers'. Among them 'policy instability' has the highest

[1] Co-author's address : Dr. Michael Atafo Adabre, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong. Tel:+85266450743
E-mail address: 17902405r@connect.polyu.hk

[2] Co-author's address: Prof. Albert P.C. Chan, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong. E-mail address: albert.chan@polyu.edu.hk

[3] Corresponding author's address: Dr. Amos Darko, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong.. E-mail address: amos1.darko@polyu.edu.hk

loading, suggesting that it is the biggest barrier to sustainable housing. Essentially, the findings unraveled the causal-effect relationships among the four categories of barriers and a predictive model between the barriers and sustainable housing. Accordingly, the 'institutional barriers' are causal barriers that have multiplier effects on 'economic', 'social' and 'environmental' barriers.

Keywords: institutional barriers; economic barriers; social barriers; environmental barriers; sustainability; sustainable housing

1. Introduction

Sustainable development has become a global pursuit due to increasing greenhouse gas emissions and depletion of natural resources at a faster rate (Sarkodie and Strezov, 2019; Bekun et al., 2019; Adabre et al., 2021a). These have engendered a collaborative effort on key areas that require more attention from diverse policymakers at the national level (i.e. governments) and international level (i.e. the World Bank and the United Nations). Housing is one of the main foci that require exigent policies for sustainable development. Sustainable housing development entails a holistic attainment of institutional, economic, social and environmental sustainability goals (Adabre et al., 2020). Through facilitative efforts of the supranational institutions, governments have deployed institutional strategies via policies development to incentivize various stakeholders in housing provision towards achieving the economic, social and environmental sustainability goals in housing (Giddings et al., 2002; Scott, 2008; Ranta et al., 2018; Sarkodie and Strezov, 2019).

Housing provision in developing countries is classically divided into two main groups of formal and informal modes (Keivani and Werna, 2001 p.193). Typical in Ghana, the formal mode of provision entails housing supplied by recognized institutions such as the Tema Development Cooperation (TDC), State Housing Cooperation (SHC), Social Security and National Insurance Trust (SSNIT), Ghana Real Estate Developers Association (GREDA), Public Works Department (PWD), Ministry of Water Resources, Works and Housing (MWRWH) (Ghana Housing Profile, UN-Habitat, 2011). Consultancy firms such as Building and Road Research Institute (BRRI), Architectural and Engineering Service Limited (AESL) offer services to some of the recognised institutions for housing supply. Concerning the informal sector, housing supply is dominated by self-builders. About 90% of the housing supplies are from the informal sector while the remaining 10% are from the formal sector (Ghana Housing Profile, UN-Habitat, 2011; Ehwi et al., 2020). Housing provision from the formal institutions mainly caters for high income-earners of the urban population. Besides, through parastatal bodies, the government also provides housing to government employees. However, the inability of the recognised institutions in the formal sector to augment housing supplies to the high number of low- and middle-income earners in the country has partly contributed to the intransigent housing deficit. The inadequate supply from the formal sector has been attributed to barriers (Adabre and Chan, 2021).

Studies have been conducted globally on barriers to sustainable housing development and specifically in the Ghanaian housing market regarding the formal sector (Obeng-Odoom, 2010; Arku et al., 2012; Djokoto et al. 2014; Adabre et al., 2020). A list of some barriers includes: 'lack of incentives' (Darko et al., 2018; Owusu et al., 2019); 'lack of government support' (Ametepey et al., 2015; Adabre et al., 2020); 'excessive interest rates' (Amoatey et al., 2015); 'excessive inflation rate' (Owusu et al., 2019) and 'policy instability' (Twumasi-Ampofo et al., 2014). Notwithstanding the essence of providing a checklist of barriers that could influence sustainable housing (Adabre et al., 2020; Owusu et al., 2019), empirical assessments concerning the influence of barriers on sustainable housing are inadequate. Prior studies (Adabre et al., 2021b; Adabre and Chan, 2021) have investigated inter-relationships among factors as well as their effect on sustainable housing development albeit some limitations are evinced in their scopes. Study by Adabre et al. (2021b) focused on the influence of risk factors as opposed to barriers to sustainable housing. Regards study by Adabre and Chan (2021), the barriers were categorized from the economic sustainability perspective. Thus, institutional barriers were grouped as economic sustainability barriers. Consequently, adequate grouping and assessment of the interactive effects of the barriers vis-à-vis the four pillars of sustainability – economic, social, environmental and institutional – are lacking. For these reasons, it is essential to identify the barriers with respect to the four sustainability pillars, account for the interactions /causal relationships among the barriers and assess the influence of each category on sustainable housing development.

Assessing the interactive effects among the categories of barriers is essential for identifying causal-effect relationships among economic, social, environment and institutional barriers (Eybpoosh et al., 2011). This will enable policymakers and practitioners to appropriately allocate resources towards mitigating causal barriers. Thus, misallocation of resources to addressing the outcomes or effects of barriers could be avoided (Adabre et al., 2021b). Furthermore, assessing the barriers' impacts on sustainable housing could unearth barriers that hinder the realization of the United Nations (UN) sustainable development goals (SDGs) in housing for appropriate interventions by policymakers. This would contribute to the achievement of the UN SDGs by 2030 among developing countries in general and Ghana in particular.

Various techniques have been employed for analyzing barriers. Analytical techniques have evolved with succeeding techniques building on the weakness of preceding ones (Kim et al., 2009; Guan et al., 2020; Adabre et al., 2021b). Among different analytical techniques such as traditional multiple regression (TMR) analysis (Roufechaei et al., 2014), artificial neural network (ANN) (Kim et al., 2009), interpretive structural model (ISM) (Guan et al., 2020), fuzzy-DEMATEL (Addae et al., 2019), structural equation modelling (SEM) is considered as one of the most appropriate techniques for assessing interactive effects among groups of variables. For instance, following a comparative assessment of different techniques (i.e. TMR, ANN and SEM), Kim et al. (2009) asserted that interactive networks produced by structural equation model proffer enhanced outcomes on causal relationships among project barriers and goals. Therefore, the partial least squares structural equation modelling (PLS-SEM) is deployed in this study to develop a network of interactive effects among groups of barriers on one hand and to assess impacts of the groups of barriers on goals of sustainable housing. Findings on the network would enable policymakers and practitioners to re-evaluate barriers to sustainable housing supply, and they could serve as decision support network for improving housing provision from the formal sector of the housing market in Ghana and in other sub-Saharan African countries.

2.1 Sustainable Housing Criteria and Barriers: A Literature Review

As part of the United Nations Sustainable Development Goals, various critical success criteria (CSC) have been specified for gauging sustainable housing development. CSC are the set of standards through which judgement can be made (Ahadzie et al., 2011). They could be qualitative or quantitative criteria and are, therefore, measured subjectively or objectively, respectively (Mulliner et al., 2008; Adinyira et al., 2014). Chan and Adabre (2019) categorized CSC for sustainable housing into six groups, with the following key underlying criteria, viz:

‘time of housing project completion’; ‘cost performance of housing project’; ‘quality performance of project’; ‘safety performance (crime prevention) of housing facility’; ‘environmental-friendly (eco-friendly)’; ‘ease of maintenance or maintainability of housing facility’; ‘energy efficient housing facility’; ‘price affordability of housing facility’; ‘rent affordability of housing facility’; ‘transportation cost of household to the facility’ and ‘technology transfer / innovation’. Most of these CSC are confirmed as the sustainable development goals (SDGs) in housing as indicated in Target 11.1 of the UN SDG II, which states that ‘By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums’ (UN, 2015). Therefore, CSC or SDGs in housing are herein referred to as sustainable housing criteria (SHC) (refer to Table 1).

Attaining the SHC has been plagued by barriers. In response to devising effective strategies for mitigating the barriers, studies have been conducted from which many barriers have been identified. Through questionnaire administration to developers, Owusu et al. (2019) identified 23 barriers of which the top ranked barriers include: ‘complex tenure arrangements’; ‘land litigations’; ‘difficult land registration procedures’, ‘lengthy permit approval’ and ‘high cost of land’. Adabre et al. (2020), through a survey of construction professional in both developing and developed countries, identified 26 barriers to sustainable development in affordable housing. Among the barriers are ‘excessive cost of service land’; ‘inadequate infrastructure development’; ‘social exclusion and segregation’; ‘income inequality’; ‘weak enforcement of planning control on property development on land’ and ‘excessive interest rates’. In Djokoto et al. (2014), 20 barriers were identified, including, ‘higher final cost of sustainable construction’, ‘lack of government’s support’ and ‘inadequate policies/strategies to promote sustainable construction’. Similarly, Darko et al. (2018) identified 20 barriers to sustainable housing development (i.e. green building technologies adoption in housing), namely, ‘lack of government incentives', 'higher costs', 'inadequate professional knowledge and expertise', 'lack of financing schemes' and 'inadequate policies for sustainable development'. Providing a checklist of barriers, as evidenced in prior studies, is fundamental to managing barriers. In addition to this basic benefit, lists of project barriers have been decomposed into smaller groups via classification techniques to ensure more manageable barriers.

