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IMPACTS OF SOCIAL CAPITAL ON HOUSING PRICES: THE CASE OF SPECIAL RELATIONSHIP-BASED TRANSACTIONS

Chun-Chang LEE[1], Wen-Chih YEH[2,*], Zheng YU[3], Chih-Min LIANG[4]

[1] *Department of Real Estate Management, National Pingtung University, Pingtung, Taiwan*
[2] *Department of Real Estate Management, HungKuo Delin University of Technology, New Taipei City, Taiwan*
[3] *Department of Land Economics, National Chengchi University, Taipei City, Taiwan*
[4] *Department of Public Finance and Tax Administration, National Taipei University of Business, Taipei City, Taiwan*

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Abstract. In Taiwan, many housing transactions are special relationship-based transactions that involve family and friends, debt relations, urgent purchases and sales, and government agencies. As such, the prices in such transactions should differ from those in what we consider to be normal arm's length transactions. In this regard, social capital theory can be used to analyze these transactions. The empirical data on housing transactions conducted in Taipei City from January 1, 2012 to December 31, 2018 were collected for this study. The empirical results showed that the prices in transactions involving debt relations and urgent purchases and sales were 22.6% lower than those in normal arm's length transactions. The prices in transactions with government agencies were 48.9% lower than those in normal arm's length transactions. The prices in transactions with first-degree, second-degree, and third-degree relatives were respectively, 57.3%, 53.1%, and 50.3% lower than those in normal arm's length transactions. The prices in transactions involving friends were 28.0% lower than those in normal arm's length transactions. The empirical results highlight the importance of the impacts of personal relationships or social relations on housing prices in special relationship-based transactions. The results also supported the social capital hypothesis.

Keywords: special relationship-based transactions, normal arm's length transactions, social capital, social capital hypothesis, personal relationships, housing prices.

Introduction

In Taiwan, many real estate transactions are either non-arm's length transactions or transactions conducted based on special relationships, such as those involving family and friends, urgent purchases and sales, debt obligations or debt offsetting, and government agencies. As such, the prices in such transactions should differ from those in what we consider to be normal transactions, and the difference in transaction prices is an issue of concern among various parties. In the past, the price gap between special relationship-based transactions and normal arm's length transactions is determined by the experiences of market participants. The lack of rigorous theoretical explanations and empirical arguments has casted doubts on the reliability of these experiences.

As these transactions are based on special relationships, they often involve personal relationships between buyers and sellers. In this regard, social capital theory can be used to analyze these transactions. Robison et al. (2002a) defined social capital as "an individual or a group's sympathy or sense of obligation toward another individual or group". Social capital can act as a substitute for physical inputs since it affects the way one party treats another party in a transaction. Since the different levels of closeness between the parties in the transaction result in different levels of preferential treatment, different incentives will lead to differences in the behavior of one party toward the other. Therefore, social capital affects the terms of transaction. Becker and Murphy (2009) introduced the concept of social markets and concluded that the outcome of a market transaction is the result of interactions between traditional market behaviors and social customs or norms.

Previous studies on non-arm's length real estate transactions often emphasized the effects of various characteristics on real estate prices. These studies also applied

*Corresponding author. E-mail: *wen00126@mail.hdut.edu.tw*

the hedonic price model for analysis and focused less on buyer/seller characteristics. Rosen's (1974) valuation of a heterogeneous asset was based on the various characteristics of the asset and excludes buyer characteristics or personal relationships. In a traditional hedonic price model, the estimated coefficient of a hedonic price function represents the implicit price of each asset characteristic, and the sum of its product with the quantity value of each characteristic represents the total price of the asset. If buyer characteristics are taken into account, the implicit price of the asset characteristics will be influenced by buyer characteristics. By directly incorporating buyer characteristics into the hedonic function, the independent variables will imply that the coefficients of the intrinsic characteristics no longer represent implicit prices, but merely reflect the extent to which each variable explains the changes in the land price per acre (Long, 1995; Tsoodle et al., 2006).

Earlier studies that incorporated personal characteristics into the real estate market mostly covered farmland prices. The authors introduced the concept of social capital into the traditional model to explain its impact on the terms of farmland transactions (Schmid & Robison, 1995; Siles et al., 2000; Robison et al., 2002b). Some studies specified the land price per acre as a function of buyer characteristics and the intrinsic characteristics of the land (Chicoine, 1981; Dunford et al., 1985; Long, 1995; Tsoodle et al., 2006). In a recent study on the impacts of farmland landlord-tenant relationships on rental contracts, Bryan et al. (2015) specified familial relationship as a binary dummy variable in which familial relationships-based transactions were specified as 1 while non-familial relationships-based transactions were specified as 0. Their empirical results revealed that familial relationships have no significant impacts on the length of the rental contract. In a similar vein, while investigating the social capital relations between farmland tenants and landlords, Taylor and Featherstone (2018) obtained empirical results which showed that long-term leasing relationships generated negative impacts on farmland lease and the lease is reduced by about 10% when the lease is lengthened from 11 to 22 years. Tang et al. (2019) investigated the impacts of social relations and public interventions on farmland rent deviation, in which social relations was specified as a binary dummy variable, and rental relationships between acquaintances were specified as 1 while rental relationships between non-acquaintances were specified as 0. Their empirical results showed that rents involving existing social relations increases the deviation between the rent and the actual price of a farmland, which leads to inefficient farmland use.

People often engage in informal bargaining for services or assets with high value, such as used cars and housing. The dependence on informal bargaining in the housing market means that the final transaction price as well as the buyer-seller relationship should have significant economic implications. Real estate is geographically fixed and cannot be moved from one location to another. This characteristic implies that many potential buyers tend to live near landmarks. In this regard, buyers and sellers are often neighbors, which means that personal relationships exist (Kostov et al., 2008). This description was based on the study by Kostov et al. (2008), which examined the farmland transactions that involve agricultural problems such as irrigation and fertilization. Social connections exist in a transaction that involve adjacent farmland lots, because the owners of these lots know one another. This is not the case for typical housing transactions, because most buyers and sellers do not know one another. At present, with the exception of studies on farmland prices, no studies have explored the price differences of other real estate products from the perspective of buyer-seller or personal relationships. Therefore, in our study, we used personal relationship variables in a hedonic price function, so as to express social capital effects through personal relationships and differentiate our study from previous studies. In addition, the infrequent occurrence of special relationship-based real estate transactions could indicate imperfect competition, which implies that the determination of real estate transaction prices in non-arm's length transactions lacks competitiveness (Kostov et al., 2008). Under such circumstances, personal relationships may influence transaction prices, that is, buyer/seller characteristics are important determinants of transaction prices. Our study is based on the context of Kostov et al. (2008) study and aims to validate the characterization of imperfect competition on special relationship-based real estate markets from the perspective of buyer or personal relationships.

