Using the Fuzzy-Set Qualitative Comparative Analysis (fsQCA) Method to Analyze the Factors Affecting the Housing Market:

A Case Study of 10 Asian Countries

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Abstract— **A house is an essential human factor. A housing market is formed by the demand and supply of houses. A global housing market fluctuates by each country's policies and situations. Because of the various social, cultural and economic aspects affecting complexity, it is difficult to analyze the factors affecting the housing market. Consequently, in this paper, we analyze several housing market factors using the fuzzy-set Qualitative Comparative Analysis (fsQCA) method. Variables of importance were found to include: the aging population, purchasing power, population growth, house prices, and youth unemployment. In this paper, we determine the issues that need to be addressed to revitalize the housing market the entire world; the results can be used to assist in the development of national policy.**

Keywords— fsQCA, Housing Market, fuzzy-set(key words)

I.   Introduction

A. *Background and Objectives*

The housing market is formed by the demand and supply of houses. Scale, development and social, cultural, and economic influences on the market vary between countries. Nowadays, the changes in the population and in households are transmuting into the housing market. Because of the various factors involved, including many complex national situations and the different housing markets in each country, it is difficult to analyze the effect of housing market factors and determine a common phenomenon. Also, because of durability, immobility and high prices, it is more difficult to determine the balance point for demand and supply in housing as goods, than it is for other goods. Thus, the housing market needs to be a political agenda.

B. *Research Framework*

To analyze the factors affecting the housing market, in this paper, we set up variables for 10 Asian countries. We then

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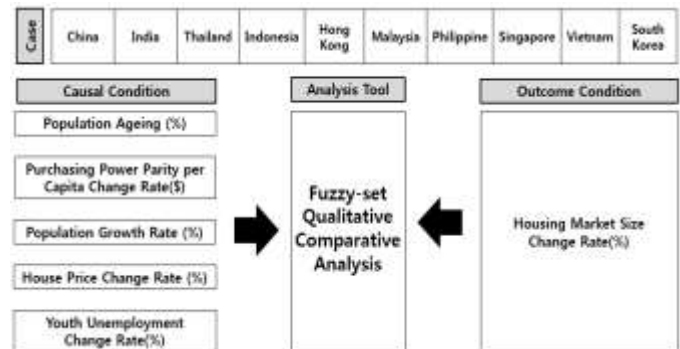Architecture Engineering / Kwangwoon University
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Figure 1. Framework of research

develop a hypothesis of the factors affecting the consumer's house purchasing power, the unemployment of young people who demand houses, people that are growing old, fluctuating house prices and the growing population. We analyze how these factors affect the housing market.

For an analysis this complex, we use a fuzzy-set qualitative comparative analysis (fsQCA). The fsQCA is a research method using a number of cases between a case-oriented (e.g., single case study, qualitative study) and a variable oriented (e.g., Quantitative study of covariation, quantitative study) number of cases. We allow for the formal analysis of the qualitative evidence and small-N situations using Boolean Algebra, rather than a correlational method. We rely on fuzzy sets and use a language that is a half-verbal-conceptual, half-mathematical-logical. The fsQCA allows for the assessment of equifinality and complex causality with multiple contingencies in organizations (Ragin, 2006). Fig. 1 presents the framework of this research, showing the research flow. Throughout this paper, we determine the problems and the situational influence on the housing market and suggest ameliorate solutions for the social, cultural, and economic problems. This conclusion can help in the development of political agendas.

II.   Preliminary Review

A. *Previous Housing Market Research*

To determine a set of hypotheses about the factors affecting the housing market, a preliminary study was conducted. The factors affecting the housing market included the aging population rate, consumer house purchasing power, the growing population, fluctuating house prices and the unemployment of young people.

After Mankiw and Weil's (1989) 'hypothesis of asset price collapse' , where the theory of house demand fell in accordance with the aging population of America's baby boomers and retirement, many researchers studied the influence of aging populations on the housing market. Most of the studies in the past 10 years found that the influence of the aging population did not affect the housing market. The broad view shows that the population is aging because of a population decline in production, which affects the demand and supply of houses and changes the preferences of specific house types. Thus, changing the housing market because of the aging population is not an independent phenomenon, but is a mutual relationship phenomenon. This should be considered when making housing policies.