One technique of barrier classification is clustering by nature (Marle et al., 2013). That is, the checklist of barriers could be a priori classified (included in the methodology or empirically classified) or a posteriori classified based on the nature of the barrier (Marle et al., 2013). For instance, regarding a priori classified barriers, Darko et al. (2018) deployed factor analysis for clustering barriers into 'government-related', 'human-related', 'knowledge and information-related', 'market-related' and 'cost and risk-related' barriers. Similarly, through confirmatory factor analysis, Adabre and Chan (2021) grouped sustainable housing barriers into three categories: 'cost-related barriers', 'incentive-related barriers' and 'retrofitting-related barriers'. On the other hand, using a posteriori clustering of barriers, Owusu et al. (2019) made a clear distinction between economic barriers and institutional barriers. Yet, broadening on these two distinctions, study by Adabre et al. (2020) grouped the barriers based on their potential impacts on the four sustainability goals. Thus, in Adabre et al. (2020), barriers from extant literature were clustered into 'institutional sustainability barriers'; 'economic sustainability barriers'; 'environmental sustainability barriers' and 'social sustainability barriers'. Notwithstanding the two different forms of clustering barriers by nature – a priori and posteriori –, their essence is to facilitate identification of stakeholders or entities that have the requisite skills and expertise for mitigating clustered barriers. Yet, both forms of clustering barriers do not account for prioritization of the clustered barriers (Marle et al., 2013; Adabre et al., 2021b).

For appropriate allocation of resource, barriers have further been classified based on their importance or level of criticality/impact values on sustainable development. For example, in Owusu et al. (2019), descriptive statistical analysis through mean scores was used to rank the economic and institutional barriers. It was concluded that the institutional barriers have higher level of impact on sustainable housing development than the economic barriers', and, therefore, the institutional barriers deserve more attention. Nevertheless, Daniel (2006) asserted that economic barriers have higher level of criticality on sustainable development. Yet still, barriers to social sustainability have been prioritized as the most important among the four categories of barriers (Vallance et al., 2011). Concerning classification of barriers based on prioritization, courses of action are carried out on barriers that have the highest priority or rankings (Fang & Marle, 2012). However, it is worth noting that less prioritized barriers could be the main causal barriers that originate the most prioritized barriers (Kwak et al., 2018). In such a situation, allocating resources to the most prioritized barriers could be liken to allocating resources to the effects (i.e. the most prioritized barriers) instead of the causes (i.e. the less prioritized barriers). Therefore, a major limitation on the prioritizations of the institutional, economic, social and environmental barriers in extant literature (Owusu et al., 2019; Daniel, 2006; Vallance et al., 2011) is that they do not account for the interactive effects or impacts among these barrier categories as well as their interactive impacts on the goals of sustainable housing. Thus, establishing possible causal-effect relationships among the quadruple categories of barriers and sustainable housing remains a pressing knowledge gap in the sustainable development literature.

Although extant literature has revealed the influences of the barriers on one another through correlation analyses (Adabre et al., 2020), correlation does not imply causation. Similarly, Owusu et al. (2019) surmised that the institutional barriers could influence the economic barriers albeit without empirical investigation on causation between the barriers. Besides, attributed to limitations in most techniques such as decision making trial and evaluation laboratory (DEMATEL) (Sivakumar et al., 2018); fuzzy DEMATEL (Addae et al., 2019); interpretive structural modelling (Guan et al., 2020); fuzzy weighted interpretive structural modelling (Tavakolan and Etemadinia, 2017), regression and artificial neural network (Kim et al., 2009), developing a statistically validated network of the impact of barriers on sustainable housing is also a knowledge gap regarding the analytical techniques. For instance, test of statistical significance among causal relationships cannot be achieved with the ISM and fuzzy-DEMATEL. Although such test is possible in regression analysis, this technique is only suitable for one dependent variable with at least two independent variables (Astrachan et al., 2014; Adabre et al., 2021b). Therefore, this study seeks to bridge the identified knowledge gaps by making empirical and methodological contributions through the PLS-SEM technique.

The categorization of underlying barriers into the four sustainability pillars – economic, social, environmental and institutional (refer to Table 1) – is based on prior studies (Hosseini & Kaneko, 2012; Adabre et al., 2020; Jing & Wang, 2020). According to Hosseini & Kaneko (2012), economic sustainability factors include macroeconomic variables (i.e. inflation, interest rate, consumer prices). Institutional sustainability barriers involve factors that influence governments' effectiveness, regulatory quality, control of corruption, political stability, rule of law. Environmental sustainability barriers lead to depletion of natural resources (i.e. land depletion, net forest depletion, energy depletion) while social sustainability barriers negatively affect social inclusion, equality, empowerment and social phenomena (i.e. lifestyle and cultural forms) (Jing & Wang, 2020).

Table 1: SHC and Barriers to Sustainable Housing

Category	Code	Underlying Variables	References
Sustainable Housing Criteria (SHC)			
	SHC1	Timely completion of project	Adabre & Chan (2018); Chan & Adabre (2019) Adinyira et al. (2014); Ahadzie et al. (2011) Mulliner et al. (2008); Osei-Kyei & Chan (2017) Cruz et al. (2019)
	SHC2	Construction cost performance	
	SHC3	Quality performance	
	SHC4	Safety performance (crime prevention)	
	SHC5	Environmental-friendly (Eco-friendly)	
	SHC6	Ease of maintenance of housing facility	
	SHC7	Energy efficient housing	
	SHC8	Affordable price of facility	
	SHC9	Affordable rent of facility	
	SHC10	Commuting cost of household to facility	
	SHC11	Technology transfer/innovation	
The Four Main Categories of Barriers to Sustainable Housing			
Economic Barriers	ESB1	Inadequate public funding	Owusu et al. (2019); Adabre et al. (2020)
	ESB2	Excessive cost of serviced land	Keivani and Werna (2001); Owusu et al. (2019)
	ESB3	Excessive cost of sustainable building materials/technologies	Amoatey et al. (2015); Darko et al. (2018); Owusu et al. (2019)
	ESB4	High approval cost due to high taxes and fees on developers	Owusu et al. (2019)
	ESB5	Inadequate incentives for private investors	Darko et al., (2018); Eduful & Hooper (2019)
	ESB6	High interest rates	Arku et al. (2012); Amoatey et al. (2015)
	ESB7	High inflation rates	Amoatey et al. (2015); Owusu et al. (2019)
	ESB8	Tight credit conditions	Amoatey et al. (2015); Owusu et al. (2019)
Social Barriers	SSB1	Income inequality	Arku et al. (2012); Dong (2018); Eduful & Hooper (2019)
	SSB2	Social exclusion and segregation	Eduful & Hooper (2019); Niembro et al. (2021)
	SSB3	Poor maintenance culture/inadequate retrofitting of existing housing	Agyefi-Mensah et al. (2015); Mete & Xue (2020)
	SSB4	High loan/mortgage default rates by clients	Ebekozien et al. (2019); Adabre et al. (2020)

	SSB5	Negative culture towards mortgage	Ebekozien et al. (2019); Adabre et al. (2020)
Environmental Barriers	NSB1	Inadequate access to land within cities/towns	Adabre et al. (2020); Tetteh & Amponsah (2020);
	NSB2	Peripheralization of housing projects/facilities	Cobbinah & Amoako (2012); Grant et al. (2019)
	NSB3	Low-rise housing development	Agyemang et al. (2018); Kalantari & Shepley (2020)
Institutional Barriers	ISB1	Difficult land registration procedures	Amoatey et al. (2015); Siiba et al. (2018)
	ISB2	Inadequate mortgage/financing institutions	Amoatey et al. (2015); Owusu et al. (2019)
	ISB3	Policy instability	Amoatey et al. (2015); Liu et al. (2016); Zhu et al. (2020)
	ISB4	Weak enforcement of planning system control on property development on land	Siiba et al. (2018); Cobbinah et al. (2020); Zhu et al. (2020)
	ISB5	Abandoned management of public housing projects / facilities	Twumasi-Ampofo et al. (2014); Mete & Xue (2020)
	ISB6	Shortage of skilled labor	Djokoto et al. (2014); Ametepey et al. (2015)
	ISB7	Low capacity of service providers on infrastructure development	Agyemang et al. (2018)

2.2 Theoretical Model of Barriers and Sustainable Housing

A theoretical model was established for assessing the causal relationships among the institutional, economic, social and environmental barriers as well as evaluating their impacts on sustainable housing. Review of the extant literature suggests the following theoretical model (refer to Fig. 1) and hypotheses:

Hypothesis 1: 'Institutional barriers' significantly influence 'economic barriers'. That is, if this statement is confirmed in the data analysis, then institutional barriers originate economic barriers to sustainable housing development in the regulated sector of the housing market (Owusu et al., 2019).

Hypothesis 2: 'Institutional barriers' significantly influence 'social barriers'. Thus, institutional barriers cause social barriers (i.e. income inequality, social exclusion and segregation etc.) (Eduful and Hooper, 2019; Sulemana et al., 2019) in the regulated sector of the housing market, provided this hypothesis is valid.

Hypothesis 3: 'Institutional barriers' have a significant impact on 'environmental barriers'. If this statement is verified, then 'environmental barriers' are caused by existing institutional challenges in the housing market (Cobbinah & Amoako, 2012).

Hypothesis 4: 'Economic barriers' have a significant impact on 'social barriers'. Thus, on condition that this hypothesis is confirmed, there is a causality from 'economic barriers' to 'social barriers' (Hosseini & Kaneko, 2012); this implies that social barriers could be alleviated by mitigating economic barriers in the housing market (Sulemana et al., 2019).

Hypothesis 5: 'Economic barriers' have a significant impact on 'environmental barriers'(Hosseini & Kaneko, 2012). That is 'economic barriers' instigate 'environmental barriers' in the Ghanaian housing market, on condition that the hypothesis is valid.