With the exception of studies on farmland prices, no study thus far has examined the housing price differences in special relationship-based transactions in the urban real estate market from the perspectives of buyer/seller or personal relationships. This was the motivation of our study. Additionally, relevant studies on housing prices in Taiwan often omit housing prices in special relationship-based transactions because they are difficult to analyze. For example, Feng et al. (2021) used a quantile regression model to analyze the relationship between house size and housing prices in the National Taipei University Special Zone in Taiwan. However, for the sake of the consistency of the data quality, the study removed all factors that could potentially affect the housing prices, such as urgent buying/selling, and transactions between family members and relatives. The reason why the data was removed is because the actual price registration system of the Ministry of the Interior automatically screens and removes transaction prices that differ significantly from normal market prices, as well as non-arm's length transaction information. Therefore, not all successful transactions can be queried. However, if the registrant inputs keywords related to the how the transaction price was arrived (i.e. non-arm's length transaction) into the Remarks section, the information will be disclosed (Land Administration Department, New Taipei City Government, 2017). This study examined the special relationships (transactions between relatives or

friends, urgent purchasing/selling) disclosed in the aforementioned Remarks section to compensate for the lack of research in this field. This study analyzed personal and individual relationships through social capital (social relations), so as to offer more complete information on housing prices as well as a reference for the government to formulate real estate industry policies in the future.

The objective of this study is to explore the impacts of social capital on housing prices, or in other words, the differences in housing prices under different personal relationships, such as those involving first-degree relatives[1], second-degree relatives[2], third-degree relatives[3], and friends; debt relations and urgent purchases and sales; and government agencies.

1. Literature review and theoretical basis

1.1. Literature review

The term "social capital" was coined by Loury in 1977 and popularized by Coleman in 1990. There is no paucity of literature related to social capital in the field of economics (Becker, 1996; Swann, 1999; Woolcock, 1998; Robison et al., 1999; Becker & Murphy, 2009). Some scholars (Hyden, 1993; Robison & Schmid, 1994; Siles et al., 1994; Robison & Siles, 1999; Perry & Robison, 2001; Tsoodle et al., 2006; Taylor & Featherstone, 2018; Seifert et al., 2021) studied social capital in the context of agricultural economics. There are only a handful of studies that examined the theory of social capital in farmland leasing (Gwilliam, 1993; Rainey et al., 2003; Taylor & Featherstone, 2018). Gao et al. (2019) show that both social capital and land tenure security have significant positive effects on family farms' adoption of green control techniques (GCTs).

Some researchers conducted empirical studies by applying the impacts of personal relationships on transactions. Robison et al. (1999) utilized farmland survey data and incorporated social capital into a neoclassical model to elucidate how personal relationships change the minimum-sell price of farmland, as well as the likelihood of trade between people with different relationships. Their empirical results showed that the types of relationship between farmland buyers and sellers have statistically and economically significant effects on the minimum-sell price. In comparison with arm's-length transactions, the minimum-sell price of farmland is lower for transactions between sellers and their friendly neighbors/relatives. On the other hand, the seller will ask for premiums from unfriendly neighbors and influential community members. In addition, social capital can have an impact on interpersonal trust (Hasan et al., 2022; Lins et al., 2017). Tong et al. (2020) pointed out that social networks, social norms and trust have an impact on migration choices when studying the relationship between Shenzhen residents' migration choices and social capital. The empirical results of Yi et al. (2016) show that in mainland China, house-purchasing decisions are influenced by relatives-related variables such as distance from parents and educational years of family head's father. Li and Zhang (2021) believe that social capital has a very important impact on neighborhood satisfaction.

Rainey et al. (2005) applied Probit models in their study on the factors (including social capital factors) affecting farmland leasing. Their empirical results revealed that when the length of a lease between a tenant and a landlord increases, the tenant's lease costs will decrease. This is because the tenant/landlord relationship strengthens with the length of the lease, thereby reducing the loss caused by asymmetric information. As such, their empirical results validated the social capital theory. Siles et al. (2000) investigated farmland transactions in Illinois, Michigan, and Nebraska and highlighted significant differences in the prices offered to strangers, neighbors, influential people, and relatives. In particular, the prices offered to unfriendly neighbors were the highest while the prices offered to friendly relatives were the lowest. Perry and Robison (2001) examined the role of personal relationships in the farmland market in Linn County, Oregon. Their results revealed that buyers' characteristics and personal relationships influence the conditions of farmland transactions. This conclusion is in agreement with the social capital hypothesis. However, the influences of buyer characteristics and personal relationships on the implicit prices of land characteristics are non-uniform and extremely non-linear. The authors suggested that transactions involving relatives and neighbors are more frequent, which is a phenomenon that must be taken into special consideration. Transactions involving parents and children and between neighbors involve significantly lower prices than those between strangers, while sales transactions through brokers or advertisements are priced at a significant premium. Drawing from farmland sales data from between June 1992 and December 1997, the authors managed to obtain a total of 160 sets of data from surveyed buyers. The category of familial relationships included relationships with parent and child, grandparents and grandchildren, siblings, and other family members. The category of non-familial relationships included relationships with strangers and acquaintances, which were specified as dummy variables. The authors also included a binary variable that represents whether the buyer had a previous lessee relationship with the seller. Their results showed that parent-child relationships had the most significant influence on

[1] First-degree relatives include: parents, parents-in-law, children, children-in-law.

[2] Second-degree relatives include: grandparents, siblings, siblings-in-law, grandchildren.

[3] Third-degree relatives include: great-grandparents, aunts, uncles, nieces, nephews, nieces-in-law, nephews-in-law, great-grandchildren. For more information on the classification scheme of a family structure, please visit the website of the Taiyuan Skill Training Institute, Agency of Corrections, Ministry of Justice: https://www.tuv.moj.gov.tw/362849/362889/362906/623892/ Last accessed February 2, 2020.

farmland prices, in which transactions were discounted from 31% to 38%. Transactions involving neighbors resulted in discounts ranging from 11% to 23%, which are slightly higher than the discounts ranging from 7% to 19% that were observed in transactions involving other family members. Transactions involving former tenants had premiums ranging from 9% to 12%, while transactions involving acquaintances were discounted from 0% to 10%.

