The Effects of Diverse Polling Methods on the Estimation of Candidates' Approval Ratings: The Case of 19th Presidential Election in South Korea

Jongho Choi, Taegyoon Kim, and Kangwook Han*

In election polls, do the RLC (the ratio of landline surveying to cellphone surveying), response rate, ARS (Auto Response System) influence the estimation of candidates' approval ratings and the gap between them? Using data on 86 election polls during the 19th presidential election, this paper empirically analyzes the effects of different polling methods – RLC, response rate, and ARS – on the estimation of approval ratings of electoral candidates. The results of empirical analysis show that the approval rating of Moon Jae-in (the progressive candidate who receives overwhelming support from the 20s and the 30s) tends to increase in election polls where the proportion of cellphone surveying is high, response rate is low, and ARS is adopted. After all, the result suggests that the deep generational cleavage and the solidity of the supporters are being reflected in election polls.

Keywords: The 19th Presidential Election, Election Polls, Polling Methods, Candidate Approval Ratings

1. INTRODUCTION

In election polls, do different polling methods affect the estimation of candidates' approval ratings? Specifically, does RLC (the ratio of landline surveying to cellphone surveying in mixed-mode designs: hereafter RLC)[1] lead to biased estimation of approval ratings? Also, does the adoption of ARS (Auto Response System) influence the estimation of competing candidates' approval ratings? Employing data on election polls during the 19th presidential election in Korea, this paper analyzes the influence of different polling methods – RLC, response rate, and the adoption of ARS – on the estimation of approval ratings of electoral candidates.

In general, election polls were traditionally assumed to play the role of passively tracing changing public opinions. Not only is that not true, however, it has been recently pointed out that they actively form public opinions (Ansolabehere and Iyengar, 1994; Park, 2013). For these reasons, it is suggested that election polls be able to provide prudent guidance for future public opinions as well as be a reliable indicator of the current public opinions (Cho and Jang, 2012).

However, election polls in many democracies have often failed to predict the winner or accurately estimate the gap between a winner and runners-up. In 2016, election polls across the democratic world performed so poorly that they were criticized as useless: elections polls

in the 20th Korean general election, the Brexit referendum, and the 45th U.S. presidential election completely failed to predict the election results.

Observing these failures, many scholars and polling experts have pointed out potential bias inherent in polling methods as the reason for the inaccuracy.[2] Firstly, it is claimed that the arbitrary selection of RLC in mixed-mode designs decreases polling accuracy. Secondly, low response rate (among cellphone numbers in particular) is argued to play a role in weakening the accuracy of polling. Thirdly, it is alleged that the adoption of ARS might cause bias by lowering the response rate among passive and politically apathetic respondents. In response, many solutions have been suggested in order to reduce bias in election polling. Unfortunately, efforts to improve polling accuracy are still limited to securing large samples.

In May 2017, the 19th South Korean presidential election was unexpectedly conducted in the wake of the former president *Park Geun-hye*'s removal from the office. In the newly-constructed five-party system, the election had as many as fifteen candidates either from political parties or independent.[3] In the end, a total of five candidates from five different political parties acquired a significant portion of the votes.

In this context, election polls drew public attention. However, their results widely varied making it difficult to trace the electoral competition. There were many problems related to election polls. For example, survey questions were inconsistent across numerous polls. In addition, some polls arbitrarily excluded strong contenders. In contrast, other polls listed too many candidates that they failed to reflect the real approval ratings of major contenders. In consequence, the approval ratings of potential candidates widely varied from one poll to another, sometimes making potential candidates give up their candidacy.[4]

Immediately after the former president's impeachment, 9th of May was confirmed as the date for the 19th presidential election. Accordingly, the five major political parties started their own presidential election primaries. During the period between the confirmation of the election date and the imposition of the ban on publication of election polls, four to five election polls were released per day and registered to *National Election Survey Deliberation Commission* (the institute which supervises election polls).[5] During the party primaries, many

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[2] Generally speaking, election polls are not without bias (Park 2013). Therefore, no poll can make an exact prediction on election outcomes. Bias exists when specific segments of the voting population are systematically under-represented in the polling data. Also, bias becomes more prominent when particular segments of respondents are weighed in a post-hoc manner in order to fill up the insufficient sample quota. In addition, different survey methods such as telephone interview or ARS can be an important source of bias in election polls (Jang and Cho 2013, Kim and Yun 2016, Heo and Yi 2016).

[3] Previously, presidential elections in South Korea were held under the two party system (or two and a half party system) where candidates from the right (*Liberty Korea Party*) and the left (*the Democratic Party*) competed with each other. In the 20th general election, however, the left was divided between *the Democratic Party* and *People's Party* (a political party regionally based on *Honam*). In addition, in the wake of the former president's Park's impeachment, *the Bareun Party* (a spin-off political party from *Liberty Korea Party*) was founded. Furthermore, *Justice Party*, a traditional labor party, has remained solid. Accordingly, the 19th presidential election was vied for among five candidates from *the Democratic Party, Liberty Korea Party, People's Party, the Bareun Party,* and *Justice Party*.

[4] *Ban Ki-moon*, the former Secretary General of the United Nations, dropped out of the race in January 2017. *Hwang Kyo-ahn*, then the Prime Minister, also announced that he would not run for the presidential election in March 2017.

