The Effect of a Special Interest Group on Apartment Price Collusion

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This paper examines the effect of collusion by a special interest group (Association of the Resident Housewives, ARH) in the apartment market between 2006 and 2007 in Korea. Using the Difference-In-Difference (DID) design and carefully matching the apartments, it is estimated that every instance of collusion results in an increase of from KRW 7.2 to 40.3 million in the apartment price. The amount of increase varies by districts and apartment unit characteristics. The result in this paper shows that the effects of collusion explain the cause of a rapid rise in the price of apartment between 2006 and 2007. This paper contributes to the collusion literature by closely examining how a special interest group (ARH) affects price through the collusion.

Keywords: Apartment price, Collusion, Special interest group, Difference in Difference (DID), Bidding ring

JEL Classification: C5, D4

I. Introduction

In Korea, residential apartments are considered as an effective solution for providing housing in major metropolitan areas. Apartments do not only provide housing but further serve as symbol of wealth and social status as they are highly valuable assets, constituting the largest portion of a typical household's wealth. Therefore, the price volatility of the apartments is a very serious concern for apartment residents.

There were three periods of large increases on apartment prices for the periods of 1990 to 1991, 2001 to 2002, and 2006 to 2007 in Korea.[1] These price increases are striking compared to other periods. Regarding drastic price increases of apartments, there has been a fierce debate about the real estate bubble including apartments in Korea since early 2000 (Lee and Kim 2006; Kim 2006; Park 2009). In this continuing debate, researchers have mainly focused on the large shifts in apartment prices but have paid less attention to the causes of the large price shifts.

The most commonly accepted reason for the price increases is the lack of apartment supply, especially in the period from 2006 to 2007.[2] Such phenomenon seems trivial using the Demand-Supply curve framework. However, the sudden and dramatic increase in price does not seem to be fully captured by a supply shortage alone. Collusion in the apartment market has been mentioned as another culprit of sudden price increases since 2000 but only got the full attention in 2006. Hence, this paper investigates another potential source of the housing price increase: collusion. Specifically, the paper examines the effect of collusion in the apartment market and further estimates the effect of collusion on the price increase.

Collusion in the apartment market by the Association of the Resident Housewives (ARH)[3] has been suspected as an important source for the price increases since 1980s in Gangnam district[4] in Seoul.[5] Articles

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[1] Refer to Appendix Figure 1.

[2] "Ways to stabilize the real estate market," a report by the Ministry of Construction and Transportation (MOCT) in November 15th, 2006, shows that the number of supply of residential buildings was the lowest for all types of building; it decreased from 29.7 million in 2003 to 18.2 million in 2006.

[3] ARH is a cohesive neighborhood association comprised of women who represent each apartment in Korea. It is not a legal or corporate entity, it has been delegated of certain rights from the Committee of the Repesentative Residents (CRR) of each apartment complex, which is the only official entity based on the law on the management of residential apartments (for more information, refer to III.A).

[4] It is necessary to differentiate Gangnam and Gangnam district in this paper. Koreans use the Han river as the border to divide Seoul into two areas, Gangnam (south of the Han River) and Gangbuk (north of the Han River). Gangnam indicates all districts below the Han river in Seoul and Gangbuk also indicates all districts above the Han river. "Gangnam district" (Gangbuk district) is just one district in Gangnam (Gangbuk). For more information, please refer to the administration system in Korea, Appendix 1.

[5] "Investigation of collusion for the Bubble Seven Regions, Gangnam *etc.*", Financial News, July 30, 2006.

"Revelation of 58 complexes having a price collusion", Kook-min il bo, July

about collusion led by ARH are not difficult to find in the internet.[6] It is notable that there is a larger number of articles from 2006 to 2007 than from 2000 to 2005.[7] The price increases from 2006 to 2007 is also special for two reasons. First, the Korean government started prosecuting collusion in apartments for the first time. Second, the price fluctuated more in Seoul and Gyeonggi province compared to other regions, which is different from 1990 to 1991 and from 2001 to 2002 price increase periods. Survey results on apartment price collusion also indicate that the rise in prices is closely related to collusion.[8] Along with the evidence of statistics on the number of articles and survey results, government investigation further indicates that the period from 2006 to 2007 offers the best setting to examine the real effect of collusion by ARH. If the result shows that there is an effect, we can conclude that collusion is another culprit besides lack of supply, which explains the steep price increase in apartments in Seoul from 2006 to 2007.

Although this paper does not explicitly introduce a model, from a theoretical view, apartment market collusion can be viewed in the perspective of "bidding rings," especially with dynamic auctions. This concept is applicable in explaining the apartment market collusion despite its auction setting. In this setting, bidders are able to not only observe the current bid price but also bid multiple times until the highest price wins the bid. These rules make the dynamic auction vulnerable to collusion since they do not bid against other cartel members. Also, since there are no incentives to cheat on their values, they bid their true values. Hence, it minimizes the problem of information misrepresentation by its members (Kovacic 2006). This collusion setting also can be interpreted with a repeated bilateral bargaining using auction in a bidding ring

21, 2006.

[6] Appendix Figure 2 shows the number of articles related to apartment price collusion.

[7] There were 84 news articles on collusion, excluding overlapping news, quotations from government reports. Among these articles, 44 were from 2000 to 2007, with 44% reporting on Gangnam and 56% reporting on Gangbuk. Before the rate between the two provinces were 76% and 24%, respectively.