Regarding housing transaction price, Hilber (2010) examined the data of the Social Capital Community Benchmark Survey performed by Harvard University on 41 communities between July 2000 to February 2001. The study showed that home ownership and individual social capital investment are positively related, and social capital operates more flexibly in older communities and newer communities. Because of the connections between residents within a social network, their direct or indirect relationships enable their interactions to be more easily embedded within the community. Dai et al. (2020) used the difference-in-differences approach to investigate the housing price inequality in China on the basis of trust in social capital. The results showed that the economic control plan implemented in 2008 in response to the global financial crisis had increased housing prices, exacerbated the fiscal inequality, and further degraded the residents' trust in the housing prices specified by the government. Based on the above, during the application of social capital on housing price transactions, network connections strengthen the links between overall climate, neighborhood and communities, and individuals (between family members). Against this backdrop, this study centered on relationship networks as a social capital to understand better and analyze the impacts of personal relationship-based transactions and special relationship-based transactions on housing prices or the impacts of social relations on housing prices.

1.2. Theoretical basis

Becker and Murphy (2009) directly considered the impacts of social forces on utilities, while Tsoodle et al. (2006) applied their theory to analyze farmland values. We shall introduce the arguments put forth by Becker and Murphy (2009) and Tsoodle et al.'s (2006) are presented in this section to clarify this issue. The scholars argued that the social environment is a variable that influences a utility function, which differs from the conventional definition of a utility as a function of good and services. Therefore, a consumer's pursuit of a utility is maximized as:

$$Max\ U(x,\ y;\ S)\ \ subject\ to\ p_x x + y = I, \tag{1}$$

in which x and y are all kinds of goods and services (y is the numeraire good); S represents the impact of social influences on utility through the accumulation of social capital stocks. p_x is the relative price of a good x; and I is income. This analytical approach emphasizes the crucial role of price as a social inter actor in market behavior. Under first-order optimality conditions, the following equation can be obtained:

$$\frac{dx}{dS} = \frac{p_x U_{yS} - U_{xS}}{D < 0}, \tag{2}$$

here, if $p_x U_{yS} < U_{xS}$ and assuming that the increase in the marginal utility of x due to the raise in S is more pronounced that the increase in the marginal utility of y, then increasing S will raise the demand of x.

$$\frac{dS}{dp} = \frac{\frac{1}{N}\sum \partial x^y / \partial p}{1-m}, \quad m = \left(\frac{1}{N}\sum \partial x^j / \partial S\right) > 0. \tag{3}$$

In Eq. (3), the numerator represents the mean variation in individual demand. m is the social multiplier and has a denominator smaller than one. As mentioned by Becker, the social multiplier has a positive value as a result of social interactions. When m increases, the impact on aggregate demand increases as well (Tsoodle et al., 2006).

The fundamental assumptions in the application of social capital theory on economics are: (1) The relationship between individuals i and j changes the levels and terms of transactions; (2) The strength of a relationship varies and is changeable (Perry & Robison, 2001). Perry and Robison (2001) and Tsoodle et al. (2006) employed Becker and Murphy's (2009) utility function, in which the utility function of an individual i influenced by individual j is:

$$Max\ U_i = U\left[\pi_i(x),\ K_{ii}(x),\ \pi_j(x),\ K_{ji}(x),\ K_{ij}(x)\right]; \quad \forall\ j \neq i = 1,2,3.....,n, \tag{4}$$

The equation above is constrained by the time of i and the upper limit of resource x. n is the upper limit of an individual's relationships. Robison's utility function included income arising from the profits of i and j. In the equation above, the variables π_i and π_j represent the incomes or other measures of well-being of i and j. In Becker and Murphy's (2009) text, m is similar to K_{ij} in the equation above. These social capital coefficients measure how changes in the well-being of individual j influences the well-being of individual i. Social capital coefficients are used to construct the strength of interpersonal relationships or the degree to which the changes in the well-being of individual j affects the well-being of individual i. Assume that the marginal utility of K_{ii}, K_{ij}, K_{ji} and π is positive. Then, the first-order condition of utility maximization is:

$$\frac{\partial U_i}{\partial x} = \frac{\partial U}{\partial \pi_i}\cdot\frac{\partial \pi_i}{\partial x} + \frac{\partial U}{\partial K_{ii}}\cdot\frac{\partial K_{ii}}{\partial x} + \frac{\partial U}{\partial \pi_j}\cdot\frac{\partial \pi_j}{\partial x} + \frac{\partial U}{\partial K_{ji}}\cdot\frac{\partial K_{ji}}{\partial x} + \frac{\partial U}{\partial K_{ij}}\cdot\frac{\partial K_{ij}}{\partial x}. \tag{5}$$

This classic social capital framework generated the following results. First, increases in social capital are expected to change the terms of transactions and increase the likelihood of transactions involving family and friends. Next, increases in social capital are expected to be beneficial toward the economically less well-off agent in the transaction arrangements between social capital-rich traders (Perry & Robison, 2001).

2. Research method

2.1. Empirical model settings

Perry and Robison (2001) first proposed a social capital-based empirical model for farmland values. Kostov et al. (2008) and Kostov (2010) further extended and applied the model. In this study, the model is applied to the housing market and is described as follows:

$$P = \prod_{j=1}^{m} g_j z_j \left[\sum_{i=1}^{n} f_i(x_i) \right], \tag{6}$$

where: P is the housing price; $f_i(x_i)$ represent functions that may be non-linear; x_i represents the individual hedonic characteristics of a house; z_j represents social capital or individual characteristics variables which may change or condition the hedonic pricing of a house; g_j is the coefficient of shift variables; n is the number of housing attributes; and m is the number of shift or conditioning variables. The structure of the model implies that shift and conditioning variables have the same effect on the implicit prices of each attribute of a house in the hedonic function. In order to clarify the meaning of Eq. (6), it is rearranged and expressed as Eq. (7):

$$P = \sum_{i=1}^{n} \left(\prod_{j=1}^{m} g_j z_j f_i(x_i) \right), \tag{7}$$

in which $\prod_{j=1}^{m} g_j z_j$ scales the implicit prices of each hedonic characteristic.