[5] http://www.nesdc.go.kr

incidents took place adding more uncertainties to the election. In particular, in the wake of *the Democratic Party*'s primary, it became a red hot issue where the support for the defeated primary candidates (*Ahn Hee-jung*, the Governor of *Chungcheongnam-do* and *Lee Jae-myung*, the Mayor of *Seongnam-si*) would head: either to *Moon Jae-in* (the official candidate of *the Democratic Party)* or to candidates from the other political parties.[6] In the end, the five major parties finalized their presidential candidates at the beginning of April.[7]

In this muddling context, election poll results were problematized for their RLC, response rate, and the adoption of ARS. First of all, more and more pollsters were adopting mixed-mode designs that combine landline numbers and cellphone numbers as the proportion of people who have cellphones – even without home phones – has been increasing since the mid-2000. However, there were no criteria for the appropriate level of RLC. Consequently, election pollsters were determining RLC on their own judgement and even polls from the same pollster had a different level of RLC. In addition, more and more pollsters chose to adopt ARS in order to save money and time leading to decrease of response rate.

Many experts claim that three factors in polling methods – RLC, response rate, and the adoption of ARS – can be a potential source of bias in election polls. Also, these factors can be particularly prominent in the context of the wide generational cleavage in Korea.[8] Many scholars assume that RLC in mixed-mode designs has a significant effect on the estimation of candidates' approval ratings and the gaps between them. The logic underlying the assumption is that as the proportion of landline surveying increases the poll disproportionally captures the older and more conservative segment of the population. On the other hand, higher proportion of cellphone surveying reaches the younger and more progressive segment of the population. For similar reasons, it is also argued that low response rate and the adoption of ARS can lead to bias in election polls.

Other experts cast a doubt on the claim that differences in polling methods can lead to bias. From this counter-perspective, it is believed that the level of bias in polls depends on whether sampling is conducted in proportion to the population distribution in terms of age, gender, and region. They claim that mixed-mode designs are simply an approach for achieving an unbiased sample in terms of age, contradicting the view that there is a significant difference in ideological or generational preferences between landline respondents and cellphone respondents.

This paper argues that differences in polling methods among pollsters in the 19th presidential election affected the estimation of candidates' approval ratings. Considering

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[6] Three candidates for *the Democratic Party*'s presidential election primary (*Moon Jae-in, Ahn Hee-jung*, and *Lee Jae-myung*) had higher approval ratings than the candidates from all the other political parties.

[7] *Justice Party* confirmed its candidacy on 16th February, *the Bareun Party* on 28th March, *Liberty Korea Party* on 31st March, *People's Party* on 3rd April, and *the Democratic Party* on 4th April.

[8] A generational cleavage in Korea began to emerge in the early 2000s and became more prominent than the regional cleavage. the regional cleavage which divides *Youngnam* region and *Honam* region was the deepest social cleavage in South Korea but it is becoming less and less prominent from the early 2000s. In the 19th presidential election reveals that the country is heavily divided along the generational cleavage. According to polls by *Hankook Research* and *Institute for Democracy* (on 2nd May 2017), *Moon Jae-in*, the winner of the election, received overwhelming support from the 20s, 30s, and 40s (over 60% of the votes). However, the support for him started to drop among the 50s and lagged behind *Hong Jun-pyo* and *Ahn Cheol-soo* among the 60s or the older. The results from a vast majority of election polls during the campaign period were more or less the same.

Korea's political context where voters are sharply divided along the generational cleavage, it is possible to reason that biased sampling inherent in particular polling methods can lead to errors in the estimation of candidates' approval ratings and the gaps between them. In order to test the argument, this paper conducts an empirical research employing data on 86 polls during the period between 3rd of April (the day when the list of candidates for the election was finalized) and 2nd of May (the day when the ban on the publication of election polls was imposed) in the 19th presidential election.

The next section reviews existing studies on the effects of the selection of RLC, response rate, and ARS. After exploring them, the third section presents the hypotheses of this paper based on the existing studies and current scholarly debates. The fourth section provides the descriptive statistics for 86 individual election polls conducted between 3rd of April and 2nd of May. Then, the fifth section presents the results of statistical analysis. Finally, this paper comes to a conclusion including some implications of this paper in the last section.

2. LITERATURE REVIEW: BIAS IN RLC, RESPONSE RATE, AND ARS

There are mounting criticisms that election polls solely based on landline surveying do not adequately reflect public opinions. These criticisms rose in the global context where the number of cell-only users has been continuously increasing since the mid-2000s (Cho and Jang, 2012; Kennedy and Everrett, 2011; Kim and Woo, 2012; Lee et al., 2012). Pollsters' predictions on election outcomes across the democratic world have so frequently failed that some experts insist that landline surveying be substituted by cellphone surveying.

It was during the U.S. 2003 presidential election when the first attempt to reduce estimation errors by introducing cellphone surveying was made (Steeh, 2004). In 2007, cell-only users in the U.S. took 12.8 percent of the entire population and its proportion has been on a growing trend. Accordingly, it was consistently suggested that insisting on landline RDD (Random Digit Dialing) would cause bias in estimating approval ratings and in predicting election outcomes (Keeter et al., 2007). In 2010, the proportion of cell-only users in the country exceeded 25 percent, which led to mounting arguments for adopting mixed-mode designs that combine landline surveying and cellphone surveying (AAPOR, 2010).

On the other hand, other experts claim that the introduction of cellphone survey needs more careful consideration. From this view, it is argued that responses in cellphone surveying tend to be less accurate than in landline surveying. This is both because respondents are more likely to focus on other tasks while using cellphones and because the sound quality of cellphones is lower than that of landline phones (Kennedy and Everett, 2007). Thus, election pollsters attempted to reduce bias either by developing a sampling method which reduces the gap between landline surveying and cellphone surveying or by employing mixed-mode designs which include both landline numbers and cellphone numbers (Brick et al., 2007).