[8] A total of 830 people participated in this questionnaire ("How much does the public announcement of investigation influence on the collusion and apartment price by Bu-dong-san 114) on July 21, 2006. The responses to this question are as follows: "No effect on the price stability and collusion" 37%, "Decrease the collusion itself, but no effect on the price stability" 20%, "Increase the price because of the reduction of trades" 16%. A total of 73% had negative impressions of price stability and only 27% answered "price stability and less collusion."

concept. If all the buyers are in the ring, the seller's offer price will become the reserve price. Therefore, the ring accepts or rejects the reserve offer and the auction can reduce to a repeated bilateral bargaining (Phillips and Menkhaus 2009).[9]

Overall, this paper contributes to the collusion literature with a unique setting of a special interest group (ARH), which affects the price through collusion based on the bidding ring framework. The remainder of this paper is organized as follows. Section II reviews the existing literature. Section III explains the unique characteristics of the Korean apartment market compared to that of the U.S., and describe the data. Sections IV and V discuss the model on the collusion in the apartment market and show empirical results, respectively. Section VI concludes.

II. Literature Review

Three branches of literature are relevant to this paper. Previous work on determinants of the housing price, characteristics of collusion and usage of internet news data have contributed to the formulation of the research agenda formulated in this paper.

Studies on determinants of housing price use the Hedonic Model, which are heavily influenced by works of Lancaster (1966) and Rosen (1974) help contextualize the explanation of apartment price fluctuations. Based on the model, Huh and Guak (1994) did an empirical research in Korea and argued that apartment size, the number of bathrooms, education quality and traffic convenience are positively related to prices while pollution is negatively related. There are some studies on how new towns (newly built residential districts) affect the local apartment prices (Ahn and Huh 2008; Gu *et al.* 2009). These papers, in general, insist that apartment prices increased after the announcement of new towns. In addition, Seo (2008) and Choi (2010) explore the effects of government policy on apartment prices using a VAR model. Overall, these papers

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[9] Residential collusion may be viewed using the bilateral agency model framework. In this setting, the principal is the ARH and the agent is the real estate agency. ARH has influence over the real estate agents and can observe information about apartments. However, it is different from a traditional bilateral agency model for the following four reasons. First, the principals are regarded as the one entity, not just because of non-conflicting objectives, but because of collusion. Second, ARH is not a business. Third, principal has the right to reject the suggestion of agents (veto-based delegation). Finally, principal has the firm beliefs that price will rise.

contribute to finding important variables that affect apartment prices.

The second branch of literature relevant to this study is collusion. Theoretical papers for bidding rings — including Graham and Marshall (1987) — deal with a variety of topics such as static collusion in different settings like first price auction, second price auction, and dynamic collusion. Empirical papers on bidding rings examine diverse topics like highway paving (Porter and Zona 1993) school milk (Porter and Zona 1999), and wholesale stamp dealers (Asker, 2010). With a closer focus on firms, Besanko and Spulber (1989, 1990) theoretically explain the collusion with the assumption that consumers or anti-trust entities partially trust information regarding the creation of a cartel. With an additional assumption, Harrington and Chen (2004) show that the price is less modified under collusion than it is under competition because any change in variable cost will only partially be reflected during collusion period. Abrantes-Mets *et al.* (2006) empirically introduce the case of a seafood delivery company. Their results reveal a decrease in the average price (16%) and an increase in the standard deviation (263%). Coefficient variation (the ratio of the standard deviation to the average price) during the price-fixing period was 332% lower than the price during non-collusion period.

The third branch of literature discusses the method of using Internet sources as data. Gathering data from the online based sources is growing more common in a wide variety of studies, including works related to unemployment rate (Ettredge *et al.* 2005), unemployment payments (Baker and Fradkin, 2011), and inflation (Guzman 2011). Among search tools using internet sources, Google search engine is a popular one (Choi and Varian 2010' Kahn and Kotchen 2010; Egan *et al.* 2010). Choi and Varian (2010) shows that the use of query indices such as free shipping in Google searches is often correlated with various economic indicators and may be helpful for short-term economic prediction. Kahn and Kotchen (2010) also uses Google search to represent environmental concerns and proves that environmental concerns move contrary to business cycles, which are measured using unemployment rates. Egan *et al.* (2010) explores how second-order beliefs work to create a return expectation and a risk-bearing behavior. In this paper, the number of articles — including apartment market collusion cited on internet news portals — is used to estimate the timing and the duration of collusion activities.

III. Background and data

A. Unique characteristics in Korea

The two most distinctive characteristics of the Korean residential market are the concept of apartments and the special interest group, ARH. First, in Korea, the perception of apartment ownership differs substantially from the U.S. Apartment in Korea is similar to a condominium or a villa in the U.S. residential market. In the U.S., one individual or company generally owns an entire apartment complex and leases apartment units through an agent or an office that specializes in leasing. However, in Korea, an individual (or a family) owns a single apartment unit like condominium in U.S.

Another major difference in the housing market is the strong presence of ARH. The ARH is a cohesive neighborhood association mainly comprised of housewives. Each ARH represents one apartment complex. Although it is not a legal or corporate entity, it has been delegated certain rights from the Committee of the Repesentative Residents (CRR) of each apartment complex, which is the only official entity based on the law on the management of the residential apartments. The ARH often helps the CRR to support works that the CRR cannot accomplish including neighborhood initiatives, recycling, and decorating the apartment complex. The influence of ARH on civic centers and even city halls is common knowledge in Korea. It has been documented that ARH had a role in the collusion of apartment markets in the Gangnam district during the 1980s.[10] Furthermore, there have been anecdotes in which ARH forced real estate agents to cooperate with the collusion by threatening not to do any real estate business with them.[11] Hence, it is likely that ARH exerted certain influence on the price rise from 2006 to 2007. This prediction is in line with the government's swift action in middle of 2006, where prosecutors started investigating potential apartment collusions and threatened full prosecution for collusions.