This study followed the model settings used by Taylor and Featherstone (2018), Bryan et al. (2015), and Tang et al. (2019), in which housing transactions involving first-degree relatives, second-degree relatives, third-degree relatives, friends, debt relations and urgent purchases and sales, and transactions with government agencies were specified as dummy variables and parameter estimation was adopted. The dependent variable is the natural logarithm of the total transaction price of a house, the independent variables include housing structure characteristics, neighborhood characteristics, administrative districts, non-arm's length transactions and temporal changes. The ordinary least squares (OLS) approach was used for estimation. The settings and description of variables are listed in Table 1. The model is specified as Eq. (8):

$$\begin{aligned} \ln P_{it} = {} & \alpha_1 + \alpha_2 AREA + \alpha_3 AGE + \alpha_4 AGES + \alpha_5 ROOM + \\ & \alpha_6 LIVROOM + \alpha_7 BATH + \alpha_8 TYPE_1 + \alpha_9 TYPE_2 + \\ & \alpha_{10} FLOOR1 + \alpha_{11} BISMART + \alpha_{12} DISTHIGHSCH + \\ & \alpha_{13} DISTMIDSCH + \alpha_{14} DISTLEMSCH + \alpha_{15} DISTCBD + \\ & \alpha_{16} DISTRAIN + \sum_{j=1}^{3,6} \beta_j RELATED_j + \sum_{k=1}^{11} \gamma_k ADMINIST_k + \\ & \sum_{l=1}^{6} \theta_l TREND_l + \varepsilon_{it}, \end{aligned} \tag{8}$$

in which $\ln P_{it}$ is the logarithm of the transaction price of the i th house at time t; α_1 is the intercept; $\alpha_2 \sim \alpha_{10}$ are the coefficients of the housing characteristics variables; $\alpha_{11} \sim \alpha_{16}$ are the coefficients of the neighborhood characteristics variables; β_j represent three or six social capital coefficients (regression models 1 and 2 in Table 4); γ_k is the coefficient of administrative district characteristics variable; θ_l is the coefficient of time; and ε_{it} is the error term for a normal distribution.

2.2. Selection and setting of variables

Lee et al. (2017) suggested that setting the total price as a dependent variable can comprehensively elucidate the overall housing price, and complete data can be observed in a more efficient manner during estimation. Many studies in the past have also adopted the logarithm of the total housing price for estimation (such as those of Boymal et al., 2013; Dubé et al., 2014; Lee et al., 2017). This study selected the logarithm of the total housing price $(\ln P_{it})$ as a dependent variable.

In this study, the variables influencing housing prices were categorized into four characteristics that serve as independent variables: Housing structure characteristics (such as area, housing age, number of rooms/living rooms/bathrooms, floor number, type of housing, etc.); neighborhood characteristics (such as distance to the nearest MRT/school and to the CBD); administrative district characteristics (the administrative district in which the house is located in); and transaction type. The settings hdescription of variables are listed in Table 1. The important variables of this study were further delineated in which the transaction type is either based on special relationships (non-arm's length transactions) or is a normal arm's length transaction. Special relationship-based transactions were identified from the actual housing price registration system as sales involving family and friends (including transactions involving fathers and sons, mothers and sons, third-degree relatives, cousins, and friends); transactions involving first-degree relatives, second-degree relatives, third-degree relatives, and friends; transactions involving debt obligations or debt offsetting and urgent purchases and sales (including urgent buying, urgent selling due to seller migration, and urgent selling due to seller in need of cash); and transactions with government agencies based on special relationships. In particular, sales involving family and friends include transactions involving parents, siblings, cousins, and friends. In the actual housing price registration system data, however, these relationships were not specified or distinguished as transactions involving mothers and sons, fathers and sons, second-degree relatives, third-degree relatives, and friends. First, sales involving first-degree relatives, second-degree relatives, third-degree relatives, and friends were consolidated as sales involving family and friends. This and the two other transaction types (transactions involving debt relations and urgent purchases and sales, transactions with government agencies) were then analyzed. Normal arm's length transactions served as the basis of reference, and three dummy variables $RELATED_j$, $j = 1 \sim 3$ representing social capital variables were specified. Sales involving

Table 1. Description of variables

Variable	Description	Expected symbol
Dependent variables		
Total housing transaction price ($\ln P_{it}$)	Logarithm of registered total real estate transaction price. Unit in NT$10,000	
Independent variables		
Area (AREA)	A continuous variable that refers to the registered building transfer area. Unit in *ping* (1 *ping* is equal to 35.6 ft^2 or 3.31 m^2)	+
Housing age (AGE)	A continuous variable that refers to the day of construction completion to the day of transaction. Unit in years	–
Square of housing age (AGES)	A continuous variable. Unit in years	+
Number of rooms (ROOM)	A continuous variable that refers to the number of rooms in a house	+
Number of living rooms (LIVROOM)	A continuous variable that refers to the number of living rooms in a house	+
Number of bathrooms (BATH)	A continuous variable that refers to the number of bathrooms in a house	+
Floor number (FLOOR1)	A dummy variable. Houses on the first floor are indicated as 1, while houses on other floors are indicated as 0	+
Housing type (TYPE)	A dummy variable. Housing types consist of residential buildings, apartments, and *huaxia* apartments. Apartments served as the basis of comparison in this study. In TYPE1, residential buildings are indicated as 1, while other housing types are indicated as 0. In TYPE2, *huaxia* apartments are indicated as 1, while other housing types are indicated as 0. In Taiwan, apartments refer to housing structures that are four or five stories high and have no elevators. *Huaxia* apartments refer to housing structures no taller than ten stories and have elevators and a basement parking lot. Residential buildings to housing structures taller than ten stories that have a courtyard, garden, gym, swimming pool, and other leisure facilities	+
Distance to the nearest MRT station (DISTMRT)	A continuous variable that refers to the distance from a house to the nearest MRT station. Unit in meters	–
Distance to the nearest senior high school (DISTHIGHSCH)	A continuous variable that refers to the distance from a house to the nearest senior high school. Unit in meters	–
Distance to the nearest junior high school (DISTMIDSCH)	A continuous variable that refers to the distance from a house to the nearest junior high school. Unit in meters	–
Distance to the nearest elementary school (DISTELESCH)	A continuous variable that refers to the distance from a house to the nearest elementary school. Unit in meters	–
Distance to the CBD (DISTCBD)	A continuous variable that refers to the distance from a house to CBD. Unit in meters	–
Distance to the nearest railway station (DISTTRAIN)	A continuous variable that refers to the distance from a house to the railway station. Unit in meters	–
Administrative district (ADMINIST)	There are 12 administrative districts in Taipei City. Wanhua District, which has lower housing prices, served as the basis, and 11 dummy variables are established	+/–
RELATED	Special relationship-based transactions were identified from the actual housing price registration system as sales involving family and friends; transactions involving debt obligations or debt offsetting and urgent purchases and sales; and transactions with government agencies based on special relationships. Normal arm's length transactions served as the basis of reference, and three dummy variables $RELATED_j$, $j = 1 \sim 3$ representing social capital variables were specified. The six transactions types: transactions involving first-degree relatives, second-degree relatives, and third-degree relatives; transactions involving debt obligations or debt offsetting and urgent purchases and sales; transactions with government agencies; and transactions involving friends were analyzed. Normal arm's length transactions served as the basis of reference and six dummy variables $RELATED_j$, $j = 1 \sim 6$ were specified	–
TREND	is a time trend variable, which reflects the changes in the trends of arm's length transaction prices in the real estate market. The data collected spanned the period from January 1, 2012 to December 31, 2018. The year 2012 served as a basis of reference, and six dummy variables were specified	+/–