Hypothesis 6: 'Environmental barriers' have a significant impact on 'social barriers'. It is hypothesized that problems related to conservation of natural resources such as land (environmental barriers) lead to social sustainability challenges such social exclusion and income inequality (Haidar & Bahammam, 2021). Besides, according to Zhang et al (2014), environmental barriers (regarding land use) can destabilize an ecosystem and instigate social barriers. Therefore, there is a significant effect of environmental barriers on social barriers, provided this claim is valid. Otherwise, 'environmental barriers' do not cause 'social barriers'.

Hypothesis 7: 'Institutional barriers' significantly influence sustainable housing. If this hypothesis is validated, then sustainable housing is negatively affected by institutional barriers in the Ghanaian housing market (Owusu et al., 2019).

Hypothesis 8: 'Economic barriers' significantly influence sustainable housing. That is, sustainable housing is negatively affected by 'economic barriers' provided the hypothesis is confirmed. Otherwise, economic barriers do not have any significant impact on sustainable housing development in the Ghanaian housing market (Owusu et al., 2019).

Hypothesis 9: 'Environmental barriers' significantly influence 'sustainable housing'. This could imply that sustainable housing development is directly and negatively affected by environmental barriers (Hosseini & Kaneko, 2012).

Hypothesis 10: 'Social sustainability barriers' significantly influence 'sustainable housing' in the Ghanaian housing market. If this statement is corroborated, there is a causality from social barriers to sustainable housing development .

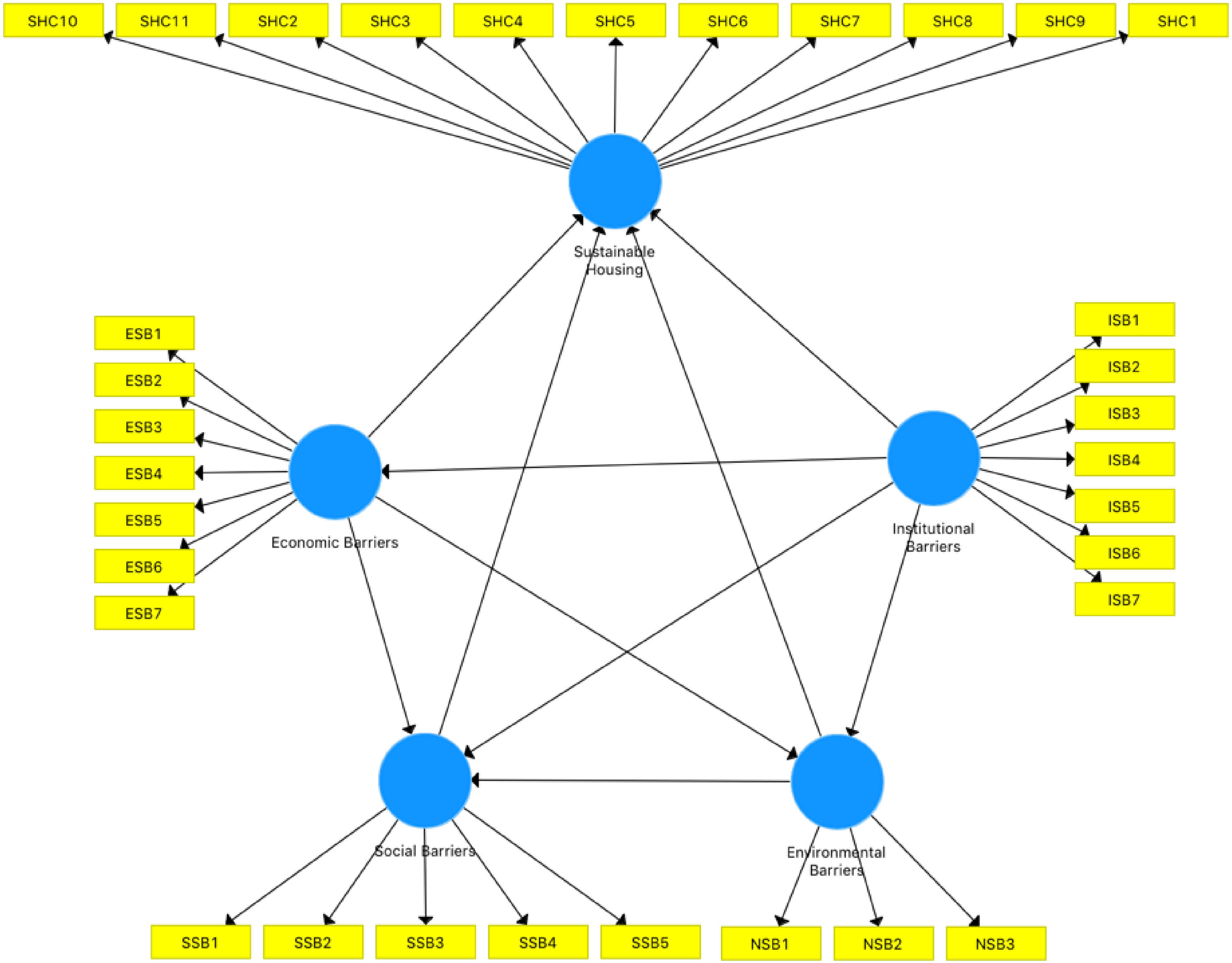

Fig. 1: A Conceptual Model of the Interactive Effects Among Barriers and Sustainable Housing

3.1 Research Methodology

The research epistemological positioning was framed within a postpositivist philosophical stance and deductive reasoning for testing the stated hypotheses derived from existing literature. Similar approach has been employed in contemporary studies on construction management (Hou et al., 2020; Aghimien et al., 2020; Edwards et al., 2020) and specifically on sustainable housing (Adabre et al., 2021b). A closed-ended questionnaire survey was employed for data collection.

3.2 Questionnaire Design

The closed-ended questionnaire was deemed suitable for expediting on the solicitation of quantitative data for assessing the interactive effects among the barriers categories on sustainable housing. The questionnaire consisted of five sections. The first section solicited for demographic data of respondents, the second section invited respondents to rate the importance of a list of sustainable housing criteria (refer to Table 1). Section three invites respondents to rate a set of risk factors. In section four, the respondents were requested to rate the level of criticality of the listed barriers (refer to Table 1) that hinder sustainable housing using a five-point Likert scale (1=not critical; 2=less critical; 3=neutral; 4=critical; 5=very critical). Finally, respondents' views were solicited on the importance of a list of strategies or interventions for sustainable housing. In this study, only the views of respondents on the criticality of the barriers with regard to the sustainable housing criteria (SHC) are reported. The questionnaire was piloted among four experts who are abreast of the Ghanaian housing market. The experts have at least five years of industrial experience. Besides, they have conducted various studies concerning the Ghanaian housing market. Views of the pilot participants were used to improve and finalize the questionnaire for data collection.

3.3 Population and Sampling

The population for this study includes members of the formal/regulated sector of the Ghanaian housing market. Some of these include: MWRWH; PWD; SHC; SSNIT; TDC; AESL; BRRI and GREDA. Due to inadequate list of the members of these institutions, probability sampling could not be deployed for data collection. However, non-probability sampling techniques such as purposive sampling and snowballing were utilised for collecting data. These established non-probability sampling techniques are suitable in situations where it is difficult to assess the representativeness of the sample vis-à-vis the population of the study (Adabre et al., 2021b). Yet, the problem of sample size biased could occur in using non-probability sampling techniques. Therefore, appropriate strategies were employed for the data collection from the different institutions to ensure that sampling bias was minimized as far as practicable. This was achieved by first identifying the institutions within the formal sector of the Ghanaian housing market through a comprehensive literature review and snowballing with professionals (Adabre et al., 2021b).

3.4 Data Collection

To prevent sampling bias, the time for administering the questionnaire is important and was, therefore, taken into consideration. The questionnaire was administered at the Annual General Meeting (AGM) of the Ghana Institution of Surveyors (GhIS), which was held on 2nd March 2019 in Accra at the Ghana Institute of Management and Public Administration (GIMPA). At the AGM, most quantity surveyors, land surveyors and valuers of the regulated institutions were present since attending such meeting is a requirement on all professionals of the GhIS. The questionnaire was administered to members who worked in the formal sector of the Ghanaian housing market after briefly introducing them to the aim of the study. The participants at the AGM were mostly identified through snowballing. Other professionals who do not belong to the GhIS did not attend the AGM. Therefore, the researchers visited the offices of the formal institutions such as PWD, SHC, SSNIT, TDC, MWRWH, AESL and BRRI. The questionnaires were administered to architects, engineers and planners. Concerning the developers, a brochure containing the email addresses and phone numbers of the developers was obtained from the head office of GREDA. Phone calls were made to members of GREDA to book appointment with them for either face-to-face questionnaire administration or questionnaire administration via email. The members of GREDA, who participated in the survey, were kindly requested to forward the questionnaire by email to other interested members who could provide the required data for achieving the study's aim. A total of 110 questionnaires were administered via email and face-to-face contacts, out of which 47 valid questionnaires were retrieved which corresponds with a 42.7% response rate.

3.5 Respondents' Profile

Respondents' profile was descriptively analysed using the Statistical Package for Social Science (SPSS). Results showed that 47.9% of the respondents are employed in the public sector, 35.4% are employed in academic institutions and 16.7% were private developers. On professions of the respondents, most (55.3%) were quantity surveyors, followed by architects (19.2%), then construction managers (12.8%) and planners and engineers constituting 12.7%. On housing projects handled, most of the respondents (52.2%) stated that they have handled $\geq$ two projects in Ghana, of which 55.1% are state or public housing projects. Concerning years of working experience of respondents, 63.9% have $>$ 5 years working experience. The respondents' profile shows that they are abreast of the Ghanaian housing market (Adabre et al., 2021b). Therefore, they could provide the required data for assessing the interactive effect among the economic, social, environmental and institutional sustainability barriers as well as evaluating their impact on sustainable housing.