B. Definition of collusion

Collusion is generally defined as a conduct in which different parties

[10] "Gangnam's new trend in real estate agency and price collusion by ARH," Kyunghyang shinmun, May 13. 1983.
[11] "Real Estate Agents can no longer tolerate ARH price collusion and go on a strike, closing agencies," Seoul Economy, June 20, 2006.

under competition mutually determine the price and quantity of their product through invisible cooperation, thereby removing unnecessary competition. The essential element of collusion is compensation mechanism, which helps sustain cooperation for a long term. However, the apartment market generally does not provide a direct compensation mechanism.

ARH is a nonprofit organization and does not directly earn any profit. But there are three main factors that enable ARH to keep price-fixing. First, there is usually no direct cost in participating in price fixing. In general collusion setting, a firm that takes part in price-fixing may experience a reduction in profits as sales decrease. On the contrary, in the Korean apartment setting, each member of the ARH usually has only one or two apartment units and there is no direct cost of colluding. Second, government cannot penalize ARH albeit their alleged price-fixing until 2006. ARH is not a business group and according to the Fair Trade Law of Korea, only businesses can be prosecuted for collusion. Third, there are no incentives for ARH to deviate from price-fixing. Residents had already learned through the past apartment price shocks that the price can be manipulated much higher.

Incorporating these features, this paper defines collusion as ARH's collective action to influence price and quantity of available apartments through tacit or explicit agreements that restrict competition from 2006 and 2007.[12]

C. Reasons for collusion

There are three main reasons for collusion. First, the fundamental reason for collusion is to increase wealth through raising prices. An apartment is the largest asset of Korean households and its changing price has a significant impact on the wealth of the households. Since collusion is the easiest way to boost wealth in a short period of time, many people, including real estate agents, or speculators tried to collude to reap profits.

Second, the expectation about rising housing prices may have encouraged collusion. Table 1 shows the result of questionnaires; the majority of respondents from varying social statuses and ages expected that apartment prices would increase from 2006 to 2007. Such belief possibly encouraged ARH to unite further and collude as a ring.

[12] This definition of price collusion is more n line with the legal definition rather than that from economic theory which usually requires profit-pursuing subjects and a compensation mechanism.

TABLE 1

RESULT OF INQUIRY ABOUT EXPECTATION ON THE APARTMENT PRICE

Institution	Time	Group	Question	Answer
Korea Research Institute for human settlements	06.1.12	Professionals	Prospect for housing economy in 2006	40% Increase
Real estate serve	06.5.9~16	Internet users	Prospect for housing economy on Q2,2006	Continuing to increase 46.2% (decrease: 31.1%
Financial news	06.6.23	corporation CEO or leader	Prospect for housing economy in 2nd half	Increase 22.0% Decrease 10.7%
PB Research center of Samsung securities co.	06.7.19	107 people living in Gang-nam	Prospect for housing economy in 2nd half and investing real estate	Keep this level or increase after 2~3 years 64.5%
Mae-il economy	06.10.4	Professionals	Prospect for housing price after Chu-seok	increase: 48.5% decrease: 21%
Shin-han bank	06.10.16	6483 more than 20 years old	Prospect for housing economy	Continuing to increase 48% decrease 21%
Real-estate 114	07.1.17	200 brokers	Prospect for housing economy in 2nd half	Continuing to increase 85.5%

Source: Naver & each institute.

Third, a sense of deprivation may also have encouraged collusion. The districts suspected of collusion were less wealthy than other districts were. When ranking the price of apartment by size, or pyung, 77% of all of the colluding regions were below the median price. Furthermore, the increased price gap between Gangbuk and Gangnam region after 2001 is supported by Figure 1.

Compared to the CPI, price gap is increased more than seven times from 2000 to 2006. In addition, Table 2 represents the new apartment construction cost showing the increased price gap. We can suspect that residents of Gangbuk may have tried to decrease the price gap. According to interviews, those who have apartments in the districts with low rankings regarded their apartments similar to apartments in the districts with high rankings. Hence, the apartment collusion may be
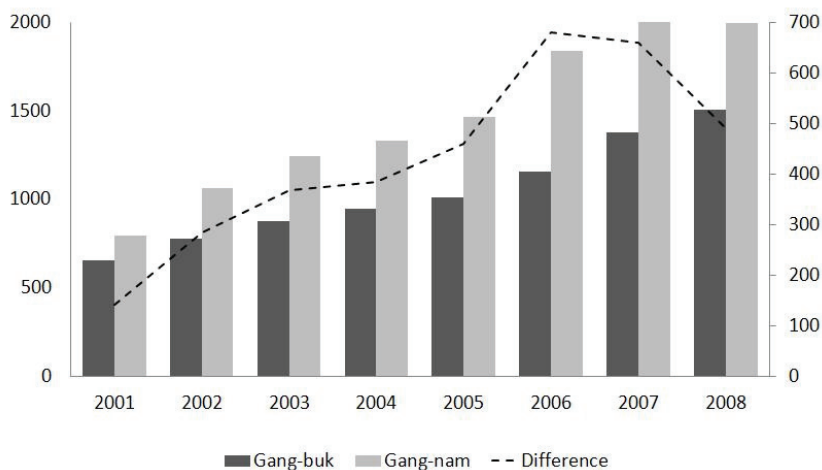
Source: Seoul survey 2008.