family and friends (including transactions involving fathers and sons, mothers and sons, third-degree relatives, cousins, and friends) were then excluded, and transactions involving first-degree relatives, second-degree relatives, third-degree relatives; transactions involving debt relations and urgent purchases and sales; transactions with government agencies; and transactions involving friends were analyzed. Normal arm's length transactions served as the basis of reference and six dummy variables $RELATED_j$, $j = 1 \sim 6$ were specified. It is expected that the coefficients of the transactions involving first-degree relatives, second-degree relatives, third-degree relatives; transactions involving debt relations and urgent purchases and sales; transactions with government agencies; and transactions involving friends will be significantly lower than those of normal arm's length transactions.

TREND is a linear time trend variable, which reflects the changes in the trends of arm's length transaction prices in the real estate market. The data collected spanned the period from January 1, 2012 to December 31, 2018. The year 2012 served as a basis of reference, and six dummy variables were specified.

3. Data sources and description of sample statistics

3.1. Data sources

The housing transaction data of this study were obtained from the Ministry of the Interior's Real Estate Actual Transaction Price Inquiring System (Ministry of the Interior, 2018). The data on housing transactions in Taipei City collected in this study spanned from January 1, 2012 to December 31, 2018. Housing types consist of apartments, and *huaxia* apartments, and residential buildings. Data for which the day of transaction or day of construction completion was unspecified (which made it impossible to calculate the housing age); or the total number of floors or transferred number of floors were specified as 0; or lacked specifications on important characteristics variables were omitted. Furthermore, unusual housing transactions such as those with a total price of 0 were mostly specified in the remarks column of the actual price registration system. Such transactions were identified through the remarks column. Samples that did not involve actual transactions, such as transfer of ownership or non-housing transactions were omitted as well. This study focused on data that included social capital or personal relations, such as the special relationship-based transactions in the actual price registration system that were specified as transactions involving relatives, employees, shareholders, friends; transactions involving debt relations; urgent buying; urgent selling; transactions involving folk customs; transactions with government agencies; and transactions involving the prices in private deeds 20 years ago. The prices in such transactions may deviate from current market values or are discounted.

In this study, special relationship-based transactions were identified from the actual housing price registration system as sales involving family and friends (including transactions involving fathers and sons, mothers and sons, third-degree relatives, cousins, and friends); transactions involving first-degree relatives, second-degree relatives, third-degree relatives, and friends; transactions involving debt obligations or debt offsetting and urgent purchases and sales (including urgent buying, urgent selling due to seller migration, and urgent selling due to seller in need of cash); and transactions with government agencies based on special relationships. In particular, sales involving family and friends include transactions involving parents, siblings, cousins, and friends. In the actual housing price registration system data, however, these relationships were not specified or distinguished as transactions involving mothers and sons, fathers and sons, second-degree relatives, third-degree relatives, and friends. First, sales involving family and friends (including transactions involving parents, siblings, cousins, and friends); transactions involving first-degree relatives, second-degree relatives, third-degree relatives, and friends were consolidated as sales involving family and friends. This and the two other transaction types (debt relations and urgent purchases and sales, transactions with government agencies) were then analyzed. Then, sales involving family and friends (including transactions involving parents, siblings, cousins, and friends) were excluded, and transactions involving first-degree relatives, second-degree relatives, third-degree relatives; debt relations and urgent purchases and sales; transactions with government agencies; and transactions involving friends were analyzed.

3.2. Descriptive statistics of samples

In terms of the descriptive statistics of samples, there are inconsistencies in the actual housing price registration system data: special relationship-based transactions are indicated as transactions involving family and friends, first-degree relatives, second-degree relatives, third-degree relatives, and friends. However, first-degree relatives, second-degree relatives, third-degree relatives, and friends are also included in the category "family and friends". Therefore, family and friends, first-degree relatives, second-degree relatives, third-degree relatives, and friends were consolidated into one category and analyzed with debt relations and urgent purchases and sales, transactions with government agencies, and normal transactions. There were 28,955 sets of data in total. Next, to further distinguish among first-degree relatives, second-degree relatives, third-degree relatives, and friends, the "family and friends" transaction type was removed, leaving 25,589 sets of data.