In response to the global trend of adopting mixed-mode design, South Korean election pollsters also presented research on differences between landline survey and cellphone survey and methods for adjusting them (Cho et al., 2007; Cho and Jang, 2012; Jang and Cho, 2013; Jang et al., 2014; Kim and Woo, 2012). In South Korea, it was during the 14th presidential election when telephone surveying was used for the first time. In 1997, it turned out to be fairly accurate and soon started to play a central role in election polling (Jang and Cho, 2013). At the time, the sampling for telephone surveying was conducted mainly based on the telephone directory. However, it was soon criticized because the number of households

whose phone numbers were unregistered in the telephone directory was rapidly increasing. In response, RDD telephone surveying was introduced in order to supplement the shortcomings of random sampling based on the telephone directory, which led larger sample sizes and more randomness. However, the reliability was still far from guaranteed as a significant number of people without landline phones were excluded from RDD samples.

It was during the 2010 local election when arguments for the introduction of cellphone surveying in election polls became powerful. Prior to 2010, almost all election polls were solely based on landline surveying despite the above-mentioned problems. During the campaign period in 2010, election pollsters expected a sweeping victory for *GNP* (*Grand National Party*: the predecessor of *Liberty Korea Party*) based on landline surveying. However, it turned out to be a complete misprediction: *the Democratic Party* won more positions, both local executive and local legislative (Jang and Cho, 2013). Thereafter, pollsters started to examine the feasibility of mixed-mode designs. For instance, Lee et al. (2012) proposed mixed-mode designs as a solution for the problems of existing election polls. They numerically verified the applicability of mixed-mode designs by analyzing the preliminary opinion poll results of the Seoul Mayor by-election of 26th of October in 2011.

Mixed-mode designs in various forms have become the norm among major media companies and pollsters since the 18th presidential election. Many pollsters combined landline RDD, cellphone RDD and ARS. Reflecting this trend, some research was conducted on the validity of cellphone RDD revealing that samples from cellphone RDD are very unlikely to represent the female-old segment of the voting population (Lee et al., 2012).

In addition to RLC, response rate was also pointed out to be a potential source of bias in election polls. A vast majority of pollsters in Korea collect samples in proportion to the population distribution in terms of age, gender, and region. Important to note is that they weight insufficiently-sampled segments by differently adjusting weighing factors. Thus, it is claimed that low response rate may cause bias depending on how pollsters determine weighing factors. Also, landline surveying tends to have lower response rate than cellphone surveying as people are increasingly opting for cellphones instead of home phones. Thus, it is suggested that polls with low response rate not be published or their results be adjusted by auxiliary variables before publication (Kwak and Choi, 2014; Kim, 2017).

Finally, the adoption of ARS was questioned for its potential for bias. Respondents on ARS hear pre-recorded questions and are required to answer by pressing buttons on the phone (Cho and Jang, 2013). Thus, it is claimed that ARS has more bias because it has lower response rate than telephone interview. In line with this, Kim and Hwang (2014) statistically proved that polls partly or fully based on ARS have more bias and errors.

Accordingly, pollsters have attempted to decide the most appropriate level of RLC and to improve response rate. Besides, they also try to beware of the bias which might come from the adoption of ARS. Unfortunately, they are unable to effectively deal with the above-mentioned problems due to the lack of scientific research on them. In consequence, many pollsters stick to their traditional polling methods. For instance, pollsters have arbitrarily determined their RLC – from 1 (landline) : 9 (cellphone) to 4.5 (landline) : 5.5 (cellphone) – as there has been little scientific research on the appropriate level of RLC (Hahn, 2017). In short, shortcomings of existing polling methods have been uncovered but proper solutions for them have yet to be found, leading to different outcomes depending on different polling methods.

3. HYPOTHESES

This section presents three main hypotheses of the analysis. As previously mentioned, the goal of this paper is to test whether the selection of RLC, response rate, and the adoption of ARS affect estimated approval ratings of competing candidates with different ideological positions or generation. In other words, this paper attempts to verify that different results of election polls reflect the generational cleavage of voters and solidarity of supporters in South Korea.

The first hypothesis is related to the selection of RLC. Recent election polls adopt RDD method regardless of whether they are landline based or cellphone based. The problem is that the method does not consider any information about respondents as it makes a random call. Therefore, polls with a high proportion of cellphone surveying naturally over-represent younger voters – young office workers and students in particular – who tend to use cellphones more frequently than other segments of the population. On the other hand, polls with a high proportion of landline surveying over-represent older voters and full-time homemakers. Considering the fact that generation was one of the strongest predictors of voting decision in the 19th presidential election, it can be hypothesized that higher proportion of cellphone surveying leads to higher approval ratings for progressive candidates and higher proportion of landline surveying leads to higher approval ratings for conservative candidates. Thus, the first hypothesis is

> H1: Polls with a higher proportion of cellphone surveying present a higher approval rating for the progressive candidate *Moon Jae-in* (thus, wider gap between *Moon Jae-in* and other candidates).