FIGURE 1

TREND AND DIFFERENCE IN SALE PRICES IN GANG-NAM AND GANG-BUK

TABLE 2

NEW APARTMENT CONSTRUCTION COST

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Under 18 Pyung	544.04	622.26	686.81	764.18	1052.03	1041.48			
18~25.7 Pyung	570.5	620.74	728.08	967.58	1207.23	1043.12			
Above 25.7 Pyung	721.31	837.09	1083.56	1359.63	1504.08	1250.66			
Average	611.95	693.36	832.82	1030.46	1254.45	1111.75	1477	1630	1808

Source: Seoul survey 2008.

driven by the desire to increase wealth, expected higher prices and the desire for the less wealthy district to decrease the price gap.

D. Data description

All panel data on the specific characteristics of apartments are taken

from Real Estate Bank. Asking prices are used instead of sales price from the Ministry of Land, Transport and Maritime Affairs (MLTM) due to data errors and short time span. The asking prices are the average prices for each floor in each building by month. The average price was used because the asking prices itself was not available at the time of the study.[13]

This paper uses two particular periods. From July 1996 to March 1998 represents standard period, meaning no collusion. From April 2006 to December 2007 exemplifies collusion period. The collusion period differs for each apartment complexes. Moreover, the sizes of any apartments subject to collusion that are not available through the media or Internet resources are assumed to be 30 pyung (about 99 m^2), which is the average size of the apartments with available data. To set the instance and period of collusion, a number of citations from various articles are used. The main source of the online news is Naver.com, Korea's most-used search engine, which divides the information into eight categories and provides searches using parameters such as the amount of content and the date of publication as well as other advanced search functions. Other search engines including Daum, Google, Yahoo, or Nate do not offer detailed parameter specifications. Data for macro-variables are retrieved from Economics Statistics System (ECOS).

IV. Model

The collusion effect in the apartment market is measured by using a 'Difference in Difference (DID)' model. The DID model is widely accepted for determining the effect of a program by controlling other external economic variables. In this paper, the program is collusion. The participants of the program are the colluding districts and the nonparticipants are non-colluding districts. The equation for this effect is as follows:

$$y_{is} = a + bD_{is} + cD_i + dD_s + \varepsilon_{is}$$
$$y_s = e + fM2_s + gCDR_s + hSTOCK_s + iAVGP_s + \varepsilon_s$$

(1)

Here is an issue why additional variables specified on 'i' and 's' to

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[13] One referee commented that it would be better to replace the price level with the rate of the price change. However, the price used in this paper is the average price for each apartment, so the price level does not change frequently. This leads to an econometric problem in this short period analysis.

control other effects on the price are not considered. The main reason is that it is difficult to find such variables in housing market. Independent variables in a usual setting should be time-varying variables in each apartment. However, most of the important variables are time-invariant variables and in reverse, all macro variables are place-invariant. Because of such reason, this paper sets the two equations separately to take into account of other effects that may reduce the overestimated effect of collusion.

y_{is} represents the asking price of an apartment in district 'i' at time 's', and 'D' represents the dummy variable for the colluding market and time. '$i=1$' represents a colluding market, and '$s=1$' represents the time at which the collusion occurs. Therefore, the market and the period under collusion are represented by $D_i=1$ and $D_s=1$, respectively. That is, $D_{is}=1$; otherwise, $D_{is}=0$.

In addition, $M2$, the cd rate (CDR), Korea's composite stock index (STOCK) and the average apartment price (AVGP) in Gangnam and Gangbuk are all used for the colluding apartments to control for macro-environment. Macro level variables are not included in the DID because macro-level data for districts cannot exist. To make up for this weakness, a level regression is run including macroeconomic variables to get an approximate effect of the macroeconomics. For the DID specification, the following apartment characteristic variables are matched: size (pyung (3.3 m^2)), apartment construction company, the date that residents moved into the apartment and other and physical factors. The more specific matching process is discussed in the next section.

The model coefficients are interpreted as follows. Coefficient 'a' represents the average apartment price in the typical market during a typical period. Coefficient 'c' also shows the price difference between the colluding market and the typical market during normal periods. Coefficient 'd' is the price difference between the colluding period and the non-colluding period in the typical market. Finally, the most important key factor, 'b', can be interpreted as the effect of price-fixing. Coefficient 'b' can be obtained by subtracting the difference between the two periods in the typical market 'd' from the difference between the periods in the colluding market '$b+d$' or by subtracting the difference in the market during typical periods and 'c' from the difference in the market during the colluding period '$b+c$'

Regarding the unit root, differentiation of two dates (t, $t-1$) is not used for the following two reasons. First, if a structural break is not recognized, though it really is, the test will indicate a unit root where

there is none. In other words, with a structural change, all unit root tests are biased towards the non-rejection of a unit root (Perron 1989). Furthermore, it is often argued that unit root tests are relatively weak when used with short time spans of data; therefore, the failure to reject the unit root null should be interpreted with caution. In this paper, despite the monthly data, co-integration is not used because the properties of most data are connected to the weaknesses of the unit root test; the duration for which the data are available is short, approximately one year, and the primary analytical process is the comparison of two separate periods.