3.6 Data Analysis Technique – PLS-SEM

Structural equation modelling (SEM) is deemed appropriate for this study because of the limitations in other statistical techniques as elaborated in extant literature (Kim et al., 2009; Eybpoosh et al., 2011; Astrachan et al., 2014; Ahmadabadi & Heravi, 2019). SEM is suitable for assessing potential interactive effects among the four constructs of barriers and for establishing a predictive model between the barrier categories and sustainable housing (Adabre et al., 2021b). Therefore, the stated hypotheses (hypotheses 1 to 10) could be tested with the use of SEM, either with the partial least square structural equation modeling (PLS-SEM) or covariance-based structural equation modeling (CB-SEM). The PLS-SEM is suitable for testing hypotheses with relatively small sample size of non-normally distributed data. In contrast, the CB-SEM is appropriate for testing existing theories with large sample size of data (i.e. > 200) that are normally distributed (Adabre et al., 2021b). Since this study aims to test hypotheses using relatively small sample of data that are not normally distributed, the PLS-SEM is more appropriate for data analysis (Astrachan et al., 2014).

Notwithstanding the PLS-SEM's relative low sensitivity to sample size compared to the CB-SEM's, adequate sample for statistical analysis was assured. This was achieved by meeting basic requirements for statistical analysis. First, the data must fulfill the central limit theorem requirement of a sample size of 30. Since a sample size of 47 valid responses were obtained, the data fulfilled the central limit theorem and are appropriate for statistical analyses. Besides, one of the requirements for employing the PLS-SEM is that the estimated sample size should be more than 10 times the maximum number of arrows pointing at a construct (Hair et al., 2012). From the conceptual model (refer to Fig. 1), there are four maximum number of arrows pointing at the sustainable housing construct. Therefore, the required sample size should be more than 10 times the maximum number of arrows pointing at the sustainable housing construct (i.e. 10x4 =40). Since the sample size 47 > 40, the data is deemed suitable for statistical analysis using the PLS-SEM. However, regards CB-SEM, it is a requirement that the sample size should be five times the number of indicators included in the original model (Astrachan et al., 2014).

In conducting the PLS-SEM, the measurement model was first estimated. This was achieved by establishing the relationships between the constructs (i.e. the barrier categories and sustainable housing) and their indicators. All constructs were reflectively measured by their indicators. This was followed by assessments of the measurement model through reliability and validity checks. Cronbach's alpha, composite reliability and rho-alpha were used for assessing reliability of the measurement model while convergent validity (via factor loading and average variance extracted) and discriminant validity (via Fornell & Lacker criterion, cross loadings and heterotrait-monotrait/HTMT) were used for assessing validity of the measurement model. The measurement model assessment was followed by specification of the structural model which establishes the potential relationships among the clustered barriers and sustainable housing. The structural model was checked for multicollinearity using the variance inflation factor (VIF). Afterwards, test of significance of the relationships (i.e. hypotheses) was conducted using bootstrapping analysis.

4. Results of Data Analysis

4.1 Descriptive and Reliability Analysis

The content validities of the data were first assessed using the Cronbach's alpha values obtained from the SPSS data analysis. Estimated Cronbach's alpha values of 0.878 and 0.882 were determined for the indicators of sustainable housing and the indicators of the various barrier categories, respectively. Since these estimated Cronbach's alpha values are > 0.700 (i.e.

the recommended threshold for data validity), the results imply adequate validity of the data. Mean scores and standard deviations were estimated for the indicators of sustainable housing and the barriers. The underlying indicators of the constructs were ranked using their mean scores. For two indicators that have the same mean scores, their rankings were based on their standard deviations. In that case, the indicator with a lower standard deviation is ranked higher. Table 2 shows the mean scores and standard deviations of the indicators. '*Construction cost performance', 'quality performance of housing projects'*, *'timely completion of projects'*, *'affordable price of facility'* and *'affordable rent of facility'* are the top five ranked criteria of the sustainable housing construct. Concerning the barriers, their mean scores (refer to Table 2) revealed that the top ranked underlying barriers include: *'high interest rates'*; *'excessive cost of sustainable building materials/technologies'*; *'excessive cost of serviced land'*; *'policy instability'* and *'tight credit conditions'*. Most of the top five highly ranked barriers are in the 'economic barriers' category (refer to Table 2).

Table 2: Descriptive Statistics of the Underlying Variables/Indicators

Constructs	Code	Observable Variables	Mean Score	Standard Deviation	Rank	Corrected Item-total correlation	Cronbach's Alpha if Item Deleted	Overall Cronbach's Alpha
Sustainable Housing Criteria (SHC)								
	SHC1	Timely completion of project	4.340	0.815	3	0.378	0.875	0.813
	SHC2	Construction cost performance	4.468	0.584	1	0.231	0.878	
	SHC3	Quality performance	4.343	0.644	2	0.496	0.872	
	SHC4	Safety performance (crime prevention)	4.085	0.803	7	0.654	0.867	
	SHC5	Environmental-friendly (Eco-friendly)	4.085	0.803	7	0.380	0.875	
	SHC6	Ease of maintenance of housing facility	4.283	0.851	5	0.566	0.869	
	SHC7	Energy efficient housing	3.915	0.880	9	0.547	0.870	
	SHC8	Affordable price of facility	4.298	0.749	4	0.393	0.875	
	SHC9	Affordable rent of facility	4.196	0.824	6	0.472	0.872	
	SHC10	Commuting cost of household to facility	3.787	0.999	10	0.582	0.869	
	SHC11	Technology transfer/innovation	3.468	0.856	11	0.621	0.868	
Underlying Barriers to Sustainable Housing								
Economic Barriers								0.882
	ESB1	Inadequate public funding	4.404	0.742	8	0.436	0.861	
	ESB2	Excessive cost of serviced land	4.467	0.710	3	0.386	0.837	
	ESB3	Excessive cost of sustainable building materials/technologies	4.467	0.544	2	0.395	0.838	
	ESB4	High approval cost due to high taxes and fees on developers	4.170	0.637	12	0.326	0.839	
	ESB5	Inadequate incentives for private investors	3.872	0.924	20	0.553	0.829	
	ESB6	High interest rates	4.761	0.427	1	0.443	0.837	
	ESB7	High inflation rates	4.404	0.712	7	0.414	0.836	
	ESB8	Tight credit conditions	4.404	0.680	6	0.397	0.837	
Social Barriers								
	SSB1	Income inequality	3.979	0.737	16	0.427	0.835	
	SSB2	Social exclusion and segregation	4.085	0.905	13	0.905	0.830	
	SSB3	Poor maintenance culture/inadequate retrofitting of existing housing	4.213	0.907	11	0.493	0.832	
	SSB4	High loan/mortgage default rates by clients	3.915	0.974	18	0.430	0.861	
	SSB5	Negative culture towards mortgage	3.894	0.890	19	0.354	0.863	
Environmental Barriers								

	NSB1	Inadequate access to land within cities/towns	4.043	0.908	15	0.437	0.835
	NSB2	Peripheralization of housing projects/facilities	3.596	0.798	22	0.379	0.807
	NSB3	Low-rise housing development	3.600	0.881	21	0.414	0.861
Institutional Barriers							
	ISB1	Difficult land registration procedures	3.936	0.895	17	0.391	0.837
	ISB2	Inadequate mortgage/financing institutions	4.319	0.726	9	0.313	0.840
	ISB3	Policy instability	4.404	0.648	4	0.404	0.837
	ISB4	Weak enforcement of planning system control on property development on land	4.239	0.728	10	0.579	0.830
	ISB5	Abandoned management of public housing projects / facilities	4.404	0.648	4	0.404	0.837
	ISB6	Shortage of skilled labor	3.255	1.170	23	0.134	0.855
	ISB7	Low capacity of service providers on infrastructure development	4.043	0.806	14	0.488	0.833

4.2.1 Results of PLS-SEM: Measurement Model Estimation

The PLS-SEM analysis was conducted using Smart PLS version 3.27 for assessing the interactive effects among the categories of barriers and their effects on sustainable housing development. On establishing the measurement model, indicators' factor loadings which were below 0.50 were deleted, and the analysis was performed repeatedly until the retained indicators have loadings ≥ 0.50. Table 3 shows the outcome of the valid and reliable measurement model (Hair et al., 2012). From Table 3, all the factor loadings and the average variance extracted (AVE) are above the required 0.50, which indicates data validity. Besides, the composite reliability (CR) and the rho alpha (Rho_A) values are greater than the recommended 0.70, which imply satisfactory reliability of the measurement model (Hair et al., 2012).