According to Table 2, the mean housing price was NT$24.1 million; the mean number of rooms was 2.921; the mean number of living rooms was 1.830; the mean number of bathrooms was 1.755; the mean area was 44.315 *ping* (1 *ping* is equal to 35.6 ft^2 or 3.31 m^2); the mean housing age was 20.376 years. The mean distance to the nearest MRT station, senior high school, junior

Table 2. Descriptive statistics of all samples

All samples (N = 28,955)	Mean	SD	Minimum	Maximum
PRICE (in NT$10,000 units)	2,410	1,960	110	22,000
Number of rooms (ROOM)	2.921	0.809	1	8
Number of living rooms (LIVROOM)	1.830	0.432	1	8
Number of bathrooms (BATH)	1.755	0.604	1	8
Area (AREA)	44.315	22.717	15.001	150.899
Housing age (AGE)	20.376	14.457	0.011	55.027
Distance to the nearest MRT station (DISTMRT)	689.104	520.915	1.940	4692.603
Distance to the nearest senior high school (DISTHIGHSCH)	765.059	481.807	14.913	3561.912
Distance to the nearest junior high school (DISTMIDSCH)	587.398	331.634	12.441	2291.621
Distance to the nearest elementary school (DISTELESCH)	399.498	221.630	13.958	2228.899
Distance to the CBD (DISTCBD)	5552.091	2840.931	75.755	12703.290
Distance to the nearest railway station (DISTTRAIN)	6262.173	2658.286	530.522	11738.930
	Frequency	Percentage	Cumulative percentage	
Housing type (TYPE)				
Residential building	9,459	32.67%	32.67%	
Huaxia apartment	9,241	31.92%	64.59%	
Apartment	10,255	35.41%	100.00%	
Floor number (FLOOR)				
First floor	2,049	7.08%	7.08%	
Not the first floor	26,906	92.92%	100.00%	
Type of special-relationships-based transaction (RELATED)				
Transactions involving debt relations and urgent purchases and sales	61	0.21%	0.21%	
Transactions with government agencies	351	1.21%	1.42%	
Transactions involving family and friends	4,304	14.86%	16.28%	
Arm's length transactions	24,239	83.72%	100.00%	

high school, elementary school, the CBD, and railway station were 689.104 m, 765.059 m, 587.398 m, 399.498 m, 5552.091 m, and 6262.173 m, respectively. 32.67%, 31.92%, and 35.41% of houses were residential buildings, *huaxia* apartments, and apartments, respectively. 7.08% of houses were located on the first floor, while 92.92% were not on the first floor. As a percentage of special relationship-based transactions, debt relations and urgent purchases and sales, transactions with government agencies, and transactions involving family and friends accounted for 0.21%, 1.21%, and 14.86%, respectively, while arm's length transactions accounted for the remaining 83.72%.

According to Table 3, the mean housing price was NT$25.7 million; the mean number of rooms was 2.912; the mean number of living rooms was 1.847; the mean number of bathrooms was 1.760; the mean area was 45.208 *ping*; the mean housing age was 19.301 years. The mean distance to the nearest MRT station, senior high school, junior high school, elementary school, the CBD, and railway station were 687.990 m, 768.743 m, 591.065 m, 402.731, 5601.350 m, and 6344.956 m, respectively. 34.43%, 32.44%, and 33.13% of houses were residential buildings, *huaxia* apartments, and apartments, respectively. 6.63% of houses were located on the first floor, while 93.37% were not on the first floor. As a percentage of special relationship-based transactions, debt relations and urgent purchases and sales, transactions with government agencies, transactions involving first-degree relatives, transactions involving second-degree relatives, transactions involving third-degree relatives, and transactions involving friends accounted for 0.24%, 1.37%, 0.48%, 2.88%, 0.25%, and 0.09%, respectively, while arm's length transactions accounted for 94.69%.

We applied ANOVA to test the differences between different types and residential prices, and the results showed that F was 44.24, reaching the 1% significant level, indicating that there was a significant difference in the average residential prices between arm's length transactions and six types of special transactions. The Scheffe post hoc comparison method shows that the average prices of Transactions involving first-degree relatives, Transactions involving second-degree relatives, Transactions involving third-degree relatives, and Transactions with government agencies and arm's length transactions are significantly different.

Table 3. Descriptive statistics of samples (in terms of degree of kinship)

Degree of kinship (N = 25,598)	Mean	SD	Minimum	Maximum
PRICE (in NT$10,000 units)	25,700,000	19,900,000	1,253,939	216,000,000
Number of rooms (ROOM)	2.912	0.821	1	8
Number of living rooms (LIVROOM)	1.847	0.421	1	8
Number of bathrooms (BATH)	1.760	0.605	1	8
Housing age (AGE)	19.301	14.469	0.011	55.027
Area (AREA)	45.208	23.107	15.001	150.899
Distance to the nearest MRT station (DISTMRT)	687.990	519.107	1.940	4692.603
Distance to the nearest senior high school (DISTHIGHSCH)	768.743	483.800	14.913	3561.912
Distance to the nearest junior high school (DISTMIDSCH)	591.065	333.483	12.441	2291.621
Distance to the nearest elementary school (DISTELESCH)	402.731	223.395	13.958	1995.537
Distance to the CBD (DISTCBD)	5601.350	2842.942	75.755	12703.290
Distance to the nearest railway station (DISTTRAIN)	6344.956	2661.271	530.522	11738.930
Transactions involving debt relations and urgent purchases and sales	1560	980	135	6640
Transactions with government agencies	2610	1040	1180	3900
Transactions involving first-degree relatives	736	354	349	1420
Transactions involving second-degree relatives	989	884	205	10500
Transactions involving third-degree relatives	1090	831	100	4300
Transactions involving friends	1520	926	330	4180
	Frequency	Percentage	Cumulative percentage	
Housing type (TYPE)				
Residential building	8,813	34.43%	34.43%	
Huaxia apartment	8,305	32.44%	66.87%	
Apartment	8,480	33.13%	100.00%	
Floor number (FLOOR)				
First floor	1,698	6.63%	6.63%	
Not the first floor	23,900	93.37%	100.00%	
Transaction type				
Type of special-relationships-based transaction (RELATED)				
Transactions involving debt relations and urgent purchases and sales	61	0.24%	0.24%	
Transactions with government agencies	351	1.37%	1.61%	
Transactions involving first-degree relatives	124	0.48%	2.09%	
Transactions involving second-degree relatives	737	2.88%	4.97%	
Transactions involving third-degree relatives	64	0.25%	5.22%	
Transactions involving friends	22	0.09%	5.31%	
Arm's length transactions	24,239	94.69%	100.00%	

4. Empirical results and discussion

The empirical results of this study are shown in Table 4, which includes regression models (1) and (2). In model (1), transactions involving family and friends were not separated, while in model (2), transactions involving family and friends were separated. We used the variance inflation factor (VIF) to check for the presence of multicollinearity between the explanatory variables. As suggested by Neter et al. (1990), a VIF smaller than 10 indicates the absence of multicollinearity between the explanatory variables. With the exception of house age, square of house age, distance to the city center, and distance to a train station, which had a VIF exceeding 10, all the other variables had a VIF smaller than 5. With regard to the problem of heteroskedasticity between the error term variables, White suggested that robust standard errors should be used in

large sample sizes, regardless of whether heteroskedastic errors are present between the error terms. If heteroskedasticity is present, robust standard errors can be used to avoid the problems of incorrect interval estimations and statistical validations. Therefore, we used robust standard errors for hypothesis testing and deduction.