A. Selecting the usual market

The apartment unit matching process consists of three steps and carefully proceeds in a rigorous way. First, the most similar district is matched by five criteria.[14] Second, after selecting the most similar district, other factors including district renovation plans controlled by the new town plan map.[15] Third, apartment characteristics are matched by size, apartment construction company, date that residents moved into an apartment. The model assumes that the factors that affect the price difference between two districts will have the same effect. This assumption is reasonable from the perspective of selecting the most similar districts through a correlation analysis.

In principle, the matching among districts is satisfied when the correlation value is the highest or, specifically, when the value is over 99% among all of the candidate districts. Due to their shared unique qualities, some districts are compared to similar districts. Moreover, when identifying typical apartments, there are two rules to consider. First, if a colluding apartment is in a Dong(the smallest level of administrative division) and experiences a town-wide event, the matched districts must also experience a similar effect. Second, the matched district should have very similar environments (especially, subway) compared to the collud-

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[14] The criteria are as follows: education (entrance rate of all types of high school except for special types, to Seoul national university, Yeon-sei and Korea University in 2009), income (sale price per the area in pyung in 2006), population (the number of inhabitants per 100 m^2 in 2006), traffic (the index of general traffic safety in 2006), and the environment (the number of facilities that release pollutants in 2005).

[15] There are three new town developments in Seoul. The 1st and 2nd developments of a new town are regarded as having identical effects for each of the two event periods.

ing Dong.

B. Selecting the collusion period and time

One of the major challenges in collusion research is identifying the exact beginning and length of collusion. In this paper, a number of internet articles related to the housing collusion and the beginning of the collusion stated by the government are used to identify the best estimate for the inception of housing collusion. Although internet articles from prominent media are informative and credible, it is possible that collusion has not been revealed. In addition, media may be biased. There-fore, for the identification of the beginning and the length of the collu-sion, this paper also considers general collusion cases in the industries.

According to FTC (Fair Trade Commission), the length of collusion among companies varies from 14 years to 9 months. The targets of col-lusion are diverse, from food items such as sugar, milk, and chicken, to LPG, oil and even interest rates. None of the above targets of collusion are similar to apartments which are fairly expensive and has high sub-stitution rate among residential apartments. Therefore, it is reasonable to refer to these types of examples together rather than comparing the apartment prices to only one type of apartment.

Furthermore, we consider the government investigation. During the period of June 2006 and January 2007, there were five cases in which the same apartments were exposed twice.[16] Hence, from this govern-mental investigation, it is reasonable to infer that price collusion con-tinued even after the time when the government identified the colluded cases. We cannot be sure that there were no collusions in other periods. However, considering that we rarely find the news on the collusion and that we know it is hard to collude during recess time periods (Borenstein and Shepard 1996), it is reasonable to regard from 1996.7 to 1998.3 as a standard period[17] and from 2006.4 to 2007.12 as a collusion period.

In this paper, for the apartments that were uncovered by the first

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[16] Jung-ang Heights, Jung-gye Dong, Nowon district (1st, 5th) / Dong-bu Centrevil, Gil-eum Dong, Seongbuk Gu (2nd, 3rd) / Brown-stone Tae-reung, muk Dong, Jungnang Gu (2nd, 3rd) / Hyun-dae, Lee-mun Dong, Dongdaemun Gu (4, 5th).

[17] This period shows that the most similar trend on GDP with collusion period. The contraction phase began in the standard period until August 1998 which was the lowest point publicly announced. Also, this was before the phrase 'invincibility myth in Gangnam (newly coined term indicates a phenomenon that an investment in apartments or land in Gangnam never fails) began spreading. Refer to Appendix for more explanation on collusion period and market.

investigation, the collusion is assumed to have occurred in May 2006, two months before July 2006, when the investigation started. This assumption follows from available news shown in Figure 2 which shows that the interest about collusion drastically increased since May 2006. Another reason for this assumption is that most apartments selected here for analysis joined in the collusion relatively late, which is based on the observation. The collusion period is set at fourteen months under the assumption that the apartments that were exposed twice may have started colluding on price two months before they were exposed. In addition, it is considered that it took six months before these apartments were exposed again. However, this treatment will only be applied to the apartments that were exposed by the first investigation. For the second case, the term during which there is collusion will be one year from the moment when the price-fixing is revealed. The reason for the reduction of two months comes from the assumption that ARH behaved rationally. That is, it is unreasonable to think that ARH would be likely to shift from an internal to an external approach to collusion while investigations are being conducted.[18]

As a result of the matching using these suppositions, seven apartments are chosen. Several candidate apartments are removed because their data are too limited to be used; specifically, the apartments for which there are no data from July 1996 to March 1998 are not considered.

V. Results

Table 3 shows the effect of collusion is relatively strong except for one apartment.[19] The variation in the coefficients of the macro variables is measured as the percentage variation when an independent variable increases by 1% as all the variables are log except for the dummy variables and the CD rate. Before showing the results, it is necessary to understand that district time trend is not reflected in the estimation

[18] The number of samples is also considered for setting one year as a collusion period.

[19] ① Seo-gwang apartment, Wol-gye Dong, Nowon district, ② Shin-dong-ah apartment, Yong-du Dong, Dongdaemun district, ③ Hyun-dae apartment, Jang-an Dong, Dongdaemun district, ④ Jung-ang Heights apartment, Seok-gwan Dong, Seongbuk district, ⑤ Han-sin apartment, Dok-san Dong, Geumcheon district, ⑥ Yoo-won apartment, Mun-rae Dong, Youngdeungpo district, ⑦ Han-jeon Hyun-dae apartment, Dang-san Dong, Youngdeungpo district

TABLE 3

FINAL RESULT 1

	D_{is}	D_i	D_s
①	0.03**	0.08**	-0.06
②	0.08**	0.12**	0.08**
③	0.13**	-0.05**	0.11**
④	0.04**	0.05**	-0.03
⑤	0.11**	0.08**	-0.26
⑥	0.002	-0.16**	-0.14**
⑦	0.06**	-0.02	0.18**

Source: The author.