Table 3: Measurement Model Results

	Items	Loadings	AVE	CR	Rho_A
Sustainable Housing	SHC10	0.520	0.516	0.837	0.811
	SHC3	0.624			
	SHC7	0.651			
	SHC8	0.848			
	SHC9	0.881			
Economic barriers	ESB1	0.741	0.627	0.870	0.811
	ESB2	0.743			
	ESB3	0.828			
	ESB7	0.850			
Social barriers	SSB2	0.656	0.571	0.841	0.810
	SSB4	0.800			
	SSB5	0.743			
	ESB5	0.813			
Environmental barriers	NSB1	0.865	0.571	0.796	0.744
	NSB2	0.597			
	NSB3	0.781			
Institutional barriers	ISB1	0.790	0.702	0.876	0.804
	ISB3	0.874			
	ISB4	0.848			

Items deleted: indicators' factor loadings < 0.5: SHC1;SHC2;SHC4;SHC5;SHC6;SHC11; ESB4;ESB5;ESB6; ESB8; SSB1;SSB3;ISB2;ISB5;ISB6;ISB7

4.2.2 Discriminant Validity

Further assessments of the measurement model were conducted using the cross loadings of the variables, the Fornell and Lacker criterion and the heterotrait-monotrait (HTMT) ratio of correlation (refer to Tables 4, 5 & 6). Concerning cross-loadings, all indicators of the sustainable housing constructs and barriers had the highest loadings in the constructs they were hypothesized to measure (refer to Table 4). On the Fornell and Locker criterion, the condition is that each construct should have the highest correlation with itself. Such correlations are shown diagonally in Table 5. Regarding the HTMT ratio of correlations, the condition for assessment is that the correlations should be compared to an established threshold i.e. 0.90 ($HTMT_{0.90}$) as proposed by Teo et al. (2008), and all the correlations should be lower than the established threshold. All correlations of the HTMT (refer to Table 6) are < 0.90, which further confirmed the adequacy of the measurement model regards discriminant validity.

Table 4: Indicators' Cross Loadings

Indicators /Variables	Sustainable Housing	Economic Barriers	Social Barriers	Environmental Barriers	Institutional Barriers
SHC10	**0.520**	0.079	0.016	-0.077	0.090
SHC3	**0.624**	0.347	0.291	0.197	0.409
SHC7	**0.651**	0.181	0.084	0.121	0.351
SHC8	**0.848**	0.141	-0.128	-0.105	0.230
SHC9	**0.881**	0.111	0.009	-0.154	0.334
ESB1	0.141	**0.741**	0.244	0.347	0.148
ESB2	0.216	**0.743**	0.092	0.162	0.214
ESB3	0.207	**0.828**	0.186	0.173	0.372
ESB7	0.186	**0.850**	0.317	0.139	0.240
SSB2	0.126	0.293	**0.656**	0.091	0.319
SSB4	-0.068	0.268	**0.800**	0.315	0.411
SSB5	0.118	0.159	**0.743**	0.218	0.311
ESB5	0.050	0.148	**0.813**	0.505	0.603
NSB1	-0.007	0.142	0.401	**0.865**	0.608
NSB2	-0.025	0.152	0.222	**0.597**	0.254
NSB3	-0.014	0.349	0.286	**0.781**	0.256
ISB1	0.372	0.241	0.404	0.356	**0.790**
ISB3	0.263	0.272	0.573	0.605	**0.874**
ISB4	0.416	0.272	0.460	0.386	**0.848**

Table 5: Fornell and Lacker Criterion

Construct / Categories	Sustainable housing	Economic barriers	Social barriers	Institutional barriers	Environmental barriers
Sustainable housing	**0.718**				
Economic barriers	0.235	**0.792**			
Social barriers	0.063	0.272	**0.756**		
Institutional barriers	0.410	0.313	0.579	**0.838**	
Environmental barriers	-0.017	0.260	0.420	0.548	**0.756**

Table 6: Heterotrait-monotrait ratio of Correlation **(**HTMT)

Construct / Categories	Sustainable housing	Economic barriers	Social barriers	Institutional barriers	Environmental barriers
Sustainable housing					
Economic barriers	0.328				
Social barriers	0.269	0.365			
Institutional barriers	0.523	0.387	0.691		
Environmental barriers	0.284	0.395	0.507	0.667	

4.2.3 Structural Model Estimation

The structural model was estimated by conducting path analyses to assess the impact of the constructs among themselves. That is, the structural model was developed to assess the interactive effects among the categories of barriers and their impacts on sustainable housing. Result of the structural model is shown in Fig. 2.

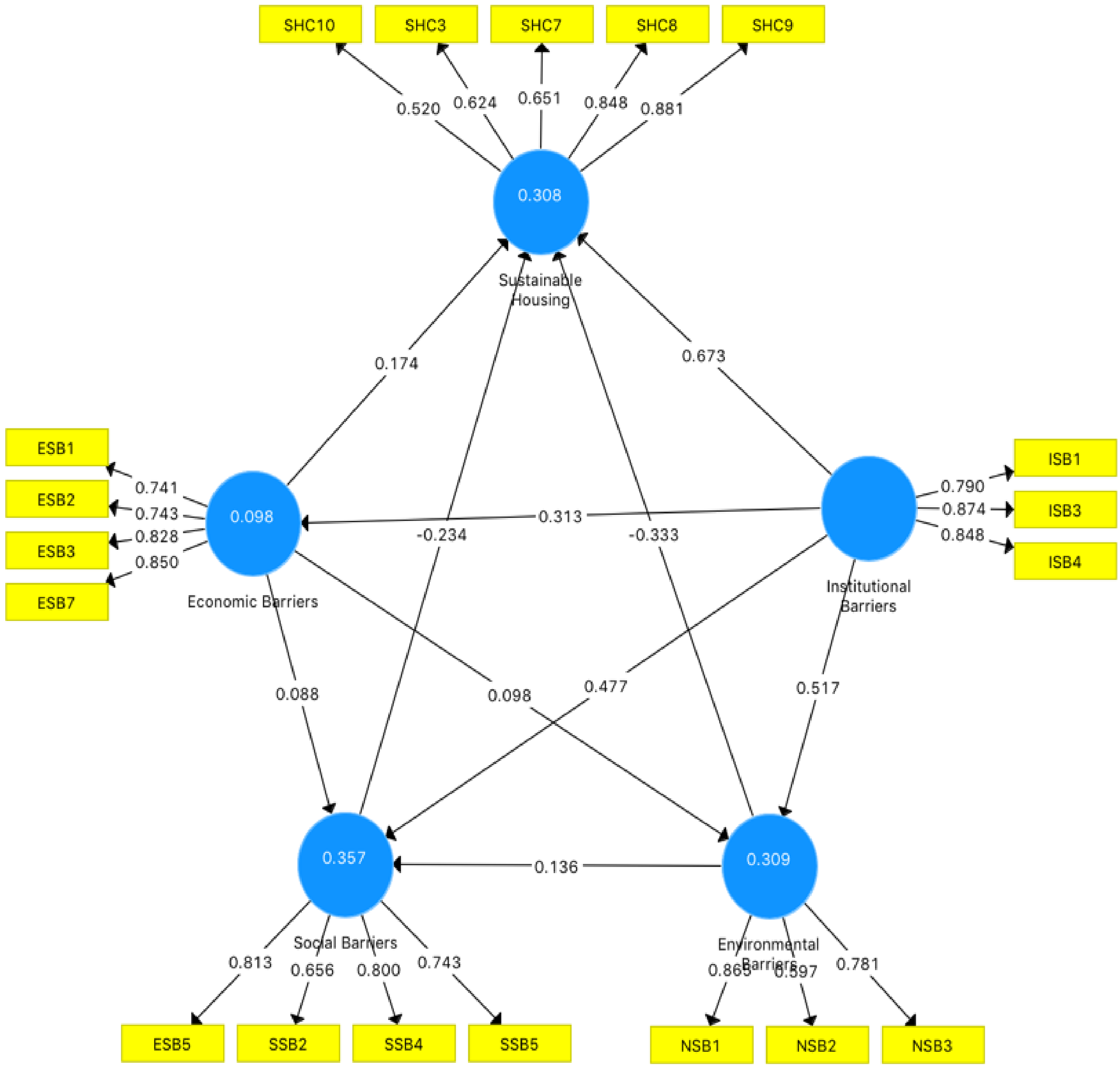

Fig. 2: Structural Model of the four Barrier Categories and Sustainable Housing Construct

4.2.4 Structural Model Assessment

The structural model was estimated to determine the significance of the hypotheses. Prior to that, the model was tested for multicollinearity using the variance inflation factor (VIF). Minimum multicollinearity was obtained since all estimated values of VIF were < 5.00, which implies that there was no problem of multicollinearity. Furthermore, the structural model was assessed using the coefficient of determination (R^2) to evaluate the total effect size and variance explained in the sustainable housing constructs by the four categories of barriers. It is recommended that R^2 of the sustainable housing construct should be ≥ 0.10 (Gorai et al., 2015).

Tests of significance of the path / hypotheses were performed by first assessing the normality of the data. Results of the test showed estimated Mardia's multivariate skewness and kurtosis of 8.81 and 38.96 were greater than their respective cut-offs of ±1 and ±20 for data normality. Thus, the data were non-normally distributed, and the tests of significance of the paths were conducted using bootstrapping analysis (refer to Fig. 3). Bootstrapping analysis is suitable for measuring the direct impact of all the hypotheses (hypotheses 1 to 10) of non-normally distributed data.