After the global financial crisis, the world economy recovered rapidly, but lately, the economic growth rate has slowed down. If the GDP growth rate decrease continues for the long-term, it will cause the population and the demand for houses to decline (Kim, 2012). So when an economy booms, consumers who want to buy houses enhance their purchasing power to buy houses and create a balance between the demand and supply; this leads to revitalization in the housing market. But when an economic recession continues, the purchasing power of customers and housing demand declines, causing an unbalanced demand and supply in the housing market; this is a shock to the housing market. So the economic power of a country certainly effects the housing market, and hence, can predict the countries housing market.

After 2000, almost all countries around the world entered into an aging society. Many social experts predicted this super-aging society would last until 2050 (David, 2011). In addition, changes in lifestyles and households are occurring. Unlike during the baby-boomer generation, the fertility rate is decreasing and is causing a decrease in the population. Because of this, the youth population, who can work, is decreasing and the housing market is becoming unstable. On the other hand, there is a change from a big family to a nuclear family. This can fluctuate the household composition (e.g., one-person household, two-person household, etc.) and can cause an increasing demand in houses and the housing market. There is also a need to analyze how population growth affects the housing market.

House prices are picking up globally. The Case-Shiller index released on 2013 New Year's Eve reported price increases of 13.6% in the year up to October 2013 (Economist, 2014). An argument about house price's propriety started during America's sub-prime mortgage crisis in 2008. House prices in America consistently increased to the mid-2000s, but after the sub-prime mortgage crisis, house prices fell significantly. Because of this, the world's housing market entered a recession. In addition, the rapidly aging population, the prediction of decreases in the population and the retirement of the baby-boomer generation may have also been causes of the housing market recession.

There was mass unemployment at the beginning of the 1990s (Ray Forrest, 2013). An investigation by Linköping University found that a new culture of unemployment was developing, especially among young people, who were finding it extremely difficult to enter the labor market (Hallström, 1998). Thus, the decreasing youth age's purchasing power and a delay in marrying time can lead to a decrease in housing demand. As such, there is need to analyze youth unemployment, as it may indirectly affect the housing market. This can help make policies that solve youth unemployment.

B. *Fuzzy-Set Qualitative Comparative Analysis*

Fuzzy sets are especially powerful, because they allow researchers to calibrate the partial membership in sets using values in intervals between 0 (non-membership) and 1 (full-membership) without abandoning the core set of theoretic principles (e.g., the subset relationship). The subset relationship is central to the analysis of causal complexity fsQCA (Ragin, 2008). A conventional (or "crisp") set is dichotomous: A case is either "in" or "out" of a set (e.g., the set of Protestants). Thus, a conventional set is comparable to a binary variable with two values: 1 ("in," i.e., Protestant) and 0 ("out," i.e., non-Protestant).

A fuzzy set, by contrast, permits membership in the interval between 0 and 1, while retaining the two qualitative states of full membership and full non-membership. Thus, the fuzzy set of Protestants could include individuals who are "fully in" the set (fuzzy membership=1.0), some who are "almost fully in" the set (membership=.90), some who are neither "more in" nor "more out" of the set (membership = .5, also known as the "crossover point"), some who are "barely more out than in" the set (membership=.45), and so on down to those who are "fully out" of the set (membership=0). It is up to the researcher to specify procedures for assigning fuzzy membership scores to cases; these procedures must be both open and explicit, so that they can be evaluated by other scholars.

Using this methodology, a hypothesis can be developed about how several combinations of causal conditions affect an outcome. It is important to set a causal condition based on a theoretical truth and verification. The calibration of the degree of membership in a set should be based entirely on the researcher's substantive and theoretical knowledge. That is, the collective knowledge base of the social scientists should provide the basis for the specification of precise calibrations (Ragin, 2006). The next step involves collecting data about the causal and outcome conditions. This data should then be calibrated to a fuzzy-set score. For this, there should be a suitable calibration for the researcher's situation.

To analyze the correlation of the variables, a crisp truth table should be used. A multidimensional vector space constructed from a fuzzy set has 2k corners; this is just as a crisp truth table has 2k rows (where k is the number of causal conditions). There is a one-to-one correspondence between the causal combinations, truth table rows, and a vector space corner. When using a truth table to analyze the results of fuzzy set assessments, the truth table rows do not represent the subsets of the cases, as they do in crisp set analyses. Rather, they represent the 2k causal arguments that can be constructed from a given set of causal conditions (Ragin, 2000). By using a consistency value, can know how a combination of causal conditions belongs to an outcome variable. If a consistency score is 1.0 or near 1.0, it means a high consistency; 0.0 or

TABLE I . OUTCOME VARIABLE DATA

Country	Variation Rate of Housing Market (2010~2013)
China	7.4
India	9.9
Thailand	3.9
Indonesia	2.4
Hong-Kong	4.7
Malaysia	1.9
Philippine	2.5
Singapore	3.5
Vietnam	6.7
South Korea	0.9

AECOM, ASIA CONSTRUCTION OUTLOOK 2013

near 0.0 means low consistency (i.e., each case is not the same as the result).A consistency score from 0.3 to 0.7 means a mid-membership degree (Ragin, 2008). This research defined a standard of consistency score to be more than 0.8, which belongs to 1.0 as much as 0.8.