TABLE 4

FINAL RESULT 2

	M2	CD rate	stock	AVGP
①	0.33**	-0.0003	0.11*	-0.38
②	0.42**	0.002	-0.10	0.18
③	0.04	0.002	0.14	0.81
④	0.004	-0.0001	0.12**	0.7**
⑤	-0.10	-0.0005	0.06	0.60**
⑥	-0.04	0.03**	0.30*	1.40**
⑦	0.82**	0.007	0.29*	0.02

Source: The author.

because of a lack of data. Therefore, the effect of collusion maybe over-estimated.

The apartment prices used in this paper were generally priced at from KRW 2 to 3 billion during the period of from 2006 to 2007, and among all case studies, the price of each apartment affected by collusion increased from KRW 7.2 million to 40.3 million.[20] Based on this result, the price-fixing in apartments significantly increased the price of the colluding apartments between 2006~2007. Comparing this value to real figures, proportions (the price variation rate by DID model over the average increase rate of apartment sales index in identical period a year ago) are 11%, 249%, 131%, 212%, 18%, 77%, and 33% (one invalid value is not shown). From these figures, we learn that collusion is partially

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[20] Using the sale price, the calculated effect of collusion is approximately from KRW 67 to 390 million, depending on which price we use, and varies from KRW 1.1 to 26.3 million.

responsible for the dramatic increase. With regard to Dongdaemun, the level of price fluctuation differs from one apartment to another and one district to another. One interesting point is that the rate of the price increase of two apartments (②, ③) through collusion in Dongdaemun is much greater than the average rate of increase in the same district. However, the collusion effects are dependent on the Dong in the Youngdeungpo district (⑥, ⑦). For the Nowon district (①), the rate of increase under collusion is relatively low.[21] These differences may be due to incompletely controlled variables, such as the uniqueness of apartments or positive regional events; however, the difference might come from the different level of efficiency in each collusion case.

It is interesting that some elements of the collusion effect are proved because price-fixing cannot be sustained when we consider economic theory. In this example of collusion, the subject is a non-business party, ARH, which is a type of social gathering and whose members are mainly housewives. These members inherently respond to costs and benefits, but the educational environment of their children, their husbands' jobs and liquidity shocks are more important factors that may lead them to buy or sell their houses. In addition, the resistance of real estate agencies and government investigations may disturb collusion. However, the result of DID supports this paper's assumption that the role of collusion by ARH is highly influential in causing dramatically increased price of apartments. We can reasonably believe that collusion was well established for at least one year. Consequently, high price increase in 2006 and 2007 has not been just caused by the lack of supply but also collusion.

Table 4 also shows the effect of other variables, in particular, the macro finance variables. However, only one or two macro variables affect the apartment price in each district, indicating that macro variables may not be so influential in the period of collusion. Furthermore, the trend effect in Gangnam and Gangbuk only affect apartment price rather than macroeconomic variables in three district. Interestingly, the trend

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[21] The variation in variables are similar if we narrow the period under collusion by two to four months or extend it by one to ten months on the basis of the number of accusatory articles. For the first case, the collusion effect decreases in No-won and Dongdaemun and increases in Geumcheon and Youngdeungpo by less than 1%. Other variables move against the collusion effect and vary at rates below 2%. In the second case, the variables change at most by 4%, and the effects in all districts except for Youngdeungpo are more pronounced. Furthermore, as the period under study increases, the some variables that were previously statistically insignificant become significant. This shift may have resulted from the uncontrolled effects of positive events.

effect varies even in the same district, Youngdeungpo district, but not in the Dongdaemun district. Such variation may be due to some omitted variables not captured by the model. In addition, the weak relation between apartment price and macro variables may suggest that apartment prices are abnormal as it does not reflect the macroeconomic conditions. Considering that the coefficient of trend is large and statistically significant in Seongbuk, Geumcheon and Youngdeungpo districts, the effect of collusion may be overestimated due to the omission of the district time trend in the model.

VI. Concluding Remarks

It is difficult to isolate the effects of pure collusion on apartment prices in Korea. Unlike other products, apartment prices are affected by many more factors including education, living conditions and social status. Furthermore, it is difficult to expose collusion by ARH because collusion itself is secret and there are no measure to reveal collusion except for price (in case of a firm, for example, varying cost also can be a good clue to disclose the collusion). Moreover, government does not have incentives to investigate collusion by ARH since ARH is a non-profit organization. In this sense, this paper is a pioneering effort to measure the effect of collusion in the apartment market in Korea. This paper shows that price-fixing by ARH did increase apartment price by approximately from KRW 7.2 to 40.3 million from 2006 to 2007. However, this collusion effect may be overestimated due to the omitted trend effect.