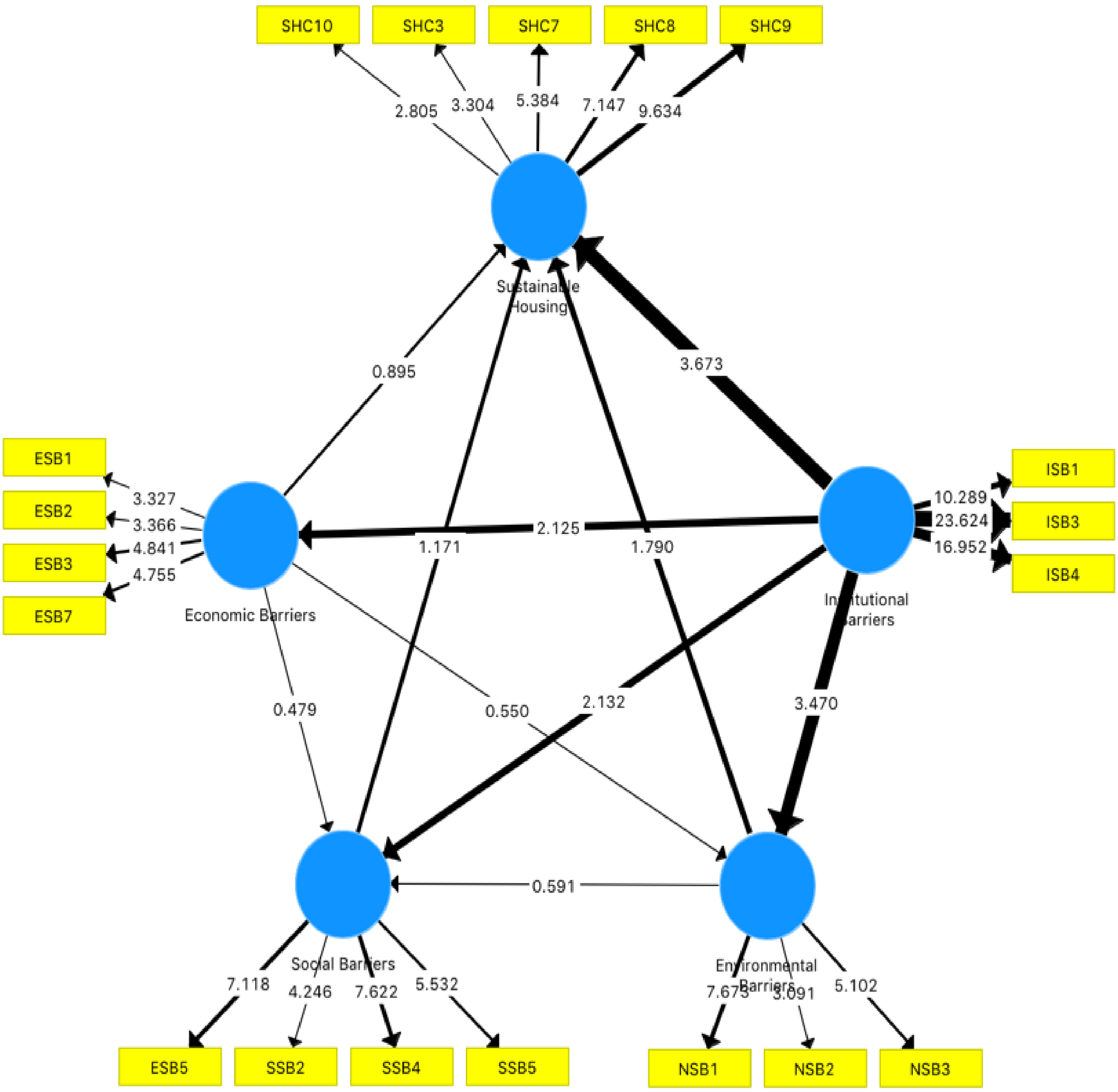

Fig. 3: Results of Bootstrapping Analysis of the four Barrier Categories and Sustainable Housing Construct

4.2.5 Validation of Hypotheses

The coefficients of the bootstrapping analysis (refer to Fig.3) are the t-values for assessing the significance of the paths. The significant paths for a two-tailed test are paths with t-values of 1.65 (for significance level =10%), t-values of 1.96 (for significance level = 5%) and t-values of 2.58 (for significance level = 1%) (Astrachan et al., 2014). Therefore, for the interactive effects among the barriers, the t-value of 2.125 for the 'institutional barriers' to 'economic barriers' path is supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$). Similarly, the t-value of 2.132 for the 'institutional barriers' to 'social barriers' path is supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$). With a t-value of 3.470, the 'institutional barriers' to 'environmental barriers' path is supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$) (refer to Fig. 3). Concerning the relationships between the 'barriers' and 'sustainable housing', the 'institutional barriers' and 'sustainable housing' path is supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$) since its t-value is 3.673. Besides, with an estimated t-value of 1.790, the 'environmental barriers' to 'sustainable housing' path is supported at a significance level of $p < .10$ ($t_{0.1} > 1.65$) (refer to Fig. 3). However, the 'economic barriers' to 'sustainable housing' path and the 'social barriers' to 'sustainable housing' path are not supported at any of the significance levels.

4.2.6 Effect Sizes of the Structural Model

In addition to conducting test of significance, the structural model was further evaluated by estimating the effect sizes of some barrier constructs and the sustainable housing construct. Effect size (f^2) measures how strongly one independent construct contributes to explaining a certain dependent construct in terms of R^2 (Adabre & Chan, 2021, p.11). The effect sizes were calculated by assessing changes in the R^2 to determine possible substantive interactive impacts among the barrier categories on one hand and between the barrier categories and sustainable housing on the other hand. Results of the changes in R^2 were then employed for calculating the f^2 using the following equation, eqn. (1) as employed in Adabre et al. (2021b).

$$f^2 = (R^2_{included} - R^2_{excluded}) / (1 - R^2_{included}) \quad \text{......eqn. (1)}$$

where $R^2_{included}$ and $R^2_{excluded}$ are the R^2 values of the dependent construct when a selected independent construct is included or excluded from the model, respectively (Adabre & Chan, 2021). The changes in the R^2 values are estimated by conducting the PLS path analysis twice: once with the independent construct included which yields $R^2_{included}$ and the second time with the independent construct excluded which yields $R^2_{excluded}$. The effect size of a construct is small if $0.02 \leq f^2 < 0.15$; medium if $0.15 \leq f^2 < 0.35$ and large if $f^2 \geq 0.35$ (Cohen, 2013; Adabre & Chan, 2021). The estimated values of f^2 for some of the paths are shown in Table 7. From Table 7, the effect size of 'institutional barriers' on 'economic barriers' is small ($f^2 = 0.109$). Likewise, 'environmental barriers' have small effect size ($f^2 = 0.085$) on 'sustainable housing'. However, 'institutional barriers' have moderate effect sizes on 'environmental barriers' ($f^2 = 0.297$), 'social barriers' ($f^2 = 0.275$) and 'sustainable housing' ($f^2 = 0.257$). Nonetheless, the effect sizes of the remaining paths (refer to Table 7) were negligible since their f^2 were below the estimated range for small effect.

Table 7: Hypotheses Testing

Hypotheses	Relationships	Std Beta	Std Error	/t-value/^	Decision	f^2	P-Values	95%CILL	95%CIUL
H1	Institutional Barriers -> Economic Barriers	0.348	0.144	2.125**	Supported	0.109	0.030	0.092	0.550
H2	Institutional Barriers -> Social Barriers	0.483	0.219	2.132**	Supported	0.275	0.030	0.096	0.823
H3	Institutional Barriers -> Environmental Barriers	0.539	0.138	3.470***	Supported	0.297	0.000	0.326	0.736
H4	Economic Barriers -> Social Barriers	0.080	0.187	0.479	Not Supported	0.000	0.639	-0.236	0.420
H5	Economic Barriers -> Environmental Barriers	0.105	0.182	0.550	Not Supported	-0.001	0.588	-0.189	0.406
H6	Environmental Barriers -> Social Barriers	0.132	0.228	0.591	Not Supported	0.039	0.550	-0.279	0.493
H7	Institutional Barriers -> Sustainable Housing	0.659	0.194	3.673***	Supported	0.257	0.001	0.330	0.932
H8	Economic Barriers -> Sustainable Housing	0.161	0.191	0.895	Not Supported	0.030	0.362	-0.191	0.451
H9	Environmental Barriers -> Sustainable Housing	-0.328	0.198	1.790*	Supported	0.085	0.093	-0.630	0.006
H10	Social Barriers -> Sustainable Housing	-0.209	0.217	1.171	Not supported	0.036	0.283	-0.554	0.164

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$

R^2 (Sustainable housing = 0.308)

Effect sizes are according to Cohen (1988), f^2 values: 0.35 (large), 0.15 (medium), and 0.02 (small)

4.2.7 Importance-Performance Analysis (IPMA)

Importance-performance analysis (IPMA) was conducted to measure the importance and performance of the barrier categories on the target construct – sustainable housing. The x-axis displayed as 'Total Effects' shows the standardized path coefficients or importance of the barrier constructs (refer to Fig. 4) while the values on the y-axis represent the average values (performances) of the barriers on the sustainable housing construct (Adabre et al., 2021b). For decision-making using the IPMA results, constructs that have the highest total effects, notwithstanding possible low performance scores, are the target constructs. Thus, from Fig. 4, the 'institutional barriers' have the highest total effect (0.325) and performance of 76.048%, which implies that strategies or interventions on mitigating the institutional barriers could have substantive impact on sustainable housing development. This finding buttresses the results of the bootstrapping analysis in which the 'institutional barriers' category was identified as the causal barrier that has multiplier effects on the remaining barriers and sustainable housing. Therefore, the 'institutional barriers' require more attention of policymakers and practitioners. In addition, the IPMA results showed that the next target group of barriers that are exigent are the 'economic barriers' which have effect size of 0.132 and performance of 85.762%. Although the 'economic barriers' were identified as effects that originate from the institutional barriers (refer to Fig. 3), the IPMA results imply that effective strategies on controlling 'economic barriers' could enhance sustainable development in housing. Thus, for significant improvement on sustainable housing, institutional strategies should be more focused on eliminating economic barriers.