Regression Model (1) had a *F*-statistic of 3098.53, which attained the 1% level of significance and had a good model fit. The adjusted R^2 was 0.821. In terms of the estimated results of the housing characteristic variables, the estimated coefficient of the number of living rooms/bathrooms; housing age; square of housing age; area; *huaxia* apartments; and residential buildings were in line with the results of previous studies and attained a level of significance. The impacts of controlling for time and administrative districts have been aforementioned. The estimated coefficient of transactions involving debt relations and urgent purchases and sales was –0.268, which attained the 1% level of significance. This shows that the prices in transactions involving debt relations and urgent purchases and sales were 23.58% (convert with $(e^{\alpha} - 1)$) lower than those in normal arm's length transactions. The estimated coefficient of transactions with government agencies was –0.684, which attained the 1% level of significance. This shows that the prices in transactions with government agencies were 49.5% lower than those in normal arm's length transactions. The estimated coefficient of transactions involving family and friends was –0.682, which attained the 1% level of significance. This shows that the prices in transactions involving family and friends were 49.4% lower than those in normal arm's length transactions.

Regression Model (2) had a *F*-statistic of 3007.96, which attained the 1% level of significance and had a good model fit. The adjusted R^2 was 0.848. Similarly, in terms of the estimated results of the housing characteristic variables, the estimated coefficient of the number of living rooms/bathrooms; housing age; square of housing age; area; *huaxia* apartments; and residential buildings were in line with the results of previous studies and attained a level of significance. The impacts of controlling for time and administrative districts have been aforementioned. The estimated coefficient of transactions involving debt relations and urgent purchases and sales was –0.256, which attained the 1% level of significance. This shows that the prices in transactions involving debt relations and urgent purchases and sales were 22.6% lower than those in normal arm's length transactions. The estimated coefficient of transactions with government agencies was –0.671, which attained the 1% level of significance. This shows that the prices in transactions with government agencies were 48.9% lower than those in normal arm's length transactions. The estimated coefficients of transactions involving first-degree, second-degree, and third-degree relatives were –0.851, –0.757, and –0.700, respectively, which all attained the 1% level of significance. This shows that the transaction prices involving all three degrees of kinship were respectively 57.3%, 53.1%, and 50.3% lower than those in normal arm's length transactions. The discounts decrease when the degree of kinship becomes more distant. The estimated coefficient of transactions involving friends was –0.329, which attained the 1% level of significance. This shows that the prices in transactions involving friends were 28.0% lower than those in normal arm's length transactions. In Model (1), the actual discounts between friends and different degrees of kinship cannot be discerned since family and friends were not separated. The empirical results supported the social capital hypothesis.

The discount in transactions involving debt relations and urgent purchases and sales was lower than that in transactions involving friends. This highlights the importance of personal relationships or social relations, whereas the value of personal relationships in debt relations and urgent purchases and sales merely take into account interests and costs. The discount in transactions involving debt relations and urgent purchases and sales was lower than that in transactions involving friends.

The prices in transactions with government agencies were significantly lower than those in normal arm's length transactions. A possible reason is that the government would sell real estate to generate income, and when this happens, the selling of non-public use real estate is often prioritized. However, non-public use real estate is easily occupied by others or other legal sources of right may exist, and this makes management difficult. Such scenarios include the occurrence of land superficies, 375 rent reduction, legal occupation, etc. In consideration of their work burdens, the government agency would often sell off the real estate with a discount on their specified price. This explains why the prices in transactions with government agencies are significantly lower than those in normal arm's length transactions. However, at present, when the government sells state-owned land or public land, a real estate evaluator must perform a valuation for the land is sold. This is to prevent people or groups from making illegitimate profits out of the land as well as to reflect the land's objective price offered by the government. By comparing the Ministry of the Interior's TGOS system with the transactions with government agencies in this study, many data involved placement policies, such as 167 sets of transactions in Beitou District were sold by the Ministry of National Defense to military dependents. As a result, the prices were lower than half the market value. However, in accordance with Article 24 of the Act for Rebuilding Old Quarters for Military Dependents, the buyers are not permitted to transfer the real estate within five years.

Siles et al. (2000) investigated farmland transactions in Illinois, Michigan, and Nebraska. Their findings indicated that the prices offered to unfriendly neighbors were the highest while the prices offered to friendly relatives were the lowest. Perry and Robison (2001) examined the role of personal relationships in the farmland market in Linn County, Oregon. Their results revealed that transactions involving parents and children and between neighbors have significantly lower prices than those between strangers. In addition, parent-child relationships had the most significant influence on farmland prices, in which

Table 4. Empirical results

Variables	(1)	(2)
Number of rooms (ROOM)	0.023*** (0.003)	0.032*** (0.003)
Number of living rooms (LIVROOM)	0.061*** (0.005)	0.060*** (0.005)
Number of bathrooms (BATH)	0.035*** (0.004)	0.043*** (0.004)
Housing age (AGE)	–0.008*** (0.001)	–0.007*** (0.001)
Square of housing age (AGES)	0.001*** (0.001)	0.001*** (0.001)
Area (AREA)	0.018*** (0.001)	0.018*** (0.001)
First floor (FLOOR1)	0.158*** (0.008)	0.172*** (0.007)
Huaxia apartment	0.120*** (0.006)	0.147*** (0.005)
Residential building	0.115*** (0.007)	0.140*** (0.006)
Distance to the nearest MRT station (DISTMRT)	–0.001*** (0.001)	–0.001*** (0.001)
Distance to the nearest senior high school (DISTHIGHSCH)	–0.001*** (0.001)	–0.001*** (0.001)
Distance to the nearest junior high school (DISTMIDSCH)	–0.001** (0.001)	–0.001** (0.001)
Distance to the nearest elementary school (DISTELESCH)	–0.001*** (0.001)	–0.001*** (0.001)
Distance to the CBD (DISTCBD)	–0.001*** (0.001)	–0.001*** (0.001)
Distance to the nearest railway station (DISTTRAIN)	0.001*** (0.001)	0.001*** (0.001)
Transactions involving debt relations and urgent purchases and sales	–0.268*** (0.066)	–0.256*** (0.067)
Transactions with government agencies	–0.684*** (0.021)	–0.671*** (0.021)
Transactions involving family and friends	–0.682*** (0.008)	–
Transactions involving first-degree relatives	–	–0.851*** (0.037)
Transactions involving second-degree relatives	–	–0.757*** (0.018)
Transactions involving third-degree relatives	–	–0.700*** (0.058)
Transactions involving friends	–	–0.329*** (0.086)
Time fixed effects	YES	YES
Administrative district fixed effects	YES	YES
Constants	15.834*** (0.019)	15.775*** (0.019)
F	3098.53***	3007.96***
R^2	0.821	0.848
Adjusted R^2	0.821	0.848