For future research, researchers can explore other additional data to verify the collusion periods, and help identify the duration of collusion periods. Although it may be challenging, researchers can collect apartment bid prices through real estate agencies. Also, different matching methods, for instance propensity score matching, can be applied. Applying various matching methods may generate a larger pool of matching results. Furthermore, researchers may consider other apartment characteristics such as proximity to the Han river, traffic convenience to further improve the matching. Finally, the potential ripple effect of district apartment prices on other districts can also be studied. Although some (Seo 2007) find that ripple effect may be negligible, with further studies, it may be found otherwise.
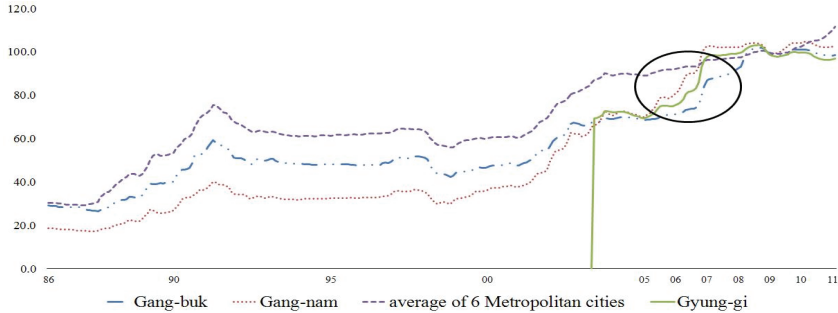
Source: Kookmin bank (Available at: www.nland.kbstar.com)

APPENDIX FIGURE 1
INDEX OF APARTMENT SALE PRICES IN GANG-BUK, GANG-NAM,
SIX METROPOLITAN CITIES, AND GYUNG-GI PROVINCE

Appendix 1[22]

Administration System in Seoul

There are seven major big cities (Seoul, Busan, Incheon, Daegu, Daejeon, Gwangju, Ulsan) and nine provinces (Gyeonggi-do, Gangwon-do, Chungcheongbuk-do, Chungcheongnam-do, Gyeongsangbuk-do, Gyeongsangnam-do, Jeollabuk-do, Jeollanam-do, Jeju-do) in Korea. Seoul and Gyeong-gi province have the highest population in each category. This paper concentrates on 25 districts in Seoul (Appendix Figure 3). Each district has different size and population. Each district also consists of few 'dongs' which are smaller administrative unit in each district. In addition, there are two smaller unit of administration in Seoul, which are 'tong' and 'ban.' In summary, Seoul consists of 25 districts, 522 dongs, 13,787 tong and 102,796 ban. In this paper, 'dong' is the smallest unit of administration.

Korean unofficially categorize Seoul into two parts: Gangnam (11 districts: Dongjak, Gangnam, Gangseo, Gangdong, Geumcheon, Guro, Gwanak, Mapo, Seocho, Seongdong, Songpa, Yangcheon, Yeongdeungpo) and Gangbuk (14 districts: Dobong, Dongdaemun, Eunpyeong, Gangbuk, Gwangjin, Jongno, Jung, Jungnang, Mapo, Nowon, Seodaemun, Seongdong, Seongbuk, Yongsan) using Han-river. Gangnam indicates all districts below the Han river in Seoul and Gangbuk also indicates all districts

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[22] https://en.wikipedia.org
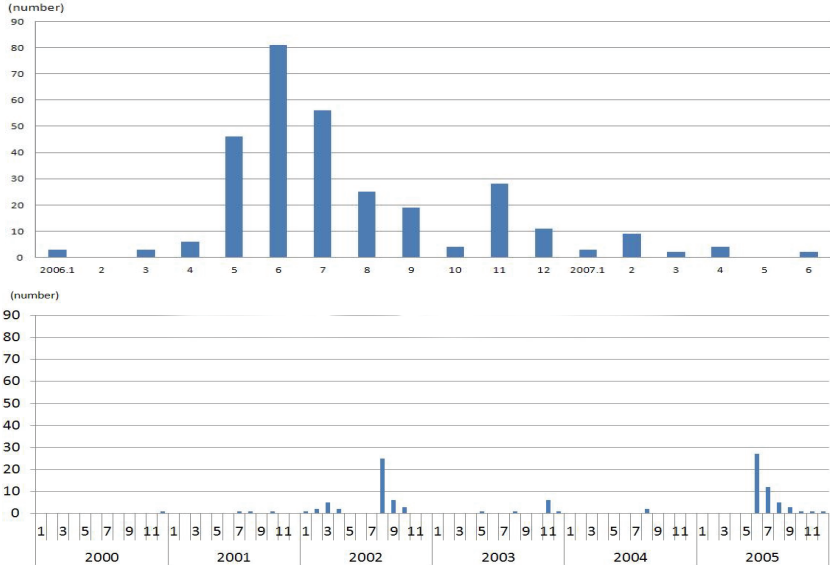
Source: Naver news (Available at: www.naver.com)

APPENDIX FIGURE 2
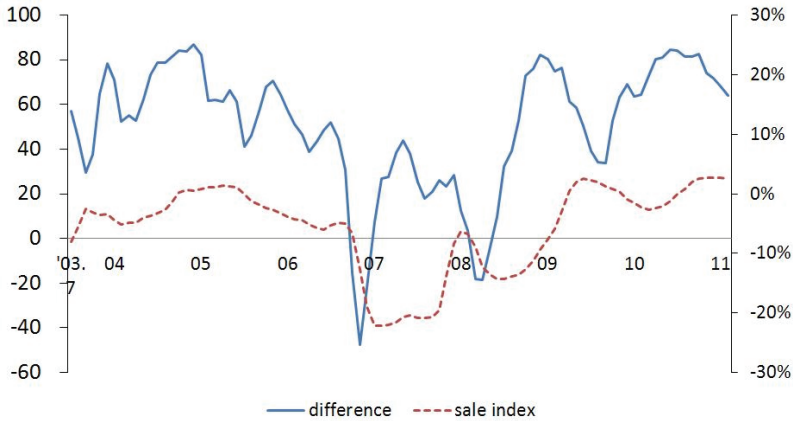
THE NUMBER OF ARTICLES FOUND BY THE TERM "PRICE-FIXING FOR AN APARTMENT" IN 2006~2007 AND 2000~2005