The second hypothesis is associated with response rate. In general, it is believed that election polls with high response rate tend to be more accurate. From this perspective, low response rate can cause bias by selectively representing the opinions of particular segments of the population such as the young or the conservative. For example, older respondents tend to have higher response rate while younger respondents tend to have lower response rate. Considering the fact voter turnout is comparatively low among younger generations, it is possible to reason that younger voters tend to be more politically apathetic and this tendency can affect the relationship between response rate and approval ratings. Therefore, the second hypothesis is

> H2: Polls with higher response rate present a lower approval rating for the conservative candidate *Hong Jun-pyo* (thus, wider gap between *Moon Jae-in* and *Hong Jun-pyo*).

The third hypothesis is related to the adoption of ARS. It is widely believed that respondents who answer ARS polls are likely to vote on the election day. In other words, answering machine-recorded calls indicates that they are highly interested in politics. Thus, it is likely that candidates with a solid base of support – whether progressive or conservative – have higher approval ratings than those who do not. In contrast, interview-based surveys are likely to include voters who are apathetic about politics as well as ones interested in politics. Thus, the third hypothesis is

> H3: Polls adopting ARS present higher approval ratings for *Moon Jae-in* and *Hong Jun-pyo*

whose base of support is solid (thus, wider gap between *Moon Jae-in* or *Hong Jun-pyo* and other candidates).

4. DESCRIPTIVE STATISTICS

This section provides the descriptive statistics of the subsequent statistical analysis. According to *the Public Official Election Act* in South Korea, all election polls are under the supervision of *the National Election Survey Deliberation Commission*. Also, they must register their poll results before publication.

In October 2016, the former president Park's corruption scandal broke. In the wake of the scandal, election pollsters started to conduct polls on the 19th presidential election while expecting an early election. However, the polls carried out between October 2016 and March 2017 were not about asking voting decision among official candidates but about simply asking preferences for potential candidates whose names were bandied about as a future president. It was March 2017 when the election date was confirmed and serious polls on the presidential election started to be conducted. Accordingly, the empirical analysis of this paper is based on 86 polls from 14 pollsters during the presidential campaign period (30 days from April 3, 2017 to May 2, 2017). The data includes variables such as approval ratings for three major presidential candidates (*Moon Jae-in*, *Hong Jun-pyo*, and *Ahn Cheol-soo*), the gaps between their approval ratings, RLC, and the adoption of ARS.

Table 1 shows each pollster's RLC, the number of polls conducted by each pollster, and whether they adopted ARS. The data includes 14 pollsters which conducted polls at least twice during the 30-day period. The number of polls conducted by these pollsters range from 2 (*The Opinion, Research Plus,* and *Matrix*) to 18 (*Realmeter*). All the polls by *Research View* and *R&Search* were carried out solely with cellphone surveying. Also, *Jowon C&I* has the highest proportion of landline surveying (44.5 percent). ARS was adopted by *Realmeter*, *Research View*, *R&Search*, and *Jowon C&I* while the other pollsters used telephone interview. Response rate widely differs from one to another with *Realmeter* at the bottom (7.6 percent) and *Gallup Korea* at the top (27.3 percent).

Table 2 presents the summary statistics for the dependent variables, the independent variables, and the control variables. The dependent variables are candidates' approval ratings and the gaps between them. *Yoo Seong-min* and *Sim Sang-jung*, the 4th and the 5th vote-getters, were excluded from the analysis since polling methods are unlikely to affect their approval ratings which stably ran under 8 percent. Gaps between candidates, one of the dependent variables, are the difference in approval ratings among the three candidates (*Moon*, *Hong*, and *Ahn*). For example, the gap between *Moon* and *Hong* is *Moon*'s approval rating subtracted by *Hong*'s.

The mean approval ratings for *Moon*, *Hong* and *Ahn* are 40.65 percent, 11.83 percent, and 28.21 percent respectively. The standard variation tells *Ahn*'s approval rating heavily fluctuates across polls and *Moon*'s is the most stable among the three candidates. The mean gaps in approval ratings between *Moon* and *Hong*, *Moon* and *Ahn*, and *Hong* and *Ahn* are 28.83 percent, 12.44 percent, and 16.39 percent respectively. The cellphone ratio, one of the most important independent variable, averages 77.4 percent and response rate averages 17.4 percent. The number of polls adopting ARS is 27 out of 86. The number of days between a poll and the 2nd May and the square of it are included as control variables since approval ratings can change either over time or after crucial events.

Table 1. RLC, Response Rate, and ARS on Fourteen Pollsters

Pollster	The number of polls	The mean ratio of landline surveying	The mean ratio of cellphone surveying	ARS	Mean response rate (landline)	Mean response rate (cellphone)
KSOI (Korea Society Opinion Institute)	4	0.193	0.808	NO	0.183	0.213
The Opinion	2	0.37	0.33	NO	0.183	0.203
Research View	5	0	1	YES	-	0.117
Research&Research	8	0.195	0.805	NO	0.09	0.215
Research Plus	2	0.485	0.515	NO	0.19	0.238
Realmeter	18	0.128	0.872	YES	0.076	0.152
Macromill Embrain	5	0.334	0.666	NO	0.11	0.222
Matrix	2	0.254	0.746	NO	0.09	0.199
R&Search	4	0.25	0.75	YES	-	0.044
Jowon C&I	6	0.445	0.555	2 telephone interview surveys 4 ARS surveys	0.095	0.098
Joongang-ilbo Survey and Research Team	4	0.302	0.698	NO	0.261	0.336
Kantar Public	7	0.452	0.548	NO	0.123	0.192
Gallup Korea	6	0.167	0.833	NO	0.169	0.273
Hankook Research	13	0.177	0.823	NO	0.162	0.259