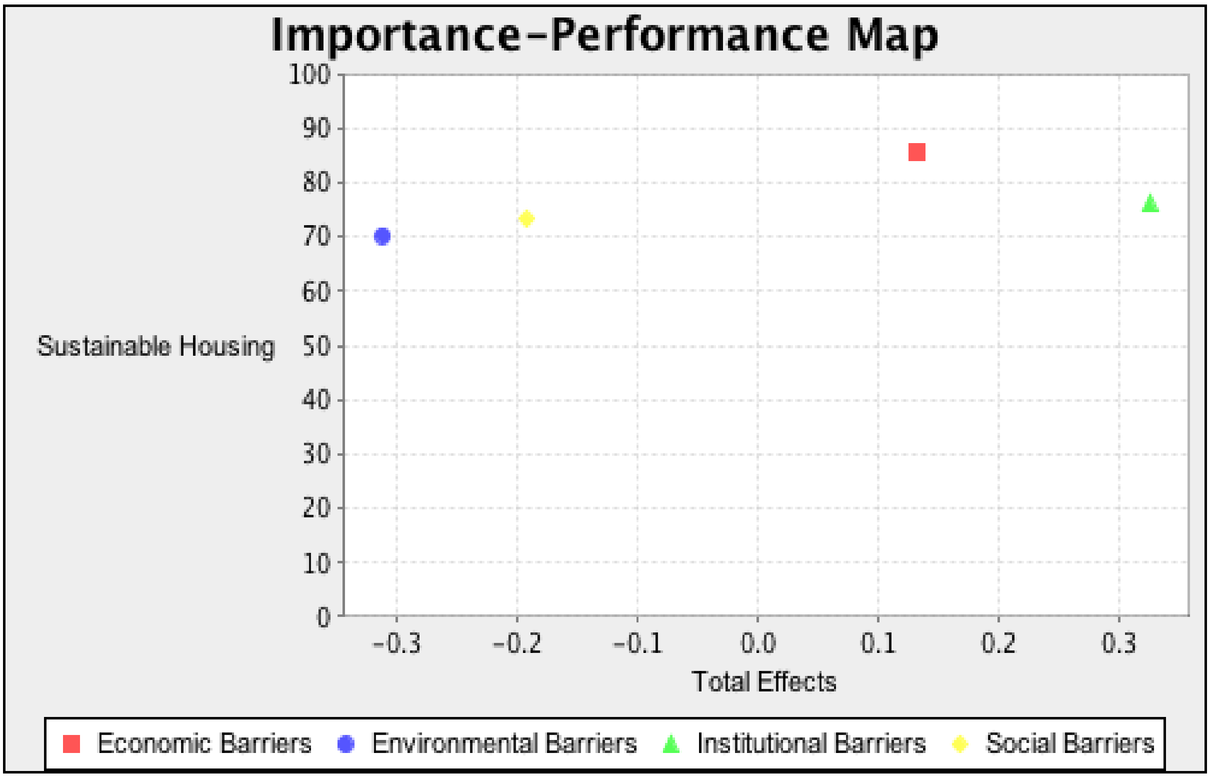

Fig. 4: Importance-Performance Analysis (IPMA)

5. Discussion of Results

5.1 'Institutional Barriers' to 'Economic Barriers' Path

At an estimated t-value of 2.125, the 'institutional barriers' have a significant impact on 'economic barriers', which is supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$). Indicators or underlying barriers of the 'economic barriers' category, that are highly loaded include: '*ESB1-inadequate public funding*'; '*ESB2- excessive cost of serviced land*'; '*ESB3-excessive cost of sustainable building materials/technologies*' and '*ESB7-high inflation rate*'. These underlying barriers could influence one another. For instance, the barrier '*ESB7- high inflation rate*' could lead to '*ESB2- excessive cost of serviced land*' and '*ESB3-excessive cost of sustainable building materials/technologies*'. Besides, inadequate public funding scheme such as subsidies on sustainable building materials and technologies could be a contributory factor to high cost of sustainable building materials. Similarly, Adabre and Chan (2021) concluded that the effects of '*high cost of sustainable building materials*' and '*high cost of* *serviced land'* in the Ghanaian housing market are attributed to inadequate financial incentives for developers or investors.

The significant path from 'institutional barriers' to 'economic barriers' implies that the underlying 'economic barriers' are caused by the underlying 'institutional barriers'. For example, policy instability regarding macroeconomic instability is the main cause of fluctuations in inflation rates in the Ghanaian housing market. *'Fluctuations in inflation rates'* lead to increase speculations on land which could cause excessive cost of serviced in land in cities and towns. Furthermore, the effects of *'fluctuations in inflation rates'* on cost of sustainable building materials and technology are compounded by bureaucracy on land administration regarding land registration, validation and permit for land development. Delays in acquiring permit for land development could be attributed to the inadequate financial and human resource at the planning departments (Siiba et al., 2018), which leads to weak enforcement of planning control on land development. Therefore, to control the underlying economic barriers, there should be effective strategies on mitigating the underlying institutional barriers, namely, *'ISB1- difficult land registration procedures'*; *'ISB3-policy instability'*; *'ISB4-weak enforcement of planning control on property development'*. Specifically, expedited land administration and permit on land development by the Land Commission and Land and Spatial Planning Authority, respectively, could prevent developers from incurring extra cost on building materials and technologies attributed to increasing inflation rate. Additionally, draconian measures on macroeconomic variables such as interest rate and inflation rate at the institutional level are essential for successful economic development and economic sustainability.

5.2 'Institutional Barriers' to 'Social Barriers' Path

At an estimated t-value of 2.132, 'institutional barriers' have a significant impact on 'social barriers', which is supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$). Highly loaded indicators or underlying barriers in the 'social barriers' category include: *'ESB5-inadequate incentives for developers/investors'*; *'SSB2-social exclusion and segregation'*; *'SSB4-high loans/mortgage default rates by client'*; *'SSB5-negative culture towards loans/mortgage'*. It is worth noting that although the barrier *'ESB5-inadequate incentives for developers/investors'* was initially considered as an underlying economic barrier as shown in the conceptual model (refer to Fig. 1), the outcome of the measurement model (refer to Table 4) revealed that it has the highest loading under the 'social barriers'. Accordingly, the underlying barrier – *'ESB5-inadequate incentives for developers/investors'* – was considered as a social barrier (refer to Table 4 and Fig. 3). This could be ascribed to a possible high correlation or influence among the *'ESB5-inadequate incentives for developers/investors'* and the other underlying social barriers.

'Inadequate incentives for developers/investors' could influence *'social exclusion or segregation'*, *'high loans/mortgage default rates by clients'* and *'negative culture towards loans/mortgage'*. For instance, without adequate incentives on land supply to most developers, *'social exclusion/segregation'* evinced in gated communities development in cities will continue to be on the rise. Moreover, inadequate incentive concerning access to loans/mortgage could disincentivize developers from augmenting housing supply to most middle- and low-income earners because of the high cost of supplying housing facilities. High interest rate and short-term loans could lead to 'high loans default rates' among developers considering that real estate or housing supply is a long-term investment and therefore requires long term for developers to be able to amortize loans. Consequently, most developers are focused on high-

income earners for maximum profit margin and for ensuring high-take rate of housing facilities in order to amortize loans or to break-even at high interest rates of short-term loans.

The significant path from 'institutional barriers' to 'social barriers' implies that some underlying institutional barriers could originate some underlying social barriers. For instance, the underlying social barrier *'social exclusion or segregation'* could be caused by institutional challenges such as *'ISB1 - difficult land registration procedures'* and *'ISB4 - weak enforcement of planning control on property development on land'*. Ehwi et al. (2019) revealed that gated community development, which is a main source of social exclusion or segregation in urban areas, continues apace due to land administration challenges. These challenges include bureaucracy in land registration, validation and permit on land development. Similarly, Kasanga and Kotey (2001) and Gambra (2002) concluded that the land registration process is highly bureaucratic. The time for perfect land transfer could be between 6 months and 10 years. Besides, the process is fraught with corrupt practices carried out by the Land Commission's officials, which could render land title registration costly (Ehwi and Asante, 2016). The main effect of the land administration challenges is that they derive gated community development in urban areas since people consider gated communities as a panacea to these challenges. High cost of residential facilities in the gated communities leads to social segregation between high-income earners and low-income earners (Zheng et al., 2017), since gated communities are priced beyond the reach of most Ghanaians (Soyeh et al., 2020); they are mostly affordable to high-income earners, namely, expatriate, returnee migrants and employees of Ghanaian based foreign companies.

The underlying social barriers could be controlled through the state's interventions on incentives to developers. For example, through effective land supply/allocation to developers, the state or government could ensure inclusionary housing supply to middle and low-income earners in unaffordable urban areas (Eduful and Hooper, 2019). This could serve as a strategy to control social exclusions and segregation. Additionally, expedited land administration on registration, validation and permit approval on land development is essential for mitigating social exclusion ascribed to gated community development. This could be achieved through institutional development. Effective anti-corrupt practices in land title registration could prevent the deliberate delays perpetrated by the employees of the Land Commission. This could also reduce the associated cost of land registration due to rent-seeking practices (Ehwi and Asante, 2016). Moreover, delays on permit approval concerning development on land are caused by inadequate human resources and financial resources at the Land and Spatial Planning Authority. Therefore, ensuring that the planning authorities are adequately provided with financial and human resources will enable them to expedite regulatory procedures on land development. Besides, adequate financial resources for remunerations could alleviate the rent seeking practices and other corrupt practices by planning officials (Fuseini and Kemp 2015).