C. *Outcome Variables*

For an analysis affecting the housing market, this paper sets the outcome variable as the residential construction size, which represents U.S. dollars. To know what factors affect the fluctuating housing market, we collect a variation of data for residential construction size from 2010 to 2013. Table I . presents data about the outcome variables that represents the residential construction variation rate for each country.

D. *Causal Variables*

There were 5 causal variables: the aging population rate, the GDP base on Purchasing Power Parity (PPP) per capita, the population growth rate, the house price variation rate and the youth unemployment rate. These variables are analyzed in a preliminary study of effects on the housing market. The aging population in this research means people over 65 years in age. The population and the GDP base on PPP are used to index each country's purchasing power.

TABLE II . CAUSAL VARIABLES DATA

Country	Variation of				
	Aging Population	*GDP PPP*	*Population Growth*	*House Price*	*Youth Unemployment*
China	1.05	1.18	1.00	9.08	1.09
India	0.99	1.05	1.00	-9.10	1.04
Thailand	1.11	1.09	2.50	3.87	1.03
Indonesia	1.04	1.08	0.77	2.91	0.96
Hong-Kong	1.09	1.03	0.57	10.25	0.86
Malaysia	1.06	1.07	0.88	7.39	1.07
Philippine	1.07	1.12	1.12	10.56	0.96
Singapore	1.11	1.03	1.11	-0.91	0.72
Vietnam	1.07	1.08	1.10	2.19	0.89
South Korea	1.08	1.04	0.40	-0.03	1.02

Aging Population – UN, World Population Ageing (2013)
GDP PPP – World Bank (2014)
Population Growth Rate – CIA, The Fact Book(2014) and David E et (2011)
House Price – Economist (2014)
Youth Unemployment – CIA, The World Fact Book (2014)

TABLE III. FUZZY-SET SCORING OF EACH VARIABLES

Country	fs(fuzzy-set)					
	aging	*gdp ppp*	*pp grth*	*house prc*	*yth unmp*	*house mk*
China	0.31	0.95	0.45	0.91	0.95	0.84
India	0.05	0.19	0.45	0.05	0.88	0.95
Thailand	0.95	0.58	0.95	0.53	0.83	0.4
Indonesia	0.26	0.54	0.22	0.46	0.53	0.15
Hong-Kong	0.87	0.05	0.1	0.95	0.23	0.54
Malaysia	0.48	0.35	0.32	0.84	0.93	0.11
Philippine	0.53	0.77	0.54	0.95	0.51	0.17
Singapore	0.94	0.07	0.53	0.26	0.05	0.32
Vietnam	0.52	0.53	0.53	0.42	0.31	0.78
South Korea	0.77	0.1	0.05	0.3	0.82	0.05

fsaging(Aging population) = calibrate(1.109,1.033,0.988)
fsgdpppp(GDP base on PPP) = calibrate(1.181,1.077,1.027)
fsppgrth(Population Growth Rate) = calibrate(2.500,1.045,0.400)
fshouseprc(House Price) = calibrate(10.56,3.62,-9.10)
fsythunemp(Youth Unemployment) = calibrate(1.087,0.956,0.718)
fshousemk(Variation of Housing Market) = calibrate(9.9,4.38,0.9)

The youth (15-24 year old people) unemployment rate is used. To compare the same condition causal variables with outcome variables, the causal variables data period was set to 2010 to 2013. Table. presents the date of the causal variables data and the reference of the data; this is in the bottom of the table.

III. Fuzzy-Set Scoring and Truth Table Analysis

For an fsQCA, there is a need to determine a fuzzy score for each variable. The original data was calibrated using fsQCA2.0 software made by Ragin, who suggested the fsQCA methodology.