Table 2. The Descriptive Statistics of Variables

|	Observations	Mean	Standard Deviation	Minimum	Maximum
Moon's approval rating	86	40.66	3.04	32.2	47.4
Hong's approval rating	86	11.83	4.07	5.7	21.2
Ahn's approval rating	86	28.22	6.42	15.7	38.3
Gap between Moon and Hong	86	28.83	4.745	19.2	37.7
Gap between Moon and Ahn	86	12.44	7.201	-2.2	28.5
Gap between Hong and Ahn	86	-16.39	10.189	-31.8	1.8
The ratio of cellphone numbers (*wireless*)	86	0.7736	0.1631	0	1
Time (*time*)	86	16.89	9.628	0	29
Time squared (*time squared*)	86	377.0	314.8	0	841
Response rate (*r-rate*)	86	0.177	0.066	.0375	0.3335
ARS (*ARS*)	86	0.360	0.483	0	1
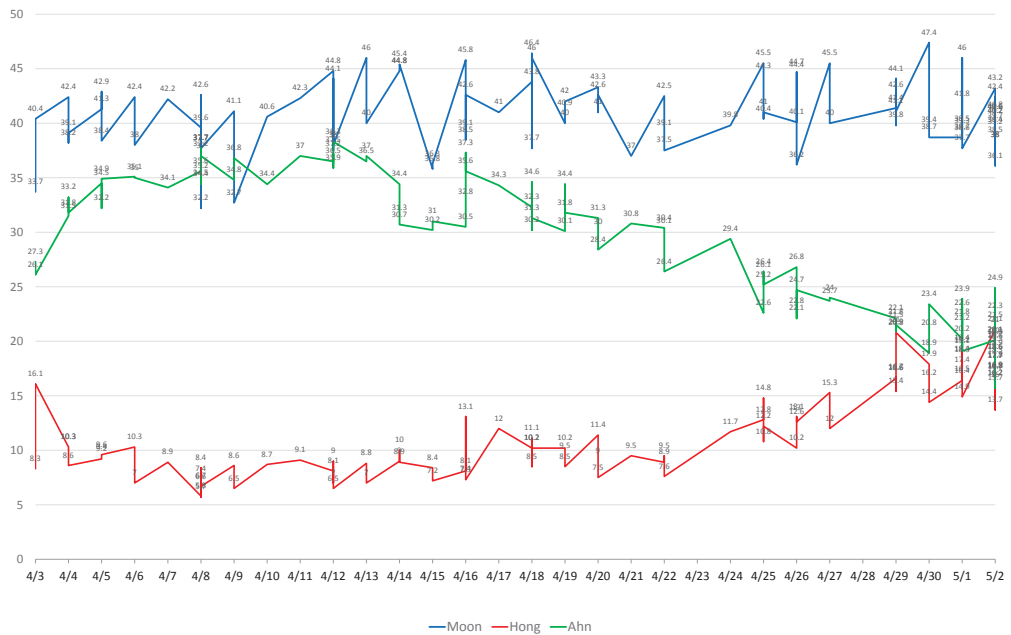
Figure 1. The trend for the approval ratings of *Moon*, *Hong* and *Ahn*

Figure 1 illustrates the approval ratings for *Moon*, *Hong,* and *Ahn* during the 30-day period. During the period, *Moon*'s rating narrowly varied from 32.2 percent to 47.4 percent. In contrast, *Ahn*'s rating widely ranged from 15.7 percent to 38.3 percent. Specifically, his rating jumped after 3rd April when the candidate registration was confirmed and started to plunge after his flip-flop on the kindergarten issue[9] and a series of television debates. *Hong*'s rating ranged from 5.7 percent and 21.2 percent. With solid support from conservative voters, *Hong*'s rating sharply rose during the last stage of the campaign.

During the campaign period, the gap between *Moon* and *Ahn* continued to increase. After the finalization of candidate registration, *Ahn*'s rating skyrocketed and even exceeded *Moon*'s. On the other hand, the gap between *Ahn* and *Hong* grew bigger and bigger as the election day approached. It was after the television debates when *Ahn*'s rating started to drop and *Hong*'s began to rise. On the final day before the ban on the publication of poll results, *Hong* even outstripped *Ahn* in some poll results. On the actual election, *Moon* gained the 41.1 percent of the total votes while *Hong* and *Ahn* each gained the 24 percent and the 21.4 percent.

5. EMPIRICAL ANALYSIS

This section conducts an empirical analysis using the data presented in the previous

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9 The kindergarten issue refers to a political debate which revolved around adding new public kindergartens. Contrary to his campaign pledges, *Ahn* stated that he objected to adding more public kindergartens. Soon, his remark met with massive protests from young parents. It is believed that the remark significantly diminished his approval rating.