Source: Wikipedia (Available at: https://en.wikipedia.org)

APPENDIX FIGURE 3

ADMINISTRATION SYSTEM IN SEOUL

Source: Kookmin bank (Available at: www.nland.kbstar.com)

APPENDIX FIGURE 4
RELATIONSHIP BETWEEN "POWER OF SELLING-BUYING" AND
"FLUCTUATION RATE OF SALE INDEX" IN GANG-NAM

above the Han river. "Gangnam district" (Gangbuk district) is just one
district in Gangnam (Gangbuk).

Appendix 2

The reason for choosing Gangbuk before 2000

By examining Appendix Figure 4, Appendix Figure 5 and Appendix
Figure 6, Gangnam dominates Gangbuk in terms of the apartment sales
index in 2003 and the rate of variation during 1999~2000. Gangnam's
dominance signifies that before that period, the price difference between
Gangnam and Gangbuk was generally small and that the price in
Gangbuk was even greater than the price in Gangnam. Therefore, there
could be less motivation for the people in Gangbuk to collude before
2000.

From Appendix Figure 4 and Appendix Figure 5, in Gangnam before
2007, the "difference between the power of selling and buying" and "the
fluctuation rate of the sales index" measured for the same period of the
previous year exhibited opposite directions; such relationship disappeared
in Gangnam after 2007. In the case of Gangbuk, the relationship bet-
ween the same indices is opposite to the relationship found in Gangnam.
A positive relationship in the "difference between powers of selling and
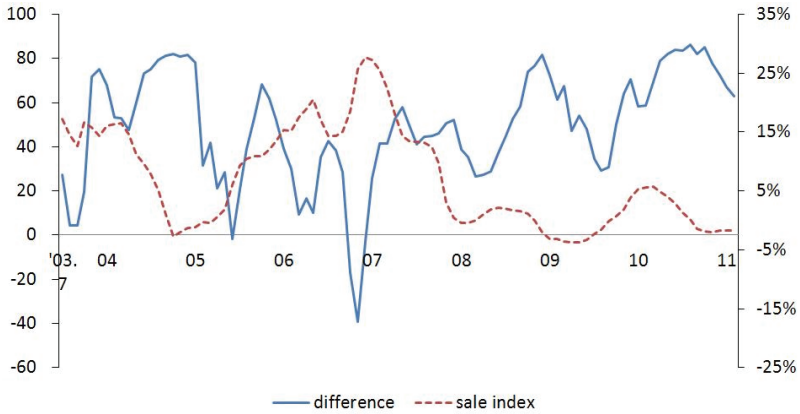
Source: Kookmin bank (Available at: www.nland.kbstar.com)

APPENDIX FIGURE 5

RELATIONSHIP BETWEEN "POWER OF SELLING-BUYING" AND
"FLUCTUATION RATE OF SALE INDEX'" IN GANG-BUK
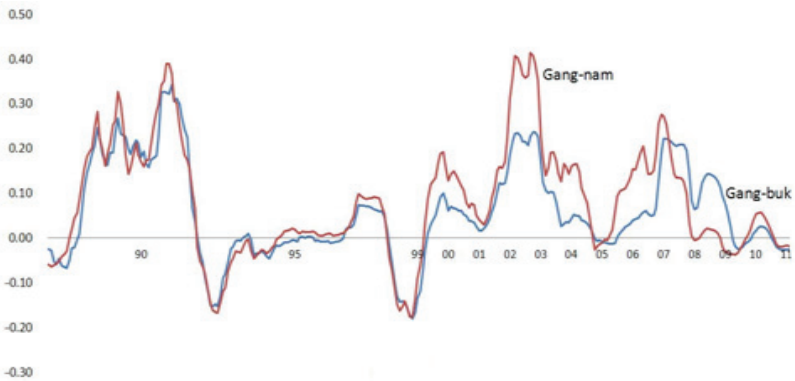
Source: Kookmin bank (Available at: www.nland.kbstar.com)

APPENDIX FIGURE 6

THE RATE OF APARTMENT SALES PRICE INDEX VARIANCE IN THE SAME
PERIOD LAST YEAR IN GANG-BUK AND GANG-NAM

buying" indicates that the sellers have significant power and vice versa.
Appendix Figure 4 and Appendix Figure 5 show an increase in average
apartment price when the sellers' power is weak (buyers' power is
strong). In general, considering that agents of collusion used to reduce

the quantity of products sold in the market, applying this notion to the last interpretation, collusion might have been strong before 2007 and absent in Gangnam after 2007. However, in Gangbuk, the relationship between the "power of selling-buying" and "the fluctuation rate of the sales index" commences in 2007.

Because only a few data points on the sellers' and buyers' power before July 2003, it is difficult to find evidence of this relationship before 2003. However, the three figures above are consistent with the finding that the accusatory news stories significantly decrease in Gangnam. Therefore, if the levels of the sellers' and buyers' power behave similarly prior to 2003, it can at least be said that collusion was not popular during that period, even if we cannot be sure that collusion was nonexistent in Gangbuk. Therefore, there are no problems with treating Gangbuk as a typical region prior to 2003.

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