5.3 'Institutional Barriers' to 'Environmental Barriers' Path

The 'institutional barriers' to 'environmental barriers' path had an estimated t-value of 3.740 which is supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$). Highly loaded underlying indicators of the 'environmental barriers' category include: *'NSB1-inadequate access to land within cities/towns'*; *'NSB2- peripheralization of housing projects/facilities'* and *'NSB3-low-rise housing development'*. High association among the underlying environmental barriers is evinced in their high loadings. This implies that the underlying barriers could influence one another. For instance, *'low-rise development of residential facilities'* could lead to faster depletion of land resources. This could influence *'inadequate access to land within cities/towns'* which could instigate '*peripheralization of housing projects/facilities*'.

Besides, the significant path from 'institutional barriers' to 'environmental barriers' suggests that the underlying environmental barriers are caused by some underlying institutional challenges. For example, the core institutional barriers, viz: *'ISB3-policy instability'* and *'ISB4-weak enforcement of planning control on land development'* have been identified as causes of environmental barriers regards land use. Through a review study, Howes et al. (2017) concluded that the challenge to improving environmental sustainability is due to policy implementation failure at the international and national level of government. Typical in Ghana, the then Town and Country Planning Department in Kumasi established a policy on a standard building height of four storey minimum for residential facilities within the central business districts (Agyemang et al., 2018). The aim of this policy was to ensure optimum utilization of land. However, Agyemang et al. (2018) stated that due to *'policy instability'* as well as implementation challenges, *'low-rise development of residential facilities'* is still evinced in Kumasi and in other urban centers in Ghana. Furthermore, inadequate financial and human resources at the planning institutions have contributed to *'weak enforcement of development control on land'*. Consequently, potential households continue to rely on chieftaincy institutions and other traditional approaches instead of the planning institutions for permit on land development. The reasons for these include convenience and expedited decision on land development by the chiefs. This leads to unauthorized development and unsustainable urban land development (Siiba et al., 2018).

Effective strategies on land use are vital for controlling the underlying environmental barriers. Key among the strategies are adequate and stable policies on high-rise residential development within cities. Such strategies should be supported through capacity building of specific institutions such as the Ghana Water Company Limited and the Ghana National Fire Service. In Agyemang et al. (2018), it was found that low capacity of these institutions to deliver services to high-rise facilities has partly contributed to low take-up rate of high-rise rental facilities. Therefore, to ensure effective implementation and adherence to policies on high-rise facilities in central business district, these institutions should be supplied with adequate resources for improved service supply in high-rise facilities. This could motivate high social acceptance of such facilities which could incentivize developers to construct high-rise facilities for optimum utilization of land.

5.4 'Barriers' to 'Sustainable Housing' Path

Among the various barrier paths to the sustainable housing construct, two paths showed significant impacts. The 'institutional barriers' to 'sustainable housing' path had an estimated t-value of 3.673 which is supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$). Likewise, the 'environmental barriers' significantly influence 'sustainable housing', which is supported at a significance level of $p < .10$ ($t_{0.10} > 1.65$) at a t-value of 1.790. Between the two categories of barriers, the 'institutional barriers' category has higher impact on sustainable housing as revealed in its t-values (i.e. 3.673 > 1.790). Yet, both categories could negatively influence sustainable housing by affecting the following sustainable housing criteria: *'SHC10-commuting cost of household to housing facility'*; *'SHC3-quality performance of housing facility'*; *'SHC7-energy efficient housing facility'*; *'SHC8- affordable price of facility'*; *'SHC9-affordable rent of facility'*. Therefore, strategies for sustainable housing should aim to mitigate the underlying institutional barriers (i.e. '*ISB1-difficult land registration procedures'*; '*ISB3-policy instability'* and '*ISB4- weak enforcement of planning control on land development'*) and fundamental environmental barriers (i.e. '*NSB1-inadequate access to land within cities/towns'*; '*NSB2- peripheralization of housing projects/facilities'* and '*NSB3-low-rise housing development'*).

5.5 General Discussion and Policy Recommendations

From the network analysis, the institutional barriers have multiplier effects as they originate the other barriers, namely, economic, social and environmental barriers. Besides, they have a higher impact on sustainable housing development as compared to the impact of the environmental barriers. Similarly, Liu et al. (2016) concluded that instability of government and policies (law changes) could instigate economic barriers regards resource prices, foreign exchange rate and interest rate. On barriers to sustainable old residential neighborhood renewal, for example, Zhu et al. (2020) also found that immature law and regulations are the most important barriers that cause other barriers. The multiplier effects of institutional barriers as found in this study and in prior studies (Liu et al., 2016; Zhu et al., 2020; Panayides et al., 2015; Keivani and Werna, 200) indicate that controlling the institutional barriers could be a panacea for the remaining economic, social and environmental barriers in sustainable housing development. Three underlying institutional barriers require the most attention, namely, *'ISB1- difficult land registration procedures'*; *'ISB3- policy instability'* and *'ISB4- weak enforcement of planning control on land development'*. Among these three, *'ISB3- policy instability'* has the highest loading which suggests that it is the biggest barrier to sustainable housing in the formal sector. Therefore, effective and sustained policies are salient measures for controlling institutional barriers (Panayides et al., 2015). Additionally, government's support (i.e. public funding incentives or housing financing strategies) to stakeholders of the formal sector in addition to effective and stable policies on public-private partnership could assuage economic, social and environmental barriers to sustainable housing development (Keivani and Werna, 2001). Through public-private partnership, the state could provide suitable land and tax incentives while private firms could finance construction of housing facilities. Upon completion, some of the facilities could be sold at the prevailing market price while the rest could be offered at affordable prices to low- and middle-income earners. This could be an effective strategy for ensuring mixed-income housing which could mitigate some social barriers – income isolation and social exclusion (Eduful and Hooper, 2019). In Ghana where land is dominantly owned by customary institutions, the state could provide adequate policies or regulatory system and incentives for partnership between the customary landowners and private developers for improved sustainable housing development (Keivani and Werna, 2001). This strategy could be deployed for redevelopment of dilapidated residential facilities for urban renewal.

6. Conclusions

This study assessed the interactive effects among institutional barriers, economic barriers, environmental barriers and social barriers in addition to evaluating a predictive model between these categories of barrier and sustainable housing development. Through a questionnaire survey, data were solicited from professionals in the regulated sector of the Ghanaian housing market and analyzed using PLS-SEM.

Results of the PLS-SEM showed that, among the barriers, the 'institutional barriers' category was significantly measured by three indicators, namely, *'difficult land registration procedures'*; *'policy instability'* and *'weak enforcement of planning control on land development'*. With these underlying barriers, the 'institutional barriers' have significant impacts on all the other barrier categories. At an estimated t-value of 2.125, the 'institutional barriers' to 'economic barriers' path was supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$). Similarly, the 'institutional barriers' to 'economic barriers' path was supported at a significance level of $p < .05$ ($t_{0.05} > 1.96$) at a t-value of 2.132 while at a higher t-value of 3.470, 'institutional barriers' to 'environmental barriers' path was supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$). Between the barriers and sustainable housing, a higher estimated t-value of 3.673 of the ‘institutional barriers’ to ‘sustainable housing’ path was supported at a significance level of $p < .01$ ($t_{0.01} > 2.58$). Though relatively low, a t-value of 1.790 supported at a significance level of $p < .10$ ($t_{0.1} > 1.65$) was estimated for the ‘environmental barriers’ to ‘sustainable housing’ path. Thus, both the ‘institutional barriers’ and ‘environmental barriers’ have significant impacts on ‘sustainable housing’. These barriers significantly influence the following sustainable housing criteria (SHC): ‘quality performance of housing facility’ (SHC3); ‘energy efficiency of housing facility’(SHC7); ‘affordable price of facility’(SHC8); ‘affordable rent of facility’(SHC9) and ‘commuting cost of household to facility’(SHC10).

Among the barriers, the study’s findings imply that ‘institutional barriers’ are causal barriers while the ‘economic barriers’, ‘social barriers’ and ‘environmental barriers’ are the multiplier effects of institutional barriers. That is, the ‘institutional barriers’ category originates the other three barrier categories. Besides, the ‘institutional barriers’ have significant influence on sustainable housing development in the formal sector. Therefore, the ‘institutional barriers’ should be the focus of policymakers and practitioners for sustainable housing regarding the formal sector. Specifically, policymakers should ensure policy interventions or strategies for controlling the following underlying institutional barriers: *‘difficult land registration procedures’*; *‘policy instability’* and *‘weak enforcement of planning control on land development’*. Interventions on bureaucratic delays should entail expedited land registration procedures, planning permit approval and building permit. On policy instability, a legal system is essential for enforcing completion of public housing projects and for establishing public private partnerships (or customary landowners and developers partnership) for sustainable housing development. Moreover, improved macroeconomic policies (i.e. fiscal policies) and public incentive schemes should be ensured and sustained for sustainable housing. This could be achieved by ensuring that successive governments adhere to a common agenda for housing development. On *'weak enforcement of development control on land'*, the Land and Spatial Planning Authority should be provided with adequate financial and human resources. Additionally, a collaboration between landowners (i.e. chiefs and family heads) and planning authorities on developing master plans could serve as a check on landowners for appropriate land allocation. This could also facilitate the prerogative of the spatial authority concerning development control on land.

The study has some limitations and potential extensions for future study. The sample size is relatively low. In addition, the PLS-SEM does not account for the dynamics of the sustainable housing barriers. Therefore, future study could employ the CB-SEM to confirm the findings of this study or otherwise. Besides, future study could utilize system dynamic modeling to account for the dynamics of barriers in sustainable housing development.

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