Table 3. The Results of Robust Regression Analysis on the Approval Ratings of *Moon*, *Hong*, and *Ahn*

	(1) Moon	(2) Moon	(3) Moon	(4) Hong	(5) Hong	(6) Hong	(7) Ahn	(8) Ahn	(9) Ahn
wireless	10.08***	9.899***	5.888***	2.230	1.875	-0.443	2.396	2.465	3.662
	(1.528)	(1.596)	(1.355)	(1.324)	(1.073)	(0.977)	(1.832)	(1.889)	(2.133)
time	0.233*	0.228*	0.250**	-0.462***	-0.472***	-0.459***	0.411**	0.413**	0.407**
	(0.103)	(0.101)	(0.093)	(0.110)	(0.090)	(0.091)	(0.123)	(0.124)	(0.127)
time squared	-0.00686*	-0.00656*	-0.00642*	0.0250***	0.0256***	0.0257***	-0.0311***	-0.0312***	-0.0312***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
r-rate		-6.044	-0.387		-11.82***	-8.554**		2.295	0.607
		(3.446)	(3.541)		(3.129)	(3.160)		(4.532)	(4.911)
ARS			3.246***			1.876***			-0.968
			(0.490)			(0.325)			(0.651)
constant	31.52***	32.70***	33.20***	8.475***	10.79***	11.08***	31.14***	30.69***	30.54***
	(1.391)	(1.712)	(1.545)	(1.286)	(1.454)	(1.482)	(1.845)	(2.184)	(2.240)
N	86	86	86	86	86	86	86	86	86
R^2	0.365	0.382	0.574	0.827	0.863	0.899	0.883	0.884	0.888
adj. R^2	0.341	0.351	0.548	0.821	0.857	0.893	0.879	0.878	0.881
RMSE	2.467	2.449	2.045	1.723	1.542	1.332	2.334	2.242	2.28

Standard error in parentheses *p<0.05, **p<0.01, ***p<0.001

section. Stata Version 11 was used for statistical analysis. First, the table 3 provides the result of robust regression analysis[10] on which factors affect the estimated approval ratings of *Moon*, *Hong* and *Ahn*. The dependent variables are the approval ratings of *Moon*, *Hong* and *Ahn* (*Moon*, *Hong*, and *Ahn*). The proportion of cellphone surveying (*wireless*), response rate (*r-rate*), the adoption of ARS (*ARS*) were included as independent variables. The number of days between a poll and 2nd May (*time*) and the square of it (*time squared*) are included as control variables since approval ratings can vary either over time or after politically significant events. The *time squared* variable intends to consider the fact that the approval ratings of the candidates significantly changed after a series of television debates (the approval ratings of *Hong* and *Ahn* in particular). A great deal of popular attention was paid to the election since it was one held in the wake of the nation's first presidential impeachment. Accordingly, the television debates were more spotlighted than ever and heavily affected the approval ratings of the competing candidates. Thus, it is necessary to include *time squared* variable as well as *time* variable.

The Models from 1 to 9 present the results of statistical analysis on the effects of various polling methods – the ratio of cellphone surveying, response rate and the adoption of ARS – on each of three candidates' approval ratings in election polls (Model 1~3: *Moon*, Model 4~6: *Hong*, Model 7~9: *Ahn*).[11]

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[10] Robust regression methods are designed to be not overly affected by violations of assumptions by the underlying data-generating process (Andersen, 2008).

[11] We conducted Variance Inflation Factor (VIF) to see if there is multicollinearity among the independent variables in our model. The VIF for *wireless* was 1.30, *r-rate* was 1.10, and *ARS* was 1.38. These were considerably below 3, the point above which presence of multicollinearity is suspected.

According to the Model 1 and 2, the ratio of cellphone surveying has a statistically significant effect on *Moon*'s approval rating. To be specific, Model 1 demonstrates that 1 percent point increase in the ratio of cellphone surveying results in 0.1 percent point increase in *Moon*'s approval rating.

Model 2 includes response rate as another independent variable in addition to the ratio of cellphone surveying. According to Model 2, one percent point rise in the ratio of cellphone surveying leads to 0.989 percent point increase in *Moon*'s approval rating. In contrast, one percent point rise in response rate results in 0.06 percent point decrease of his approval rating. However, response rate is not statistically significant at the 95 percent confidence interval.

In addition to the ratio of cellphone surveying and response rate, Model 3 includes the adoption of ARS as a binary independent variable. When a pollster adopted ARS, it was coded as 1. It is important to note that the substantial effects of the independent variables in Model 2 significantly diminished in Model 3: the regression coefficient of the ratio of cellphone surveying dropped to 5.888 (from 9.899 in Model 2) and that of response rate dropped to -0.387 (from -6.044). In contrast, in Model 3, the regression coefficient of the ARS variable is 3.246 and statistically significant at the 99.9% confidence interval: on average, a poll which adopts ARS presents 3.4 percent point higher *Moon*'s approval rating than a poll which does not.

On the other hand, Models 4 to 6 show that the ratio of cellphone surveying does not have a statistically significant effect on *Hong*'s approval rating. Also, they demonstrate that response rate has a negative effect on *Hong*'s approval rating: polls with lower response rate tend to present higher level of approval rating for *Hong*. Lastly, the adoption of ARS results in 1.876 percent point increase while 1 percent point increase in response rate leads to 0.86 percent point decrease. It appears that ARS calls are more likely to reach *Hong*'s supporters who tend to be politically participative and loyal to conservative ideologies. Considering ARS polls have lower response rate, it can be concluded that the two variables have an effect on *Hong*'s approval rating. In the case of Models 7 to 9, none of the independent variables have an effect on *Ahn*'s approval rating. However, it is worth attention that the time variable has a great effect on his approval rating. From this result, it can be speculated that his strategic failures during the campaign period (the flip-flop on the kinder garden issue, persistent negative campaigning, and a series of blunders in the television debates) reduced his popularity.

Figure 2 illustrates the *ceteris paribus* effect of the ratio of cellphone surveying on *Moon*'s approval rating. In the figure, polls with no cellphone surveying estimates his approval rating at 36 percent while in polls solely based on cellphone surveying *Moon* goes up as high as approximately 42 percent. With other conditions being equal, adopting cellphone surveying method has an effect of increasing *Moon*'s rating by 6 percent point.