A. *Fuzzy-set Scoring*

By calibrating the fsqca2.0 software, the original data was calibrated using the fuzzy-set scoring. Fuzzy-set scoring lets you know the original data's degree of membership, from 0 to 1. The calibration formula is presented in Eq. (1).

$$\text{calibrate}(X_1, X_2, X_3)\text{''} \quad \text{.....................} \quad (1)$$

X1 : Biggest number of case, X2 : Average number of case, X3 : Smallest number of case

Ragin recommended the median to be X2. In this research, because of data range of the cases being so narrow, we used the average value of each case. The recommended median value is if the data gap of the case is too big, then it is difficult to conduct an accurate analysis, as there may be errors. This research data's gap is very narrow; therefore, it doesn't use the median number, rather than the average, for the calibration's accuracy. Table. shows the fuzzy-set numbers for each of the variables and uses an abbreviation for the words; this explanation is placed at the bottom of the table.

B. *Truth Table Analysis*

The calibrated fuzzy-set data was inserted into a

TALBE Ⅳ. TRUTH TABLE ANALYSIS

Truth table							
aging	*gdp ppp*	*pp grth*	*house prc*	*yth unmp*	*house mk*	*number of case*	*Consistency*
1	1	1	0	0	1	1	0.946
1	0	1	0	0	1	1	0.836
1	0	0	1	0	0	0	0.773
0	0	0	0	1	0	0	0.724
0	0	1	0	0	0	0	0.696
1	1	1	1	1	0	0	0.687
0	1	0	1	0	0	0	0.633
0	0	0	1	1	0	0	0.538
1	0	0	0	1	0	0	0.531

TABLE Ⅴ. ABBREVIATION RESULT

combination	Coverage	Consistency	Country
popugrth*~pricehouse	0.510	0.846	Singapore,Vietnam
~yunemp*popugrth*ageing*~pricehouse	0.343	0.841	Singapore,Vietnam
~yunemp*popugrth*gdpppp*ageing*~pricehouse	0.285	0.946	Vietnam

Truth Table. The fuzzy-set score is a conception of the previous crisp-set. When calibrating the fuzzy-set scoring, it was found that the data was equally distributed between 0 and 1. This table identifies what causal variable combination affects the outcome variable. The fuzzy-set score changes from 0 or 1 if the fuzzy-set score is under 0.5. If it is the table's number 0 and the upper 0.5, then it is 1. In the table, it illustrates the combination of each variable affected by the outcome variable.

Table Ⅳ is the truth table of this research. It shows the consistency place in the last column, which means the degree of membership. The key point for the assessment of the consistency is that with fuzzy sets, cases can have varying degrees of membership in a set, with membership scores ranging from 0.0 to 1.0. This research sets up a meaningful consistency upper value of 0.8; thus, the consistency value of top 2 combinations are meaningful. And also Table Ⅳ is a variable's abbreviation research that shows the coverage and consistency of each causal variable combination. Coverage is only gauged from the empirical importance, not the theoretical importance. A sufficient relationship may be quite "rare" from an empirical point of view, and thus, exhibit low coverage, but it still could be centrally relevant to the theory.

C. *Analysis Result*

As a result, the combination of the increasing population growth rate and the decreasing house price rate mostly affects the housing market. The population growth and the aging population result in an extensive housing market. There is less youth unemployment with low house prices; this results in an increase in the demand for house purchases. This can cause an increase in the housing market. In the case of Vietnam, rising purchasing power affects house demand and leads to overseas construction companies and supplies coming in as a result of the increase in the housing market. This activated the housing market in Vietnam.

Ⅳ. **Conclusions**

In this paper, we analyzed the factors affecting the housing market using a fuzzy-set Qualitative Comparative Analysis.

To accomplish this, we first conducted a preliminary study of the influential factors in the housing market. The housing market is decreasing in the population with an aging population, a stabilizing housing market with increasing purchasing power, changing households and a decreasing demand for houses with the population growing, reducing housing demand for people with youth unemployment, balancing housing market with house price stabilization. These five factors analyzed how it affects the housing market using an fsQCA. For the analysis, we collected data for each country and calibrated a fuzzy score. Data was placed in a truth table. The causality was analyzed ; this included the outcome variables. The high population growth and the decreasing house prices were mostly found to affect the housing market's boom. Other factors included a decreasing youth unemployment rate, growing aging population rate, and increasing purchasing power parity; these factors also affected the growth in the housing market. In this research, a combination of each causal factor's effect on the housing market and the results revealed a problem called the bad effect factor on the housing market. This information should be reflected on when making policy. However, the factor affect housing market is very complicated. As such, there needs to be a more microscopic analysis of the variety of factor and depth cases for each country's situation. Through this paper, research will be conducted about the analysis structure and the demand and supply of the housing market.

Acknowledgment

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