Note: Values in parentheses are robust standard errors; *, **, and *** represent, respectively, 10%, 5%, and 1% significance levels.

discounts in these transactions ranged from 31% to 38%. Transactions involving neighbors resulted in discounts from 11% to 23%, which is slightly higher than the discounts from 7% to 19% that were observed between other family members. Transactions involving former tenants had premiums from 9% to 12%, while transactions involving acquaintances were discounted from 0% to 10%.

The study by Perry and Robison (2001) showed that parent-child relationships had the most significant influence on farmland prices, in which transactions were discounted from 31% to 38%. In this study, transactions involving first-degree to third-degree relatives were discounted from 50.3 to 57.3%, which are significantly higher than those of studies conducted in Western countries. Transactions involving first-degree relatives had higher discount rates than those between second-degree relatives, while transactions involving second-degree relatives had higher discount rates than those between third-degree relatives. This shows that the price differences exist between relatives and varies across their degree of kinship, including transactions involving direct relatives (first-degree relatives such as children or parents) or collateral relatives (second-degree relatives in the collateral line of descent such as siblings or second-degree relatives in the direct line of descent such as children). The closer the degree of kinship, the larger the price gap and the discount rate between the sale price and the arm's length transaction price.

The relatively low transaction price between relatives could be due to the following reasons: (1) The seller may regard a piece of real estate as their offspring, thus when they sell it to close relatives, their emotional attachment to the house will influence their trust toward their relatives, that is, they believe that their relatives will utilize the real estate in the same way that they themselves do. (2) The seller has a general understanding of their relatives' personal credit and ability to pay. As a result, they are willing to sell a piece of real estate at a price lower than the market value, so as to reduce the payment risks during the transaction. (3) Transactions involving relatives often do not involve a real estate broker, and by substituting the brokerage fee with a personal discount, the seller is able to complete the transaction with their relatives. (4) Transactions involving relatives are often bound by certain terms and conditions that stems from the seller's obligations, which explain the lower selling price. (5) Transactions involving relatives often take tax avoidance into account. If the seller's total assets are substantial, they might transfer some of these assets to close relatives in order to reduce their total assets and decrease their inheritance tax in the future. Such transfers are often achieved through buying/selling and gifting. Regardless if the buying/selling or gifting is occurring between first or second-degree relatives, these transfers are often subject to land value increment tax as well as gift tax. If a transfer is based on buying/selling, the land value increment tax can be taxed through the land value increment tax for self-use residence, which reduces tax burden. Therefore, transfers through buying/selling between relatives are more common than gifting. Moreover, if a party is able to provide proof of the actual transaction price between second-degree relatives, they can be exempted from paying gift tax. A sale price that is lower than the normal price facilitates the buyer to declare their proof of funds. Therefore, transactions involving relatives often taken into account inheritance tax, gift tax, and increment tax, which explains why the sale prices are often lower than normal arm's length transaction prices.

In general, this study may imply that the impacts of social capital on transaction prices is influenced by the amount of value-added tax and capital gains tax paid by the seller, as well as the tax burden undertaken by the buyer during a future transaction. Furthermore, the owners in such special relationship-based transactions may avoid the payment of inheritance tax in the future. Such implicit effects can explain the enhanced impacts of social capital on transactions.

Conclusion and recommendation

The price gap between special relationship-based transactions and normal arm's length transactions is a common subject of interest among all parties in market transactions. In the past, brokers provided this information, which were not theoretically backed and could not be verified for reliability. For this reason, a large gap exists in the research on special relationship-based housing transactions, which has substantial impacts on the rights of customers. Previous social capital studies, such as those conducted by Bryan et al. (2015), Kostov (2010), and Taylor and Featherstone (2018), focused primarily on the market for farmland, and the social relations discussed were limited to family and friends. This study applied the principles of social capital to investigate its impacts on housing prices. This approach sheds light on the price difference, the reasons between special relationship-based transactions and normal arm's length transactions, and other social relations, such as transactions involving family and friends, debt relations and urgent purchases and sales, and transactions with government agencies. This is a breakthrough in validating the depth of the social capital theory.

The empirical results supported the social capital hypothesis and showed that the prices in transactions involving debt relations and urgent purchases and sales were 25.6% lower than those in normal arm's length transactions. The prices in transactions involving friends were 32.9% lower than those in normal arm's length transactions. The prices in transactions with government agencies were 67.1% lower than those in normal arm's length transactions. The results showed that the transaction price between first-degree, second-degree, and third-degree relatives were respectively 85.1%, 75.7%, and 70.0% lower than those in normal arm's length transactions. The discounts decrease when the order of the degree of kinship becomes more distant. Research into special relationship-based housing transactions can be more in-insightful depth and accurate if friendships can be further subcat-

egorized according to the degree of closeness and if the actual price registration system is able to indicate if a transaction involved neighbors, acquaintances, or tenant-landlord relationships. Lastly, we recommend that the Ministry of the Interior enhance the actual housing price registration system by Specifying clarifying the transaction type in sales involving family and friends (including transactions involving fathers and sons, mothers and sons, third-degree relatives, cousins, and friends). This is will improve the quality of academic research and the implementation of actual policies. To make up for this gap in research, the findings of our study are expected to enhance the practical implications and transaction security of the actual price registration system, as well as to serve a reference for the government to formulate real estate industry policies in the future.

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