Figure 3 demonstrates the approval ratings for *Hong* and *Ahn* over time. '0' on the horizontal axis indicates the date when all the major parties finalized their presidential candidates (3rd of April). The following figures on the right hand mean the number days between 3rd of April and the date of estimation.[12] *Ahn*'s approval rating sharply rose right

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[12] Figure 3 is the result of simulation using Gary King's Clarify. Clarify is a program that uses *Monte Carlo* simulation to convert the raw output of statistical procedures into results that are of direct interest to researchers, without changing statistical assumptions or requiring new statistical models (King et al., 2000; Tomz et al., 2003).
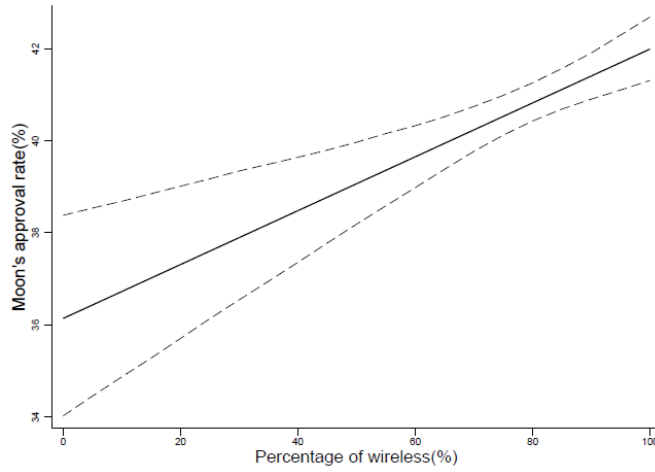
Figure 2. The Effect of the Ratio of Cellphone Surveying on *Moon*'s Approval Rating
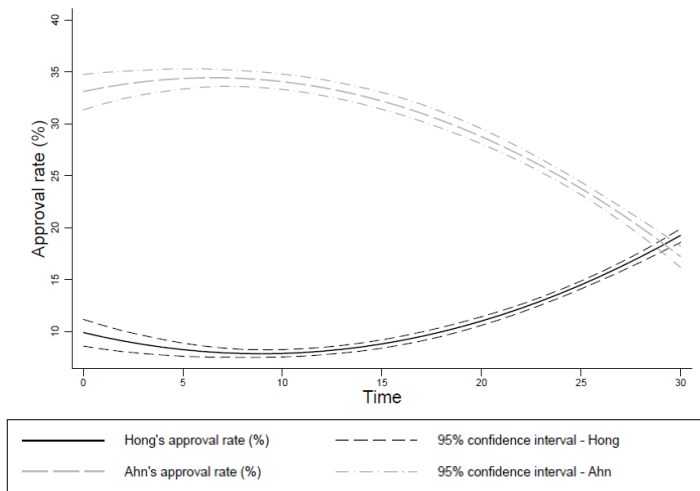

Figure 3. The Change of the Approval Ratings for *Hong* and *Ahn* over Time

after his nomination as the presidential candidate of *People's Party*, started to diminish after 11th of April, and continued to plunge after 13th of April (the date when the first television debate was broadcasted). By contrast, *Hong*'s approval rating began to rise after the first television debate. It seemed that his touch talks on ideological issues (e.g. policies towards North Korean nuclear missile and the deployment of THAAD in South Korea) attracted conservative voters who initially either supported *Ahn* or had been vacillating between *Ahn* and *Hong*.

Table 4 presents the result of robust regression analysis on the gaps in approval ratings between each of the three candidates (*Moon* and *Hong, Moon* and *Ahn, and Hong* and *Ahn*). Models 1 to 3 shows the effect of the ratio of cellphone surveying, response rate, and ARS on the gap between *Moon* and *Hong*. Most of all, Model 1 shows that 1 percent point

Table 4. The Results of Robust Regression Analysis on the Gaps between *Moon* and *Hong*, *Moon* and *Ahn*, and *Hong* and *Ahn*

	(1) Gap between *Moon* and *Hong*	(2) Gap between *Moon* and *Hong*	(3) Gap between *Moon* and *Hong*	(4) Gap between *Moon* and *Ahn*	(5) Gap between *Moon* and *Ahn*	(6) Gap between *Moon* and *Ahn*	(7) Gap between *Hong* and Ahn	(8) Gap between *Hong* and *Ahn*	(9) Gap between *Hong* and *Ahn*
wireless	7.850***	8.024***	6.331***	7.684**	7.434*	2.226	-0.166	-0.591	-4.105
	(1.725)	(1.605)	(1.808)	(2.725)	(2.869)	(2.884)	(2.287)	(2.333)	(2.299)
time	0.695***	0.700***	0.709***	-0.179	-0.186	-0.157	-0.874***	-0.885***	-0.866***
	(0.105)	(0.099)	(0.096)	(0.195)	(0.192)	(0.193)	(0.197)	(0.181)	(0.186)
time squared	-0.0319***	-0.0322***	-0.0321***	0.0242***	0.0246***	0.0248***	0.0561***	0.0568***	0.0570***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
r-rate		5.779	8.167*		-8.339	-0.994		-14.12*	-9.162
		(4.068)	(4.002)		(6.705)	(7.628)		(5.934)	(6.764)
ARS			1.370*			4.214***			2.844***
			(0.538)			(1.006)			(0.811)
Constant	23.04***	21.91***	22.12***	0.380	2.010	2.664	-22.66***	-19.90***	-19.46***
	(1.432)	(1.607)	(1.542)	(2.841)	(3.341)	(3.353)	(2.625)	(3.171)	(3.260)
N	86	86	86	86	86	86	86	86	86
R^2	0.776	0.783	0.797	0.715	0.721	0.779	0.906	0.914	0.928
adj. R^2	0.768	0.772	0.784	0.705	0.707	0.765	0.903	0.910	0.923
RMSE	2.285	2.266	2.205	3.912	3.900	3.491	3.177	3.053	2.826

Standard error in parentheses *p<0.05, **p<0.01, ***p<0.001

increase in the ratio of cellphone surveying widens the gap between *Moon* and *Hong* by 0.079 percentage point. In addition, as shown in Model 2, response rate does not influence the gap between the two candidates. However, when ARS is added as in the Model 3, all the three independent variables (the ratio of cellphone surveying, response rate, and ARS) are shown to have a statistically significant effect on the gap between the two candidates. Therefore, it can be concluded that polls with higher ratio of cellphone surveying, higher response rate and ARS method tend to emphasize the gap between *Moon* and *Hong*. In the context of cellphone surveying and ARS, *Moon* has a significant advantage over *Hong*. Here, cellphone surveying plays a very prominent role of widening the gap between *Moon* and *Hong*. This is because cellphone surveying results in over-representation of *Moon*'s supporters who are younger are more familiar with using cellphones than *Hong*'s. On the other hand, the effect of ARS appears less prominent because its tendency to over-represent politically-loyal voters applies not only to *Hong*'s supporters but also to *Moon*'s. In addition, the *time squared* variable is also statistically significant signifying that their gap continued to increase up to a certain point of time and then started to decrease.

The following can be concluded from the Models 4 to 6 of which the dependent variable is the gap in approval rating between *Moon* and *Ahn*. Above all, the gap between *Moon* and *Ahn* widens as the ratio of cellphone surveying increases. Second, the gap between the two candidates is greatly affected by whether the poll adopted ARS or not: on average, polls which adopt ARS estimate the gap 4.2 percent point higher than polls which do not. Finally, the *time squared* variable is shown to have a negative relationship with the gap between *Moon* and *Ahn*. The gap between the two candidates continued to decrease up to a certain point of time and then started to increase. Again, it seems that the television debates and *Ahn*'s oscillating remarks on the kindergarten issues reduced his popularity.

Models 7 to 9 show that response rate and ARS have a statistically significant effect on the gap between *Hong* and *Ahn*. In other words, the gap between the two candidates widens when response rate drops and when polls adopt ARS. It is worth noting that, contrary to the assumption that older respondents are unfamiliar with ARS, ARS is shown to give an advantage to *Hong* over *Ahn*. It can be speculated that ARS tends to over-represent *Hong*'s extreme-right supporters who are more politically participative than *Ahn*'s.

In summary, the empirical analysis confirms the three hypotheses of this paper. Firstly, the progressive candidate *Moon*'s approval rating rises as the ratio of cellphone surveying increases. Secondly, the conservative candidate *Hong*'s approval rating decreases as response rate increases. Lastly, the adoption of ARS has a positive effect on the approval rating of both *Moon* and *Hong*. It appears that voters politically active and loyal to particular ideologies tend to support either *Moon* (progressive voters) or *Hong* (conservative voters).

6. CONCLUSION

Recent failures of pollsters to predict election outcomes have facilitated various efforts to improve the accuracy and the rigor of polling methods. These efforts aimed to reduce the problems of bias which have risen in the context of increasing use of cellphones and the introduction of ARS. Ideally, election polls should be accurate and rigorous enough to reflect the real public opinions as they are. In addition, they are expected to play the role of providing reliable guidance for future public opinions. Using the data on the 19th presidential election in South Korea, the paper has analyzed whether various polling methods affect the

estimation of competing candidates' approval ratings and the gaps between them. The results show that the selection of RLC, response rate, and the adoption of ARS have a significant effect on the estimation of electoral candidates' approval ratings.

The analysis has the following implications. Above all, a majority of election polls have their own bias. Thus, it is impossible for them to make an exact prediction on election outcomes. In addition, high ratio of cellphone surveying, high response rate, and telephone interview have positive bias for candidates who are likely to receive support of younger voters and to have solid base of support. After all, the result suggests that the deep generational cleavage and the solidity of the supporters is being reflected in election polls.

The contribution of this paper to the literature of election polls can be found in the fact that it empirically analyzed whether pollsters' polling methods can affect the estimation of electoral candidates' approval ratings. Clearly, there is room for improvement in this paper: more accurate data and more rigorous analysis would have strengthened the quality of the research. Nevertheless, it can be functioned as the groundwork for future research on the effects of various polling methods on the estimation of candidates' approval ratings.

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Jongho Choi, Researcher, Social Science Research Institute, Yonsei University. 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, Republic of Korea, E-mail: choipd11@gmail.com

Taegyoon Kim, Ph.D. student, Department of Political Science, Pennsylvania State University, Pond Laboratory, State College, PA 16801, USA. Tel: +82-10-7186-3935, E-mail: txk290@psu.edu

Kangwook Han, Ph.D. candidate, Department of Political Science, Michigan State University, 228 South Kedzie Hall, 368 Farm Lane, East Lansing, MI 48824, USA. Tel: +1-213-221-5692, E-mail: hankangw@msu.edu